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Co-movement of South Asian Stock Markets and COVID Pandemic

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Abstract
The purpose of the study is to analyze the financial market movements in South Asia. The primary focus of the study is the long-term integration of India and Indonesia, as well as the development of short-term co-movements between the two markets. The data used in the study is the daily close prices NIFTY 50 and JKSE for the year April 2019 to December 2022. The window period is divided into pre and post COVID periods. The time series properties have been analyzed using Unit Root Test. The co-movements in the long and short-run have been analyzed using Johansen's Co-integration Test and Granger Causality Test. The outputs of the study show that the long-term relationship of India and the other sample markets is affected by the COVID-19 pandemic. The results also show changes in the integration between the selected capital markets. The corollary of this result is that the markets do not follow the same trend after the COVID pandemic and market participants should exercise caution when trading in these markets.
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I. Introduction

In order to keep up with the ever-changing economic dynamics, economies around the world adopted liberalized policies in line with a free market approach, which in turn stimulated the movement of capital between economies through both traditional and contemporary channels. As a result, the economies and markets began to move in tandem, and the extent of economic interdependence has increased significantly over the past few decades. The proliferation of competition in economic and financial practices by corporations, governments and investors, as well as market regulators, has led the entire world into a situation where any kind of distortion, whether economic, social or financial in nature, in any country has counter-effects on other countries, both directly and indirectly. In particular, this behavior is becoming increasingly prominent in the global financial markets, as financial institutions and banks, as well as other participants in the investing community, carry out financial transactions in various financial markets with the aim of diversifying risk and ensuring optimal capital formation through a balance between risk and return trade off.

Co-movement in financial markets across the world also brings with it the typical problems of market contagion, and the spill over of negative effects from one economy to another. The Asian Crisis of 1987 and the COVID Pandemic of 2020 have sufficiently highlighted the potential risks of financial market integration. Investors, regulators and the government are now turning to co-movement analysis and addressing the question of unison in financial markets as it can compensate for the lack of risk diversification by portfolio investment in diverse markets representing diverse economies. The progressive dismantling of regulatory barriers and liberalization of investment policies in developing equity markets have also caught international fund managers' attention as an opportunity to diversify portfolios and have also given the academic community an incentive to explore the topic of financial markets co-movements.

The purpose of this paper is to analyze the dynamic interlinkages between some emerging markets of Asia in order to understand their degree of integration and to investigate whether there has been a change in co-market movement of these markets in the wake of COVID-19. The aim of this paper will be to understand the dynamics of the interlinkages between 2 emerging equity markets of South Asia, India and Indonesia, and to understand if the systemic risk arising from COVID-19 has changed the dynamics of these markets' interlinkages.

Investors in these emerging markets can take prudent investment decisions according to the behavior of these interlinkages, while also adjusting their investment strategies in order to remain profitable. This study will help to understand the portfolio diversification strategies of international investors that operate in these markets, and will enable them to make important changes in their investment strategies to cope with COVID-19's impact. The rest of the paper is as follows: Section two discusses the existing literature; Section three deals with the data

used and methodological issues; Section four analyzes the data and interprets the result of analysis followed by Section five where conclusions and possible implications have been documented.

II. Review of Literature

The market integration concerning the markets of the United Kingdom, the United States, Germany, the Netherlands and Japan was examined in Taylor and Tonk's (1989), using data on the stock price indices for the subperiods of April 1973 through September 1979 and the subperiod of October 1979 through June 1986. Using the two-stage cointegration (Engle & Granger, 1987), they found that the United Kingdom's stock price index was co-integrated with that of the United States, the United Kingdom, Germany and the Netherlands. They found that the co-integration between the United Kingdom and Japan occurred only for the latter period. Based on their results, Taylor and Tonk concluded that portfolio diversification does not yield long-term returns for U.K investors after the removal of exchange control.

Kasa (1992) used quarterly and monthly stock market data for the years 1974-1990 to analyze the stock market trends in the United States, the United Kingdom, Japan, Germany, and Canada. The results showed that all of the sample markets followed a single stochastic pattern. Kanas (1998) used daily stock market data to analyze the relationship between stock markets in the United States and Europe, and found that the relationship between the two markets was not pair-wise.

The stock price relationship between Australia and the stock markets of the United States, United Kingdom, and Japan was first studied by Rocca (1999). Using weekly stock market information, he found that Australia did not co-integrate with other markets. However, he also found a strong causal relationship between Australia, the United States, and the United Kingdom. Li (2002) looked at the stock price relationship between the international stock markets by using non-linear co-analytic techniques. He used stock price indices from Japan, Australia and New Zealand, as well as those from the United Kingdom and the United States, to test for market integration using both linear co-analytics and non-linear ones on bi-variable and multi-variate models. Li concluded that there is much more evidence for market integration than in linear co-analytic methods.

Jansen et al. (2003) used weekly data from the German, Japanese, US and UK stock markets over the 1980's-2000's to study changes in correlation patterns at both the market and industry levels of international equity returns. They created a new GARCH model with smoothly time-variating correlation for equity returns and derived a LM statistical model to directly test the constant correlation hypothesis. They found a doubling of correlations between the German, US and UK stocks compared to the Japanese stock market.

The Indian stock market co-movements with developed markets such as the US, Japan as well as other Asian markets were examined by Bose (2005) and (Mukherjee, 2005). The analysis was based on daily data over the period of January 1999-June 2004. The pair-wise and group-wise correlations and the Granger-causality tests were used. The authors concluded that when the Indian market is excluded from a set of Asian markets, there is no or no correlation in the co-integrations. This indicates that India plays a unique role in the level of interconnectivity of these markets in the recent era of more liberalised capital markets where foreign direct investment (FDI) plays a crucial role in the analysis of markets in the region. The low degree of integration indicates that there is no immediate need for India to be concerned about potential contagion and there is still ample scope for portfolio diversification by investing in the Indian market.

In a study published in 2006, Phylaktis (2006) and (Xia (2006)) examined the sector-specific co-movements and contagion of equity markets over the 1990-2004 period in the European, Asian and Latin American economies. They looked at whether sudden shocks from a single market or a group of markets affected the sectors in different countries. The results confirmed the sector-specific heterogeneity of the contagion and suggested that there are still sectors that can provide a way to reap the benefits of cross-border diversification during a crisis, despite the prevalent contagion at market level. The results also support the role of financial relationships in the spread of contagion.

In his analysis of the long-term balance and short-term dynamic relationship between the stock market indices of India and the capital markets of the 7 developed and developing economies, Seshaiah (2006) used the cointegration approach as well as the Granger causality method on the daily data of the stock market indices from 1997 to 2005. According to Seshaiah, there is a long-term relationship between Asian stock markets and the Indian Stock Market whereas the Indian Stock Market exhibits certain short term single-directional and double-directional causal relationships with the various capital markets selected for analysis.

Majid et., al., (2007) conducted a 2-step estimation of market integration between five selected emerging markets in ASEAN (ASEAN-5) viz. Malaysia (ASEAN-6), Thailand (ASEAN-7), Indonesia (ASEAN-8), Philippines (ASEAN-10), and Singapore (ASEAN-11) and their interdependence with the US market and with the Japanese market. They used the Co-Integration method and the GMM method on closing price data for daily stock indices over the period from Jan 1988 to Dec. 2006. The results of the study suggest that the stock markets of ASEAN are moving towards a higher degree of integration, either among each other or with the USA and Japan, especially after the financial crisis of 1997. Therefore, the long-term international diversification advantages that investors can gain from the ASEAN markets tend to decline.

In his study (2008), Dr. Kozluk examined the correlation between Russian and Chinese stock market returns, volatility, and global and regional factors. The approximate factor model was used to compare the emerging stock markets of Russia (CEEC region) and China (China). The results of the study showed that while the Russian market, similar to CEEC region in terms of co-movements, significantly increased in terms of global stock market integration, the Chinese stock market moved largely independently of global movements, and only marginally in terms of regional co-movements.

III. Data

The data used in the present paper is based on daily close prices of the Indian NIFTY 50 and Indonesian JKSE for the period April 01, 2019 to December 30, 2022. The window period has been broken down into pre and post pandemic periods. The pre pandemic period spans from April 2019- March 2020 and the post pandemic period spans from March 2020- December2022. All the data has been sourced from the websites of the relevant stock exchanges. Co-integration test has been conducted separately for the pre and post Pandemic periods. The causal relationship has been analyzed using a pairwise Granger causality test by taking all time series data representing the sample countries.

IV. Methodology

Since the data used in this study are time series, it becomes necessary to transform the statistical characteristics of time series. Natural logarithm transforms the data whereas ADF test is used to observe the characteristics of data series. All the price series (indexes) in the study are transformed into their natural logarithmic price series. Since the price changes are heteroscedastic, it is recommended to transform it to log price changes. The log transformation is likely to make the price changes homoscedastic, making the series stationary. The smoothing of the price changes is achieved by this transformation as it represents the rate of change, not the actual change. The initial difference of log prices, known as log returns, have been used in the study.

Descriptive statistics have been calculated to provide a ready reference and provide basic but elementary evidence about the changes in the behavior of the time series and explain the fact that the price distribution of the stock indices is not normally distributed. This is a well-known fact in the financial literature. Given that, the existence of stochastic trends or deterministic trends in the financial time series, or its stationary / non-stationary levels, is a necessary condition for any test to be conducted, the study commences with testing the price series for the unit root using ADF test. A stationary time series has a mean and a variance that are constant over time. The mean and variance of a stationary time series depend only on the difference in time between two time periods, not on the actual moment at which they are calculated. When a unit root is present in a time series, it indicates that the series has become unsteady or non-steady; it shows an unbalanced movement. The time series variables used in this paper are the daily stock index prices of sample countries. ADF unit root test uses the following equations:

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \, \Delta Y_{t-j} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots Equation\ 1$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \, \Delta Y_{t-j} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots Equation\ 2$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^{p} \gamma_j \, \Delta Y_{t-j} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots Equation\ 3$$

In order to understand the integration/connection between the stock market indices, cointegration test has been used. The cointegration test looks at the long-term structural relationship between the variables. In simple words, it looks at whether the variables follow the same direction over the long term. The purpose of this study is to know whether the indices moving in the long term follow the same direction. To solve the above question, I have used Johansen methodology. Next, I have tested the causal relationship between the various stock indices representing the countries we are looking at by applying the granger-causal test. The following equations are used to test the relation:

$$Y_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j \, Y_{t-j} + \sum_{j=1}^{p} \beta_j \, X_{t-j} + u_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots Equation\ 4$$

$$X_t = \gamma_0 + \sum_{j=1}^{p} \gamma_j \, Y_{t-j} + \sum_{j=1}^{p} \lambda_j \, X_{t-j} + v_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots Equation\ 5$$

However, the aforementioned equations of testing the causal relationship is based on the assumption of stationery time series data. And, the different time series data used in the study are showing non-stationery behavior as sufficed by the results of ADF test. Hence, the causality equations are required to be transformed into a differenced series by taking the first order differencing where there is the presence of unit root in time series data. Further, if the variables are cointegrated, the specifications are required to be modified by inserting an error correction term as an additional endogenous variable in the equations. Accordingly, the new equations to study the causal relationship are as follows:

$$\Delta Y_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j \, \Delta Y_{t-j} + \sum_{j=1}^{p} \beta_j \, \Delta X_{t-j} + \delta ECT_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots Equation\ 6$$

$$\Delta X_t = \gamma_0 + \sum_{j=1}^{p} \gamma_j \, \Delta Y_{t-j} + \sum_{j=1}^{p} \lambda_j \, \Delta X_{t-j} + \eta ECT_{t-1} + v_t \ldots\ldots\ldots\ldots\ldots\ldots Equation\ 7$$

V. Empirical Results

The descriptive statistics in Table 1 indicate the typical characteristics of time series data with respect to all the price series representing the sample markets under study. The Jarque-Bera test statistics for NIFTY and JKSE as shown in Table 1 are 1389.078 and819.4638 respectively and statistically significant during the pre COVID period. Further, the descriptive statistics also shows excess kurtosis in case of all the time series during the pre COVID period.The Jarque-Bera test statistics for NIFTY and JKSE as shown in Table 1 are 12592.93 and 3466.158 respectively and statistically significant during the post COVID period. The computation of descriptive statistics such as skewness, Kurtosis and Jarque-Bera during the pre COVID and post COVID period provides elementary evidence about the fact that price distribution of indices is not normally distributed which is in consonance with the documented financial literature.

Table 1: Descriptive Statistics of Stock Market Indices

	Pre COVID		**Post COVID**	
Statistics	Nifty	JKSE	Nifty	JKSE
Mean	-0.001188	-0.001782	0.001004	0.000653
Std. Dev.	0.014213	0.011638	0.01343	0.01089
Skewness	-1.504783	-2.010808	-1.555259	0.711119
Kurtosis	14.71158	11.37174	24.22123	14.14498
Jarque-Bera	1389.078	819.4638	12592.93	3466.158
Probability	0	0	0	0

Source: Computed

Owing to the aforesaid fact, it is imperative to analyze whether there is the presence of unit root in all the price series. The ADF test has been conducted at level and at first difference for each of the two price series and the result is documented in Table 2 . The ADF coefficients of NIFTY and JKSEat level are 1.28321 and -2.7933 respectively and statistically insignificant during the pre COVID period which indicates the presence of unit root and all the prices series are non-stationary. But, the ADF coefficients of NIFTY and JKSE price series at first difference are -7.2755 and -1.7779 respectively and statistically significant during the pre COVID period which indicates absence of unit root and all the prices series are stationary.

Table 2:Results of Unit Root Test for Pre and Post COVID Period

	Pre COVID Period				**Post COVID Period**			
	NIFTY		**JKSE**		**NIFTY**		**JKSE**	
	t-statistic	Prob.	t-statistic	Prob.	t-statistic	Prob.	t-statistic	Prob.
Unit Roots								
At levels	1.28321	0.9986	-2.793339	0.2014	1.65833	0.9016	-2.94186	0.15
At First Difference	-7.2755	0	-1.777885	0.0077	-29.2213	0	-29.9539	0

Source: Computed

The ADF coefficients of NIFTY and JKSE price series during the post COVID period at level shows the presence of unit root whereas at first difference, the result reflects absence of unit root and the series are stationary. The outputs of ADF test are in consonance with the already documented fact about time series that most of the time series data are non-stationary at level but stationary at first difference. Further, we have applied the cointegration test pair-wise in order to study the extent of cointegration between different market indices representing the sample countries. The results of the analysis have been documented in Table 3 and Table 4.
There is co-integrating relation between the market indices series under study as evidenced by the outputs of cointegration test. The Indian stock market is cointegrated with Indonesia during the pre COVID period as the trace statistic is more than the critical value. The co-integration Trace statistics and their respective probabilities given in parentheses are 69.97002 (0) and 13.49995 (0.0002). Further, there also exist the same relationship between India and rest of the markets during the post COVID period as evidenced by the co-integration results documented in Table 4.

Table 3: Pair-wise Cointegration Test Outputs of Pre COVID Period

Johansen's Cointegration Test for Long Run Relationship				
Pre COVID Period				
India and Indonesia				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Probability.**
None *	0.22371	69.97002	15.49471	0
At most 1 *	0.058742	13.49995	3.841466	0.0002
Source: Computed				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 4: Pair-wise Cointegration Test Outputs of Post COVID Period

Johansen's Cointegration Test for Long Run Relationship				
Post COVID Period				
India and Indonesia				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Probability.**
None *	0.195483	253.3542	15.49471	0.0001
At most 1 *	0.159761	112.6228	3.841466	0
Source: Computed				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

In comparing the Eigenvalues of pre and post COVID period, It was observed that the relationship gets strengthened during the Post COVID period. The Eigenvalue of post COVID is 0.159761 compared to the Pre COVID period value of 0.05874.

Table 5: Pair-wise Granger Causality Test Outputs of Pre COVID Period

Pair-wise Granger Causality Test			
Pre COVID Period			
Null Hypothesis:	F-Statistic	Probability	Inference
Indonesia does not Granger Cause India	8.27861	0.0003	Rejected
India does not Granger Cause Indonesia	1.18059	0.3090	Accepted

Source: Computed

Table 6: Pair-wise Granger Causality Test Outputs of Post COVID Period

Pair-wise Granger Causality Tests			
Post COVID Period			
Null Hypothesis:	F-Statistic	Probability	Inference
Indonesia does not Granger Cause India	1.27690	0.2796	Accepted
India does not Granger Cause Indonesia	0.83438	0.4346	Accepted

Source: Computed

The aftermath of COVID Pandemic has altered the status of inter-linkages between India and Indonesia as there is a switch over from uni-directional relationship to no relationship.

VI. Conclusion

The growing intensity of cross border portfolio investment across countries have created a serious concern for policymakers as to how and to what extent their domestic economies move in step with the economies of the rest of the world. Essentially, the extent of market co-movement is there to determine the influence of policy makers decisions on their own economies. Further, the occurrence of pandemic at macro level magnifying the extent of systemic risk is also posing serious consequences as they are capable of distorting the magnitude of market interdependencies. In order to safeguard the market and the economy from such pandemic, it becomes inevitable to analyze the impact of COVID pandemic on market inter-linkages and to ascertain the independency of the markets.

The objective of the present study is to determine the impact of COVID Pandemic on extent of integration between the capital markets of two emerging South Asian economies viz. India and Indonesia. To explore the objective, we have used daily close prices of indices of the aforesaid countries for the period April 01, 2019 to December 30, 2022. The window period has been broken down into pre and post pandemic periods. The pre pandemic period spans from April 2019- March 2020 and the post pandemic period spans from March 2020- December 2022. To test the hypothesis, we have employed Johansen's cointegration test and Granger causality test.

The results of the analysis indicate that there is cointegration between the capital markets of India and Indonesia and there is long run equilibrium between these markets during the pre COVID and post COVID period. Further, the result of causality test indicates significant impact of COVID Pandemic on the causal relationship between sample markets. There is a shift from uni-directional causal relationship to no causal relationship between India & Indonesia after the occurrence of COVID Pandemic. The implication of the result is that these markets do not behave in the same manner after the occurrence of COVID Pandemic and the market participants should adopt a cautionary approach while playing in these markets.

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