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Macroeconomic indicators and their impact on stock markets in ASIAN 3: A pooled mean group approach

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Abstract: The objective of this paper is to examine the long-run and the short-run relationship between India, China and Japanese stock markets and key macroeconomic variables such as exchange rates and inflation (proxied by consumer price index) of ASIAN 3 economies (India, China and Japan). Monthly time series data spanning the period from 2008 January to November 2016 has been used. The unit root test, the cointegration test, Granger causality test and pooled mean group estimator have been applied to derive the long-run and short-run statistical dynamics. The findings of pooled estimated results of ASIAN 3 countries show that exchange rate has a positive and significant long-run effect on stock markets while the inflation has a negative and insignificant long-run effect. In the short run, there is no statistically significant relationship between macroeconomic variables and stock markets. This study emphasises on the impact of macroeconomic variables on the stock market performance of a developing economy (India and China) and developed economy (Japan).

Subjects: Economics; Finance; Business, Management and Accounting

Keywords: Asian markets; macroeconomics; stock markets; times series analysis; pooled mean group

1. Introduction

From past few decades, international investors and researchers have focused on emerging financial markets, especially in ASIAN markets. Stock markets in these nations have provided attractive

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PUBLIC INTEREST STATEMENT

In emerging markets, many studies in the past have pointed out that stock markets represent the true portrait of an economy's financial health. It is always being considered that macroeconomic events have a specific quantity of pressure on the stock markets. Therefore, every country produces several policies to facilitate foreign private capital flows in the form of portfolio investments. It is being noted that these investments would help the stock markets to widen their investor base and indirectly compelling local authorities to improve the trading system. While the volatility associated with portfolio capital flows is well known, in this context it is important for the investors to understand how the macroeconomic indicators affect the stock market to plan their investments.

investment opportunities to foreign investors. The effectiveness of the growing markets presumes more significant as the pattern of investments is hastening in the secondary market because of political and legal changes and liberalising all other blockades has opened the market for foreign investors. Effective Market Hypothesis advocated by Eugene F. FAMA in 1970, the stock price is a proficient market indicator which will respond to all information and facts about the changes in macroeconomic variables.

Globalisation and extensive growth in trade investment and integration of international financial markets and participation of foreign institutional investors have enhanced the relationship between global stock markets and foreign exchange markets and thereby strengthening the relationship between exchange rate changes and stock market fluctuations. This phenomenon has been the subject matter of study by scholars during various financial crises, such as the 1997 Asian financial crisis, the subprime mortgage crisis and the recent European debt crisis. Therefore, a thorough understanding of the long- and short-run interactions between the global stock markets and foreign exchange markets can be effective in enabling governments in various countries to develop relevant financial policies and investment portfolios and to reduce any possible adverse impacts on a country's economy. India's economy has been one of the stars of global economies (Economywatch, 2008), as it is among the fastest growing and fourth largest economy in terms of purchasing power parity in the world. The capital investment boom in the country drives the current growth phase of the Indian economy. Markets react promptly to any news, at times even any forms of instability including but not limited to escalating political tensions or even war rumours of war, change in regulatory environment (business), deemed as negative by the business (investing) community and interest rate fluctuations in general performance of the economy (Moneybiz, 2008). Some other variables like population, movements in global markets, money supply growth, manufacturing sector growth and aggregate deposits of scheduled banks that affect the various economic changes (Gera, 2007).

During last decade China has been demonstrating the quite significant growth of economics. This attracted quite a lot of investors. The study of Luo, Gan, Hu, and Kao (2009) showed that Chinese stock market has experienced a rapid growth and has played important roles in the growth and development of the Chinese economy since the launching of the Shanghai and Shenzhen Exchange in early 1990. According to Degan (2009), investing in Chinese stocks is finding the right way of profiting from China's expected exceptional and unique future growth in the twenty-first century, and at the same time avoiding the risks represented by corruption, murky corporate financial statements, shady corporate governance, and complicated opaque government bureaucracy. With such risks, it is not surprising that the Chinese stock markets are extremely volatile.

For Japanese stock market, Hamao (1988) concludes that changes in expected inflation, unanticipated changes in risk premia and the term structure of interest rates significantly affect the Japanese stock returns.

Mukherjee and Naka (1995) observe a long-run relationship between the Japanese stock market and six macroeconomic variables.

Many studies focused on studying the relationship between macroeconomic variables and stock markets or stock returns of individual countries. However, in this study, we attempt to do the cross-country analysis of developed and developing economies of Asian countries like India, China and Japan. In this study, we contribute to the existing literature by studying the asymmetric effects of monetary policy on real output in the ASIAN 3 countries in a panel setting using the recently formulated pooled mean group (PMG) estimator proposed by Pesaran, Shin, and Smith (1999).

In this paper, we examine the relationships between the ASIAN stock index and macroeconomic variables (Inflation, measured by consumer price index and exchange rate) on a monthly data from 2008 to 2016 using Granger causality test, cointegration tests and the pooled estimated results.

Specifically, the main objective of the study is to understand how the stock markets and macroeconomic indicators (exchange rate and inflation) are integrated in India, China and Japan. Secondly, to describe the causal relationships between stock markets and macroeconomic variables. Finally, we use panel autoregressive distributive lag (ARDL) to estimate the long-run and short-run association between stock markets and macroeconomic variables of ASIAN 3 countries.

In this backdrop, the intent of this study is to probe into the course of the relationship existing among macroeconomic variables (Exchange rate and Consumer Price Index) in ASIAN 3 countries and stock market returns of India, China and Japan with reference to NSE (NIFTY INDEX), Shanghai stock exchange and Nikkei stock exchange.

2. Review of literature

2.1. Relationship between stock market and exchange rate

Bahmani-Oskooee and Sohrabian (1992) considered S&P 500 and USD exchange rate as the variables for studying causal relationship for the short period of time. They ascertained that bidirectional causality relationship exists between the selected variables. On the contrary, the cointegration analysis was abortive to recognise the long-term association between the two selected factors.

Studies on the stock market and its impact on macroeconomic factors are not nascent in the world. It is always being considered that macroeconomic events have a specific quantity of pressure on the stock markets. In a study by Büyüksalvarci and Abdioglu (2010) studied stock prices and its impact on macroeconomic variables of Turkey, the result of the study confirmed that there is a unidirectional long-run relationship between stock price and macroeconomic variables.

The study of Kyereboah-Coleman and Agyire-Tettey (2008) showed that macroeconomic factors adversely affect the performance of stock market. It appeared from the analysis that only money supply has a significant relationship on the Turkish Stock Index. Singh (2010) tried to explore an affiliation among three macroeconomic factors and BSE Sensex using unit root tests, correlation and Granger causality test. The outcome of the study revealed that the market index, exchange rate, Index of Industrial Production and wholesale price index hold a unit root and was integrated.

Moreover, the result of the Granger causality showed that bilateral causality exists between Index of Industrial Production and Sensex, on the other hand, Sensex is having unilateral causality. In a study of Adjasi (2009) showed that higher volatility in cocoa prices and interest rates increases the volatility of the stock prices.

Inflation of country is determined by the alteration in the consumer price index. Higher the inflation, there will be an obvious increase in the living expenses and shifting of resources from investments to consumption. High inflation has an effect on corporate profits amalgamated with the rise in the cost of borrowing of the organisations, which in turn forces dividend downward and thereby lowering stock prices. In view of that, it is said that equity prices are negatively related to inflation.

2.2. Relationship between stock market and consumer price index

Fama (1981) recommended proxy hypothesis which shows the negative connection between inflation rate and stock prices. The negative stock returns with inflation are defined by the positive connection between stock returns and basic determinants of equity values, such as the cost of capital, the average real rate of return capital and productivity of a firm (Fama, 1981).

Feldstein (1980) also confirmed the effect of inflation on stock prices through corporate income taxation, cost depreciation and taxation of nominal capital gains. When inflation rate increases, the cost depreciation affects firm profits.

Since the depreciation is determined based on historical cost which is not affected by the increase in inflation rate. The depreciation is less than it is supposed to drive the real taxable earnings to go up (Hong, 1977). Omran and Pointon (2004) analyse the effect of the inflation rate on the performance of the Egyptian stock market.

2.3. Relationship between India, China and Japan markets

Numerous studies have been done to investigate stock market linkages, integration or interdependence. The stock market is said to be integrated when correlation exists between markets. While the results of these studies are mixed, inconsistent and often oppose with each other, the ultimate determination behind the studies are the advantages of diversification. If evidence of stock market linkage were found, it would imply that there is a common force that brings these markets together. Hence, the benefit of diversification would be limited.

Two developing markets, China and India have been called the Asian tigers due to the remarkable economic growth experienced by both markets in recent years. During the last decade, China's economy as measured by GDP has grown at the average of 10% per annum while India's at 7% per annum. During this period, the trade level, capital flows and common economic contracts with other markets have also improved rapidly. Having large economic size, huge population and dynamic economic growth, China and India emerge as two major prominent emerging markets which contribute to the world economy. Singh (2010) analysed the linkage between China and India with four major developed markets and concluded that both Indian and Chinese stock market are cointegrated with all the four developed markets and also there exists a bilateral causality between India and China.

Chen, Lobo, and Wong (2006) examines the bilateral relations between three pairs of stock markets, namely India–US, India–China and China–US. The result of the study shows that markets are fractionally cointegrated with each other.

A study done by Chattopadhyay and Behera (2006) did not find any causality between the Japanese stock market and Indian stock market. Miyakoshi (2003), examined the magnitude of return and volatility spillovers from Japan and the US to seven Asian equity markets. The result of the study showed that US was important for Asian market returns and there was no influence from Japan. Thus, this study aims at providing some insight on the linkage of Indian, Japanese and Chinese markets.

3. Source of data and description

With a vision to achieve the predetermined goal of the study macroeconomic variables such as Exchange rate (US Dollar/Indian Rupee), (USD/Chinese Yuan) and (USD/JPY), Consumer Price Index were selected to examine the impact of these factors on stock market with reference to NSE, Shanghai stock exchange and Nikkei stock exchange (Dependent Variables). The previous research studies indicated that there is no any set yardstick for prices and inflation, but in maximum studies wholesale price index (WPI) and consumer price index (CPI) have been used single or simultaneously both indices (e.g. Abraham & Harrington, 2016; Czapkiewicz & Stachowicz, 2016; Sibanda, Hove, & Murwirapachena, 2015; etc.). In the present study, we use consumer price index as the proxy for inflation for all the three markets selected in the study.

Monthly data from January 2008 to November 2016 are used in this study from 01 January 2008 to 30 November 2016, which consists of 107 observations (Table 1). Data on NSE (India) have been obtained from NSE website, inflation and exchange rate of India has been obtained from global-rates dot com and investing dot com; Data on Shanghai stock exchange and exchange rate have been obtained from investing dot com; inflation data of China has been obtained from global-rates dot com; data of Japanese stock market (Nikkei) and exchange rate has been obtained from investing dot com and inflation has been obtained from global-rates dot com. (More details on data source refer Appendix 1).

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Table 1. Brief description of variables

Variables	Variables description
Dependent variable	
Stock market (SM1)	Nifty
Stock market (SM2)	Shanghai stock exchange
Stock market (SM3)	Nikkei stock exchange
Independent variables	
Exchange rate (ER1)	INR vs. USD
Exchange rate (ER2)	CNY vs. USD
Exchange rate (ER3)	JPY vs. USD
Consumer price index (CPI1)	CPI, India
Consumer price index (CPI2)	CPI, China
Consumer price index (CPI3)	CPI, Japan

Note: Overview of variables used in the study.

4. Methodology

This paper employs Granger causality test and Johansen cointegration to determine whether selected macroeconomic variables are cointegrated (hence possibly causally related) with stock markets of India, China and Japan. Furthermore, PMG (pooled mean group) estimator is used to investigate the possible asymmetries between macroeconomic indicators and Indian, Chinese and Japanese stock markets. For time series analysis, it is essential to determine whether the data-set is stationary or not. If the data-set mean variance is constant then it is said to be stationary over a period of time. Time series data are stationary if the data characteristics such as mean and variance, do not change over time. Stationary nature of the data-set is tested using ADF test proposed by Dickey and Fuller (1981).

(1) ADF test is on the basis of the null hypothesis that H0: Y_t is not I (0), thus H (0) specifies the data of the specified variable is not stationary or got unit root.

The entire model with trend and intercepts is shown in Equation (1):

$$\Delta Y_t = \alpha + \beta T + \rho Y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta Y_{t-i} + e_t \quad (1)$$

H0: Y_t has unit root test or not stationary

H1: Y_t is stationary

Y_t is the variable selected for the period t, Δ is the difference operator, T denotes a time trend, e_t is an error term disturbance with mean 0 and variance as σ^2, and k corresponds to the number of lags of the differences in the ADF equation.

(2) Granger causality test

Granger causality method developed by Engle and Granger (1987) has been used to locate the path of causality among the variables. It is a tool for discovering if one-time series data is substantial in estimating another set of selected variables or not. Cointegration indicates the existence of a long-run relationship between variables. To test the Granger causality, the following regression Equations (2) and (3) can be applied:

$$Y_t = \beta_0 + \sum_{k=1}^{M} \beta_k Y_{t-k} + \sum_{l=1}^{N} \alpha_l X_{t-l} + u_t \quad (2)$$

$$X_t = \gamma_0 + \sum_{k=1}^{M} \gamma_k X_{t-k} + \sum_{l=1}^{N} \delta_l Y_{t-l} + v_t \tag{3}$$

(3) Johansen cointegration test

The Johansen's cointegration test is being considered as compact maximum likelihood test that assists for examining cointegration in a whole system of equations. Johansen cointegration test through Cointegration Rank Test has been used to determine if there subsist long-run association between the change in the stock index and the four macroeconomic variables. There could be more than one cointegrating vector in a system of variables and the Johansen method can discover all such cointegrating relations (Johansen & Juselius, 1990; Juselius, 2006; Kasa, 1992).

The trace statistics test is being specified by the following Equation (4):

$$\text{Trace}\,(r,k) = -T \sum_{i=r+1}^{k} \ln(1-\lambda_i) \tag{4}$$

H0: No cointegration among variables

H1: There is cointegration among variables

(4) Pooled mean group estimator (PMG)

This study used the pooled mean group method proposed by Pesaran et al. (1999) to contemplate a lower degree of heterogeneity, as it imposes homogeneity in the long-run coefficients while still enabling heterogeneity in the short-run coefficients and error variances. The basic presumptions of the PMG estimator are: first, the error terms are serially uncorrelated and are distributed independently of the regressors, that is, the independent variables can be treated as exogenous; second, there is a long-run connection between the dependent and independent variables; and third, the long-run factors are the same across countries. This method also provides a long-run coefficient homogeneity over a single nation or regressors. Through this estimation technique, we can provide the multiplicity between the stock markets and macroeconomic indicators.

In the present study, following panel error correction model is used:

$$\Delta X_{i,t} = \alpha_i + \theta_i(X_{i,t-1}\beta_i \Delta z'^{s}_{i,t}) + \sum_{j=i}^{p-1} yi,j\Delta z'^{s}_{i,t} + \sum_{j=1}^{q-1} \varphi i,j \Delta X_{i,t} + \mu_i + \varepsilon_{i,t} \tag{5}$$

where β_i is the long-term parameter, θ_i is equilibrium parameter, $X_{i,t}$ is a stock market index of India, China and Japan, z as the macroeconomic variables, i represents countries and t refers to time.

Pesaran et al. (1999) recommend two various estimators, which are consistent when both T and N are large. The difference between mean group (MG) and pooled mean group (PMG) is that MG estimator appears to be more constant under the presumption that both the slope and intercepts can change across the countries, whereas the PMG estimator is constant under the presumption of long-run slope homogeneity.

An alternative estimator is established under the presumption of the homogeneous slope is dynamic fixed effects (DFE), wherein the slopes are fixed and the intercepts can change across countries.

5. Empirical findings

Table 2 represents an outline of descriptive statistics of all the variables (country-wise). The results of the descriptive study show the number of observations, maximum and minimum values, the sample mean and standard deviation.

The descriptive statistics for the three variables of India, China and Japan have been obtained for empirical analysis and are presented in Table 2.

The variables are exchange rate, inflation (CPI), Nifty, Shanghai stock exchange and Nikkei stock exchange. The results of skewness and kurtosis suggest that the distribution is symmetry. Additionally, if skewness and kurtosis have values 0 and 3, it is noticed that the given data sequence is normally distributed.

The primary and easiest method for identifying whether the data sequence is stationary is the graphical representation of each variable which is presented in Figure 1 which notices the facts of mean, variance, autocorrelation and seasonality. The existence of these patterns in the time series confirms the truth that the data frame is non-stationary. The graphical representation of Nifty, Shanghai stock exchange, Nikkei, exchange rates and inflation rate shows the trend of these variables.

Figure 1 represents the unusual vertical variation of the series indicates that one part of series varies greatly from the other. Thus, showing non-constant mean, variance and making the data frame non-stationary. The graphical representation of Nifty and exchange rate shows a downward and upward trend which could be an indication of non-constant mean and variance. On the other hand, India CPI is highly volatile and show higher fluctuation.

Further, Shanghai stock exchange shows upward-downward and then less volatile and again upward trend and exchange rate of CNY vs. USD upward and downward trend and China inflation rate is downward-upward which makes less volatile when compared to Indian inflation rate. Lastly, Japan Nikkei showing a downward and upward trend, Yen vs. USD also show downward and upward trend which indicates that series can be stationary as they do not show much fluctuation.

But Japan inflation rate is slightly volatile downward-upward and again upward trend. These facts are further established by the ADF test, which is a suitable and proper testing technique for determining the stationary or non-stationary nature of the data frame.

The ADF statistics shown in Table 3 reveal that except CPI of India all other variables of China and Japan found to be non-stationary in levels, with intercept and lagged 0. All other variables of respective countries found to be non-stationary because they failed to reject the null hypothesis, which shows all other variables except CPI of India has the presence of unit root.

Table 2. Descriptive statistics

	Overview of Indian markets					Overview of Chinese markets					Overview of Japanese markets			
	Nifty	**Exchange rate (USD/INR)**	**CPI**	**Obs**		**Shanghai**	**Exchange rate (USD/CNY)**	**CPI**	**Obs**		**Nikkei**	**Exchange rate (USD/YEN)**	**CPI**	**Obs**
Mean	6,021.46	54.25	49.45	107	Mean	2,706.75	6.49	52.56	107	Mean	12,789.11	97.35	43.54	107
SD	1,585.01	8.57	28.56	107	SD	606.85	0.29	29.84	107	SD	3,695.15	13.83	26.36	107
Min	2,755.10	39.28	1.00	107	Min	1,728.79	6.05	1.00	107	Min	7,568.42	76.23	1	107
Max	8,901.85	68.60	99	107	Max	4,611.74	7.18	104	107	Max	20,585.24	124.14	91	107
Skewness	0.16	0.12	0.0039	107	Skewness	0.97	0.24	−0.004	107	Skewness	0.46	0.22	0.11	107
Kurtosis	2.32	1.62	1.81	107	Kurtosis	3.88	1.74	1.82	107	Kurtosis	1.89	2.06	1.8	107

Figure 1. Graphical presentation of data-set.

Source: Stata 13.0.

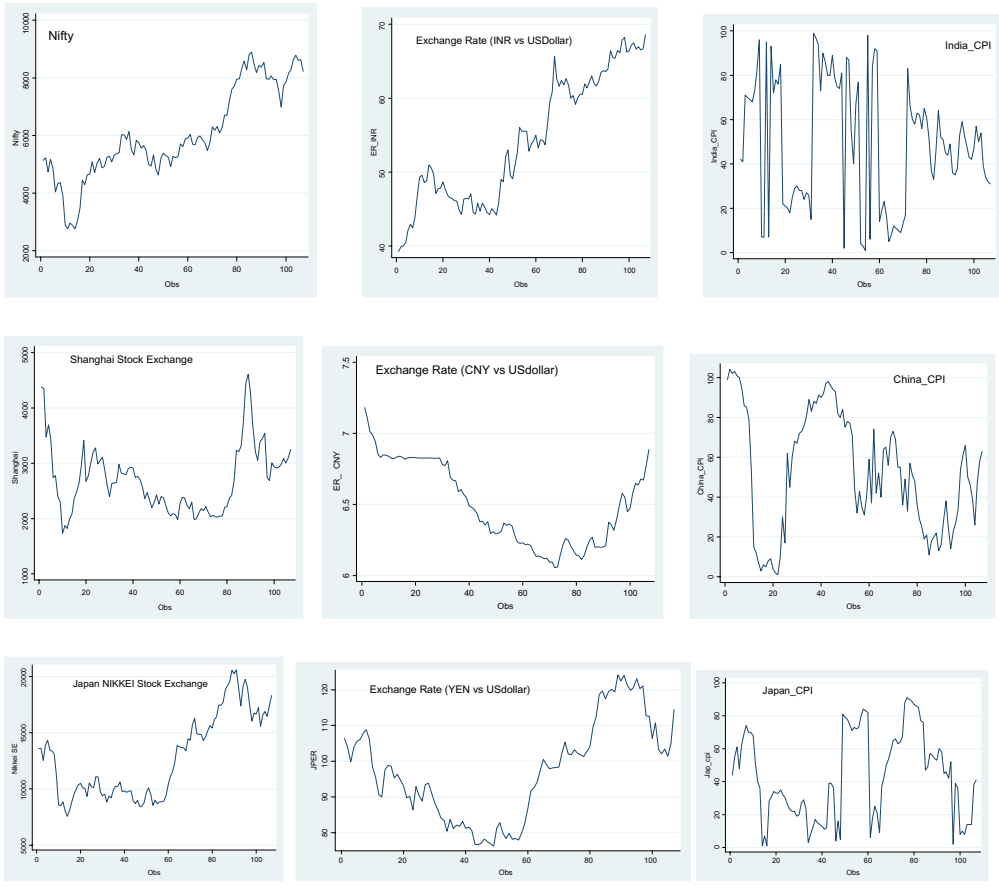

Table 3. Augmented Dickey–Fuller unit root test: Model 1 (without first difference)

No of Observations: 107			**Lags (0)**
Exogenous: Constant			
Dickey–Fuller test for unit root			
Variables	**ADF test**	**Null hypothesis**	**Result**
Indian market			
Nifty	−0.703*	Failed to reject h0	Variable is not stationary
CPI	−6.630	Reject H0	Variable is stationary
Exchange rate	−0.920*	Failed to reject h0	Variable is not stationary
Chinese market			
Shanghai stock market	−3.060*	Failed to reject h0	Variable is not stationary
CPI	−2.437*	Failed to reject h0	Variable is not stationary
Exchange rate	−2.004*	Failed to reject h0	Variable is not stationary
Japanese market			
Nikkei	−0.575*	Failed to reject h0	Variable is not stationary
CPI	−3.158*	Failed to reject h0	Variable is not stationary
Exchange rate	−0.898*	Failed to reject h0	Variable is not stationary

Note: A null hypothesis is accepted if test statistic < Critical value.

*Indicate acceptance of the null hypothesis of variable is not stationary at 1% significant levels.

Table 4 illustrates the result of the ADF test after taking the first difference. The resultant value of the ADF test statistics is compared with critical values for the above variables. All the variables after taking the first difference to the time series found to be stationary. Thus, after employing ADF test, now Johansen's cointegration test and Granger causality test has been applied further to test the long-term integration between the variables of India, China and Japan.

The result from Table 5 indicates that demonstrates the result of Johansen cointegration test. The principle discussed in Johansen (1995) is based on the principle of Pantula (1989). As per the same principle if the test statistic is less than the critical value at 5% significant level, then the null hypothesis of no cointegration cannot be rejected. The result from Table 5 it can be noted that all the pairs except Nifty—CPI (India) and Shanghai stock exchange—CPI (China) does not have cointegration

Table 4. Augmented Dickey–Fuller unit root test: Model 2 (first difference)

No of observations: 107			**Lags (0)**
Exogenous: Constant			
Dickey–Fuller test for unit root			
Variables	**ADF Test**	**Null Hypothesis**	**Result**
Indian market			
Nifty	−10.273	Reject H0	Variable is stationary
Exchange rate	−9.763	Reject H0	Variable is stationary
Chinese market			
Shanghai stock market	−8.950	Reject H0	Variable is stationary
CPI	−17.592	Reject H0	Variable is stationary
Exchange rate	−7.282	Reject H0	Variable is stationary
Japanese market			
Nikkei	−8.888	Reject H0	Variable is stationary
CPI	−8.808	Reject H0	Variable is stationary
Exchange rate	−9.002	Reject H0	Variable is stationary

Note: The null hypothesis is rejected if Test statistic > Critical value.

Table 5. Johansen's cointegration test

	Pairs	**Null**	**Trace statistics (Critical value)**	**Max statistics (Critical value)**
Indian Market (Lag 1)				
1	Nifty—Exchange rate (INR vs. USD)	$r = 0$	9.31* (15.41)	9.31 (14.07)
		$r = 1$	0.00 (3.76)	0.00 (3.76)
2	Nifty—CPI (India)	$r = 0$	38.24 (15.41)	37.78 (14.07)
		$r = 1$	0.45* (3.76)	0.45(3.76)
Chinese market (lag 2)				
1	Shanghai—Exchange rate (CNY vs. USD)	$r = 0$	15.13* (15.41)	11.90 (14.07)
		$r = 1$	3.23 (3.76)	3.23(3.76)
2	Shanghai - CPI (China)	$r = 0$	32.88 (15.41)	22.11(14.07)
		$r = 1$	10.77(3.76)	10.77(3.76)
Japanese market (Lag 1)				
1	Nikkei—Exchange rate (Yen vs. USD)	$r = 0$	10.11* (15.41)	9.35 (14.07)
		$r = 1$	0.75 (3.76)	0.75 (3.76)
2	Nikkei—CPI (Japan)	$r = 0$	10.50* (15.41)	10.17 (14.07)
		$r = 1$	0.33 (3.76)	0.33 (3.76)

Notes: Null hypothesis is accepted, if Test statistic < Critical value, Critical value considered at 5%.

among the selected pairs in the study. But it can be noted that India stock market (Nifty) and Chinese market (Shanghai stock market) has cointegration with the inflation, which means they have a long-term association or they have a long-term association or they move collectively in long run.

The result is also supported by Adam and Tweneboah (2008) where the result of the study shows the long-term relationship exists among Ghana stock exchange and macroeconomic variables. The Granger causality test is conducted to study the lead–lag relationship between ASIAN 3 markets and macroeconomic variables. Table 6 presents the results of the Granger causality test for the pairwise, the decision whether to reject or not to reject the null hypothesis is based on the *p*-values. Bidirectional Granger causality is found between Nifty and exchange rate, unidirectional causality is found Nikkei and exchange rate. Whereas relationship does not exist between Inflation (India) and Nifty and Inflation (Japan) and Nikkei implies that short-run-run differences between the markets are sufficient for investors to achieve gains by portfolio diversification.

5.1. Results of pooled estimates

To identify the impact of the variables of the exchange rate and inflation, error correction based on autoregressive distributed lag ARDL (p,q) model has been used, with focus on the pooled mean group. Table 7 reports the results of PMG estimates of the long-run coefficients, error correction term, short-term coefficients and Hausman test statistics for all the three countries (India, China and Japan) used in the study. The Hausman test statistics fail to decline the homogeneity of long-run coefficients. Hence, the PMG estimator is more efficient than the MG estimator. Table 8 reports individual countries results of PMG along with Hausman h-test to measure the comparative efficiency and consistency of PMG and MG model.

Table 7 shows that exchange rate has a positive and significant relationship with the stock market in the long run for all the three countries and stock market and inflation have no significant relationship in the long run. This result is also found in Pal and Mittal (2011), the study reveals that exchange rate and stock market have a significant relationship and stock market and inflation rate showed an

Table 6. Granger causality test

	Pairs	*df*	*F*. test	*p*-value	Conclusion
Indian market (lag 1)					
1	Nifty does not Granger cause Exchange rate	1	8.86	0.00*	
	Exchange rate does not Granger cause NIFTY	1	3.67	0.05**	Bidirectional relation exists
2	Nifty does not Granger cause Inflation (India CPI)	1	0.89	0.34	
	Inflation (CPI) does not Granger cause Nifty	1	0.35	0.55	Relationship does not exist
Chinese market (Lag 2)					
1	Shanghai stock exchange does not Granger cause exchange rate	2	0.27	0.75	
	Exchange rate does not Granger cause Shanghai stock exchange	2	1.10	0.33	Relationship does not exist
2	Shanghai stock exchange does not Granger cause Inflation (China CPI)	2	5.38	0.00*	
	Inflation (CPI) does not Granger cause Shanghai stock exchange	2	3.23	0.04**	Bidirectional relation exists
Japanese market (Lag 1)					
1	Nikkei does not Granger cause Exchange rate	1	1.26	0.26	
	Exchange rate does not Granger cause Nikkei	1	7.55	0.00*	Unidirectional Relation
2	Nikkei does not Granger cause Inflation (Japanese CPI)	1	0.00	0.95	
	Inflation (CPI) does not Granger cause Nikkei	1	0.44	0.50	Relationship does not exist

* indicate rejection of null hypothesis at 1% significant levels.

** indicate rejection of null hypothesis at 5% significant levels.

Table 7. Pooled mean group (PMG)

Pooled mean group of 3 countries		
Variables	**Coef**	**Std. Error**
Long-run coefficient		
Exchange rate	1.4360* (0.00)	0.2760
Inflation (CPI)	−0.0743(0.11)	0.0473
Error correction term	−0.2184* (0.00)	0.0681
Short-run coef		
Exchange rate	1.4614 (0.42)	0.0681
Inflation (CPI)	0.0451(0.13)	0.0299
Constant	0.9855** (0.04)	0.4878
Log Likelihood	275.1331	–
Hausman test	2.08 (0.35)	–

Estimations are done using (xtpmg) routine in Stata. The pooled mean group, all controlling for country and time effects, while the panel (LR) shows long-run effects. The second panel reports short-run effects (SR) and the speed of adjustment (ec). Monthly data 2008–2016. The total number of observation for each variable 321 (107 from each country for individual variable).

* indicates significant at 1%.

** indicates significant at 5%.

insignificant relationship in the long run. The result of the study agrees with Erdem, Arslan, and Sema Erdem (2005) where the result of this study found a negative relationship between inflation and Istanbul stock exchange's index. The short-run association between the stock market and the exchange rate is also positive and statistically significant and inflation and stock market relationship are insignificant. The error correction term is negative and statistically significant. This confirms that the cointegration relationship according to Engle and Granger representation theorem. Particularly, it shows that any deviation from the long-run expected value is adjusted by 21.84%.

Table 8 shows the result of individual country-wise where it can be noted that stock market index is positively associated with the exchange rate for all the three countries in short run. The positive association between exchange rate and stock market can also be found in Aggarwal, Davis, and Martin (1981). Inflation showed a negative and insignificant association between India, China and Japan.

Table 8. Pooled mean group (PMG)

Pooled mean group for India			Pooled mean group for China			Pooled mean group for Japan		
Variables	**Coef**	**Std. Error**	**Variables**	**Coef**	**Std. Error**	**Variables**	**Coef**	**Std. Error**
Long run-coefficient			Long run-coefficient			Long run-coefficient		
Exchange rate	1.4360*(0.00)	0.2760	Exchange rate	1.4360* (0.00)	0.2760	Exchange rate	1.4360* (0.00)	0.2760
Inflation (CPI)	−0.0743(0.11)	0.0473	Inflation (CPI)	−0.0743(0.11)	0.0473	Inflation (CPI)	−0.0743(0.11)	0.0473
Error correction term	−0.3517*(0.00)	0.6310	Error correction term	−0.1760*(0.00)	0.0534	Error correction term	−0.1274* (0.01)	0.4923
Short-run coef			Short-run coef			Short-run coef		
Exchange rate	4.7068 * (0.00)	0.9106	Exchange rate	−1.6767*(0.00)	0.2137	Exchange rate	1.3541* (0.00)	0.1588
Inflation (CPI)	0.1019*(0.00)	0.0356	Inflation (CPI)	0.0001*(0.01)	0.0284	Inflation (CPI)	0.0332*(0.00)	0.0079
Constant	1.9544*(0.00)	0.3989	Constant	0.6004**(0.03)	0.2760-	Constant	0.4018** (0.03)	0.3989
Log Likelihood	275.1331	–	Log Likelihood	275.1331	–	Log Likelihood	275.1331	–
Hausman test	2.08 (0.35)	–	Hausman test	2.08(0.35)	–	Hausman test	2.08 (0.35)	–

Estimations are done using (xtpmg full, to obtain each individual country results) routine in Stata. Pooled mean group, all controlling for country and time effects, while the panel (LR) shows long-run effects. The second panel reports short-run effects (SR) and the speed of adjustment (ec). Monthly data 2008–2016. The total number of observation for each variable 107 for each country. Hausman test is indicating that PMG is consistent and efficient estimation than MG (the *p*-value of Hausman test is >5% and hence we report only PMG results in the study).

* indicates significant at 1%.

** indicates significant at 5%.

6. Conclusion and future study

The research has made an effort towards the evaluation of the effect of exchange rate and inflation on stock markets of India, China and Japan. In the present globalised era, where capital markets are becoming significantly integrated, it has become essential to understand the underlying fundamentals influencing the markets at domestic and global level. Thus, variables like inflation, the exchange rate of India, China and Japan are taken as the independent variable and Nifty, Shanghai stock market and Nikkei are taken as an explanatory variable.

The objective of the study was to examine the relationships between the ASIAN stock index and macroeconomic variables (Inflation, measured by consumer price index and exchange rate) on a monthly data from 2008 to 2016 using Granger causality test, cointegration tests and the pooled estimated results. The PMG estimation indicated that exchange rate has a positive and significant relationship with the stock market in the long run for all the three countries and stock market and inflation have no significant relationship in the long run. The short-run association between the stock market and exchange rate is also positive and statistically significant and inflation and stock market relationship are insignificant.

The result of Johansen integration test reveals that all the pairs except Nifty—CPI (India) and Shanghai stock exchange—CPI (China) does not have cointegration among the selected pairs in the study. But it can be noted that India stock market (Nifty) and Chinese market (Shanghai stock market) has cointegration with the inflation, which means they have a long-term association or they have the long-term association or they move collectively in long run and supporting the previous studies done by Ahmed (2008). The test of the Granger causality test reveals that bidirectional Granger causality is found between Nifty and exchange rate, unidirectional causality is found Nikkei and exchange rate. Whereas relationship does not exist between Inflation (India) and Nifty and Inflation (Japan) and Nikkei implies that short-run-run differences between the markets are sufficient for investors to achieve gains by portfolio diversification. The results of VECM showed some interesting result where inflation (CPI) showed long-run causality between exchange rate and Nifty and Shanghai stock exchange showed negative long-run (short-run-run) causality among exchange rate and inflation (long-run). Whereas Nikkei showed short-run-run negative causality with inflation and positive short-run-run causality with the exchange rate.

The present study has further scope for comprehensive results. It can be extended over a longer period and with several countries and by including various macroeconomic variables, it will be more interesting to see how the stock market is affected by macroeconomic variables in European, US and other developed market. Future study can also focus on comparative study of developing and developed markets. The major implication of the study can be to governments of India, China and Japan and for the individual and institutional investors.

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Appendix 1

Data sources used in the study

(1) India

(a) INR vs. USD: https://in.investing.com/currencies/usd-inr-historical-data.

(b) Nifty (NSE): https://in.investing.com/indices/s-p-cnx-nifty-historical-data.

(c) India CPI: http://www.global-rates.com/economic-indicators/inflation/2008.aspx (Each year downloaded separately from Jan 2008 to Nov 2016 monthly data).

(2) China

(a) CNY vs. USD: https://www.investing.com/currencies/usd-cny-historical-data.

(b) Shanghai: https://in.investing.com/indices/shanghai-composite-historical-data.

(c) China CPI: http://www.global-rates.com/economic-indicators/inflation/2008.aspx (Each year downloaded separately from Jan 2008 to Nov 2016 Monthly data).

(3) Japan

(a) YEN vs. USD https://www.investing.com/currencies/usd-jpy-historical-data.

(b) Nikkei: https://www.investing.com/indices/japan-ni225-historical-data.

(c) Japan CPI: http://www.global-rates.com/economic-indicators/inflation/2008.aspx (Each year downloaded separately from Jan 2008 to Nov 2016 Monthly data).

Note: NSEindia.com, English.sse.com.cn (Shanghai stock exchange), indexes.nikkei.co.jp/en/nkave (Nikkei 225) has been also referred for additional information.