

An Econometric Analysis of Linkages between Macroeconomic Variables and Stock Markets: Evidence from Asian Emerging Markets

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Abstract

The purpose of this paper is to investigate impact of macroeconomic variables on stock markets of India and Indonesia. This paper also attempts to identify linkages between markets and macroeconomic variables. The rationale behind selecting these countries for the present study is MSCI emerging markets index of Asia, which comprises emerging economies with huge return potential for prospective investors. This study will help investors and researchers to understand dynamics of linkages between markets and macroeconomic variables. Augmented Dickey-Fuller (ADF) unit root test is used to assess the stationary of time series; Johansen test co-integration is applied to examine long-term integration among variables; Granger causality test is used to examine the causality relationship between macroeconomic variables and stock returns. The monthly data are taken for the study which ranges from July 1997 to July 2017. Currency exchange rates, interest rates, money supply, and inflation are the macroeconomic variables for the current study. Results revealed that there is one co-integrating equation of long-run equilibrium between the variables for both countries. Granger causality test reveals that there exists unidirectional and bidirectional relationship between the variables.

Keywords: Co-integration, Macroeconomic Variables, Stock Markets

JEL Classification: G-10, E-60, C-01

Introduction

This paper focuses on the relationship between stock markets and macroeconomic variables in Asian emerging markets. The concept of co-movement dynamics of stock markets and economic indicators is of great importance for asset allocation and reaping diversification benefits.

Furthermore, the study also helps in valuation of securities, as value of a security depends on two parameters: first, the present value of its dividends which is distributed from the corporate earnings; second, by real economic indicators (Leroy and Porter, 1981).

Macroeconomic variables are considered as important indicators for assessing stock returns because changes in these variables severely affect the firm's cash flows and influence the risk adjusted rate of return (Flannery and Protopapadakis, 2002). Fama (1970) stated that stock prices reflect underlying fundamentals, so macroeconomic variables should be employed as important indicators of future oriented economic activities. Chen, Roll, and Ross (1986) has applied a multivariate arbitrage pricing analysis to examine the relationship between macroeconomic variable and stock returns.

A conducive macroeconomic environment promotes the growth of businesses and elevates the economy to a stage of sustained growth. Macroeconomic variables like gross domestic product, interest rates, inflation rates, money supply, index of industrial production, exchange rates, fiscal policies, and debt position are key to stock markets performance (Pal and Mittal, 2011), because markets react promptly to news like fiscal slippages, which is evident from sudden crash in a rising rally of Indian stock markets soon after the speech of Union Budget 2018. Some other variables like money supply, increasing population, movement in world markets, IIP, deposits of banks also affect the markets (Gera, 2007).

Emerging Stock Markets of Asia

Emerging stock market index of Asia has outperformed the other related indices in the past few years, as these

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economies are growing fastest and increasing capital investments is driving their growth phase. The MSCI index of Asian emerging markets consists of nine countries China, Indonesia, India, Korea, Malaysia, Philippines, Pakistan, Thailand, and Taiwan. Among them India and Indonesia are selected for the present study due to similarities in their economic fundamentals.

Information Efficiency and Linkages between Markets

The information regarding macro- and microenvironments of an economy is easily accessible to investors due to rapid advancement in information technology. This unrestricted information flow has turned capital markets into efficient markets as the stakeholders are better placed with the new and existing information and can act in accordance of changing dynamics of an economic environment. The informational efficiency has made capital markets more efficient and integrated with other world markets and has led to volatility transmission across nations (Nikkinen and Sahlstrom, 2003). That is why, the economic scenario of emerging markets has changed due to 2008 recessionary pressures. The turmoil period has caused significant movement in the capital markets of both the economies. Adverse impacts include decline in the exports of goods, falling stock prices of IT sector companies, depreciation in the value of currency due to outflow of foreign capital, and decrease in exports (Ahmed, 2008). A clear understanding of economic variables that are affecting stock markets is needed and useful for all the stakeholders of market—policy makers, investors, traders, and researchers. Hence, this paper attempts to understand how the stock markets of India and Indonesia get affected by their macroeconomic indicators. The paper is oriented towards the study of short-run association and long-run integration, causal relationship between interest rates, inflation, exchange rates, money supply, and stock indices. The subsequent sections of the paper describe the present state of knowledge, explain research methodology adopted for the study, discussions of results conclusion, and scope for further research.

Present State of Knowledge

Literature includes studies on co-movement between markets and macroeconomic variables but had main concentration on the developed countries, on the contrary

relationship between stock markets and macroeconomic variables pertaining to emerging markets has received less attention (Schwert, 1989; Levine and Zervos, 1998). An illustrative literature on emerging markets includes Thornton (1993), Kaneko and Lee (1995), Abdalla and Murinde (1997), Mookerjee and Yu (1997), and Maysami and Koh (2000), Kwon and Shin (1999), Habibullah and Baharumshah (1996), and Ibrahim (1999).

The studies have addressed the linkages between the stock market and economic indicators and have applied econometric methods to investigate long-run and short-run association between macroeconomic variables like GDP, inflation, interest rates, and stock markets (Fama, 1981; Chen et al., 1986). Econometric techniques like co-integration tests (Nasseh and Straus, 2000; Acikalin et al., 2008), Vector Auto Regression (VAR) (Abugri, 2008), and Granger causality (Wongbangpo and Sharma, 2002) have been applied.

Acikalin (2008) investigated the presence of any relationship between local macroeconomic

Variables (GDP, interest rates, exchange rates, and the current account balances) and the Istanbul

Stock Exchange (ISE) index and found co-integration and unidirectional causal relationships among the variables over the period from 1991 to 2006. They have made an argument that the variables help in the prediction of the changes in the ISE.

Maysami et al. (2004) studied relationship between all S sector indices and economic variables of Singapore. He examined that Singapore stock market index and its property index have an integration and short-run, long-run influence of changes in interest rates, inflation, and money supply. Humpe and Macmillan (2009) applied co-integration test to examine long-term relationship between inflation, IIP, money supply, interest rates, and stock prices of the USA and Japan. He stated that there is positive relationship of stock prices with IIP and negative with CPI and interest rates for the US and Japanese markets are also positively influenced by IIP, but negatively by money supply. Khan et al. (2013) examined the impact of local, regional, and global economic factors on South Asian markets namely Pakistan, Bangladesh, Pakistan, and applied principal component analysis, VAR. He concluded that local and regional factors influence these markets and there was no influence of global factors.

Fifield and Power (2006) studied the relationship of economic factors (local and global) on 11 emerging stock markets, among them six were from Asia and five from rest of the world. Variables considered were GDP, exchange rates, money supply, world GDP, world market returns. It was concluded that the emerging markets other than Asia are influenced more by their local economic factors; whereas, the emerging markets of Asia are influenced more by markets of developed countries.

Ahmed (2008) investigated relationship between Indian capital markets and economic variables using quarterly data and with the application of Engle and Granger Error correction method concluded that a long-term relationship exists between the studied variables. Barakat et al. (2015) analysed the same with Egypt and Tunisia capital markets and applied Johansen test of co-integration, VECM, and Granger causality test. Their study concluded that variables were correlated in long run, and unidirectional and bidirectional causality lie between them. Some macroeconomic variables effect stock prices of a specific sector company like Haung et al. (1996) examined the relationship of oil price returns with the US stock prices, and provided an evidence that there exists a lead-lag relationship between oil prices and oil sector companies, and no effect on market was found.

Other researchers have argued that macroeconomic variables cannot act as explanatory variables for movements in stock markets. For example, the studies like Harvey (2000) and Verma and Ozunab (2005) concluded the same for developed and emerging markets.

Research Methodology

Research Variables

This paper aims to explore nature of linkages between stock markets and macroeconomic variables in the emerging markets. The variables are deposit rates as a proxy of interest rates, local currency of nations per USD as proxy of exchange rates, CPI as proxy of inflation, M2 as proxy of money supply and market index as proxy of stock market.

The variables are defined as follows:

Market Index: It is a collection of major firm's stock in an economy and considered a barometer of an economy's performance. The fluctuations in stock markets can be

attributed towards social and political, international, and firm-specific factors.

Interest Rates: These are defined as the rates of exchange between present and future consumption (Reily and Brown, 2003). If interest rates rise then investors invest their money in banks or in fixed income bearing securities. UddIn and Alam (2007) used interest rates and concluded that both interest rates and stock markets have inverse relationship.

Inflation: It is defined as an increase in general price level of commodities. CPI is the main measure of inflation; it can affect stock markets both positively and negatively. For instance, when inflation rate rises, the interest rates also rise which will reduce the present value of earnings of the corporate, as the discount rates increase. This phenomenon impacts stock markets negatively.

Exchange Rates: Adam and Tweneboah (2008) used national currency per USD as proxy to the exchange rates. In general, when stock prices increase, this will attract more foreign capital; and when prices fall, it leads to liquidation of investment by overseas investors.

Money Supply: Monetary aggregates can be used as a proxy to nation's money stock (Walter, 1989). These can be classified as M0, M1, M2, M3, and M4 where M1 is the narrowest of all and M4 is the broadest. The researcher has considered M2 as a proxy as supported by literature for instance Hamburger and Kochin (1972), Kraft and Kraft (1977), Sirueck (2011).

The research methodology needs to be cautiously designed so that the stated objectives can be achieved and a good methodology assumes standard and established conventions.

The monthly data are considered for study spanning from July 1997 to June 2017. The variables selected for the study and source of data collection are as follows:

Table 1

Research Variables	Proxy for Each Variables	Sources of Data
Stock market	Market indices	FRED database
Inflation	CPI	FRED database
Interest rates	Interest on deposits	IFS database
Exchange rates	National currency per USD	IFS database
Money supply	M2	FRED database

Research Hypothesis

H₁: Stock markets are not affected by interest rates in the long run.

H₂: There is no causal relationship between interest rates and stock markets.

H₃: Stock markets are not affected by inflation in the long run.

H₄: There is no causal relationship between inflation and stock markets.

H₅: Stock markets are not affected by exchange rates in the long run.

H₆: There is no causal relationship between exchange rate and stock markets.

H₇: Stock markets are not affected by money supply in the long run.

H₈: There is no causal relationship between money supply and stock markets.

Research Strategy

To accomplish the objectives of the study, econometrics tests carried out are: unit root test, ADF test by Dickey and Fuller (1981), unrestricted VAR to select an optimal lag length, Johansen test for co-integration, and Granger causality test. If the variables are co-integrated of same order then we use Johansen test and if they are not co-integrated then Granger causality test is directly used to understand direction of the causality between variables.

For analysing the relationship between macroeconomic variables on stock markets, data have to be co-integrated, that means the variables will not move away from each other in the long run. When the long-run equilibrium is established, the test generates a long-run equation with normalised co-integrating coefficients. For selection of the appropriate co-integration test, the first step is to determine order of integration of the variables by using ADF unit root test, which determines the stationary or non-stationary properties of time series (Gujarati, 2004). If all the variables taken for the study are stationary at first difference, this means that they are integrated of the same order, i.e., I (1). Once, long-run equilibrium is established through Johansen test of co-integration then, pare-wise Granger causality will be used to study the short-run causal relationship between the variables, which means that past values of a variable can help in the prediction of another variable. For example, if it is established that variable Y Granger causes variable X, this means that the historical data of Y can be used to predict X. This relation can be unidirectional or bidirectional which means X

can also Granger because Y. In other words, this test will examine whether the macroeconomic variables affect stock prices or stock prices affect the macroeconomic variables (Gujarati, 2004).

Table 2: Statistical Test Used for the Analysis

Tests	Purpose
Augmented Dickey Fuller	To test for unit root in time series
Vector Autoregressive	To choose an optimal lag length
Johansen test for co-integration	To test co-integration
Granger causality	To test the causality between variables

Table 3: Variables' Definition (Data are Converted to their log Values.)

LOGINDEX	Logarithm of monthly values of closing values of indices
LOGINT	Logarithm of monthly values of interest rates
LOGCPI	Logarithm of monthly values of inflation (CPI)
LOGMS	Logarithm of monthly values of M2 (money supply)
LOGEXCH	Logarithm of monthly values of exchange rates against US dollars

Conceptual Framework

For India

$$\text{LOGINDEX} = \beta_1 \text{LOGINT} + \beta_2 \text{LOGCPI} + \beta_3 \text{LOGMS} + \beta_4 \text{LOGEXCH} + e \quad (1)$$

For Indonesia

$$\text{LOGINDEX} = \beta_1 \text{LOGINT} + \beta_2 \text{LOGCPI} + \beta_3 \text{LOGMS} + \beta_4 \text{LOGEXCH} + e \quad (2)$$

where e is error term and $\beta_{1,2,3,4}$ are coefficients of independent variables.

Analysis and Results

ADF

The test is applied to examine the stationary properties of the time series and assessed first at level and then at first difference.

Null hypothesis: Time Series has a unit root.

The level of significance is 5%.

Table 4: ADF

Variables	Statistics	India		Indonesia	
		at level	at first difference	at level	at first difference
LOGINDEX	t-statistics	-0.628031	-11.18053	-0.365620	-14.79599
	p-value	0.8606	0.0000	0.9114	0.0000
LOGINT	t-statistics	-1.938945	-8.557096	-2.327293	-14.72291
	p-value	0.3141	0.0000	0.1643	0.0000
LOGMS	t-statistics	-2.136804	-15.88778	-2.335724	-15.34239
	p-value	0.5734	0.4736	0.1617	0.0000
LOGCPI	t-statistics	-4.03102	-8.6343	0.048348	-11.81433
	p-value	0.5220	0.0000	0.0046	0.0000
LOGEXCH	t-statistics	-1.785336	-11.88949	-1.269650	-11.56442
	p-value	0.5440	0.0000	0.6442	0.0000

Table IV: Shows that time series has a unit root at level and is non-stationary but at first difference it becomes stationary, as p value <.05 and we reject null hypothesis. But the dataset of LOGMS has a unit root at first difference i.e. I (2) (in case of India) and Dataset of LOGCPI becomes stationary at level i.e. I (0) in case of Indonesia. Hence both the variables are not included in model specification of Johansen test of co integration, as the primary condition for Johansen test of co integration is data must be I (1), else it generates spurious results.

VAR

The optimal lag length for a monthly time series ranges from 12 to 36 lags. Hence, to determine the optimal lag length unrestricted VAR is used which is based on LR test, Akaike information criterion (AIC), Final prediction error

(FPE), Schwarz criterion (SC), Hannan and Quinn (HQ). The optimal lag length used is 14 which is determined by AIC as it is better than other criteria's (Gutierrez et al, 2009).

Johansen Test of Co-integration

Then Johansen test of co-integration is applied as the data are at root level and become stationary at first difference.

Null hypothesis: There is no co-integration between the variables.

The results of Tables 5 and 7 show that there is one co-integrating vector for both the markets at 5% level of significance. This means the stock indices have long-run equilibrium with the macroeconomic variables and they will not move away from each other in the long run.

Table 5: Co integration Test (Indonesia)

Series: LOGINDEX LOGINT LOGEXCH LOGMS

Lags interval (in first differences): 1 to 14

Unrestricted Co integration Rank Test (Trace)

Hypothesised		Trace	0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob.**
None *	0.132065	51.69273	47.85613	0.0209
At most 1	0.057194	19.82413	29.79707	0.4348
At most 2	0.027479	6.572770	15.49471	0.6278
At most 3	0.001348	0.303459	3.841466	0.5817

*Trace test indicates 1 co-integrating eqn(s) at the 0.05 level

Unrestricted Co-integration Rank Test (Maximum Eigen value)

Hypothesised		Max-Eigen	0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob. **
None *	0.132065	31.86860	27.58434	0.0132
At most 1	0.057194	13.25136	21.13162	0.4294
At most 2	0.027479	6.269311	14.26460	0.5789
At most 3	0.001348	0.303459	3.841466	0.5817

** Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 0.05 level

Table 6: Co-integrated Equation (Indonesia)

Normalised co-integrating coefficients (standard error in parentheses)				
LOGINDEX	LOGINT	LOGEXCH	LOGMS	C
1.000000	0.285779	-0.074740	-1.467017	2.07
	(0.22002)	(0.48403)	(0.16001)	

$$\text{LOGINDEX} = 1.46\text{LOGMS} + .07\text{LOGEXCH} - .28\text{LOGINT} - 2.07C \quad (3)$$

Equation (3) implies that the coefficients are significant at 5% and there is negative relationship between interest rates and stock markets but positive relationship between stock markets and exchange rates, money supply. LOGCPI was eliminated from the system equation as it didn't hold to properties needed to apply Johansen test of co-integration.

Table 7: Co-integration Test (India)

Series: LOGINDEX LOGINT LOGCPI LOGEXCH

Lags interval (in first differences): 1 to 14

Hypothesised		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob. **
None *	0.158208	73.22205	47.85613	0.0000
At most 1	0.106154	34.47199	29.79707	0.5135
At most 2	0.040041	9.222070	15.49471	0.3453
At most 3	0.000123	0.027608	3.841466	0.8680

*Trace test indicates 1 co integrating eqn(s) at the 0.05 level

Unrestricted Co-integration Rank Test (Maximum Eigen value)

Hypothesised		Max-Eigen	0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob. **
None *	0.158208	38.75006	27.58434	0.0012
At most 1	0.106154	25.24992	21.13162	0.1124
At most 2	0.040041	9.194463	14.26460	0.2703
At most 3	0.000123	0.027608	3.841466	0.8680

**Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 0.05 level

Co-integrated equation (India)

Table 8

Normalised co integrating coefficients (standard error in parentheses)				
LOGINDEX	LOGINT	LOGCPI	LOGEXCH	C
1.000000	0.856660	-4.910613	8.127541	-1.57
	(0.53261)	(0.46673)	(1.28608)	

$$\text{LOGINDEX} = 4.96\text{LOGCPI} - 8.12\text{LOGEXCH} - 0.856\text{LOGINT} - 2.07C \quad (4)$$

Equation (4) implies that the coefficients are significant at 5% and there is negative relationship between exchange rates and stock markets; also, interest rates have negative relationship with stock markets. But positive relationship exists between inflation and stock market. LOGMS was eliminated from the system equation as it doesn't hold to properties required for the application of Johansen test of co-integration.

Granger Causality Test

As the long-run equilibrium is established between the markets and macroeconomic variables, the short-run association can be concluded by using pair wise Granger causality.

Table 9: Granger Causality Test (Indonesia)

Lags: 14

<i>Null Hypothesis:</i>	<i>Prob.</i>	<i>Result</i>
LOGINT does not Granger Cause LOGINDEX	0.0169	Reject
LOGINDEX does not Granger Cause LOGINT	0.0008	Reject
LOGCPI does not Granger Cause LOGINDEX	0.0077	Reject
LOGINDEX does not Granger Cause LOGCPI	0.3230	Accept
LOGMS does not Granger Cause LOGINDEX	0.00003	Reject
LOGINDEX does not Granger Cause LOGMS	0.000007	Reject
LOGEXCH does not Granger Cause LOGINDEX	0.0043	Reject
LOGINDEX does not Granger Cause LOGEXCH	0.000002	Reject

Table 9 shows results of Granger causality test for Indonesian markets and it can be inferred that there is bidirectional relationship between LOGINDEX and LOGINT, LOGINDEX and LOGMS, LOGINDEX

and LOGEXCH. There is a unidirectional relationship between inflation and stock markets. The LOGCPI does Granger causes LOGINDEX but LOGINDEX doesn't affect LOGCPI.

Table 10: Granger Causality Test (India)

Lags: 14

<i>Null Hypothesis:</i>	<i>Prob.</i>	<i>Result</i>
LOGINT does not Granger Cause LOGINDEX	0.9929	Accept
LOGINDEX does not Granger Cause LOGINT	0.6242	Accept
LOGCPI does not Granger Cause LOGINDEX	0.4172	Accept
LOGINDEX does not Granger Cause LOGCPI	0.3358	Accept
LOGMS does not Granger Cause LOGINDEX	0.6535	Accept
LOGINDEX does not Granger Cause LOGMS	0.2407	Accept
LOGEXCH does not Granger Cause LOGINDEX	0.1353	Accept
LOGINDEX does not Granger Cause LOGEXCH	0.0097	Reject

Table X depicts the results of Granger causality for India and it can be concluded that there is no causal relationship between LOGINDEX and LOGCPI, LOGINDEX and LOGMS, LOGINDEX and LOGINT, but LOGINDEX does Granger causes LOGEXCH.

Conclusion

This paper has made an attempt to study the linkages between macroeconomic variables like interest rates, money supply, inflation, exchange rates, and stock

markets. The countries selected in the study are the two developing markets of Asia which have commonalities in their fundamentals. Both the economies are important for investors strategically. The results of the study make it very clear that if one wants to make profit out of the investments then macroeconomic factors cannot be overlooked. Such studies help investors to design their investment strategies as they are able to predict the direction of the markets and can focus on significant variables. For example, knowing that exchange rate movements affect Indian stock markets negatively, whereas Indonesian markets positively, will

help the investors to optimally manage their portfolio and have the benefits of diversification. Government can also consider such linkages whilst framing policies which can lead to a robust stock market of that economy. Hence, any study that explores this area will be a huge help for practitioners, investors, academicians to understand dynamics of linkages between macroeconomic variables and stock markets in emerging economies.

Future Research Implications

The study can be extended by including other emerging markets of Asia and global economic factors like world GDP, IIP for the same. In this paper, VECM is not applied; hence, after the application of Johansen co-integration test, VECM can be applied to examine the error correction term and the speed with which the variables will turn to equilibrium in the long run. Furthermore, such studies can include the structural breaks like economic crisis and its impact on the linkages of macroeconomic variables with stock markets.

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