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Are stock markets of emerging economies informationally efficient? Causal analysis of stock prices and macroeconomic variables of EM7 economies for the recent decade

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Abstract. *An informationally efficient stock market is one of the indispensable factors for the smooth working of the economic machinery of a country. Efficient market hypothesis in this regard provides the theoretical base, which eliminates the possibility of beating the market and provides a level playing field for everyone in the market without any intervention. The informational efficiency of the major stock markets throughout the globe has been extensively researched by examining the causal links between stock prices and macroeconomic indicators. However there is considerable gap with respect to emerging stock markets. Therefore present study is an attempt to examine the efficiency of the stock markets of EM7 (India, China, Brazil, Russia, Indonesia, Mexico, and Turkey) which are going to be the epicentre of investment and growth in the coming times. Granger Causality Test is applied on monthly time series data for the recent decade spanning from 2010 to 2019. The study has found major directional relationships as unidirectional particularly running from macroeconomic variables to stock prices. The results of the study indicate that stock markets of the EM7 largely inefficient in terms of fundamental macroeconomic variables which in turn provide scope to reap abnormal returns by having prior information on macroeconomic front. The results indicated Chinese stock market as comparatively efficient among sample countries.*

Keywords: Emerging economies, granger causality, macroeconomic variables, stock market efficiency, stock markets, time series.

JEL Classification: C1, E6, F4, G1.

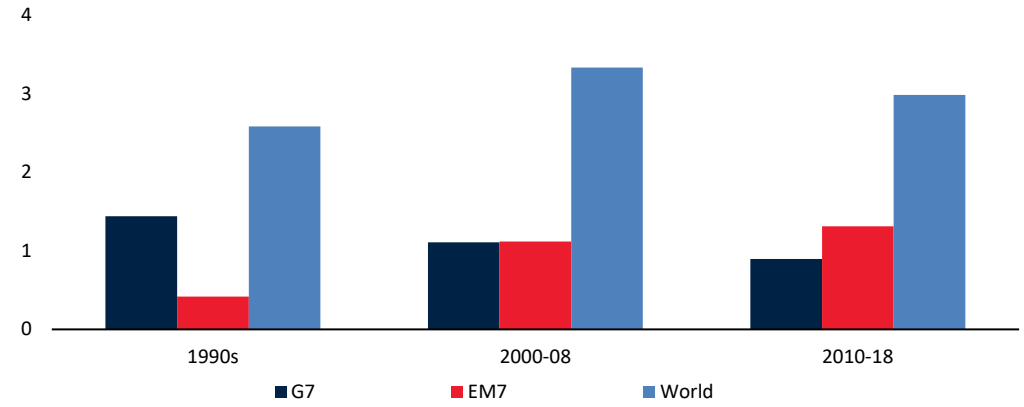
1. Introduction

The recent past has seen considerable modifications in the world economies and economic scenarios which have evoked a change in the understanding of the markets and the role of a financial system in the economic development of a country. The development of capital markets can be regarded as one of the progressions. The Role of financial markets in any economy is pivotal. Capital markets, particularly stock markets form the major component of any financial system. Stock markets possess a very crucial position and perform very important functions in any financial system. Stock markets are said to be efficient if they follow a random walk process i.e., price changes are unpredictable and existing information is already priced. "An efficient capital market encourages economic growth and prosperity by stabilising the financial sector and providing a significant investment avenue that contributes to attracting domestic and foreign capital" (Ray, 2012). The economic state of any country is measured or gauged to a large extent by the efficiency of its capital markets and hence it is said that the stock market is the barometer of the economic state of a country.

Because securities prices react swiftly to the appearance of fresh information, they currently reflect all information about the security in a functioning capital market. In addition, company profits should reflect the overall level of economic activity, and stock prices should reflect expectations about future business performance. If stock prices truly represent the underlying fundamentals, they should be regarded as leading indications of future economic activity rather than the other way around (Singh, 2010). Consequently, for formulating macroeconomic policy it is crucial to understand the causal links between macroeconomic variables and stock prices. Clive Granger proposed the Granger Causality Test in 1969. The test is performed to see if something that happened or happened in the past causes future happenings. Unlike regression, this test evaluates the ability to predict future values of a time series from previous values of another time series. The test is used to investigate whether the variables are causal or have a lead-lag connection. In the words of Dar and Butt (2021) "If the current value of Y can be described by past values of X, including past values of Y, then X is said to be the granger cause of Y. In other words, including previous X values can help forecast Y more accurately. To better predict Y, a VAR model includes not only the previous values of Y but also the past values of X". The existence of a causal relationship between macroeconomic variables and stock prices, on the other hand, violates Fama's fundamental efficient market hypothesis because it allows investors to build a mechanism to predict stock returns based on the facts available. Causality links are crucial in determining informational efficiency in major stock markets around the world (Javed and Husain, 2020). Tripathy (2011) also employed the granger causality test on the Indian stock market to conclude that the Indian stock market is not weak-form efficient as causality flows from macroeconomic variables to the stock market. Similar methodology was applied by Liu et al. (1997), Kwan et al. (1995), Arusha and Wickremasinghe (2007) and Guo et al. (2020) to examine the efficiency of stock markets. Bidirectional causality between the two series is implied if lagged changes in some macroeconomic variables cause changes in stock prices and earlier stock price swings cause changes in the economic variable. This pattern suggests stock market inefficiencies. On the other hand, when two data sets are independent of each other, it is presumed that informational efficiency is ensured by the stock market.

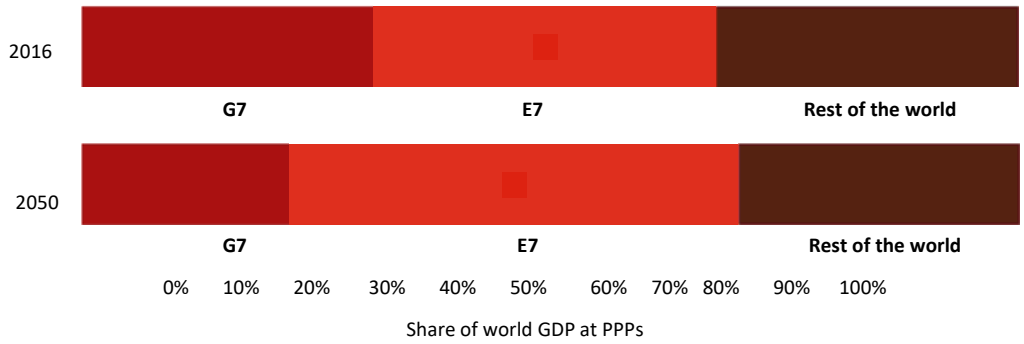
The informational efficiency of the major stock markets throughout the globe has been extensively researched by examining the causal links between stock price indexes and macroeconomic indicators. A number of studies have documented informational inefficiency in stock markets in their studies by the application of the granger causality test like that of Pan et al. (1999); Abdalla and Murinde (1997); Bhattarcharya and Mukurjee (2002); Michael (2014) and Habibullah, Baharumshah and Azali (2000). The other group of studies have confirmed that stock markets are efficient in terms of macroeconomic information like that of Oseni and Nwosa (2011); Rafay et al. (2014); Orman (2003) and Vuyyuri (2005). The present study also uses the Pairwise Granger Causality test to study short-run causal relations between macroeconomic variables and EM7 stock market returns. However, the majority of the studies have developed markets as their sample frame while the minimum number of studies has focused on developing countries. Our study will try to access the causal links between macroeconomic variables and stock returns of the most progressive and relatively new emerging market group named EM7 economies. The term EM7 is used in the World Bank report –Global Economic Prospectus, The Turning of the Tide? Published in June 2018. EM7 is a high-growth emerging market group which included India, China, Russia, Brazil, Mexico, Indonesia and Turkey. As per this report, this group constitutes 1/4th of global GDP and 19 per cent of international trade. "EM7 economies will surpass growth rate achieved by G7 economies in coming 34 years and will increase their GDP share from 35% to 50%" Hawksworth et al. (2017). Figure A will show the contribution of EM7 economies to global growth and Figure B shows the projected changes in the shares of world GDP. By looking at these figures, it can be safely concluded that the future belongs to these EM7 economies to a greater extent and these economies are going to dominate the emerging world in the coming times. To our surprise, no such study has been undertaken to access the causal or lead-lag relationship between macroeconomic variables and stock prices among EM7 countries as a group. Given these realities, a causality study of these countries' stock markets in relation to macroeconomic fundamentals is inescapable. The study will help domestic and global investors in particular in the identification of macroeconomic fundamentals which are causing stock prices of these emerging economies and thus impacting their return patterns. Further, the policymakers of these countries will get insights about the stock market informational efficiency of these countries, so that steps could be taken to make information dispersion even for all the stakeholders to prevent abnormal gains to specific players in the market. Present study is organised into various sections. Section 2 provides the review of literature, section 3 highlights the research methodology, and section 4 presents the empirical results followed by the discussion of results and conclusions thereof.

Figure A. *Contribution of EM7 to global growth*



Source: United Nations Conference on Trade and Development (UNCTAD), World Bank.

Figure B. *Projected change in shares of world GDP from 2016 to 2050*



Source: IMF for 2016 estimate, PwC projections for 2050.

Review of literature

The goal of the literature review is to summarise the key findings of research that have been conducted on the topic at hand. We have attempted to highlight more recent literature on the topic, despite the fact that there are many studies on the subject that include different countries, different macroeconomic variables, for different time periods, and by applying different methodologies. Following are some of the studies conducted on the causal analysis between macroeconomic variables and stock prices.

India, Pakistan, Korea, and the Philippines are four growing economies whose currency rates and stock prices relationship were examined by Abdalla and Murinde (1997) by applying Engle-Granger procedure. By taking monthly observations between 1985 and 1994, they were able to confirm the causal relationships between the exchange rate and the

stock market. They discovered unidirectional causality stock prices to exchange rates in the Philippines and for India, Korea and Pakistan causality runs exchange rate to stock price, when they applied cointegration using the two-step Engle-Granger approach.

Azman-Saini et al. (2002) tried to demonstrate the causal relationship between stock price and exchange rate by using Granger non-causality procedure proposed by Toda and Yamamoto (1995) for the Indonesian market. Using high-frequency daily data their study found that during pre-crisis period, unidirectional causality from stock price to exchange rate existed while bidirectional causality was found for the crisis period in a bivariate framework. The relationship was again revisited in a multivariate framework by including US stock price as a proxy for the external influence and results showed bidirectional causality for the pre-crisis period and unidirectional causality from exchange rate to stock price for the crisis period concluding exchange rate movement has significant implications for stock price behaviour.

In order to look at the dynamic relationship between stock price and exchange rate in India, Nath and Samanta (2003) conducted an empirical analysis. The analysis revealed no evidence of any causal relationship between two financial factors in either direction using daily data for the ten-year period between 1993 and 2002.

Aydemir and Demirhan (2009) tried to unravel the nexus between stock price and exchange rate in Turkish economy. Using daily data from 2001 to 2008, the study used Toda-Yomamoto procedure to explore the causal relationship due to varying integration orders among the variables. The results confirmed causality among the variables. Bi-directional causality was confirmed between exchange rate and stock price indices.

Saleem et al. (2013) analysed relationship between inflation and stock prices in Pakistan. The study used quarterly data of KSE 100 index and CPI announced by State Bank of Pakistan. The results confirmed negative relationship between stock prices and inflation. Further granger causality analysis failed to detect any causality between the two.

Michael (2014) used ARDL approach to cointegration to investigate relationship between stock returns and inflation in Ghana. On a quarterly data of stock market proxied by GSE All share index and inflation represented by CPI, the results revealed negative and significant relationship between inflation and stock prices supporting proxy hypothesis of Fama and in the long run the association turned out to be positive in tandem with Fisher hypothesis. Granger causality test revealed unidirectional causality running from inflation to stock prices suggesting that past information about inflation can be used to predict stock behaviour in Ghana which is contradictory to efficient market hypothesis.

Shah et al. (2012) studied causal relationship of interest rate and stock price on KSE-100 of Pakistan. Using Johansen cointegration test for the time period between 2007 and 2010, they found that interest rate and stock price are not cointegrated in the long run. Granger causality test confirmed unidirectional causality running from interest rate to stock price and not the other way round confirming the importance of interest rates in predicting stock price behaviour.

Jawaid and Haq (2012) focused on the influence of interest rates and currency rates on Pakistan's banking sector in particular. Cointegration research proved the significant negative long-term link between interest rate and exchange rate and stock price. On the other hand, a strong positive correlation between stock price and interest rate and exchange rate volatility was discovered. This is because these variables lead to a shift in investment from the forex market and bank deposits to stocks, increasing the value of the latter. The results of a causality study showed a one-way causal relationship between the short-term interest rate and stock prices and a two-way relationship between the exchange rate and stock prices.

According to Kraft and Kraft (1976), stock prices are unaffected by changes in the money supply, supporting the market efficiency hypothesis. There is a statistical relationship between stock prices and the money supply, according to regression results based on monthly data for the S&P 500 of US. However, causality failed to prove any sort of causality running from money supply to either to level or percentage stock prices, proving that stock market is efficient in terms of absorption of the information regarding changes in money supply and interest rates and hence do not lead stock prices.

Rogalski and Vinso (1977) investigated the causal relationship between money supply and stock returns on four major stock indices of US. The results rejected the hypothesis of independence between stock return and money supply, rather confirmed bidirectional causality between money supply and stock prices.

Rogalski (1977) supported efficient market hypothesis in terms of relationship between money supply and stock returns in US over a period of 1974 to 1983. The study conclude that US stock market is informationally efficient in terms of past and current information with regard to changes in money supply, hence no lagged impact of money supply on stock prices.

To investigate the causal relationship between the money supply and stock prices as well as the interest rate and stock prices, Hashemzadeh and Taylor (1988) analysed weekly data on stock prices, money supply, and interest rates. The findings demonstrated that there is a two-way causal relationship between the money supply and stock prices. Although there is a relationship between the weekly money supply and stock prices, the study suggested that single-cause explanatory models are insufficient and that other macroeconomic variables should be added to the model in order to improve prediction and comprehension of the causal relationship.

Li and Wu (2008) confirmed long run equilibrium relationship between macroeconomic variables (money supply and fiscal deficit) and stock prices for Taiwan, Hong Kong, Korea and Singapore. They have concluded that stock markets of these countries are informationally inefficient as they fail to adjust or absorb informational changes either in monetary policy or fiscal policy in the short run as suggested by Granger causality approach.

Faisal (2016) investigated Turkish market to determine dynamic linkage between stock market and GDP on a quarterly data from 1989 to 2014. Using ARDL approach to cointegration, the results documented strong and positive long run relationship between stock price and GDP as 1% in stock prices will lead to an increase of 0.73% increase in

GDP. The results of Granger causality tests confirm bidirectional causality between stock prices and GDP which means both the variables are equally important in determining and predicting the economic conditions of the country.

Most of the studies reviewed and documented focused on developed economies. There are studies conducting on emerging economies as well, however the studies conducted on emerging economies produce conflicting results. To our knowledge so far no study has been conducted to unravel stock price and macroeconomic causal links in EM7 economies as a group and more importantly with application of recent data base. Our study will try to fill this research gap by doing comparative study of EM7 markets on more recent data (2010-2019).

Data and methodology

Data

The study uses monthly data set of fundamental macroeconomic variables namely Inflation (CPI), Interest rate (benchmark interest rate), Real activity (Index of industrial production), money supply (M3), Exchange rate (REER) and Oil price (average of Average spot price of Dubai Fateh, West Texas Intermediate & Brent Blend). Monthly frequency is chosen for obvious reasons. Daily data contains too much of noise and variance while for weekly data, particular day of the week has to be chosen as a weekend which becomes impractical because different countries have different weekends. The study selects one major stock index from each EM7 country to represent the equity market of the country. The study has employed monthly stock price data of SENSEX for India, SSE Composite for China, MOEX for Russia, IBOVESPA for Brazil, BIST 100 for Turkey, S&P/BMV IPC for Mexico and JCI for Indonesia. The data has been collected from the Bloomberg database and Yahoo Finance. The reference period for our study is 2010 to 2019. Despite emerging countries withstanding global recession somewhat better than the developed world, the year 2010 marked the beginning of a new era for emerging markets following the damage caused by the financial crisis of 2007–2008. But despite unprecedented monetary policy accommodation and numerous rounds of fiscal stimulus, the global economy, notably EMDEs (Emerging Market Developing Economies), has faced a decade of poor growth (Kose and Ohnsorge, 2020). Because the global recession ended at the beginning of this era and the global pandemic (Covid 19) began at the end of this period, this period is also indicated as being very steady and without much turbulence, giving us the relatively stable data that is essential for any forecasting model. The data has been transformed into log form due to its various statistical features.

Causality analysis

Having a causal relationship between two occurrences means that one event must occur as a result of the other. Additionally, this is referred to as cause and effect. We use the term causality to refer to the relationship between two variables in which cause and effect are interdependent. It means a cause in one situation may be an effect and an effect in another situation may be a cause. We explore the causal relationship between stock prices and

macroeconomic variables using the Pairwise Granger causality test. In 1969, Clive Granger developed the Granger Causality test to see whether one variable that happened or occurred in the past causes another variable to occur later. Granger causality test is used to investigate causality or lead-lag relationship among any two time series by using the past values of one series to anticipate future values of another series. In the words of Dar and Butt, 2021, "In the case of time series X and Y, X is said to Granger cause Y if the current value of Y can be explained by past values of X including past values of Y. When past values of Y and X, in the scenario of two time series –x and y, can be useful in predicting current values of Y, we can say that X is granger causing Y". In other terms, it means that including previous X values result in a more accurate estimation of Y's value. To better predict Y, not only past values of Y are used but also past values of Y are included by running a VAR model. In terms of lag selection, the Granger causality test is highly sensitive. To run a Granger Causality Test in the context of two variables, the following regression model is executed:

$$P_t = w_0 + w_1P_{t-1} + ... + w_pP_{t-p} + x_1Q_{t-1} + ... + x_pQ_{t-p} + a_t \quad (1)$$

$$Q_t = y_0 + y_1Q_{t-1} + ... + y_pQ_{t-p} + z_1P_{t-1} + ... + z_pP_{t-p} + b_t \quad (2)$$

The null hypothesis of equation 1 is $x_1 = x_2 = ... = x_p = 0$, implying Q does not granger cause P. The null hypothesis of equation 2 is $z_1 = z_2 = ... = z_p = 0$, implying P does not granger cause Q. Granger causality is established upon the rejection of the null hypothesis in both equations.

Data stationarity

For the application of any econometric model and to get reliable results, data must be put to stationarity test. Non-stationary data can produce spurious results. Likewise in the case of Granger causality test, performing the stationary test is a precondition and non-stationary data needs to be made stationary, usually by differencing the level data. Further for performing Granger Causality test, data must be integrated of same order. The study uses the most popular and well documented test of stationarity namely ADF (Augmented Dickey Fuller) on our log-transformed data. The Dickey Fuller test is developed by Dickey and Fuller in 1979. The revised version of the Dickey-Fuller test is the augmented dickey fuller test Here null hypothesis is that series under consideration is non-stationary i.e., it has a unit root. The alternative hypothesis about the ADF test is that series under consideration is stationary. ADF test is performed by using the following equation-

$$\Delta x_t = \beta_1 + \beta_2 + \delta x_{t-1} + \sum_{i=1}^{k} \alpha 1 \, \Delta x_{t-1} + \varepsilon_t$$

Here Δ is the difference operator, t is the time measured chronologically, β_1 is the intercept, β_2 is the time trend. Here Null hypothesis: $\delta=0$ and the Alternative hypothesis: $\delta<0$. We confirm data stationarity in case the critical value is more than the calculated test statistic. However, the data series is differenced d times, where $d>1$, to conform it to stationary one upon the acceptation of the null hypothesis. The ADF test works on the assumption that there is no autocorrelation in the dependent variable. The introduction of lags of Δx_t in the equation of ADF "soaks up any dynamic structure present in the dependent variable to ensure that ε_t is not autocorrelated" (Brooks, 2014).

Selection of lag length

Outcome of Pair-wise granger causality test is lag sensitive. Therefore it is necessary to choose appropriate lag length for the results of the granger causality test to be reliable. For this purpose, we run VAR model for each sample country to get the appropriate lag length based on AIC criteria. AIC compares different models based on different lags of the independent variables and selects the one which best explains the variation in the dependent variable by taking minimum parameters and which best fits the data. Appropriate lag length as per AIC criteria for each simple country is: India (1), China (2), Russia (2), Brazil (2), Indonesia (5), Mexico (3) and Turkey (2). (See appendix)

Empirical findings

Table 1. *Stationary test of variables*

Augmented Dickey Fuller Test												
	EXR		IFR		IIP		ITR		MS		SP	
	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.
India	0.511	0.000	0.921	0.000	0.821	0.000	0.299	0.000	0.151	0.000	0.288	0.000
China	0.844	0.000	0.501	0.000	0.754	0.000	0.422	0.000	0.898	0.000	0.421	0.000
Russia	0.98	0.000	0.786	0.000	0.444	0.000	0.901	0.000	0.697	0.000	0.432	0.000
Brazil	0.268	0.000	0.881	0.000	0.122	0.000	0.960	0.000	0.110	0.000	0.993	0.000
Indonesia	0.654	0.000	0.991	0.000	0.565	0.000	0.652	0.000	0.898	0.000	0.132	0.000
Mexico	0.545	0.000	0.414	0.000	0.091	0.000	0.811	0.000	0.972	0.000	0.521	0.000
Turkey	0.301	0.000	0.919	0.000	0.154	0.000	0.354	0.000	0.297	0.000	0.465	0.000
	Level						First difference					
Oil price	0.301						0.000					

Note: EXR (exchange rate), IFR (inflation), IIP (industrial production), ITR (interest rate), MS (money supply) and SP (stock prices).

ADF results as indicated in Table 1 reveal that data of all the variables at level form is non-stationary as all of the P values exceed the significance level of 5%. However, it can be observed that once the data is first differenced, P value significantly comes below 5%, which suggests that data is integrated of order one i.e., data becomes stationary at first difference. Therefore differenced data is used to carry out causality analysis.

Table 2. *Results of pair-wise Granger causality test*

Hypotheses	Country						
	India	China	Russia	Brazil	Indonesia	Mexico	Turkey
LIF → *LSP*	0.0695	0.2888	0.0300	0.0806	0.0248	0.5283	0.0092
LSP → *LIF*	0.5389	0.7061	0.1665	0.5405	0.2110	0.6589	0.8935
LIP → *LSP*	0.0332	0.2674	0.0541	0.0034	0.0408	0.0376	0.0868
LSP → *LIP*	0.0001	0.9796	0.3625	0.4964	0.0960	0.3179	0.0100
LIT → *LSP*	0.0026	0.1072	0.0509	0.6736	0.3619	0.3002	0.1260
LSP → *LIT*	0.3994	0.1096	0.6198	0.0105	0.2243	0.2523	0.0521
LMS → *LSP*	0.0357	0.0856	0.1288	0.2903	0.0190	0.0225	0.0516
LSP → *LMS*	0.4285	0.7951	0.0041	0.3026	0.1193	0.0280	0.0008
LEX → *LSP*	0.0246	0.0497	0.0181	0.1282	0.7741	0.0348	0.2274
LSP → *LEX*	0.1038	0.5695	0.4187	0.3778	0.1845	0.1345	0.0005
LOP → *LSP*	0.0193	0.0042	0.0269	0.0520	0.5716	0.2983	0.1333
LSP → *LOP*	0.1115	0.0520	0.0154	0.8299	0.4651	0.1950	0.5434

Note: L stands for log, EX (exchange rate), IF (inflation), IP (industrial production), IT (interest rate), MS (money supply) and OP (oil prices). The values given in the table are P values associated with stationary tests.
Source: Author's work based on collected data.

The Pair Wise Granger Causality test results present mixed findings on the short-run causal relationship between stock prices and macroeconomic variables in the EM7 countries. In India, unidirectional and bi-directional causality runs from all macroeconomic variables to stock prices except for inflation. Therefore it can be concluded that the Indian stock market is largely inefficient as the past information about economic variables can be used to predict future stock prices. Besides except the index of industrial production (IIP), past movements in stock markets in India can't be used to predict the behaviour of different macroeconomic variables. Compared to India, there exist causal relationships of only two economic variables viz. exchange rate (unidirectional) and oil prices (bidirectional) with Chinese stock market. With respect to other macroeconomic variables, there exists neither unidirectional nor bidirectional causal relationships of macroeconomic variables with Chinese Stock market. As such it can be concluded that Chinese stock market is largely efficient. In Brazil, the results of Granger causality test are mixed. There is unidirectional causality running from industrial production and oil price towards stock prices where as stock prices seem to lead interest rate in Brazil. With respect to other variables viz. inflation rate, money supply and exchange rate, there does not exist any causal relationship. Given these mixed findings, it can be concluded that the Brazilian stock market is partly efficient. Compared to the Brazil and China, Russian stock market seems inefficient in terms of majority of macroeconomic variables except interest rate. However stock prices seem to lead money supply in case of Russia. Expectedly only oil price is found to have bidirectional relationship as it is one of the major oil exporting countries. Mixed results are also reported for Indonesia. Unidirectional causality runs from Inflation, industrial production and money supply towards stock prices, which means investors can use information on these variables to predict stock price movement in Indonesia. In case of remaining variables viz. interest rate, exchange rate and oil price, stock market is efficient. Therefore given these mixed findings, it can be concluded that Indonesian stock market is partly efficient. The results of Mexico are somehow similar, where in we found unidirectional causality running from two macroeconomic variables viz. industrial production and exchange rate where as bidirectional is reported between money supply and stock price. Therefore we can conclude that Mexican stock market is efficient with respect to some variables where as inefficient with respect some macroeconomic variables. In case of Turkey the results indicate that Turkish stock prices leads majority of macroeconomic variables viz. interest rate, industrial production, money supply and exchange rate. Therefore Turkish stock market is fairly efficient at least with respect to these macroeconomic variables.

Statistical diagnostics

Table 3. *Diagnostic test of Granger causality models of EM7*

Serial Correlation LM Test (Breusch-Godfrey)							
	India	China	Russia	Brazil	Indonesia	Mexico	Turkey
F-statistic	0.1168	0.2152	0.2901	0.3465	0.7761	0.7321	0.9123
Obs*R-squared	0.0921	0.1723	0.2561	0.3112	0.7521	0.6702	0.8479
Test of Heteroscedasticity (Breusch-Pagan-Godfrey)							
F-statistic	0.3952	0.2954	0.9012	0.7394	0.0691	0.5012	0.4732
Obs*R-squared	0.3835	0.2822	0.8951	0.7102	0.0536	0.4833	0.4511
Durbin-Watson statistic							
	1.955	2.012	1.986	2.461	1.992	1.942	2.058

For any statistical procedure to be reliable and valid; it must pass through some statistical procedures/tests and Granger Causality is no exception. The validity of Granger Causality procedure depends to a large extent on the data must being free from serial correlation and multicollinearity. From the results of Table 3, it can be seen that the F statistic and observed R squared values are above 5% significance level, therefore accepting the null hypothesis of no serial correlation and heteroscedasticity in the data. Further, it can be seen that Durbin-Watson values are around 2 for all the countries which suggest that there is no multicollinearity issue in the data.

Discussion of results

The study has found major directional relationships as unidirectional particularly running from macroeconomic variables (inflation, interest rate, money supply, exchange rate, industrial production and oil price) to stock prices in sample countries. This finding is in line with findings of many other studies like Pan, Fok and Liu (1999); Abdalla and Murinde (1997); Bhattarcharya and Mukurjee (2002); Michael (2014) and Habibullah, Baharumshah and Azali (2000). This implies that stock markets of these countries lack informational efficiency because information about these variables can be used to predict stock price movement and earn abnormal returns (Singh, 2010; Bhattachary and Mukherjee, 2006). In an efficient market, both current and historical data on the progress of these variables are completely represented in asset prices, preventing investors from formulating a lucrative trading rule based on the available data. But our results do suggest that the sample countries lack informational efficiency, maybe most of the countries are in the developing phase.

Our results also found few bidirectional causal links between stock price and industrial production, stock price and oil price and stock price and money supply like the studies of Ahmad et al. (2015) and Isaac, Gyedu and Carsamer (2020). The booming stock market leads to the inflow of capital, which enhances productive capacity in an economy, which means more cash flows for firms and more industrial production. This will enhance the demand for stocks and would lead to the enhancement of stock prices. An increase in industrial production on the other hand signals economic growth which translates into corporate earnings and hence more demand for stocks. The booming stock market means more economic and productive activities in the economy which means more corporate profits and would result in an increment of demand for crude oil because oil is the indispensable input for almost all productive activities. In the same way movement of oil prices has a definite impact on the stock market which has already been discussed in the previous section. The state of the stock market actually leads the money supply, because a bullish stock market means excess demand for stocks, which means more demand for money in the economy. Monetary authorities in that case can formulate expansionary monetary policy to fuel economic growth. Hence stock price movement (bullish/bearish) can lead the movement of money supply and how the changes in money supply impact stock prices have already been discussed in the previous section.

Our results also suggest market efficiency in terms of a few variables among the few countries: inflation (India, China, Brazil and Mexico), Interest rate (China, Russia and Indonesia), money supply (China), Exchange rate (Brazil and Indonesia) Oil price (Mexico, Turkey and Indonesia) and Industrial production (China), which are in line with studies like Oseni and Nwosa (2011); Rafay et al. (2014); Orman (2003) and Vuyyuri (2005). The absence of causal links among the variables suggests that markets are efficient in terms of the above-mentioned variables, especially in the case of China.

Conclusions

Efficiency of stock markets around the world has remained a hard debate for decades, especially for emerging stock markets which are going to be the epicentre of investment and growth in coming times. In this vein, the present study has attempted to study the efficiency of the relatively new emerging market group called EM7 by employing a very prominent and simple technique of granger causality. The study worked on monthly time series data from 2010 to 2019. Data on prominent macroeconomic fundamentals namely interest rate, inflation rate, exchange rate, industrial production, money supply and oil prices was used while monthly stock prices of main stock indices of each sample country was taken for the study. Results of causality analysis suggested that among EM7 markets, the Chinese stock market is more efficient as most of the causal pairs are independent whereas the Russian and Indian stock markets lack informational efficiency in comparison to other sample countries as most of the causal pairs show unidirectional causality running from macroeconomic variables to stock prices which indicates prior information about macroeconomic fundamentals can be used by potential investors to move stock prices and generate undue profits. From the above discussion, it is clear that EM7 nations differ concerning market efficiency. It can also be concluded that none of these markets is efficient across all macroeconomic variables. Causality analysis also suggests that the stock markets of the EM7 are largely inefficient in terms of fundamental macroeconomic variables. However Chinese stock market is comparatively efficient due to the absence of causal links for the most the variables.

Implications

The results of our study will be a rich addition to the financial literature especially in the emerging economies' context. We found bidirectional or feedback and unidirectional causality largely run from macroeconomic variables to stock prices, which mean macroeconomic information can be used by investors or fund managers to predict stock price movements leading to informational inefficiency of stock markets among EM7 nations. By tracking the past movements of the fundamental macroeconomic variables, investors can certainly influence and earn above normal returns in these high growth emerging economies. By using a suitable trading strategy, one can beat the market. However the question remains that what are the trading strategies to beat the market or at all those exist? This question is left to be answered by future research. Since the findings of the study point toward informational inefficiency in the EM7 stock markets in relation to macroeconomic variables, the finds of the study could be useful for the policy makers

and market regulatory institutions among these seven emerging economies. They need to work towards faster dissemination of financial information on a real-time basis and foster fair disclosure regulations so that information (financial reports, financial news, economic prospectus of country etc.) is made available to all participants of the market on an equal basis to provide a level playing field for everyone. Our results also point towards informational efficiency in case of Chinese stock market (though not to that extent), therefore investors in China should focus on other variables (may be country specific) which affects their stock prices and hence returns.

Future research

The study can further be extended by including developed markets as well to have comparative look at the efficiency of the stock markets. Further study time period can also be extended up to twenty to thirty years and more advanced econometric tools can be applied to capture dynamic and complex behaviour of modern financial and economic systems. Researchers can only focus on sectoral indices besides composite indices to have better understanding of the informational efficiency sector wise. Inclusion of more macroeconomic variables can be a rich addition to future research as to know which factors are actually determining the stock returns of the emerging economies more precisely.

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Appendix

Lag selection for India

Lag	Log L	LR	FPE	AIC	SC	HQ
0	960.2808	NA	1.24e-17	-19.06562	-18.88325	-18.99181
1	1841.590	1621.609	7.32e-25*	-35.71180*	-34.25291*	-35.12136*
2	1890.215	82.66205	7.47e-25	-35.70430	-32.96887	-34.59722
3	1921.126	48.22139	1.11e-24	-35.34252	-31.33056	-33.71881
4	1959.131	53.96671	1.48e-24	-35.12262	-29.83412	-32.98227
5	1984.963	33.06579	2.65e-24	-34.65927	-28.09424	-32.00228
6	2027.346	48.31667	3.63e-24	-34.52693	-26.68537	-31.35331
7	2068.845	41.49825	5.53e-24	-34.37689	-25.25880	-30.68664
8	2153.569	72.86250*	4.02e-24	-35.09137	-24.69674	-30.88448

** indicates lag selection by the criterion.*

Lag selection for China

Lag	Log L	LR	FPE	AIC	SC	HQ
0	531.8317	NA	2.01e-13	-9.371995	-9.202089	-9.303059
1	1512.554	1821.342	1.20e-20	-26.00990	-24.65065*	-25.45841*
2	1566.758	93.88820	1.10e-20*	-26.10282*	-23.55423	-25.06877
3	1595.492	46.18033	1.62e-20	-25.74093	-22.00300	-24.22433
4	1634.489	57.79949	2.03e-20	-25.56231	-20.63503	-23.56316
5	1671.034	49.59635	2.75e-20	-25.33990	-19.22327	-22.85819
6	1723.301	64.40040	2.94e-20	-25.39823	-18.09227	-22.43397
7	1781.920	64.89898	2.97e-20	-25.56999	-17.07468	-22.12318
8	1860.705	77.3783*	2.27e-20	-26.10187	-16.41722	-22.17250

***** *indicates lag selection by the criterion.*

Lag selection for Russia

Lag	Log L	LR	FPE	AIC	SC	HQ
0	836.8894	NA	1.46e-16	-16.59779	-16.41543	-16.52398
1	1733.088	1649.005	6.41e-24	-33.54175	-32.08286*	-32.95131
2	1828.808	162.7247	2.55e-24*	-34.47616*	-31.74073	-33.36908*
3	1874.748	71.6660*	2.81e-24	-34.41495	-30.40299	-32.79124
4	1900.516	36.59071	4.79e-24	-33.95032	-28.66182	-31.80997
5	1932.301	40.68501	7.59e-24	-33.60602	-27.04099	-30.94903
6	1979.351	53.63724	9.47e-24	-33.56702	-25.72546	-30.39340
7	2035.109	55.75761	1.09e-23	-33.70218	-24.58408	-30.01192
8	2095.027	51.52925	1.30e-23	-33.92053	-23.52590	-29.71364

***** *indicates lag selection by the criterion.*

Lag selection for Brazil

Lag	Log L	LR	FPE	AIC	SC	HQ
0	834.2394	NA	9.06e-16	-14.77213	-14.60223	-14.70320
1	2056.672	2270.232	7.21e-25	-35.72628	-34.36703*	-35.17479*
2	2113.457	98.36036	6.33e-25*	-35.86531*	-33.31671	-34.83126
3	2149.842	58.47605	8.13e-25	-35.64004	-31.90210	-34.12344
4	2195.890	68.24891	8.99e-25	-35.58732	-30.66004	-33.58816
5	2239.394	59.04169	1.08e-24	-35.48918	-29.37256	-33.00747
6	2298.853	73.2623*	1.01e-24	-35.67595	-28.36999	-32.71169
7	2356.489	63.81043	1.04e-24	-35.83015	-27.33484	-32.38333
8	2393.542	36.39213	1.67e-24	-35.61683	-25.93217	-31.68746

***** *indicates lag selection by the criterion.*

Lag selection for Indonesia

Lag	Log L	LR	FPE	AIC	SC	HQ
0	806.3382	NA	1.49e-15	-14.27390	-14.10399	-14.20496
1	1797.700	1841.100	7.35e-23*	-31.10178	-29.74253*	-30.55029*
2	1844.025	80.24256	7.78e-23	-31.05403	-28.50543	-30.01998
3	1879.580	57.14062	1.01e-22	-30.81392	-27.07599	-29.29732
4	1941.095	91.17526	8.51e-23	-31.03742	-26.11014	-29.03826
5	1983.191	57.12910	1.04e-22	-31.20622*	-24.79749	-28.43241
6	2033.264	61.69821	1.16e-22	-30.93329	-23.62733	-27.96903
7	2073.205	44.22017	1.64e-22	-30.77152	-22.27621	-27.32471
8	2146.548	72.0334*	1.38e-22	-30.91412	-21.52157	-27.27685

***** *indicates lag selection by the criterion.*

Lag selection for Mexico

Lag	Log L	LR	FPE	AIC	SC	HQ
0	923.5430	NA	3.37e-18	-20.36762	-20.17319	-20.28922
1	1780.401	1561.387	5.39e-26	-38.32003	-36.76460*	-37.69279*
2	1849.771	115.6167	3.50e-26*	-38.77270	-35.85626	-37.59662
3	1885.388	53.82113	4.94e-26	-39.26730*	-34.19785	-36.75038
4	1939.450	73.2830*	4.86e-26	-38.58777	-32.94931	-36.31401
5	1990.339	61.06755	5.49e-26	-38.62976	-31.63029	-35.80717
6	2032.752	44.29734	8.26e-26	-38.48337	-30.12289	-35.11193
7	2102.750	62.22052	7.72e-26	-38.94999	-29.22851	-35.02972
8	2166.028	46.40439	1.02e-25	-38.47530	-28.18481	-34.79819

***** *indicates lag selection by the criterion.*

Lag selection for Turkey

Lag	Log L	LR	FPE	AIC	SC	HQ
0	706.2625	NA	1.99e-15	-13.98525	-13.80289	-13.91145
1	1494.011	1449.458	7.64e-22	-28.76023	-27.30133*	-28.16979*
2	1562.330	116.1421	5.27e-22*	-29.14661*	-26.41118	-28.03953
3	1608.407	71.87965*	5.78e-22	-29.08814	-25.07618	-27.46443
4	1640.821	46.02756	8.63e-22	-28.75642	-23.46792	-26.61607
5	1691.771	65.21570	9.33e-22	-28.79541	-22.23038	-26.13843
6	1727.026	40.19095	1.47e-21	-28.52052	-20.67895	-25.34690
7	1782.364	55.33774	1.70e-21	-28.64727	-19.52918	-24.95701
8	1855.215	62.65193	1.57e-21	-29.12429	-18.72966	-24.91740

***** *indicates lag selection by the criterion.*