AMERICAN UNIVERSITY OF BEIRUT

EFFECT OF MACROECONOMIC VARIABLES ON STOCK PRICES: EVIDENCE FROM CHINA AND INDIA

by
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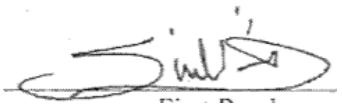

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AN ABSTRACT OF THE PROJECT OF

Rein Abdelhakim Daher for Master of Arts in Financial Economics
Major: Financial Economics

Title: Effect of Macroeconomic Variables on Stock Prices: Evidence from China and India

This project investigates the relationship between stock market prices and three macroeconomic variables which are inflation, exchange rate and interest rate in China and India. We employ monthly data on SSE Composite index as a proxy for China's stock market, BSE Sensex as a proxy for India's stock market, CPI as a proxy for inflation, China Yuan/USD and Indian Rupee/USD as proxies for exchange rates and deposit rate as a proxy for interest rate for the period from January 2009 to January 2019 in an unrestricted VAR model. The results indicate that there is a unidirectional causal relationship between stock prices and interest rate in China while in India, there is a bidirectional causal relationship between stock prices and exchange rate and a unidirectional causal relationship between stock prices and inflation. Inflation and interest rate are found to have a negative effect on stock prices while exchange rate is found to have a positive effect on them.

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CHAPTER 1

INTRODUCTION

The causal relationship between macroeconomic variables and stock returns is an important topic to study since the changes that could occur to these stock prices usually have either strong positive or negative consequences on the whole economy especially in growing economies (Barakat, Elgazzar and Hanafy, 2015). Thus, the stock market plays a huge role in the development of the economy. For this reason, governments and investors are concerned with how well their stock market is performing (Kirui, Wawire and Onono, 2014). Policy makers and investors can make better and more well-informed decisions whether concerning policies and regulations or less risky investments once they understand this relationship between macroeconomic factors and the stock prices.

The objective of this paper is to study the effect of macroeconomic variables on stock prices in China and India. One of the main reasons that makes China and India interesting countries to study is the fast rate at which they have been developing since the 1990's and their striking GDP growth rate each year. Countries under investigation (China and India) are chosen due to the insufficient literature on the impact of macroeconomic variables on the stock market of developing countries, and by studying and understanding this relationship, investors will be able to diversify their portfolios and increase their returns by choosing the right country for investment. China and India have different economic environments, so in order for investors to make a well-informed investment

decision, they need to have a good understanding of the features and behaviors of these economies (Hosseini, 2011).

Stock prices are affected by several domestic and international macroeconomic factors such as inflation, exchange rate and interest rates. In this project, we hypothesize that inflation and interest rates will have a negative effect on stock prices while exchange rate can either have a negative or positive effect on stock prices. The monthly data used in this project covers the period from January 2009 to January 2019. This project will help improve investors' understanding of the impact of inflation, exchange rate and interest rate on the stock markets in China and India in order for investors to make optimal investment decisions.

CHAPTER 2

MACROECONOMIC OVERVIEW

2.1 Research Variables

2.1.1 Inflation

Inflation is the increase in the overall price levels. Inflation increases the cost of living and decreases the purchasing power. Consumer price index (CPI) is considered as the main measure of inflation; inflation is measured as the change in CPI. Therefore, CPI can be used as a proxy for inflation. Inflation can either have a positive or negative effect on stock prices. When the demand increases and exceeds the supply, firms will increase their prices and that is the case of expected inflation. This increase in prices increases the firms' earnings and dividends paid which eventually increase the stocks' prices (Barakat, Elgazzar and Hanafy, 2015). However, when the inflation is unexpected, it leads to an increase in the cost of living which leads people to shift their resources from investment to consumption. When the demand for stocks decreases, this will lead to tighter monetary policies getting implemented such as an increase in nominal interest rates which in turn reduces the firms' present value of income and the stock prices decrease (Kirui, Wawire and Onono, 2014).

2.1.2 Exchange rate

National currency per United States dollar (USD) an be used as a proxy for exchange rate. Therefore, in this paper we use Chinese Yuan/USD and Indian Rupee/USD as the exchange rates. Exchange rate affects net exports, so for import dominated countries, it is expected that there would be a negative relationship between exchange rate and stock returns; as the currency depreciates, imports become cheaper which leads to an increase in the volume of imports and a decrease in the domestic companies' profit and stock prices (Ray, 2012). On the other hand, for export-oriented countries, a positive relationship between exchange rate and stock returns is expected since when the currency depreciates against the US dollar, the exported products of the country become cheaper in the world market which leads to an increase in the demand on these products which in turn leads to an increase in the volume of these exports. Consequently, that would increase the profit and stock prices of domestic firms (Gay, 2008).

2.1.3 Interest rate

The relationship between interest rates and stock market prices is expected to be negative; companies finance their investments through borrowing, so when interest rates increase, this means that the cost of borrowing increases. Consequently, this reduces the ability of companies to expand by increasing their investment and thus decreases their stock prices. Another reason for this negative relationship is that when a high number of stocks are purchased using borrowed money and interest rates increase, the cost of transaction in

the stock market becomes higher which leads to investors expecting higher rates of returns. Therefore, the demand on stock decreases, and their prices decrease (Naik & Padhi, 2012).

2.2 Background on China's stock market

The Chinese economy has been performing really well for the past 35 years. During these 35 years, China's GDP has tripled and in 2014, China became the largest economy in the world in terms of the Purchasing Power Parity after overtaking the US. The Chinese stock market has been growing rapidly since 1990 when two domestic stock exchanges were established: the Shanghai Stock Exchange and the Shenzhen Stock Exchange. In 2018, China's investment mounted to $5.9 trillion while the US had $4.3 trillion and Japan had $1.2 trillion making it the world's largest investor. However, China's stock market has not been performing as well as its GDP or economy growth. The Shanghai Composite index has had the worst performance right after the Japanese Nikkei index. In fact, research has found low correlation (less than 2%) between the stock market and GDP in China unlike other emerging economies, namely India, Russia, Brazil and South Africa where there is a positive correlation between their stock market and their GDP. After establishing the Shanghai Composite index in 1990, it rose at first but declined right after due to the high inflation that hit China at the time. After 2000, the pace at which new firms were being added to the stock exchanges slowed down which was caused by introducing security laws and regulations (Allen et al, 2016). China's stock market role has been dominated by the banking sector. The banking sector has been the main promoter of economic growth and the main provider of corporate financing; the Chinese stock market

has been subject to many market interventions, restrictions on shares' tradability or trading halts and tightening standards on IPOs that led to the stock market providing only 5% of firms' financing compared to 73% which was done by the banking sector in 2017. Also, China's stock market has a low number of institutional investors. However, China's stock market has been growing in importance and getting the attention of international investors with over $8 trillion in market capitalization and over 3,700 firms listed as of December 2019 (Carpenter, Lu and Whitelaw, 2020).

China has the second largest stock market in the world in terms of its market capitalization and its trading volume. This stock market has unique features; first of all, it's purely order-driven instead of being quote-driven. Second, unlike the US, it is not a fragmented market with multiple exchanges, but it is centralized; the orders are visible. Third, institutional and retail investors have equal access to the market information instead of institutional investors having an extended trading period. Lastly, China deal with excess stock market volatility by setting a daily price change limit that it no more than 10% (Carpenter, Lu and Whitelaw, 2015).

2.3 Background on India's stock market

The economy in India is considered as an important growth engine for the world's economy and India's stock market plays a huge role in that. India's Bombay Stock Exchange (BSE) is considered to be one of the oldest and fastest growing market platforms. Before liberalization, there were several measures and tight controls implemented on India's economy such as high tariffs and rates and licensing system. However, since 1991

and after the liberalization and globalization policies that were implemented by India's government, a substantial growth was seen in stock exchanges (Vaishali, 2016). This led the stock market to become an important part of India's economy and a major promoter of its financial development and economic growth (K and Pooja, 2017). India has 7 stock exchanges, but the two main indices are Bombay Stock Exchange (BSE) and National Stock Exchange (NSE) (Vaishali, 2016).

The Bombay Stock Exchange (BSE) was established in 1875 and is considered the oldest and fastest stock exchange in India. Bombay stock exchange has 5,749 listed companies and a market capitalization of $2.19 trillion dollars to make it the world's 10^{th} largest stock market. Bombay stock exchange's main index is Sensex.

The National Stock Exchange (NSE) was founded in 1993 and is now the world's 11^{th} largest stock exchange with a market capitalization of $2.1 trillion. The National stock exchange was the first exchange in India that provides a modern and fully automated screen based electronic trading system which facilitated the trading for the investors.

CHAPTER 3

LITERATURE REVIEW

The effect of the macroeconomic variables on the stock market differs between markets and economies and from one period to another. In this regard, Barakat et al. (2015) focused on the relationship between macroeconomic variables and the stock market in two developing countries (Egypt and Tunisia). They found that CPI, exchange rate and money supply have a positive relationship with the Egyptian index EGX 30 while interest rates have a negative relationship with EGX 30. On the other hand, CPI and exchange rate are the only two factors that have a significant effect on the Tunisian index TUNINDEX in the long run; there is a negative relationship between CPI and TUNINDEX while exchange rate and TUNINDEX have a positive relationship.

An increase in interest rates leads to people investing their money in banks instead of stocks which leads to a decrease in the stock prices. People's ability to invest in stocks increases as the money supply increases or the value of their local currency compared to the US dollars increases since they will have more money. Finally, stock prices also rise when inflation increases since firms' earnings increase and stock will become more attractive.

Kirui et al. (2014) examined the relationship between the NSE index and four macroeconomic variables, the exchange rate, inflation rate, Treasury bill rate and Gross Domestic Product from January 2000 to June 2012 using Engle-Granger two-step method test. This study found that only exchange rate has an effect on stock returns while other

macroeconomic variables did not have a significant effect on stock returns. The relationship between exchange rate and stock returns is a negative one; for an increase of 1 percentage in depreciation of a domestic currency, stock returns decrease by 1.4 percent.

Hosseini et al. (2011) investigated the relationship between stock market indices in China and India and four macroeconomic variables, crude oil, money supply, inflation rate and industrial production from the period between January 1999 to January 2009. Using Johansen-Juselius (1990) Multivariate Cointegration and Vector Error Correction Model technique, they found that there is indeed a relationship between these four variables and the stock market indices in these two countries. In the long run, increases in crude oil price have a negative impact in China but a positive one in India. The impact of money supply is positive on Chines stock market but negative on the Indian stock market. Industrial production has a negative impact in China and increases in inflation has a positive effect in both countries. In the short run, there is only one significant effect which is the contemporaneous effect of inflation on the Chines stock market index and that is a positive one.

Gay (2008) investigated the relationships between the macroeconomic variables of exchange rate and oil prices and stock market prices for Brazil, Russia, India and China (BRIC) from 1999 to 2006. They found a positive relationship between exchange rate and stock prices of Brazil, Russia and China, but a negative relationship between monthly oil prices and stock prices. However, these relationships did not turn out to be significant.

Several papers studied the impact of macroeconomic variables on the Indian stock market. Singh (2010) attempted to study the causal relationship between the Indian stock market index (BSE Sensex) and wholesale price index (WPI), index of industrial

production (IIP) and exchange rate (Rs/$) using monthly data from April 1995 to March 2009. This paper found that there is a bidirectional causal relationship between IIP and BSE Sensex while there is a unidirectional relationship between WPI and BSE Sensex. This is an indicator that the Indian stock market is approaching information efficiency with certain variables.

Pal and Mittal (2011) have also studied the impact of certain macroeconomic variables such as interest rate, inflation rate, exchange rate and gross domestic savings (GDS) of India on two Indian stock indices, namely BSE Sensex and S&P CNX Nifty. After using quarterly time-series from the period from January 1995 to December 2008 and applying unit root test, cointegration test and error correction mechanism, they concluded that inflation rate has a significant effect on both indices and the relationship between them is negative. On the other hand, the interest rate has an effect only on S&P CNX Nifty and the relationship turns out to be positive; this could be due to the fact that S&P CNX Nifty deals with government bonds mainly. Foreign exchange rate has a significant effect only on BSE Sensex and the relationship between them is a negative one.

Ray (2012) also found a relationship between macroeconomic variables and stock prices in India. By using annual data from 1990-91 to 2010-11 and granger causality tests between the variables, the results indicate that there is a unidirectional causal relationship between stock prices and each of these variables: inflation, exchange rate, foreign direct investment, gross domestic product and gross fixed capital information. They found that there is a bidirectional causality between stock prices and each of these variables: money supply, foreign exchange reserve, whole price index and crude oil price. However, there is no causal relationship between stock prices and each of these two variables: interest rate

and index of industrial production. As for the sign of these relationships, they conclude that oil price and gold price have a negative relationship with stock prices while interest rate, foreign exchange reserve, gross domestic product, money supply, balance of trade and industrial production index have a positive relationship with stock prices. The rest of the variables do not have a significant effect on stock prices.

Naik and Padhi (2012) also found a positive relationship between stock prices and money supply and between stock prices and industrial production in India. However, they also found a negative relationship between stock prices and inflation. They used data from 1994 to 2011 and used Johansen's cointegration and vector error correction model and the results indicate that there is a bidirectional causality between stock prices and industrial production while there is a unidirectional causality from both, money supply and interest rates to stock prices and from stock prices to inflation.

Mireku et al. (2013) used monthly data from 1991 to 2010 and vector error correction models (VECM) to examine the effect of macroeconomic variables on stock prices in Ghana. The paper concluded that interest rate and exchange rate have a negative effect on stock prices while inflation has a positive effect on stock prices. However, these macroeconomic variables exhibited a low impact on the stock prices. Kuworno (2012) examined the impact of macroeconomic variables, namely inflation, crude oil price exchange rate and interest rate on the Ghanaian stock market as well using monthly data from January 1992 to December 2008. The paper used Johansen Multivariate Co-integration Procedure and the results showed that there is a long-run equilibrium relationship between the macroeconomic variables and the stock returns in Ghana and the effects of all macroeconomic variables on the stock returns are significant. Crude oil has a

negative relationship with stock returns while inflation rate and exchange rate have a positive relationship with stock returns. In addition to that, interest rate and inflation rate exhibit significance effect on stock returns in the short run.

CHAPTER 4

EMPIRICAL MODEL AND RESULTS

4.1 Data

In this paper, we use SSE Composite index as a proxy for China's stock prices, BSE Sensex index as a proxy for India's stock prices, CPI as proxy for inflation, local currency per US dollar as proxy for exchange rate and deposit rate as proxy for interest rate for the period from January 2009 to January 2019. The dependent variables are SSE Composite index and BSE Sensex index and the independent variables are inflation, exchange rate and interest rate. We took monthly data because the more frequent the data is, the more accurate the results turn out to be.

4.2 Methodology

The empirical methods used in this paper are the standard tools of Vector Autoregressive Model (VAR).

4.2.1 Unit Root and Cointegration Tests

The first step in a time-series study is to check the order of integration of the variables. To do so, ADF (Augmented Dickey-Fuller) test, along with PP (Phillips Peron) test will be used. These two tests are based on equation (1)

$$\Delta y_t = \alpha + \gamma y_{t-1} + \theta_t + \sum \varphi_i \Delta y_{t-i} + \varepsilon t_{i=1}^{p} \quad (1)$$

where ε_t is considered to be a Gaussian white error, t is time trend and p is the number of lags selected by Akaike information criterion. The null hypothesis in this equation is H_0: $\gamma = 0$, i.e. y has a unit root, and the alternative hypothesis is: H_1: $\gamma < 0$.

If the results of the unit root tests show that some of the variables are $I(1)$, then we should check if these variables are cointegrated or in other words, have a long-run relationship. Cointegration exists when y_t and x_t are integrated of the same order and u_t is stationary. To test for cointegration, we use Engle-Granger approach and the Johansen approach. If it turns out that cointegration exists between the variables, then the rest of the study will be done using a VECM, but if it doesn't exist, then the $I(1)$ variables are will be differenced and simple unrestricted VAR will be used.

4.2.2 VAR Model

Variables in the VAR model are considered endogenous which makes it easy to construct. Its ease of estimation has made it a popular and widely used model. The VAR model in its reduced form is given by equation (2)

$$y_t = \Lambda + \Gamma_1 y_{t-1} + \cdots + \Gamma_p y_{t-p} + \varepsilon_t \quad (2)$$

where y_t is a vector of N stationary variables, ε_t is a vector of Gaussian white noise, and p is the order of the VAR. If the variables used are found to be $I(1)$ but not cointegrated, then they can be used in VAR model but after differencing them.

When using this model, it is important to specify the lag length criteria p; if p is too small, this leads to misspecification and consequently to omitted variable bias, and if p is too big, it could lead to multicollinearity. The lag length is determined by Akaike's Information Criterion (AIC), LR test, Final Prediction Error (FPE), Shwarz Criterion (SC), and Hannan and Quinn Criterion (HQ) and the maximum number of lags is determined using Schwert's formula $p_{max} = 12 * (\frac{T}{100})^{0.25}$. VAR models are mainly used for forecasting, testing Granger-causality and performing impulse response analysis to study the effects of a shock on the variables over time.

4.2.3 Autocorrelation

Omitted variables, misspecification or errors in measurement can cause serial correlation between the residual errors.

The equation between the error terms can be written this way:

$u_t = \rho u_{t-1} + \varepsilon_t$ where ρ determines the relationship between the error terms

If ρ is zero, then that means that there's no autocorrelation. However, if ρ approaches unity, then that means there is an autocorrelation, which could either be negative or positive. Autocorrelation, like heteroskedasticity, leads to unbiased and inefficient estimators and an invalid hypothesis testing.

4.2.4 Heteroskedasticity

Heteroskedasticity deals with unequal variances; that is, heteroskedasticity is when the variances or the standard errors of the residual errors are not constant. The variances of the residual errors could be increasing or decreasing which might lead to having biased estimators, inefficient estimators and higher than expected t-statistics and F-statistics.

4.2.5 Granger-causality testing

We have two variables, x and y, where y is the dependent variable and x is the independent variable. If we say that x_t "granger-causes" y_t, this means that the past values of x_t, which are x_{t-i} contain unique information on y_t that would help predict y_{t+1}. In order to determine the direction of causality between x and y, Granger causality tests are used in the VAR model.

Consider equations (3) and (4)

$$x_t = \alpha + \sum_{i=1}^{p} \gamma_i x_{t-i} + \sum_{i=1}^{p} \beta_i y_{t-i} + \varepsilon_{1t} \quad (3)$$

$$y_t = \delta + \sum_{i=1}^{p} \rho_i y_{t-i} + \sum_{i=1}^{p} \mu_i x_{t-i} + \varepsilon_{2t} \quad (4)$$

In equation (3), if both variables are stationary and if the null hypothesis which is H_0:$\beta_1 = \beta_2 = \cdots = \beta_p = 0$ is not rejected, then y_t does not Granger cause x_t; however, if the null hypothesis is rejected then y_t is said to Granger cause x_t. Similarly, in equation (4), if we do not reject the null hypothesis that states that H_o: $\mu_1 = \mu_2 = \cdots = \mu_p = 0$, then x_t does not Granger cause y_t, but if we reject it, then that means that x_t does in fact Granger cause y_t.

In order to determine the direction of causality between inflation and stock prices, exchange rate and stock prices, and interest rate and stock prices, Granger-causality tests are applied to the VAR model.

4.2.6 IRF (Impulse Response Function)

We use impulse response analysis in order to study the impact of a shock over time on the different variables. For instance, we can study the effect of a shock on inflation, exchange rate or interest rate by increasing ε_1 by one standard deviation at time t = 0, on the stock market of China and India at time t = 0 and several periods later.

It is preferable to use orthogonalized impulses based on Cholesky decomposition.

Assuming that the VAR in equation (2) is stable,

When we apply Cholesky decomposition, the variables y_t and x_t, and the Equations (2) and (3) with two types of reduced form shocks ε_y and ε_x, can be represented in Vector Moving Average, in terms of ε_y and ε_x to obtain this matrix form

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{x} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \varphi_{11} & \varphi_{12} \\ \varphi_{21} & \varphi_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{y,t-1} \\ \varepsilon_{x,t-1} \end{bmatrix}$$

4.2.7 VD (Variance Decomposition)

Another way to interpret the vector autoregression model is using variance decomposition. Similar to impulse response function, the order of variables is important. Variance decomposition will allow us to determine how much the exogeneous shocks to

variables can explain the forecast error variance of each of the variables. In this paper, the variance decomposition is taken on various forecast horizons, 1 day, 15 days and 30 days.

4.3 Empirical Results

To study the order of integration of each of the variables; whether they are stationary on level or at first difference, ADF and PP tests are performed. We test for two separate specifications, the first with a constant and trend and the second with just a constant. If, when using these tests, we reject the null hypothesis that states that the variable has a unit root test, then this means that the variable is stationary. The results of the ADF test for China and India are shown in tables 1 and 2 and the results for PP test are shown in tables 3 and 4.

Table 1 ADF test results for China

		Order of Integration	Constant and Trend	Constant
SSE	t-statistic Prob	I(1)	-2.758 0.216	-2.78 0.064
ΔSSE	t-statistic Prob	I(0)		-9.222 0.000
CPI	t-statistic Prob	I(1)	-2.019 0.585	-0.799 0.816
ΔCPI	t-statistic Prob	I(0)		-9.478 0.000

ER	t-statistic Prob	I(1)	-1.81 0.694	-1.877 0.342
ΔER	t-statistic Prob	I(0)		-7.555 0.000
IR	t-statistic Prob	I(1)	-1.899 0.652	-0.704 0.84
ΔIR	t-statistic Prob	I(0)		-4.709 0.002

Table 2 ADF test results for India

		Order of Integration	Constant and Trend	Constant
BSE SENSEX	t-statistic Prob	I(0)	-3.919 0.014	2.492 0.119
CPI	t-statistic Prob	I(0)	-1.468 0.835	-4.162 0.001
ER	t-statistic Prob	I(1)	-2.524 0.316	-0.667 0.849
ΔER	t-statistic Prob	I(0)		-10.673 0.000
IR	t-statistic Prob	I(1)	-3.108 0.109	-2.847 0.055

ΔIR	t-statistic Prob	I(0)		-10.851 0.000

Table 3 PP test results for China

		Order of Integration	Constant and Trend	Constant
SSE	t-statistics Prob	I(1)	-2.524 0.316	-2.603 0.095
ΔSSE	t-statistics Prob	I(0)		-9.112 0.000
CPI	t-statistics Prob	I(1)	-1.847 0.676	-0.83 0.807
ΔCPI	t-statistics Prob	I(0)		-9.617 0.000
ER	t-statistics Prob	I(1)	-1.64 0.771	-1.758 0.399
ΔER	t-statistics Prob	I(0)		-7.564 0.000
IR	t-statistics Prob	I(1)	-1.791 0.703	-0.67 0.849
ΔIR	t-statistics Prob	I(0)		-10.64 0.000

Table 4 PP test results for India

		Order of Integration	Constant and Trend	Constant
BSE SENSEX	t-statistic Prob	I(0)	-3.936 0.014	-2.499 0.118
CPI	t-statistic Prob	I(0)	-1.74 0.727	-3.572 0.008
ER	t-statistic Prob	I(1)	-2.55 0.304	-0.499 0.886
ΔER	t-statistic Prob	I(0)		-10.803 0.000
IR	t-statistic Prob	I(1)	-3.262 0.078	-2.875 0.051
ΔIR	t-statistic Prob	I(0)		-10.851 0.000

The results show that, for China, we do not reject the null hypotheses for SSE Composite index, CPI, exchange rate, and interest rate variables at the level at the 5% significance level, but we reject them at the first difference. This means that for China, the data was found to be non-stationary at the level and stationary after converting them to first difference. Therefore, they are integrated of order one $I(1)$. As for India, we reject the null hypothesis for BSE Sensex index and CPI at the level at the 5% significance level while we

do not reject the null hypothesis for exchange rate and interest rate at level, but we reject it at the first difference. This indicates that BSE Sensex and CPI are stationary at the level $I(0)$ while exchange rate and interest rate are stationary at the first difference; they are integrated of order one $I(1)$.

Therefore, we can say that for India, the variables do not have a long-run relationship; there is no cointegration between the variables since they are not integrated of the same order. However, for China, the variables are all integrated of the same order, so we then proceed to test for cointegration using Engle-Granger and Johansen tests to see if there is a long-run relationship between the stock market index SSE Composite index and the macroeconomic variables CPI, exchange rates, and interest rates.

We start first of all with the Johansen cointegration test. The results of this test indicate the absence of cointegration between the variables which is shown through both, Maximum Eigenvalue and Trace statistics. Second, upon performing Engel-Granger test, the results indicate that we do not reject the null hypothesis at the 5% significance level that states that the variables are not cointegrated which means that there is no long-term relationship between the variables.

Since no cointegration has been found between the variables of both countries, we can proceed with VAR model. We take the first difference of the variables with order one integration in the unrestricted VAR model. The next step is to determine the optimal lag length selection based on Akaike Information Criterion (AIC), LR test, Final Prediction Error (FPE), Shwarz Criterion (SC), and Hannan and Quinn Criterion (HQ). The results show that the optimal lag length for China is 8 and the optimal lag length for India is 12.

We then proceed to check for autocorrelation using autocorrelation LM test and we specify the number of lags to be 8 for China and 12 for India. The results of the tests are shown in tables 5 and 6. The results show that for both countries and at the 5% significance level, we do not reject the null hypothesis that states that there is no serial correlation between the residuals. This means that the data does not suffer from autocorrelation and that 8 lags is sufficient for China's data and 12 lags is sufficient for India's data.

Table 5 Autocorrelation LM test results for China

VAR Residual Serial Correlation LM ...
Null Hypothesis: no serial correlation ...
Date: 05/28/20 Time: 15:02
Sample: 2009M01 2019M01
Included observations: 112

Lags	LM-Stat	Prob
1	20.29800	0.2071
2	15.70389	0.4738
3	16.59462	0.4123
4	11.44212	0.7814
5	13.40874	0.6427
6	24.58152	0.0776
7	16.02810	0.4510
8	13.93806	0.6033

Probs from chi-square with 16 df.

Table 6 Autocorrelation LM test results for India

VAR Residual Serial Correlation LM ...
Null Hypothesis: no serial correlation ...
Date: 05/28/20 Time: 15:04
Sample: 2009M01 2019M01
Included observations: 108

Lags	LM-Stat	Prob
1	27.14242	0.0399
2	15.10231	0.5172
3	20.89389	0.1826
4	30.17622	0.0171
5	22.59588	0.1250
6	22.58485	0.1253
7	20.83042	0.1851
8	16.83204	0.3965
9	13.17400	0.6600
10	14.67695	0.5484
11	11.69770	0.7645
12	16.10632	0.4456

Probs from chi-square with 16 df.

Then, we check for heteroskedasticity using White test. The results of the test are shown in tables 7 and 8. The results of the heteroskedasticity tests for both countries indicate that, at the 5% significance, we do not reject the null hypothesis that states that there is no heteroskedasticity which means that the data does not suffer from heteroskedasticity.

Table 7 White Heteroskedasticity test results for China

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 05/28/20 Time: 20:20
Sample: 2009M01 2019M01
Included observations: 108

Joint test:

Chi-sq	df	Prob.
949.6241	960	0.5880

Table 8 White Heteroskedasticity test results for India

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 05/28/20 Time: 20:18
Sample: 2009M01 2019M01
Included observations: 108

Joint test:

Chi-sq	df	Prob.
963.3150	960	0.4638

After proving that there is no cointegration between the stock market indices and the macroeconomic variables in both countries, we can proceed to run a short run causality test using Granger causality test. Tables 9 and 10 report the results of Granger causality tests done on each of the countries. For China, at the 5% significance level, we reject the null hypothesis that states that interest rate does not Granger cause SSE Composite index. Also, we do not reject the null hypotheses that SSE Composite index Granger causes any of the macroeconomic variables. This means that SSE Composite index does not Granger cause any macroeconomic variable in this sample, and interest rate Granger causes SSE Composite index and this causal relationship runs in one direction from interest rate to SSE Composite index. Also, stock prices are not a leading indicator for future economic activity.

As for India, the results indicate that at the 5% significance level, we reject the null hypotheses that CPI and exchange rate Granger cause BSE Sensex index and that BSE Sensex index Granger causes exchange rate. Also, we reject two other null hypotheses that state that CPI does not Granger cause exchange rate and that interest rate does not Granger cause CPI. This means that there is a bidirectional causal relationship between exchange rate and BSE Sensex index. There is also a causal relationship between CPI and BSE

Sensex index that runs only in one direction from CPI to BSE Sensex. Further, there are also two other causal relationship between CPI and exchange rate and interest rate and CPI running in one direction from CPI to exchange rate and from interest rate to CPI respectively.

Table 9 Granger causality test results for China

Null Hypothesis	Chi-square (Prob)	Result
SSE Composite does not Granger cause CPI	11.559 (0.172)	Do not reject
SSE Composite does not Granger cause ER	3.024 (0.933)	Do not reject
SSE Composite does not Granger cause IR	8.9 (0.351)	Do not reject
CPI does not Granger cause SSE Composite	11.061 (0.198)	Do not reject
CPI does not Granger cause ER	10.26 (0.247)	Do not reject
CPI does not Granger cause IR	7.446 (0.489)	Do not reject
ER does not Granger cause SSE Composite	9.733 (0.284)	Do not reject
ER does not Granger cause CPI	13.654 (0.091)	Do not reject

ER does not Granger cause IR	2.397 (0.966)	Do not reject
IR does not Granger cause SSE Composite	20.004 (0.01)	Reject
IR does not Granger cause CPI	5.328 (0.722)	Do not reject
IR does not Granger cause ER	10.446 (0.235)	Do not reject

Table 10 Granger causality test results for India

Null Hypothesis	Chi-square (Prob)	Result
BSE Sensex does not Granger cause CPI	15.242 (0.228)	Do not reject
BSE Sensex does not Granger cause ER	34.615 (0.000)	Reject
BSE Sensex does not Granger cause IR	12.064 (0.44)	Do not reject
CPI does not Granger cause BSE Sensex	25.072 (0.015)	Reject
CPI does not Granger cause ER	27.352 (0.007)	Reject

CPI does not Granger cause IR	19.459 (0.078)	Do not reject
ER does not Granger cause BSE Sensex	21.37 (0.045)	Reject
ER does not Granger cause CPI	17.18 (0.143)	Do not reject
ER does not Granger cause IR	9.852 (0.629)	Do not reject
IR does not Granger cause BSE Sensex	15.568 (0.212)	Do not reject
IR does not Granger cause CPI	21.938 (0.038)	Reject
IR does not Granger cause ER	19.548 (0.076)	Do not reject

To better understand the effect of macroeconomic variables on the stock market in both countries, their orthogonalized impulse response functions are utilized. The test results of the impulse response function analysis for China and India can be seen in figures 1 and 2. These results show the response of a series when a one standard deviation shock is represented for each series. First of all, for China, the impact of a shock to share prices led to a significant positive effect on SSE index; however, this effect decreased dramatically and disappeared after a 3-day period. The impact of a shock to CPI on SSE Composite

index is initially negligible but becomes positive 3 days after the shock and then starts decreasing after the 4th day to become negative. The impact of a shock to exchange rate on SSE Composite index is also negligible at first until it decreases to become negative 5 days after the shock and the increases after the 7th period to become positive. As for interest rate, a shock to interest rate on SSE Composite index is negative and then increases to become positive on the 3rd day. The results of impulse response function analysis for India show that, like China, a shock to share prices on BSE Sensex is a positive effect. The effects of the one standard deviation shocks to CPI and interest rate on BSE Sensex are both negative; both shocks lead to immediate decline and remain in the negative region after that. The effect of one standard deviation shock to exchange rate initially has no noticeable impact on BSE Sensex in periods from 1 to 4. From the 4th period, it increases to become positive until period 6. However, none of these responses are statistically significant.

The positive relationship between exchange rate and SSE Composite index prices aligns with our hypothesis that says that there should be a positive relationship between exchange rate and stock returns in an export-oriented economy such as China. When the currency depreciates against the US dollar, exported products become cheaper compared to the rest of the world, so the demand on these products increases. Therefore, the stock prices of domestic firms increase (Gay, 2008). Similarly, as we have hypothesized, the relationship between exchange rate and the BSE Sensex is positive; however, this relationship is not very significant. These are similar to the findings by Naik and Padhi (2012), Gay (2008) and Singh (2010) who all found insignificant causal relationship between exchange rate and stock market prices in India.

The negative relationships between interest rate and stock returns in China and India are consistent with what we have hypothesized. The reason might be due to the idea that when a big number of stocks are purchased with borrowed money, an increase in interest rates increases the cost of stock transaction as well which leads to investors expecting a higher rate of return before they decide to invest. Consequently, the demand for stock decreases and their prices decrease as well. Also, when interest rates increase, investors prefer to invest in bonds. On the other hand, when firms finance their investments by borrowing and interest rates increase, this cost of borrowing increases as well which does not allow firms to expand and increase their investments and consequently decreases their stock prices (Naik and Padhi, 2012).

Moreover, the negative relationship between inflation and stock returns in both, China and India is consistent with Fama (1981) findings which say that the higher the inflation is, the higher the production costs are which impacts profitability and real economic activity which leads to a decrease in stock prices (Naik and Padhi, 2012). Another explanation to this is that inflation causes a decrease in the demand for stock due to people shifting their resources from investment to consumption. This leads to tighter monetary policies like an increase in nominal interest rates which as we have seen previously, leads to an increase in the cost of borrowing which in turn leads to a decrease in investment in the stock market. Thus, inflation causes stock prices to decline (Ray, 2012).

Since some macroeconomic variables cause variations in stock prices, and previous variation in stock prices cause fluctuations in these macroeconomic variables, then this might indicate that the stock market is inefficient (Singh, 2010). This is likely due to the fact that China and India are emerging economies and emerging economies are the most

volatile markets and are more likely to be affected by variations in macroeconomic variables than advanced stock markets (Naik and Padhi, 2012).

Figure 1 Impulse Response Analysis results for China

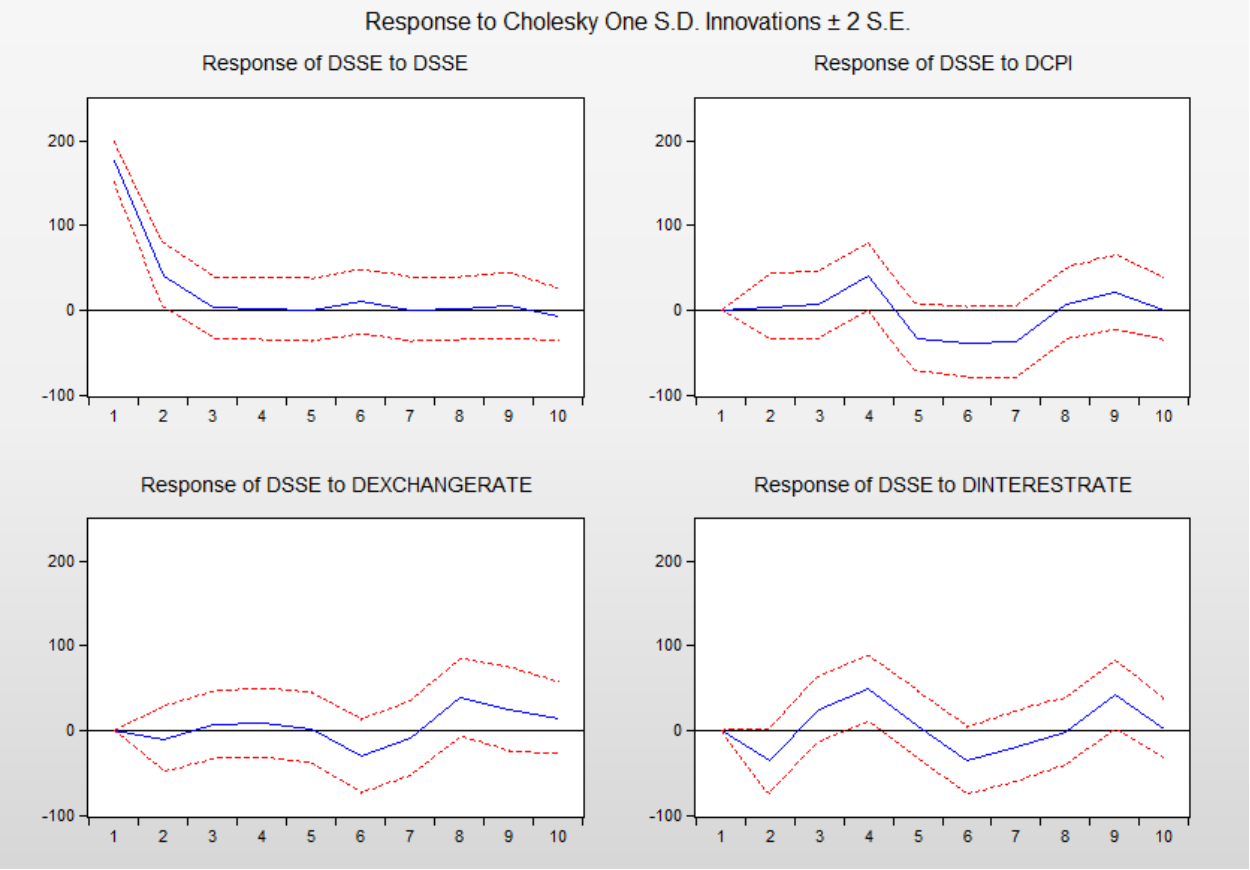
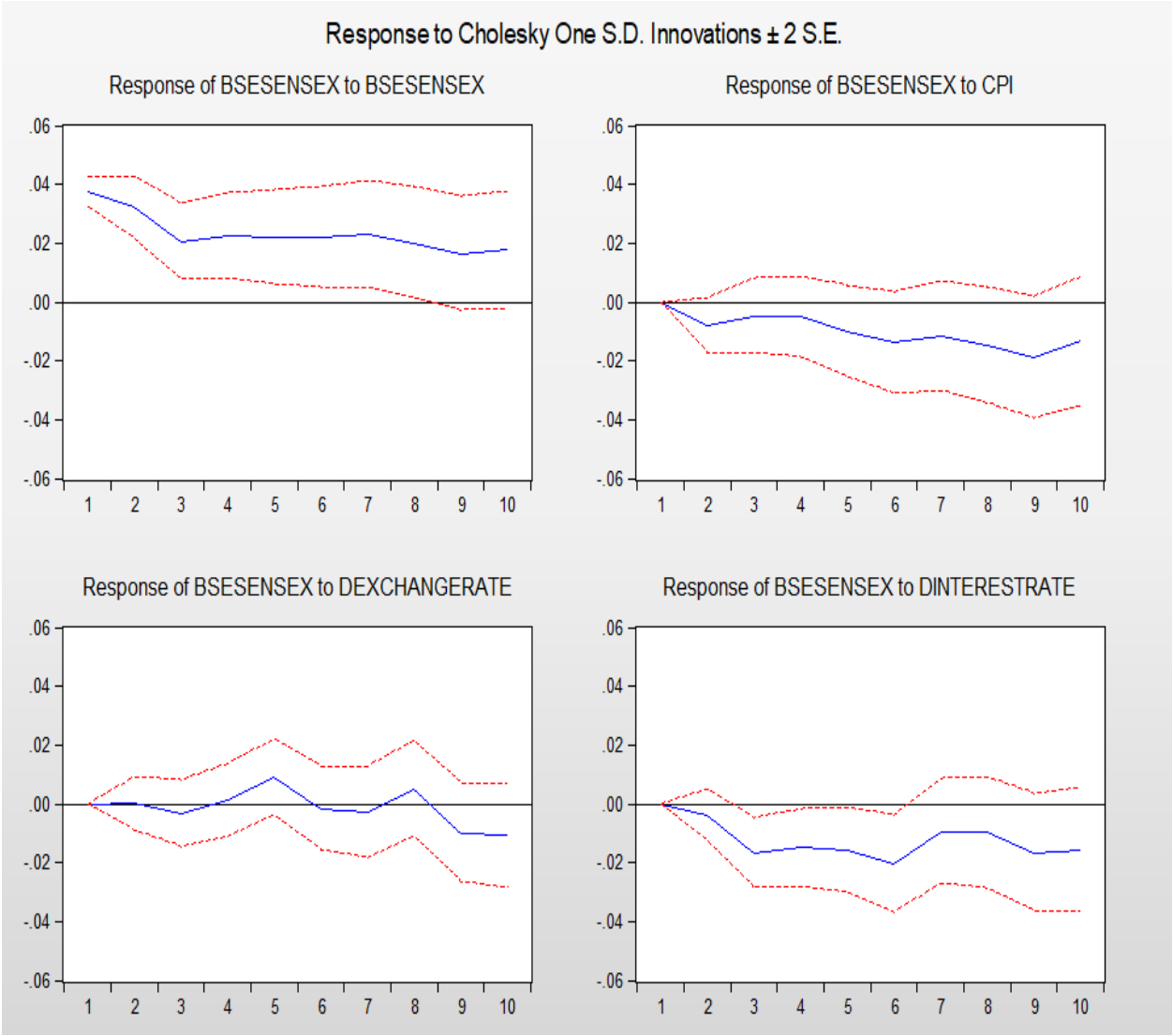


Figure 2 Impulse response Analysis results for India



Finally, we find the results of the variance decomposition analysis that are presented in tables 1 and 2 for China and India, respectively. The values represent the percentage of forecast error variance in SSE Composite and BSE Sensex indices that is attributed to their own variance and the variance of CPI, exchange rate and interest rate. We chose 1 day, 15 days and 30 days as the time horizons. For china, after 1 day, 100% of SSE Composite index's variability can be explained by its own innovation. We observe that this percentage decreases to become 63.874% after 15 days and 62.544% after 30 days. As

for India, 100% of BSE Sensex index's variability can be explained by its own innovation after 1 day. This declines to 60.453% after 15 days and then decline even more to 55.146% after 30 days. In summary, for both countries, their indices' forecast error are attributable to their own innovation at first, but then the percentage declines rapidly while the percentage of the macroeconomic variables increase especially the ones for CPI and interest rate. This indicates that shocks to CPI, exchange rate and interest rate do not have an impact on changes on both indices initially, but after few days, the impact starts to show and increase.

Table 11 Variance decomposition results for China

	Period	S.E.	SSE Comp	CPI	ER	IR
Variance decomposition of SSE Composite	1	176.233	100.000	0.000	0.000	0.000
	15	227.703	63.874	13.13	7.308	15.688
	30	230.758	62.544	13.131	8.47	15.854

Table 12 Variance decomposition results for India

	Period	S.E.	BSE Sensex	CPI	ER	IR
Variance decomposition	1	0.038	100.000	0.000	0.000	0.000
	15	0.112	60.453	14.661	4.213	20.674

of BSE Sensex	30	0.121	55.146	19.397	5.173	20.285

CHAPTER 5

CONCLUSION

The aim of this project is to find out and study the causal relationship between three macroeconomic variables, inflation, exchange rate and interest rate and the Chinese and Indian stock markets. A VAR model is used and the results show that there is no long run relationship between the variables. However, in the short run, there is a unidirectional causal relationship between interest rate and SSE Composite that goes from interest rate to SSE Composite, a bidirectional causal relationship between exchange rate and BSE Sensex and a unidirectional causal relationship between inflation and BSE Sensex that goes from inflation to BSE Sensex. As hypothesized, the relationship between exchange rates and stock prices is positive while the relationship between both, inflation and interest rate, and the stock market prices is negative in both countries. Both stock markets are volatile to the changes in macroeconomic variables which is expected in emerging economies. However, the effect of these macroeconomic variables is more significant in India than it is in China and that could be due to China's stock market being more informationally efficient. By knowing this, investors will have sufficient knowledge about the trends and behaviors of these economies and stock markets in order to enhance their investment decisions makings.

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