# Causal Relationship between Macroeconomic Indicators and Stock Market: Evidence from Sri Lanka

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*Abstract*-Researchers, economists, investors, and policymakers attempt to identify and estimate the nexus between share market indices with macroeconomic factors. The aim of this this study is to analyze the impacts of some prominent macroeconomic factors on the main share market index in Sri Lanka, ASPI (All Share Price Index) over the period 2010 January to 2020 May. Selected independent variables were All Share Price Index, Exchange Rate, Money Supply, Consumer Price Index, Brent Crude Oil, Bitcoin and Trade Balance. The study investigated the interrelationship between ASPI and other variables using Granger causality test. The findings suggest that, Stock market Granger-causes exchange rate, trade balance and is therefore leading indicator of these variables whereas money supply and stock prices is Granger causality in both directions. Other variables seem to be independent on development of the stock market.

*Index Terms -*Granger-causality, Global indices, Macroeconomics variables, ASPI, Sri Lanka

## I.    INTRODUCTION

Stock market plays and vital part of the economy of a country. For any instability or even simple changes of the economy causes to fluctuates of the stock market indices suddenly. However, it is somewhat difficult to identify specific factors that influence the stock market as completely. Fluctuation of the stock market might be affected directly or indirectly or even different time period due to economics, political affairs, natural disasters, man-made disasters and market psychology and those factor could not limit to one aspect.

Stock market performance leads economic activity is now becoming very controversial in the countries in the world and has gained much attraction in the last few months due to spreading of Covid19 virus throughout the world. Almost all the indicators such as market capitalization, trading volume, total turnover and the market index have shown tremendous collapse.

Macroeconomic factors like interest rate, inflation, production often leads stock markets fluctuations. Sri Lanka has an experiences of fluctuation of stock market due to the political changes. The presence of political incidents is a worldwide phenomenon that has affected most national stock markets (Ziobrowski, Peng Cheng, James, & Brigitte, 2004).

The relationship between stock market returns and a range of macroeconomic and financial variables with the large number of different stock markets could be observed in the literature. However, most of the studies do not consider the relationship between stock indices with the all internally and externally affected factors. This study investigates and analyses the interaction between selected foreign and local determinates with stock market index in Sri Lanka with the updates data.

The remainder of the paper is organized as follows: Section 2 briefly depicts and reviews existing literature on the nexus between stock price and macro-economic variables, section 3 explains the data and methodology; Section 4 analyses the empirical results and the final section is presented conclusion.

## II.    LITERATURE REVIEW

The relationship between stock markets and macroeconomic forces has been widely debated in the finance and macroeconomic literature. Large number of studies have focused to link the macroeconomic variables and stock market. Out of them some are aimed to analysis with market indices and some are focused to stock return. (Pal & Mittal, 2011)observed relationship (long run) between two Indian capital markets and some macroeconomic variables (interest rates, inflation, and exchange rate and gross domestic savings) with quartile data from January 1995 to December 2008 utilizing unit root test, co-integration and error correction mechanism. Inflation rate have the significant impact on both capital markets whereas interest rate and foreign exchange rate have the impact on one capital market were the findings.

(Andreas & Macmillan, 2009) conducted an analysis for comparison of US and Japan.  The study has suggested that for the US, there is a positive relationship between stock prices and industrial production while interest rate and consumer price index are negatively associated with stock prices further for Japan, their findings showed that stock prices are negatively related to industrial production and negatively related to money supply. Theoretically, change in exchange rate affects the global performances of the firms which will affect their share prices. stated that exchange rate has positive effect on stock returns according to (Abdalla & Murinde, 1997). Foreign exchange and equity market returns should be negatively correlated because of portfolio rebalancing (Hau & Rey , 2006) According to (Nesrine, Hamad, Christian, & Sahar, 2018) exchange rate volatility has a significant effect on stock market fluctuations adopting a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model.

Impact of stock markets, exchange rates and oil price on Bitcoin price were observed by (Vank Wijk, 2013). Findings was that in the long run, the Dow Jones Index, the euro–dollar exchange rate and oil price have a significant impact on the value of Bitcoin. However, it is difficult to identify the direct relationship between changing of Bitcoin prices with stock market performances (Erads & Caglar , 2018).  ( Degiannakis, Filis, & Kizys, 2014) investigated the impacts of oil price shocks on stock markets in Europe over the 1999–2010 period. The findings obtained from a structural vector autoregressive model suggested that increases in oil prices significantly affect the demand side of economies, which finally cause a negative effect on stock markets. They stressed that oil price is a good indicator on predicting stock market volatility. (Pilinkus & Boguslauskas, 2009) analyzed the short-run relationships between macroeconomic variables and the stock market index in Lithuania over the 2000–2009 period. Their findings suggested that increases in GDP and money supply raise the stock market index while increases in unemployment, exchange and interest rates reduced the index value.

(Rashid , 2008) concluded that co-integration between the stock prices and macroeconomic variables with consumer prices, industrial production, exchange rate and the market rate of interest. Further of this study estimated in the long run there is bi directional causation between the stock prices and macroeconomic variables where as in short run, the stock prices are Granger-caused by changes in interest rates.

## III.    DATA AND METHODOLOGY

**Variables**

For the analysis, data were gathered mainly stock market index named as All Share Price Index (ASPI) measured by the movement of share prices of all listed companies which based on market capitalisation and trading on the Colombo Stock Exchange. Base values are established with average market value on year 1985.

Table 1 Description of variables

| Variable | Label | Variable | Label |
|---|---|---|---|
| Financial Innovation | FI | Land & Property | L&P |
| Banks, Finance & Insurance | BFI | Manufacturing | MFG |
| Beverage, Food & Tobacco | BFT | Motors | MRT |
| Construction & Engineering | C&P | Oil Palms | OIL |
| Chemicals & Pharmaceuticals | C&E | Power & Energy | PLT |
| Diversified | DIV | Plantations | P&E |
| Footwear & Textiles | F&T | Stores & Supplies | SRV |
| Hotels & Travels | HLT | Services | S&S |
| Healthcare | H&T | Telecommunication | TEL |
| Investment Trusts | INV | Trading | TRD |
| Information Technology | IT | | |

Source: Central bank of Sri Lanka, Colombo Stock Exchange

Above table presenting the listed all investigated variables. USD to Sri Lankan (LKR) rupees monthly exchange value is considered as EX variable. Money supply denoted as total money stock that circulates among the general public at a given period and here considered M2 which includes

notes and coins with the public, deposits of public with commercial banks and time and savings deposits of the public with commercial banks as Million rupees. CPI is an index which is calculated considering the change in the cost to the average consumer of acquiring a basket of goods and service. As a global index Brent crude oil exchange price (USD) per barrel and Bitcoin price were considered. Trade balance of a country normally obtain the difference between export and important and normally Sri Lanka having practices of negative values of its. The data on all the variables are collected on monthly basis for the period from January 2010 to May 2020.

**Methodology**

In order to check the interaction between FI and the selected sector specific variables, as a first step it is mandatory to determine whether the data is stationary or not. In this analysis the most popular and widely used test for the unit root is Augmented Dickey–Fuller test (ADF) ( (Dickey & Fuller, 1979), has utilized.

As a second step, create bivariate VAR models for data in levels and determine appropriate lag length $p$. The most common approach for model order selection involves selecting a model order that minimizes one or more information criteria evaluated over a range of model orders is Akaike Information Criterion (AIC) :

$$AIC = 2k - 2\ln(L)$$

Here $L$ is the maximum value of the likelihood function for the model and $k$ is the number of estimated parameters in model. The decision for the best model is one with the minimum AIC value.

Next step is testing co-integration to see possible presence of integration using Johansen's methodology, takes its starting point in the vector auto regression (VAR) of order p given by

$$\boldsymbol{y_t} = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t$$

where $y_t$ is an nx1 vector of variables that are integrated of order one – commonly denoted I(1) – and $\varepsilon_t$ is an nx1 vector. if two time series are integrated, then there must exist Granger causality between them in any direction or in both directions

Last step is to apply (Toda & Yamamoto, 1995)approach for testing Granger causality. If the data in level with lag length $p + m$, it requires creating bivariate VAR models. Here $p$ is the number of lags found in VAR model following AIC and $m$ represents maximal order of integration of variables in the process. Granger causality test is a technique for determining whether one time series is significant in forecasting another (Granger, 1969)

$$Y_t = a_0 + \sum_{t=1}^{p+m} a_t Y_{t-1} + \sum_{t=1}^{p+m} b_t X_{t-1} + \varepsilon_{t1}$$

$$X_t = c_0 + \sum_{t=1}^{p+m} c_t X_{t-1} + \sum_{t=1}^{p+m} d_t Y_{t-1} + \varepsilon_{t2}$$

In this case variable Y is Granger caused by variable X if variable X assists in predicting the value of variable Y. If this is the case, it means that the lagged values of variable X are statistically significant in explaining variable Y. It can be tested using Walt test statistics. When the null hypothesis that X does not Granger-cause Y:

$$H_{nul}; \sum_{t=1}^{p} b_t = 0 \qquad vs \qquad H_{all}; \sum_{t=1}^{p} b_t \neq 0$$

And when Y does not have Granger-cause X;

$$H_{nul}; \sum_{t=1}^{p} d_t = 0 \qquad vs \qquad H_{all}; \sum_{t=1}^{p} d_t \neq 0$$

# IV.    RESULTS

Figure 1 presented that the distribution of all variable according to the selected time period. All of the above visual inspection suggests that the variables in levels do not have constant mean. Further, it is illustrated that all the time series plots are not stationary and showing the pattern of trend and fluctuations along with time. Variable ER, CPI, M2 and BT are presented increasing trend whereas BO and TB showed negative trend.
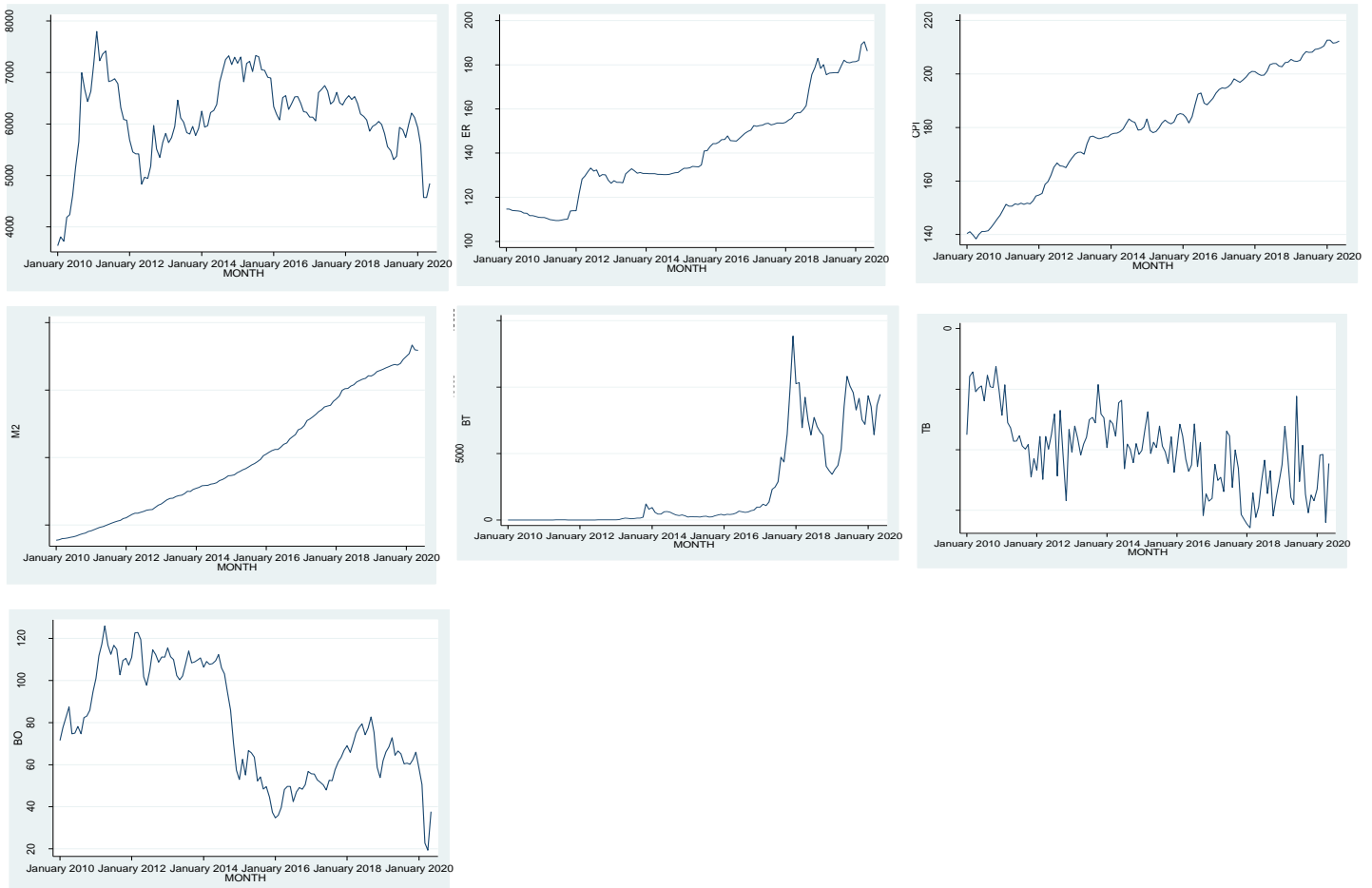


Figure 1: Time series plot for all variables

**Table 2 descriptive statistics for the variables**

| Variable | Mean | SD | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| ASPI | 6146.6 | 803.4 | 3636.4 | 6194.6 | 7798 |
| ER | 140.93 | 22.52 | 109.45 | 133.26 | 190.5 |
| M2 | 3971059 | 1755168 | 1551744 | 3553629 | 7335948 |
| CPI | 180.04 | 21.35 | 138.4 | 181.6 | 212.7 |
| BT | 2303 | 3473 | 0.1 | 416 | 13850 |
| BO | 78.57 | 26.66 | 19.33 | 74.64 | 125.89 |
| IM | 224815 | 53989 | 111494 | 218424 | 329465 |
| EX | 124221 | 31910 | 53721 | 119857 | 202850 |

Source: Author's own calculation

Mean, standard deviation, minimum medium and maximum value foe the monthly data for the period of 2010 January to 2020 May presented in table 2.

**Table 3: Results of ADF test**

| Variable | Data in level | | Data in first difference | |
|---|---|---|---|---|
| | t-statistics | P-value | t-statistics | P-value |
| ASPI | -2.883 | 0.168 | -10.182 | 0.00 |
| ER | -1.933 | 0.638 | -8.333 | 0.00 |
| M2 | -1.832 | 0.689 | -11.171 | 0.00 |
| CPI | -2.076 | 0.559 | -8.401 | 0.00 |
| BT | -2.468 | 0.344 | -10.976 | 0.00 |
| BO | -2.362 | 0.400 | -8.59 | 0.00 |
| TB | -7.529 | 0.000 | -18.315 | 0.00 |

Source: Author's own calculation

Unit root in data in level and data in first difference under the ADF test are presented in table 3. Except TB variable other all variables are not stationary and it is clearly showed that the null hypothesis of the existence of unit root is rejected at 5% significance level for the first difference data. Finally results are suggested that time series are characterized as I(1).

**Table 4: Results of Lag selection**

| VAR Model | Lag | AIC | P value |
|-----------|-----|-----|---------|
| ASPI«ER | 1 | 18.245 | 0.00 |
| ASPI«M2 | 1 | 38.176 | 0.000 |
| ASPI«CPI | 4 | 17.465 | 0.001 |
| ASPI«BT | 1 | 30.8908 | 0.00 |
| ASPI«BO | 2 | 20.765 | 0.023 |
| ASPI«TB | 3 | 37.037 | 0.089 |

Source: Author's own calculation

Selecting optimal lag length using VAR model with constant association are presented in Table 4 according to Akaike Information Criterion (AIC) for every model. Presence of serial correlation of the residuals are tested with this analysis.

**Table 5. Result of *Johansen's cointegration tests***

| Rank | Variable | | | | | | Critical value |
|------|------|------|------|------|------|------|----------------|
| | ER | M2 | CPI | BT | BO | TB | 5% |
| r = 0 | 13.417 | 21.496 | 13.305 | 13.297 | 12.559 | 29.058 | 15.41 |
| r ≤ 1 | 0.0441 | 1.171 | 0.530 | 0.8137 | 2.39 | 8.462 | 3.76 |

Source: Author's own calculation

Under the result of ADF has suggested that all the variables are characterized by I(1). For the multiple individual time series found to be integrated of order one, then another test used to determine whether long-term relationship exist among the variables, an additional test is required to determine whether long-term relationships exist among the variables. Table 5 presented the results for Johansen test between ASPI and all other six variables. According to the results, possible cointegration occurs between ASPI with M2 and ASPI with TB. It is that there is an evidence to reject null hypothesis of no cointegrating vectors (r=0) on significance level 5 % and accept the alternative of one or more integrating vectors. The presence of cointegration between stock market prices and selected macroeconomic variables provide firm evidence that there exists an interactive relation between them. If we discover some sort of this relationship in bivariate analysis, there inevitably exists a causal relationship at least in one direction.

Final step of the analysis is to test the Granger causality with the help of Wald test statistics. According to the results of Table 6 there is an evidence to reject null hypothesis by giving the conclusion that Granger causality from ASPI to Exchange Rate at the 5% significance level. Results showed that next important relationship between ASPI and broad money supply (M2) because that variable has Granger causality in both directions at the around 5 % significance level. There is one direct Granger causality from ASPI to Trade Balance and its significant at the 5% significant.

**Table 6: Results of bivariate Granger Causality**

| Null hypothesis | Lags | Test statistics | P-value |
|---|---|---|---|
| ASPI does not cause ER | 1 | 0.762 | 0.3843 |
| ER does not cause ASPI | 1 | 3.8766 | 0.051 |
| ASPI does not cause M2 | 1 | 5.6723 | 0.0188 |
| M2 does not cause ASPI | 1 | 3.438 | 0.066 |
| ASPI does not cause CPI | 4 | 1.027 | 0.396 |
| CPI does not cause ASPI | 4 | 1.449 | 0.222 |
| ASPI does not cause BT | 1 | 0.393 | 0.532 |
| BT does not cause ASPI | 1 | 1.746 | 0.189 |
| ASPI does not cause BO | 2 | 0.878 | 0.418 |
| BO does not cause ASPI | 2 | 0.037 | 0.963 |
| ASPI does not cause TB | 3 | 0.656 | 0.581 |
| TB does not cause ASPI | 3 | 3.299 | 0.023 |

Source: Author's own calculation

## V. CONCLUSION

This paper is to explore the impact of different macroeconomic and global variables on the stock market in Sri Lanka using Granger causality approach. For the analysis, exchange rate, money supply, Consumer Price Index, Bitcoins, Brent oil and trade balance with All Share Price Index are considered for all monthly data from January 2010 to May 2020. According to Johansen cointegration test, it is concluded that there is cointegration between ASPI with exchange rate, Consumer Price Index, Bitcoins and Brent oil in Sri Lanka. Further finding bivariate causal relationship using Granger causality, there is a relationship with ASPI and exchange rate. So exchange rate may be the one of leading factors for the stock index in Sri Lanka. The next important bi-directional Granger causality emerged between stock market and money supply and also it further shown on theoretical and empirical evidence. The final significant relationship with ASPI occurs in trade balance. Depending on the import and export variables, investors can take their decision on stock market investment and trade balance may be the one of leading factor. However, other variables in the analysis of stock market relationship are independent.

## REFERENCES

Abdalla , I., & Murinde, V. (1997). Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines. *Applied Financial Economics*.

Andreas , H., & Macmillan, P. (2009). Can macroeconomic variables explain long-term stock market movements? A comparison of the US and Japan. *Applied Financial Economics*.

Degiannakis, S. A., Filis, G., & Kizys, R. (2014). The Effects of Oil Price Shocks on Stock Market Volatility: Evidence from European Data. *The Energy Journal* .

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time. *Journal of American Statistical Association*.

Erads, M. L., & Caglar , A. E. (2018). Analysis of the relationships between Bitcoin and exchange rate, commodities and global indexes by asymmetric causality test. *Eastern Journal of European Studies*.

Granger, C. W. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. *Econometrica*.

Hau, H., & Rey , H. (2006). Exchange Rates, Equity Prices, and Capital Flows. *Review of Financial Studies, Society for Financial Studies*.

Nesrine, M., Hamad, B., Christian, P., & Sahar, C. (2018, 6 20). *The Impact of the Exchange Rate Volatilities on Stock Market Returns Dynamic.* Retrieved from https://hal.archives-ouvertes.fr/hal-01766742v1

Pal, K., & Mittal, R. (2011). Impact of macroeconomic indicators on Indian capital markets. *Journal of Risk Finance*.

Pilinkus, D., & Boguslauskas, V. (2009). The Short-Run Relationship between Stock Market Prices and Macroeconomic Variables in Lithuania: An Application of the Impulse Response Function. *Inzinerine Ekonomika-Engineering Economics*.

Rashid , A. (2008). *Macroeconomic Variables and Stock Market Performance: Testing for Dynamic Linkages with a Known Structural Break.* Retrieved from https://mpra.ub.uni-muenchen.de/26937/

Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*.

Vank Wijk, D. (2013). *What can be expected from the BitCoin? Working Paper No. 345986*. Rotterdam: Erasmus Rotterdam Universiteit.

Ziobrowski, A. J., Peng Cheng, James, B. W., & Brigitte, Z. J. (2004). Abnormal Returns from the Common Stock Investments of the United. *Journal of Financial and Quantitative Analysis*

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