Macroeconomic Variables and Stock Market Prices in Frontier Markets: A Panel Data Analysis

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Abstract

This study attempts to investigate the relationship between three macroeconomics indicators and the stock market prices of three South Asian frontier markets, namely; Sri Lanka, Bangladesh and Vietnam. Specifically, the paper studies exchange rate, consumer price index and industrial production index using monthly data over the period of February 2013 to June 2018. It employs a battery of tests, which includes panel unit root, panel co-integration, dynamic ordinary least square and granger causality to examine the long run association, long run elasticities and short run causality between the said variables. Pedroni panel co-integration test confirms the existence of long run equilibrium. The argument is further supported with the results of panel DOLS long run elasticities. The consumer price index and industrial production index have a statistically significant influence on the market prices in the long run. However, the test fails to confirm a long run association between the exchange rate and stock market prices. In contrast, the causality test provides support towards a short run association between exchange rate and market prices, whereas no other short run causality is found to be running from the remaining macro variables to the stock prices. Frontier markets with very high growth potentials and mounting opportunities can be considered as a gold mine to the right set of investors. Hence, these findings will be useful for economic policymakers, academics and to the investors and investment advisers in numerous ways.

Keyword: causality, cointegration, DOLS, frontier markets, macroeconomic variables, panel analysis

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Introduction

The relationship between stock market prices and macroeconomic factors has been researched and proved by numerous researchers over the past few decades. As a result, asset pricing theories such as Arbitrage pricing theory (APT) (Ross, 1976) were emerged as alternatives to the highly accepted Capital Asset Pricing Model (Sharpe, 1964). The immense acceptance of APT lead number of other multifactor asset pricing models, that incorporate macroeconomic variables as explanatory factors of equity return. Existing literature attempts to explain the type of relationship that exists between different macroeconomic variables and equity returns. However, these studies were concluded with inconsistent findings (Ahmad *et al.*, 2015). Even though there is a strong intuitive appeal towards the hypothesized relationship between macroeconomic factors and market returns, there is a lack of empirical support (Flannery and Protopapadakis, 2002).

Contemporary economic conditions are drastically changing. Hence, equity markets have become more vulnerable to these abrupt changes. The impact is unavoidable and long-term. Adding to that, different markets respond to the diverse economic conditions in numerous different ways. For instance, Garcia and Liu (1999) investigated the macroeconomic determinants on stock market development based on 15 industrial and developing countries. This study failed to support the hypothesized relationship between the macroeconomic factors and the stock market. Chan, Karceski and Lakonishok (1998) concluded a very weak association between the equity returns and the macro factors in two developed markets; Japan and UK. Bilson, Brailsford and Hooper (2001) studied 20 emerging markets and found moderate evidence on the relationship between macro factors and the equity returns. On a different note, Agarwal and Mohtadi (2004) concluded a statistically significant relationship between macro variables and stock prices in emerging markets. This result was proven by Chandrashekar *et al.* (2018).

A study based on Ghana, one of the frontier markets in the African region discovered a significant relation among the market returns and coca prices, where all other macroeconomic determinants such as money supply, oil prices and gold prices were found to be insignificant in explaining market prices (Adjasi, 2009). A study based on selected ASEAN countries concluded, macroeconomic variables have a greater influence on Islamic stock indices than on the conventional stock indices. They further disclosed that Islamic indices are more responsive to the macroeconomic changes (Jamaludin, Ismail and Ab Manaf, 2017). Aforesaid findings failed to map a clear picture about the macroeconomic impact on the stock market prices in general. Evidently, the findings vary based on the type of market. At the same time, it is understood that the majority of the studies up to date have focused on developed markets, developing markets or emerging markets. Minimum attention is given to study the impact of macroeconomic factors in frontier markets.

Thereby, this study is conducted to investigate the association between macroeconomic variables and the stock market in the context of frontier markets. Unlike most studies, the current study will aim at a group of markets instead of individual markets. Thus, the study focuses on the frontier markets in the Asian region. As per the most updated market classification by MCSI frontier market index, there are only three frontier markets in the Asian region, namely; Sri Lanka, Bangladesh and Vietnam. As per the author's knowledge there are minimum studies conducted to understand the relationship between macroeconomics and stock market returns in frontier markets resides in the Asian region. Given the uncounted growth potentials in these frontier markets, such a study can be considered as a timely need to provide unbiased information to the investors and policy makers.

The frontier market is an economic term introduced in 1992 by the International Finance Corporation (IFC) to describe small and inaccessible stock markets in developing countries. In other words, frontier markets are developing countries that are more developed than the least developed countries, but it is too small and risky to be considered as an emerging market. Financial Times Stock Exchange (FTSE) explains a frontier market as a market representing developing countries with higher economic growth rate but with small and relatively illiquid stock markets. Frontier markets are often in their infancy stage and have attracted attention due to the vast amount of opportunities and growth potentials. Hence, it is beneficial to examine the factors that affect frontier market performance. Based on the 2019 MSCI Frontier Market Index, there are 21 frontier markets. It is important to note that, even though these indices provide a market classification based on their standard criteria, the classification should not be viewed as static. The markets tend to upgrade/ downgrade based on their changing economic performances. However, by the time this research is conducted, the classification of frontier markets in the Asian region did not change.

The study is performed with three objectives. Firstly, to assess the long run association between the selected macroeconomic variables (Exchange rate, Consumer price index, Industrial production index) and stock market prices. Secondly, to investigate the possible causality effect between and among the independent and dependent variables. Finally, the study is conducted with the objective of adding to the prevailing stack of knowledge with regard to the macroeconomic impact on stock market prices. Moreover, throughout the study researcher attempts to build up a discussion on empirical findings of the corpus while highlighting the ambiguity dominated in this field of research.

The study will be significant in different ways. Findings will contribute to the existing literature by investigating the impact of three important macroeconomic variables in the context of frontier markets. As per the author's knowledge, this is one of the few studies based on Asian frontier markets. Thus, the findings of this study will add to the

existing literature. More importantly, the findings will greatly help the economic and market policy makers to take policy decisions. Similarly, the study is also useful for the local and regional investors who seek to invest in fast growing markets with opportunities. Results can be used to re-confirm and assess the validity of the existing literature on macroeconomics impact on equity prices.

Rest of the paper is organized as follows; section two gives an overview about the existing literature. As the literature is vast and undefined, the review is narrowed down to studies that have used panel data analysis and have studied Emerging markets or frontier markets or, in a broader sense, Asian markets. Section three elaborates the data and methodology of the study. Section four is devoted to the analysis and discussion of results. While section five elaborates the concluding remarks, the last two sections will provide the list of references and appendices that contain an additional analysis based on the variables.

Literature Review

The efficient market hypothesis argued, in an efficient market stock prices fully reflect all available information in the market (Fama, 1970). Therefore, no investor can earn an abnormal return in an efficient market. Ross (1976) brought up the Arbitrage pricing theory, which gave much larger space to the discussion of the role of macroeconomic factors in deciding the stock market returns. Following the aforementioned theoretical frameworks, the association between macro factors and the stock market has been tested and proven through a number of studies over the years (Ross, 1976; Fama, 1981; Chatrath, Ramchander and Song, 1997). A favourable economic condition upbeat the stock market performance. On the contrary, stock market performance is a deciding factor of economic growth. Hence, the performance of a stock market can be considered as a yardstick that measures the economic growth of a country. (Jamaludin, Ismail and Ab Manaf, 2017). By predicting the economic activities, investors can foresee the future market conditions in order to facilitate their buying and selling decisions and better manage the risk of their portfolios (Adjasi, 2009). Similarly, policy makers will be able to better understand the factors and areas of the economy, which influence the stock market more in order to make more effective policy decisions (Adjasi, 2009).

Ahmad *et al.* (2015) has classified the empirical literature on stock market returns and macroeconomic variables under three basic categories; developed countries, developing countries and group of countries. Accordingly, it is found to have a mixture of findings due to the method of study, macroeconomic determinants, time span and the study area (Ahmad *et al.*, 2015). Tangjitprom (2012) reviewed the literature based on different macroeconomic variables; variables based on general economic conditions, variables associated with interest rate and monetary policy, variables related to the price level, and variables reflecting international activities. Similar to Ahmad *et al.* (2015), Tangjitprom (2012) stated mixed results for the relationship between macroeconomics and the stock market.

However, he further mentioned that most of the studies conclude statistically significant results between the two (Tangjitprom, 2012). Apart from these studies, there are a number of studies conducted focusing on emerging markets, Asian markets, Islamic markets etc. This review will discuss the most related literature and prioritize studies based on emerging markets and frontier markets. Also, focus is given to studies based on panel data analysis.

Bilson, Brailsford and Hooper (2001) proposed a multifactor model incorporating local and global factors to study the phenomenon under emerging market conditions. The study was conducted using 20 emerging countries. Accordingly, the exchange rate was found to be the most influential macroeconomic variable, where the exchange rate depicts a significant negative association with the stock returns in twelve markets out of twenty. While money supply has greater importance, other factors based on real activities and goods price are found to be less important in explaining the equity market returns.

Wongbangpo and Sharma (2002) investigated the association between money supply, exchange rate and consumer price index (CPI) on the stock prices in five selected ASEAN countries (Malaysia, Philippines, Thailand, Indonesia and Singapore) employing Granger causality test. Findings revealed that stock prices in Malaysia, Thailand and Singapore positively related to the money supply, yet negatively in Philippines and Indonesia. In terms of the exchange rate, stock prices in Indonesia, Malaysia and Philippines were positively related to the exchange rate, yet negatively in Singapore and Thailand.

A study based on Sri Lanka for the period January 1985 to December 2001 tested money supply, exchange rate, treasury bill rate, consumer price index for possible long-run and short-run relationships. It is found that money supply, inflation rate, and treasury bill rate have a significant lagged influence on the stock market index. Above all, treasury bill rate depicted the greatest impact on the share index (Gunasekarage, Pisedtasalasai and Power, 2004). Further analysis concluded that, the major part of the stock index variation was explained by its own innovations, while the minority is read out by the selected macro factors (Gunasekarage, Pisedtasalasai and Power, 2004).

Abugri (2008) revealed mixed results based on four Latin American nations. The exchange rate was significant in two out of four markets, whereas the money supply was significant in only one market. One of the few studies on frontier markets, Adjasi (2009) examined the effect of macroeconomic uncertainty on stock prices volatility in a frontier market, Ghana. The study investigated seven macroeconomic variables namely, consumer price index (proxy for inflation), exchange rate, money supply, interest rates, oil price, gold price, and cocoa price. As per the findings, increased uncertainty in cocoa prices and interest rates amplify increased volatility in Ghana stock prices. In contrast, high volatility in gold prices, oil prices and money supply will reduce the volatility in the stock prices of Ghana stock market.

Ayub and Masih (2014) investigated the empirical relationship between the stock prices of Islamic banks and two macroeconomic variables, namely exchange rate and interest rates, in 13 countries employing a panel data analysis. The results suggested that the exchange rate display a significant negative relationship on Islamic bank stock prices. In contrast, the dynamic panel data analysis elaborated an insignificant negative relationship between the interest rate and the Islamic stock prices. Mohapatra and Rath (2015) addressed the same phenomenon among BIC countries (Brazil, India and China) using panel data. Results support the existence of long run equilibrium between exchange rate, industrial production, inflation rate, interest rate and the stock prices of BIC economies. However, in the short run only interest rate found to be predictive of stock prices.

Jamaludin, Ismail and Ab Manaf (2017) conducted a panel data analysis on three selected ASEAN markets focusing on inflation, money supply and exchange rate and tested the influence of macroeconomic factors on conventional and Islamic stock indices. Using panel least square regression, the results suggested a negative association with the inflation rate and a positive association with the exchange rate. The money supply is found to be insignificant. Further evidence revealed that Islamic stock indices are more responsive to the macroeconomic changes compared to the conventional indices. Overall, results showed evidence that inflation has a greater effect on both indices than other macro factors. Chal (2017) investigated Indian stock market to identify the short run and the long run equilibrium relationship between Industrial Production Index, call money rate, Foreign Institutional Investment, Wholesale Price Index, exchange rate and Share market index for the period 2006 to 2017. Results showed the exchange rate, inflation rate and gold prices as the factors capable of forecasting the Sensex index of the Indian stock market.

Chandrashekar *et al.* (2018) investigated the relationship between key macroeconomic variables; inflation, industrial production, real exchange rates in India and Brazil. Using panel Granger causality test and Johansen-Fisher panel cointegration test both short and long-run equilibrium relationship is examined. Consequently, results suggested the presence of long-run equilibrium among the stock prices, inflation, industrial production, real exchange rates and interest rate of the selected markets. The result further revealed a positive and statistically significant association between most of the key macroeconomic variables such as stocks prices and the exchange rate. One of the most recent studies based on US and Canada sector indices suggests that there is an evidencing long-term relationship between the industrial production, money supply, long-term interest rate and different sector indices in US. However, the same was not found in Canada (Bhuiyan and Chowdhury, 2020).

Methodology

Data

The present study focuses on three frontier markets out of the 21 frontier markets based on the market classification provided by MSCI – Frontier market index. The sample consists of Sri Lanka, Bangladesh and Vietnam. Sample selection was restricted by the data availability; hence, when selecting the sample, focus is given only to the Asian region. Market indices of the main/ primary exchange are selected for the analysis. For instance, All Share Price Index (ASPI) of Colombo Stock Exchange, Sri Lanka, Dhaka Stock Exchange 30 Index (DSE 30) of Dhaka Stock Exchange, Bangladesh and VN 30 of Vietnam Stock Exchange, Vietnam are used as the market indices. The information is extracted from investing.com, a web database.

As independent variables, three local macroeconomic factors are chosen to study further. These variables are well supported in the extant literature and well tested in individual markets. Hence this study incorporates the Exchange rate, Consumer price index and Industrial production index as local economic factors. Macroeconomic data are extracted from the International Financial Statistics service of IMF. The time period of the study covers 65 months, starting from February 2013 until June 2018. The data set is structured as a panel data set, and it contains observations for the same cross-section over 65 months. Consequently, the study has a balanced pool dataset with 780 total data points spread across three panels. The analysis is conducted using the EViews software. The derivation of the dependent and independent variable is illustrated in the next section.

Variable Description

Market index : Main stock market indices (MKT) of the sample markets consist of a weighted average of all the stocks listed in that exchange. Natural logarithms of the main stock market indices are taken as the market return of individual markets; thus, it is the dependent variable of the study. Market indices are taken as of the last trading day of the market. Appendix 1(a) graphically compares the movements of selected market indices. Overall, Sri Lankan stock exchange shows the least overall growth within the study period. Yet, it can be considered as a matured exchanged compared to the other two. Both Bangladesh and Vietnam exchanges experience sizable growth. The growth in the Vietnam stock exchange is obvious given the fact, Vietnam established its stock exchange in July 2000.

Exchange rate: The exchange rate (EX) is the national currency per US dollar (EX) as at the end of the period. Since exchange rates are available daily, the model incorporates the exchange rate contemporaneously (Bilson, Brailsford and Hooper, 2001). Exchange rate fluctuations are graphically illustrated in Appendix 1(b). As per the diagram, it is evident that Vietnam has been maintaining more or less a pegged exchange rate system during the period 2013 February till 2015 December. (Throughout this period, the country has devalued their currency at several points,

within intervals of 12 months, 6 months and 4 months etc.) Aftermath, Dong shows fluctuations on a monthly basis, indicating a change in the exchange rate policy of the country. Evidently, in January 2016, the State Bank of Vietnam has moved into a new exchange rate system which pegged Dong to a basket of 8 currencies, replacing the previous USD pegged exchange rate regime (Huyen, 2018). At the same time, when comparing the three exchange rates, Dong can be considered as a highly depreciated currency compared to the other currencies in the region. Moreover, Sri Lanka and Bangladesh show a floating exchange rate policy (managed float) within the study period.

Consumer price index: The consumer price index (CPI) is employed as a proxy for the inflation rate. This is based on all items of the defined market basket of the country based on domestic currency values (the base years may differ in different markets). All three markets experienced an increase in the inflationary pressure, more or less in a similar amount. This can be due to the common regional economic conditions. Refer to appendix 1(c).

Industrial production index: The industrial production index (IPI) is taken as a proxy for economic activities and calculated based on domestic currency. Bangladesh tends to show a considerable growth in the economic activities relative to the other markets. Based on the movements of IPI, both Sri Lanka and Vietnam have overcome drastic drops in IPI at the beginning of 2016 and at the end of 2016 respectively. Refer to appendix 1(d).

Consequently, the conceptual framework can be developed as follows.

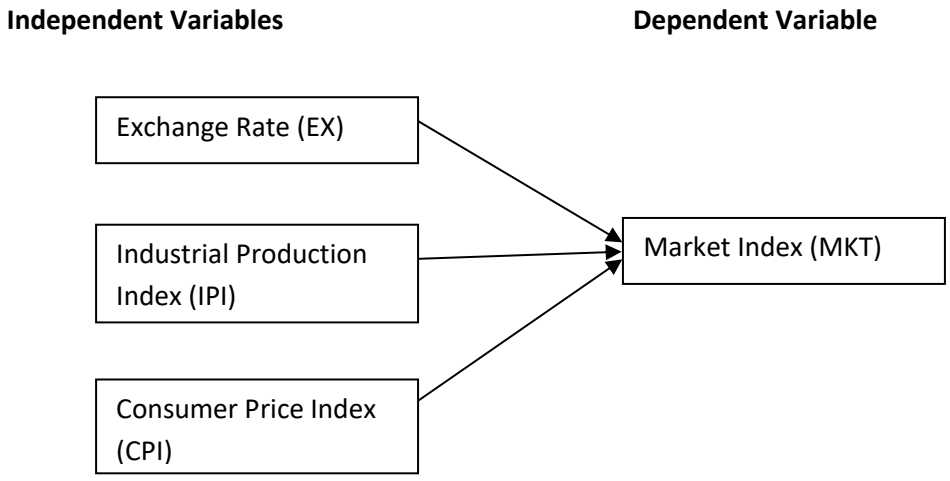

Figure 1 Conceptual Framework

Model Specification

The relationship between exchange rate, consumer price index, industrial production index and stock market index can be specified as follows using a regression model;

$$MKT_{i,t} = \alpha_0 + \alpha_1 ER_{i,t} + \alpha_2 CPI_{i,t} + \alpha_3 IPI_{i,t} + \varepsilon_{i,t}$$

Where $MKT_{i,t}$ is the natural logarithm of the market index at time *t*, for the *i* th market. $ER_{i,t}$, $CPI_{i,t}$ and $IPI_{i,t}$ are the natural logarithm of the exchange rate at time *t*, for the *i* th market, consumer price index at time *t*, for the *i* th market and industrial production index at time *t*, for the *i* th market. α_1, α_2 and α_3 respectively are the coefficient of ER, CPI and IPI. Finally, $\varepsilon_{i,t}$ is the error term of the model which represents the error term.

Data Analysis Procedure

All variables are tested for stationarity by employing multiple panel unit root tests. Existing studies have followed different panel unit root tests to test the stationarity of data. Wongbangpo and Sharma (2002) and Bilson, Brailsford and Hooper (2001) used Dickey– Fuller (ADF) and Phillips–Perron (PP) unit root tests, Chandrashekar *et al*. (2018) used Levin, Lin and Chu (LLC) and I'm, Pesaran and Shin (IPS). The current study uses two unit root tests Levin, Lin and Chu (LLC) and I'm, Pesaran and Shin (IPS) tests. For two tests, the null hypothesis states that there is a unit root, and the alternative hypothesis states otherwise. If all three tests indicate a unit root (nonstationary) at the level of data and no unit root (stationary) at first order difference, it suggests the possibility of having a long-run equilibrium relationship between the variables as a group. Thereby, the panel Co-integration test is adopted to test the long run equilibrium relationship between variables. Following Mohapatra and Rath (2015) long run relationship between variables is tested using seven test statistics suggested by the Pedroni panel cointegration test. Once the panel cointegration is confirmed, the study runs a dynamic ordinary least square (DLOS), which is considered superior to ordinary least square (OLS) model. DOLS explores the long run elasticities of the exchange rate, industrial production index and consumer price index on the stock market index. Finally, to investigate the possible short run causality between variables, study adopts a Granger causality test.

Analysis and Discussion

Descriptive Statistics

Table 1 summarizes the descriptive statistics of the independent and dependent variables. Stock indices of all three markets are at an average of 7.9%, with a minimum of 6.3% and a maximum of 8.9%. The standard deviation of the index series is 1.02, where the dispersion mainly arises from the VN 30 (Appendix 1(a)). The average exchange rate is 6.43%, and the standard deviation of 2.53 shows a large dispersion of exchange rates around the mean. This dispersion mainly arises from the Vietnamese dong, as Dong is a much-depreciated currency against the US dollar, compared to other regional currencies (Appendix 1(b)). However, a country wise analysis tells that all countries try to control their

Table 1. Summary of Descriptive Statistics

	MKT	EX	IPI	CPI
Mean	7.914872	6.432154	4.775077	4.957949
Median	8.430000	4.950000	4.690000	4.970000
Maximum	8.900000	10.03000	5.540000	5.120000
Minimum	6.280000	4.350000	4.040000	4.790000
Std. Dev.	1.024412	2.529797	0.343417	0.081771
Skewness	-0.670719	0.678765	0.402214	-0.114100
Kurtosis	1.578453	1.500146	2.387645	2.284122
Observations	195	195	195	195

exchange rates with minimal fluctuations to ensure a stable value for the local currency. The average IPI is 4.77%, with a comparatively lesser standard deviation, 0.34. The minimum and maximum IPI values are 4.0 and 5.5, respectively. Analysis of CPI shows a minimum dispersion around the mean. Accordingly, CPI has a standard deviation of 0.08. Both market index and CPI have a negative skewed/ left skewed distribution. Exchange rate and IPI have a positively skewed distribution. CPI seems to be normally distributed, yet all other variables are not normally distributed.

Panel Unit Root test

The study examines the stationarity level of data series using two panel unit root tests ; Levin, Lin & Chu (LLC) and Im, Pesaran and Shin (IPS). Table 2 depicts the results of the panel unit root test. Results are presented for level data and for the first difference. Both tests are done with an individual intercept. Accordingly, LLC and IPS tests fail to reject the null hypothesis of MKT, EX, CPI and IPI, suggesting non-stationarity at the level form (except for one situation). However, all data series reject the null hypothesis at first difference, implying stationarity. Apart from the two tests explained here, researcher has also explored unit root using other unit root tests such as Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Hadri which further valid the non-stationarity at level form and stationarity at first difference. These results are not mentioned in the paper as the results are almost similar to the one presented below in table 2. In order to perform a cointegration test all variables must be stationary on the same order. Thereby, the entire data series meets the precondition to perform a cointegration test. Hence, it is evident that there is a possible cointegration relationship between all variables in the long run. The applicable test is conducted in the next section to verify the long run equilibrium relationship.

Table 2. Results of Unit root test at level data and first difference

Variable	Levin, Lin & Chu (LLC)	Im, Pesaran and Shin (IPS)
MKT	0.15493 (0.5616)	0.09620 (0.5383)
D1_MKT	-14.3295*** (0.0000)	-13.0623*** (0.0000)
EX	1.26358 (0.8968)	3.40606 (0.9997)
D1_EX	-16.5413*** (0.0000)	-14.3808*** (0.0000)
IPI	-0.34916 (0.3635)	-0.63072 (0.2641)
D1_IPI	-14.9167*** (0.0000)	-17.9790*** (0.0000)
CPI	-2.38694 (0.0085) *	0.89354 (0.8142)
D1_CPI	-6.78678*** (0.0000)	-11.8185*** (0.0000)

Note: Probability values are in parenthesis.
***, **, * denote statistical significance at 1%, 5% and 10% level.

Panel Co-integration test

Section 4.2 suggest MKT, EX, CPI and IPI data series under the review are non-stationary at level form and stationery at the first difference. This indicates the presence of a long run equilibrium relationship among the variables. Thus, this study applies Pedroni panel co-integration test to examine the possible long run relationship. Table 3 illustrates the results. Results are validated based on the seven tests suggested by Pedroni co-integration test. Six out of the seven test results are statistically significant at 5% and 10% level. Thus, it can be concluded that there is a possible long run relationship between stock market index, exchange rate, consumer price index and industrial production index. Obtained results are in line with the prevailing studies, which concluded a long run equilibrium relationship between the market index and macroeconomics variables (Mohapatra and Rath, 2015; Chandrashekar *et al.*, 2018).

Table 3 Results of Panel Co-integration test

Test statistic		Probability
Panel v-statistics Panel	1.050880	0.1467
Panel rho-statistics Panel	-1.342543*	0.0897
Panel PP-statistics Panel	-1.567771*	0.0585
Panel ADF-statistics Panel	-1.509966*	0.0655
Group rho-statistics Panel	-1.401191*	0.0806
Group PP-statistics Panel	-1.982941**	0.0237
Group ADF-statistics Panel	-1.934389**	0.0265

***, **, * denote statistical significance at 1%, 5% and 10% level.

Dynamic Ordinary Least Square

Having examined the panel cointegration, long run elasticities of the three exploratory variables are confirmed using a DOLS. Table 4 reports the results of DOLS. The table 3 represents the long run elasticities for all three countries as a group. Accordingly, out of the three macroeconomic variables, only two are statistically significant at 1% and 5% significance levels. This indicates that frontier market prices do have an influence from the selected macroeconomic factors in the long run. Adding to this, few more observations can be made based on the test results. The exchange rate seems to have a negative yet insignificant association with the frontier market prices. Inflation (proxied by CPI) and the real economic activities (proxied by IPI) seem to have a positive and statistically significant long run impact of the stock indices. Accordingly, CPI is significant at 1% significance level and IPI is significant at 5% significance level.

The above results comply with the existing literature to a certain extend. In line with the finding of Mohapatra and Rath (2015) and Chandrashekar *et al.* (2018) the inflation (proxied by CPI) and economic activities (proxied by IPI) positively affect the stock market in the long run. Yet, Chandrashekar *et al.* (2018) failed to suggest a significant result for inflation. Results of the current study contradict with the findings of Ayub and Masih (2014), who discovered an inverse relationship between the CPI and stock market indices. However, their result is not statistically significant. As per the currents results, the highest impact seems to be coming from CPI. This is in line with the results of Jamaludin, Ismail and Ab Manaf (2017). As per the corpus, the exchange rate and the market indices are positively and significantly associated, yet in the case of frontier markets the results indicate a negative and insignificant relationship.

Table 4 Results of Dynamic OLS

Variable	Coefficient	Probability
EX	-0.255780	0.3776
CPI	2.254422***	0.0000
IPI	0.264821**	0.0294

***, **, * denote statistical significance at 1%, 5% and 10% level.

This result seems to be affected by the exchange rate systems of the three countries. It is important to note that, the impact of the exchange rate needs to be further analyzed, at the country level, while keeping in mind the aforementioned difference among the three selected frontier markets.

Panel Causality test

Pairwise granger causality test is conducted to explore the short-run relationship among variables. The results are revealed in table 5. The test has used the first difference of all data series, where there is no unit root. Thereby it is understood that exchange rate granger causes the frontier market indices, whereas the consumer price index and industrial production index do not. In addition to that, reverse causality is found from the stock index to consumer price index at 10% significance. Moreover, a short run causality is also running from CPI to IPI at 5% significance level. No other causalities were found between and among the explanatory variables. Market and industrial production do not have any form of causality. Thus, in conclusion, the exchange rate is the only variable which affects the market index out of the selected three macroeconomic variables. Extant literature suggests mixed results on this cause. Wongbangpo and Sharma (2002) also observed the same phenomenon in the short run, where they discovered a short run causality running from the exchange rates to the stock market index, yet none in terms of reverse causality. This result contradicts with Mohapatra and Rath (2015) and Chandrashekar *et al.* (2018). Similar to Chandrashekar *et al.* (2018) a reverse causality is found from CPI to the stock market index. It should be noted that, short run causality results seem to be less uniform across the prevailing studies.

Table 5. Results of Ganger Causality test

Null Hypothesis:	F-Statistic	Probability
D(EX) does not Granger Cause D(MKT)	3.10165**	0.0474
D(MKT) does not Granger Cause D(EX)	0.50597	0.6038
D(CPI) does not Granger Cause D(MKT)	0.74152	0.4778
D(MKT) does not Granger Cause D(CPI)	2.77819*	0.0648
D(IPI) does not Granger Cause D(MKT)	0.53223	0.5882
D(MKT) does not Granger Cause D(IPI)	0.00265	0.9973
D(CPI) does not Granger Cause D(EX)	0.56198	0.5711
D(EX) does not Granger Cause D(CPI)	1.32313	0.2689
D(IPI) does not Granger Cause D(CPI)	0.56303	0.5705
D(CPI) does not Granger Cause D(IPI)	3.21978**	0.0423

***, **, * denote statistical significance at 1%, 5% and 10% level.

Conclusion

This study investigates the long run and short run relationship between selected macroeconomic variables and the stock market returns of three frontier markets in the Asian region; Sri Lanka, Bangladesh and Vietnam. As per the researcher's knowledge, there is very limited literature on the selected frontier markets. Even though there are studies based on certain frontier markets at an individual level, literature does not provide much evidence based on a group of frontier markets. Therefore, this study can be considered as one of the limited studies conducted to investigate the macroeconomic impact on frontier market returns using a panel approach. The study uses monthly data from 2013 February till 2018 June, accounting for 65 months altogether. The study examines the long run and short run relationship between the exchange rate, consumer price index, industrial production index and the stock market index using panel co-integration test, dynamic OLS and granger causality test.

Having confirmed the preconditions of the data set: i.e., stationarity at the first difference, this study employed the Pedroni panel co-integration test to investigate for a possible long run association between variables. Empirical results concluded a long run association between macroeconomic variables and stock market indices. Long run elasticities were then measured using a dynamic ordinary least square. Accordingly, the consumer price index and the industrial production index seem to be positively and statistically significant in determining the stock

market indices in the long run. The results corroborate the findings of earlier studies. However, results suggest a positive and insignificant association between exchange rate and market index. As per the detailed study carried out on the exchange rate systems of three countries (where Vietnam is using a comparatively different exchange rate system compare to Sri Lanka and Bangladesh), the researcher suggests further study about the exchange rate systems before concluding the results. Granger causality provides minimum evidence towards the existence of a short run association between variables. Yet, the results found to be interesting, where out of all three macroeconomic factors, the exchange rate is the only variable with a short run association with the market index. On the contrary, the exchange rate does not support the hypothesis of having a long run association to the market index. These results add to the divisive results of the prevailing literature.

Given the existing findings, it can be concluded that exchange rate, inflation (proxied by CPI) and economic activities (proxied by IPI) plays a significant role in determining the frontier market index both in the long run as well as in the short run. Thereby, policy makers need to pay attention into the identified relationships when making policy decision in a frontier market. At the same time, they need to monitor the macroeconomic variables closely to reduce the unnecessary fluctuations in the stock markets. Furthermore, it is important to be vigilant about the fundamental differences between the three countries when interpreting the results of this study. Thereby, the researcher would like to suggest further analysis on the selected macro-economic variables, and if possible, to add other macro-economic indicators to the study as improvements.

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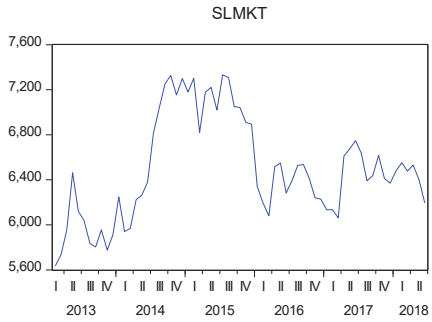
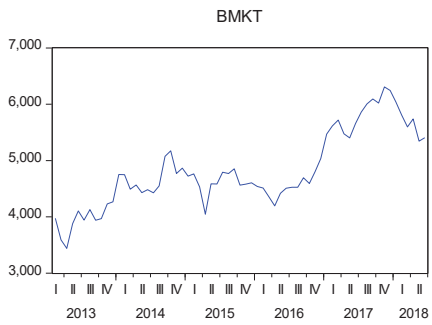
Appendix

Diagram 1(a) Market index





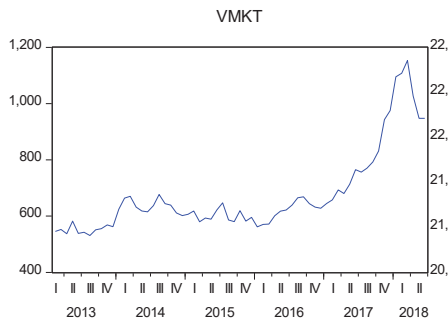
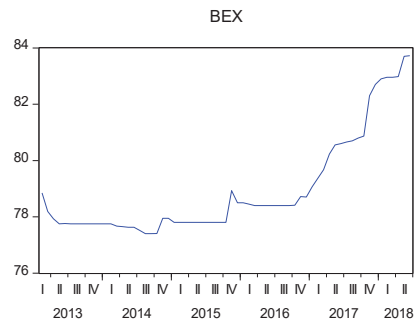


Diagram 1(b) Exchange rate



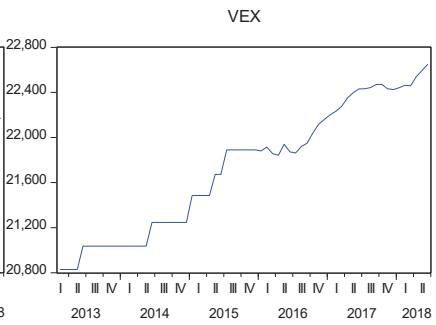


Diagram 1(c) Consumer price index Diagram 1(d) Industrial production index