



# Exploring the growth direction: the impact of exchange rate and purchasing managers index on economic growth in Sri Lanka

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## Abstract

Numerous studies have been conducted, globally and locally, on the impact of the exchange rate on economic growth. In the local context, only a handful of research have investigated this area of study to determine the extent to which the Purchasing Managers' Index influence economic growth with the exchange rate, with limited research have been performed in Sri Lanka. This study explores the impact of exchange rate and Purchasing Managers' Index on economic growth. Consequently, adopting an applied research methodology, the present study was based on secondary data published quarterly by the Central Bank of Sri Lanka reports and the Department of Census and Statistics of Sri Lanka from 2015 to 2021. The Vector autoregression model and Granger Causality Wald test were performed in this study. The empirical findings highlighted that economic growth and Purchasing Managers' Index have a significant negative impact on the economic growth, while the exchange rate had a significant positive impact on the economic growth. Furthermore, the exchange rate and the Purchasing Managers' Index did not help to predict the exchange rate. The implications of the study demonstrate the relevance of the exchange rate and manufacturing Purchasing Managers' Index as indicators of changes in overall economic growth activities at the macro level. The findings will assist the Sri Lankan Government, policymakers, and foreign investors for effective decision making.

**Keywords** Economic growth · Exchange rate · Purchasing managers' index · Vector autoregression

## 1 Introduction

One of the key aims of all countries is economic growth, which has also been one of the most critical concerns in emerging countries since World War II. Moreover, economic growth indicates that national production and national income are growing. Despite its

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complexities, the Gross Domestic Product (GDP) is used to quantify economic growth. Since it expresses labour and capital productivity as well as its evolution, GDP is of considerable significance that is accepted as a comprehensive economic measure. It demonstrates how various sectors of the local economy contribute to production (Khalil 2015). Economic growth entails the expansion of products and their sources, the expansion of factor input as well as total productivity of the respective factor (Christensen et al. 1980).

Moreover, to enhance economic growth in countries, it is beneficial to identify other macroeconomic variables that have a significant impact on the same. Exchange rate fluctuation is one such aspect that has varied effects on nations economic growth. The fluctuations of the exchange rate have been influenced by economic growth. The level of growth of any country's financial markets may be considered as one of the variables affecting how exchange rate variations impact economic growth (Basirat et al. 2014). The inflation rate includes the nominal exchange rate, hence, researchers too have used this to measure the effects of exchange rate on economic growth in Sri Lanka.

The exchange rate has been recognised as a determinant in the turning the trajectory of a country's economic growth, which has also been experimentally validated by numerous researches. The exchange rate can identify as a reversal factor driving the country's economic growth, and some relevant studies have empirically confirmed. The fluctuation or the stability of the exchange rate is the key concern that defines the significance and behaviour of macroeconomic variables (Ramasamy and Abar 2015). Furthermore, the economy of Sri Lanka is small and open. In contrast, Aghion et al. (2009) state the exchange rate is crucial since it influences both export and import prices while the selection of exchange rate fluctuations is currently an important component of macroeconomic policy in emerging countries. This statement is valid in the context of Sri Lanka while the exchange rate fluctuations have a considerable effect on the country's continuing trade deficit, where most imports are essentials.

Purchasing Managers' Index (PMI) is a diffusion index that is based on a survey of activities related to decisions of purchasing and supply executives in manufacturing enterprises. Hence, the PMI is regarded as a good leading predictor of economic activity (Khundrakpam and George 2012). An experimental analysis of the connection between both the Wholesale Price Index (WPI) and the PMI manufacturing price indices was conducted by Meyer and Habanabakize (2019) focussing on the Indian economy, where PMIs were utilised to assess the level and direction of overall economic activity. The PMI is a leading measure of economic activity that can be used to anticipate changes in GDP, most importantly, manufacturing activity (Tsuchiya 2012). It has been emphasised, however, the PMI's effectiveness as an important predictor of economic activity has weakened in recent years as the importance for the manufacturing sector in the global economy has shrunk (Meyer and Habanabakize 2019). As per Meyer and Habanabakize (2019), the PMI was introduced in 2015 and it considers manufacturing and service sectors in Sri Lanka. Furthermore, the PMI is published monthly because the PMI sub-indices are linked to components that measure economic growth such as GDP. Therefore, it is important to examine how representative PMI in economic growth. Additionally, during the COVID-19 pandemic where travel bans and work-from-home imposed in Sri Lanka disrupted the tangible elements of operations that cannot be conducted remotely, specially in the manufacturing and service sectors. Therefore, manufacturers and service providers in Sri Lanka expected this tendency to worsen or at least remain the same amidst the the pandemic situation. This will be compounded by intensified interruptions to the mobility of people and commodities that befell across workplaces as a result of efforts to combat the COVID-19 pandemic.

Moreover, the Department of Census and Statistics of Sri Lanka (DCS) and the reports of the Central Bank of Sri Lanka (CBSL) explicate the fluctuation of the exchange rate and changes in GDP due to COVID-19 in recent years. In the Sri Lankan context, many rigorous studies have been directed regarding the impact of the exchange rate on economic growth. In addition, the ongoing 2019–2022 Sri Lankan economic crisis which is characterised primarily by economic mismanagement, depleting foreign exchange reserves, a rise in external debt, a weakened currency, and rising prices also emphasise the importance of exchange rate and PMI on the economic growth. In light of the above, the study explores the impact of the exchange rate and PMI on economic growth in Sri Lanka.

Presently, one of the most critical concerns for the entire economy of Sri Lanka is understanding the present and prospective GDP growth. Despite certain drawbacks, sentiment indicators developed for this purpose, such as the PMI, appear to be the best somewhat successful instrument for predicting the economic status, as demonstrated in other countries, but there has been relatively few research on the Sri Lankan economy. As a result of empirically validated evidence of the association between PMI and GDP in many economies throughout the world, this research aids in determining the impact of the exchange rate and the PMI on economic growth. Consequently, the current study assists in the recovery of the economic downturn triggered by the COVID-19 pandemic and the ongoing economic crisis in Sri Lanka by filling a research gap in the local context. Therefore, the study attempts to answer, "How to examine the impact of exchange rate and PMI on economic growth?". Considering Sri Lanka's status as a low-wage country still lagging as a developing economy and prevailing economic crisis, this research is important for strategic decision makers and policymakers alike. Therefore, the study aims to identify the behaviour of specific variables such as the exchange rate and PMI on economic growth in Sri Lanka. One of the main issues that Sri Lanka has encountered since 2019, is the exchange rate fluctuation that has propelled an economic downfall. Accordingly, as per the CBSL reports, the Sri Lankan Rupee (LKR) depreciated against the United States Dollar (USD) during August 2021 and since January 2022, the LKR has depreciated around 26% against the USD. Hence, the purpose of the analysis is to identify the factors behind the above-mentioned depreciation of LKR.

Currently, much attention has not been paid to the impact of the exchange rate and PMI in Sri Lanka. As such, limited research has been conducted since PMI is a new concept in Sri Lanka. Therefore, the present study to identify the extent to which both the PMI and exchange rate influence economic growth in Sri Lanka is of significance. Subsequently, the purpose of this study is to bridge the above-mentioned empirical gap by investigating the impact of both the exchange rate and PMI on economic growth with a focus on Sri Lanka. As a result, this study differs from previous studies in three main aspects while it contributes to the literature.

First, there has been a deficit of research articles in the area of study that has addressed the local domain where both the PMI and exchange rate are considered collectively. Therefore, this research will be an initial study where the most pertinent information can be utilised at a broad level to identify the direction of the country's growth rate. Secondly, since the PMI is a significant benchmark determinant of economic conditions in states and key economies, it can be used to explain economic growth in Sri Lanka by linking it to the components that go into GDP. Remedies for PMI have been recommended based on the results of the study. Third, as a result of the emerging world's globalisation, impacts on economic changes have turned out to be both positive and negative. Downturns and acknowledging the exchange rate yield the opposite effect. Strategies for exchange rate determination have been proposed which are based on the results of this study. Finally,

the findings will be advantageous to the Government of Sri Lanka (GoSL), particularly in terms of offering significant insights on the impact of the exchange rate and the PMI on economic growth, which will be evaluated, revised, applied, and created.

The rest of this article is segregated into the sections below. Section two explains the literature review on the underlying concepts, while Section three contains the data and methodology. Section four evaluates the findings as well as discussion, and Section five concludes the research.

## 2 Literature review

The categorisation of search strategies is shown in Fig. 1, where the literature search strategy of this study focussed on reputed databases with relevant keywords. A further round of review was conducted on the remaining 44 articles. Following the elimination of 8 articles, the remaining 36 were re-screened to focus the search and narrowed down the relevant literature in this context. During this stage of the process, 31 articles were recognised as accomplishing the overall requirements; the recount was downsized to 21 publications since the rest were deemed ineligible. Accordingly, the remaining 12 papers were chosen to develop this study's literature review.

Sri Lanka has a long history of maintaining international ties and engaging in international trade. As a result, Sri Lanka handles a significant amount of foreign exchange inflows and outflows, specially the latter, as noted previously due to its import mix. In this setting, the exchange rate is a key determinant factor in economic growth, especially in a developing country like Sri Lanka.

The PMI has acquired importance in the market over the years and it provides among the most important indicators for real GDP growth during in the corresponding period among the survey indicators that are accessible sooner than the shock estimate of real GDP. The fundamental finding of these research is that PMI-based nowcasts of real GDP growth are accurate even though the PMI is used alone. Within such an approach, it is demonstrated that certainty is important when predicting real GDP growth (de Bondt and Schiaffi 2015).

The PMI is a compound indicator that maintains a record of manufacturing activity and growth, as well as the country's overall economy (Chien and Morris 2016; Meyer and Habanabakize 2019). It is often regarded as one of the main indicators of economic activity to anticipate GDP changes. In addition, Afshar et al. (2007) stated that PMI is widely regarded as a significant determinant of both manufacturing and service sectors in economic growth used by industrialised economies to measure business investment. PMI is a subjective and user-friendly assessment that determines the status of a country's manufacturing and service industry (Meyer and Habanabakize 2019). Meyer and Habanabakize (2019) illustrated that the coverage of work-related research is relatively limited due to the late development of the PMI index system in the domestic economy. According to the CBSL, it is segregated into manufacturing PMI and services PMI, and the PMI indicator is published monthly. Furthermore, increased economic growth is an excellent technique for boosting manufacturing employment growth that is both rapid and long-term. Manufacturing expansion will have both forward reverse links with other sectors, resulting in even more growth.

Unprecedented fluctuations in the exchange rate and the PMI have an impact on economic growth (Habanabakize and Meyer 2017). Moreover, determining the influence of the

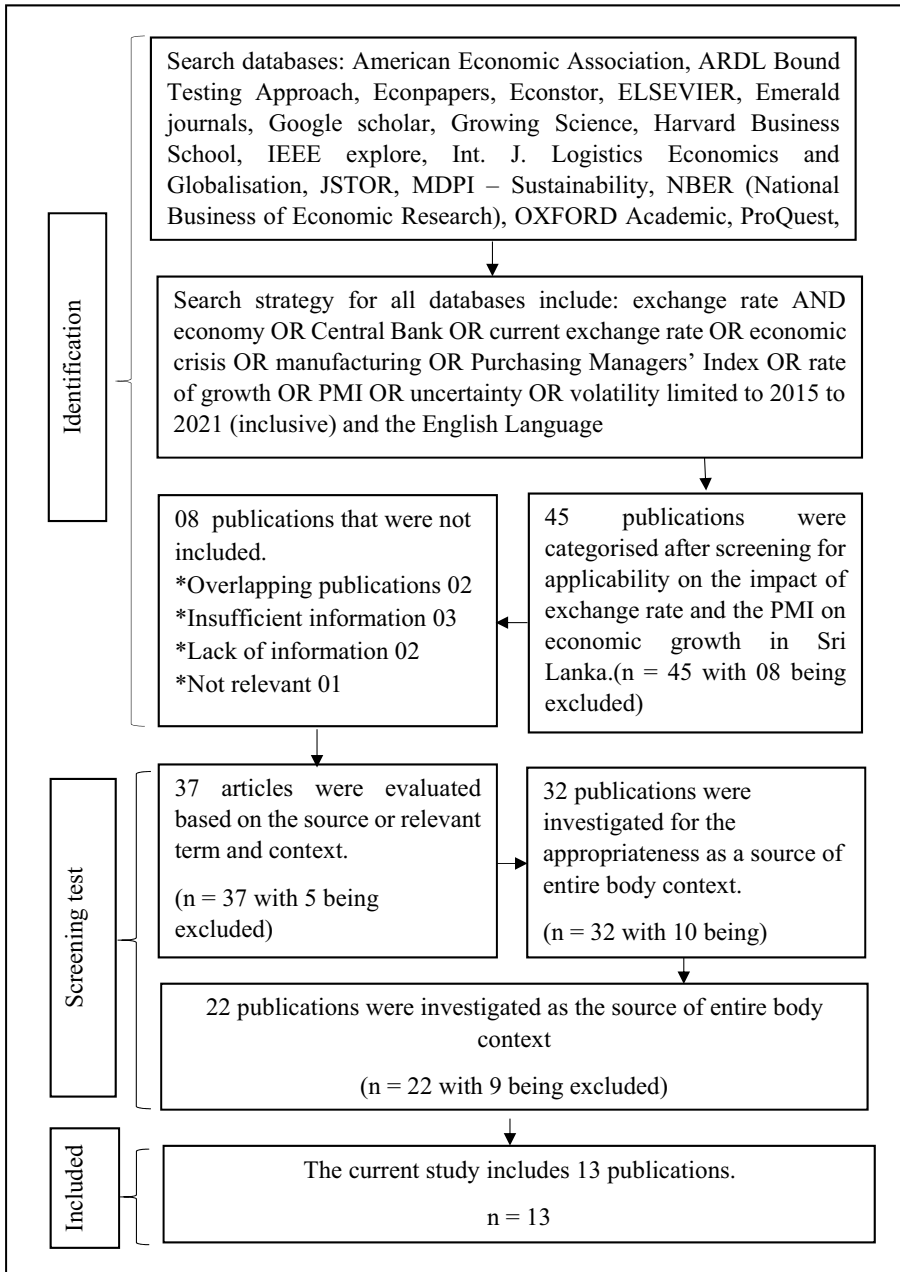


Fig. 1 Literature search flow diagram. *Source:* Based on authors' observations

exchange rate and the PMI on the country's economic growth is beneficial (Sobko and Klo-nowska 2021). PMI is entirely based on manufacturing industry data in different nations and PMI has been challenged when considering its advantages. Although individual countries' economies differ in areas including GDP structure, the relationship between economy

and growth in various countries is varied. Furthermore, in the manufacturing sector the indicators of oncoming downturn and restoration may be most visible, that is why the PMI is solely based on manufacturing data is presently the greatest predictor of GDP fluctuations. Consequently, characterising the manufacturing sector as "the core of the economy" has resulted in assertions. Several authors take a similar stance, emphasising the necessity of the output for economic development or the rate of unemployment, and claiming that the manufacturing sector is so vital that it may be referred to as the economy's flywheel. In this perspective, the exchange rate has played a significant role in globalisation and continues to do so in today's marketplace. Furthermore, Bostan and Firtescu (2018) demonstrated that a competitive and flexible exchange rate is a vital component of any economy.

According to several pieces of literature of previous studies indicated that in terms of the influence of exchange rate regimes on economic growth, (Tang 2015). The exchange rate has been recognised as a determinant in the turning vector of a country's economic growth, which has been empirically supported by various research. Results of a study based in Sri Lanka by Aslam (2016) proved how the exchange rate has affected Sri Lanka's economic growth by covering data of over four decades from 1970 to 2015. The study employed the multiple regression model and the Ordinary Least Square (OLS) approach. As per the results of the multiple regression model in this study, the exchange rate has a 1% significant positive impact on Sri Lanka's economic growth. Hence, this result supports the theory of exchange rate which assumes that maintaining a high exchange rate enhances a country's economic growth. However, researchers should have employed quarterly data to get an in-depth understanding about the impact of the exchange rate on economic growth.

Another literature illustrated the influence of an efficient multilateral exchange rate on the economic growth rate of five Asian countries during the period from 1989 to 2018. Indonesia, the Philippines, Vietnam, Malaysia and Singapore are among these countries. To avoid heteroskedasticity and autocorrelation, Pham Thi Ha et al. (2020) employed the Fixed Effects and Random Effects methods to evaluate this model. The Fixed Effects model is more appropriate than the Random Effects model, according to the Hausman test. However, the Fixed Effects technique was used to account for heteroskedasticity and autocorrelation in the estimate model. The authors were able to overcome the problem by using the Prais–Winsten (PCSE) technique. The Prais–Winsten method's estimation results suggest that a 1% rise in the effective exchange rate has a favourable influence, thus enhancing the economic growth rate by 16.2% of the above-mentioned five nations. As a result, the research advises ASEAN countries should undertake exchange rate assessments depending on the actual exchange rate in order to define a targeted exchange rate with a broader variety. To increase exports and economic progress, need to explore flexible exchange rate regulation with state control depending upon that supply and demand relation on the premise of a modest local level currency devaluation method. However, the study focussed only on the five ASEAN countries.

Furthermore, in most developing economies, the global economic crisis had disrupted trade and money flows, resulting in heightened exchange rate volatility. This is highlighted in a study conducted by Katusiime et al. (2016) which explored the impact of exchange rate fluctuation on Uganda's economic growth establishing an autoregressive distributed lag model. The study found out that both in the short and long run, exchange rate volatility had a favourable impact on Ugandan economic growth by using data during the period from 1960 to 2011 through the Autoregressive Distributed Lag (ARDL) model. In non-francophone nations, such as Uganda, exchange rate volatility had a greater impact than in francophone states. Furthermore, Uganda's growth path, like that of many emerging market economies, is influenced by exchange rate volatility and world economic movements.

Uganda has faced heightened exchange rate volatility as a consequence of international disruptions, balance-of-payments imbalances, and speculation threats on its currencies since the global financial crisis (GFC). Additionally, due to the scarcity of research on African countries' experiences, this study which focussed on a developing African country like Uganda was useful to policymakers and actors in the respective fields.

As is evidenced by the Republic of Macedonia based studies initiated by Nasir and Selimi (2017) to estimate the regression equation, the study applied the OLS approach and provided the model that assessed the effects of exchange rate on economic growth. The study used real GDP, a measure of economic growth as a dependent variable while a variety of additional macroeconomic variables were examined as independent variables, in addition to the variable of the exchange rate. Accordingly, the dynamic VAR model and Granger causality test were carried out in the above-mentioned research, where the exchange rate had a significant impact on economic growth. The sample size is insufficient for obtaining reliable findings, as time series regression methods necessitate a high sample size are the some flaws and limitations the study contains.

Meyer and Habanabakize (2019) addressed how relevant the PMI was in anticipating entire economic productivity in the South African economy, as well as if any variations in the manufacturing industry's production. The Consumer Price Index (CPI) helps to determine overall economic output. This study used a set of series data for the period from the first quarter of 2000 to the last quarter of 2017. Data for the respective study were provided by the South African Reserve Bank (SARB) and the Bureau of Economic Research (BER). The ARDL econometric model, Vector Error Correction (VEC), and Granger causality approaches were used to establish the short and long-run linkages among the variables. The results of the ARDL estimate indicated that the variables cointegrate in the long run, where changes in manufacturing output had the greatest effect on the long-term economic growth of the three variables, i.e. the PMI, exchange rate and economic growth. All independent factors had a substantial influence on economic growth in the short run. The primary findings of the Granger causality tests showed that the PMI, GDP and also PMI manufacturing productivity were bi-directionally related. The PMI, particularly as a good predictor, can assist future studies to focus on adding other significant factors to modelling of macroeconomic and fiscal policy-related indicators, such as interest rates.

There have been several techniques for determining the PMI's importance in reflecting the direction of GDP growth. Saidu et al. (2019) used the General to Specific (GETS) modelling approach, Moving-Average (MA) and Autoregressive (AR) model to investigate if the PMI can be used to predict the direction of GDP growth in Nigeria. Findings about parameter estimation for the six competing models revealed that at the first difference of the data series, five of the six models had a positive impact on real GDP. Model four demonstrated that the monthly PMI had a negative impact.

In Table 1, the supporting articles of the literature has been categorised into three main variables of the study such as the exchange rate, PMI and economic growth.

### 3 Data and methodology

The study adopted applied research methodology, therefore included both quantitative and quantitative data collection approaches to test a theory regarding the impact of exchange rates and PMI on economic growth. Exchange rates affect international trade, improve a country's international competitiveness, and so aid economic growth. Keeping a strong

**Table 1** Variables and supporting research articles. *Source:* Authors' compilations

Variables	Citations
Exchange rate	Tang (2015), Aslam (2016), Katusiime et al. (2016), Habanabakize and Meyer (2017), Meyer and Habanabakize (2019), Nasir and Selimi (2017), Bostan and Firtescu (2018), Pham Thi Ha et al. (2020) and Sobko and Klonowska (2021)
PMI	Chien and Morris (2016), Habanabakize and Meyer (2017), Meyer and Habanabakize (2019), Sobko and Klonowska (2021) and Saidu et al. (2019)
Economic growth	Tang (2015), Aslam (2016), Katusiime et al. (2016), Chien and Morris (2016), Nasir and Selimi (2017), Habanabakize and Meyer (2017), Meyer and Habanabakize (2019), Saidu et al. (2019), Sobko and Klonowska (2021) and Pham Thi Ha et al. (2020)

exchange rate, on the other hand, will raise import costs in the long run. In the period of growing inflation impacted by a variety of variables, this will place pressure on the financial and commodities markets, as well as mental stress and a variety of other factors that stifle economic progress (An et al. 2020). The study's main focus was on the impact of the exchange rate and the PMI on Sri Lanka's economic growth. The present study considered economic growth, exchange rate, the PMI and the GDP (2010=100).

The data was analysed using the VAR approach. The notions for applying these models in this study were that disclose information on multivariate time series data simply and flexibly, and that they completely explain endogenous variables by past values. Since presenting a simple and flexible model for multivariate time series data that incorporates non-statistical with a priori information. As a result, the study was based on secondary data acquired from CBSL reports, CBSL data library quarterly from 2015 2nd quarter to 2021 2nd quarter.

In a VAR model, each variable is a linear function of its previous values and the values of other variables (Damodar 2004; Gujarati 2011) The following mathematical equation of the VAR model was initially supported (Christensen et al. 1980; Damodar 2004) and it represents the relationship of variables to further elucidate macroeconomic factors impacting economic growth in Sri Lanka.

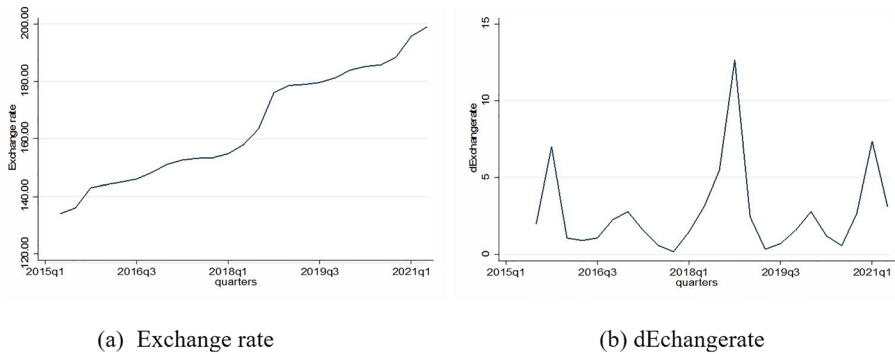
$$Real\ GDP = a_1 + \sum_{j=1}^{j=p} b_{11} ER_{t-1} + \sum_{j=1}^{j=p} b_{12} PMI_{t-1} + u_{1t}$$

where real GDP, economic growth; ER, Exchange Rate (USD); PMI, Purchasing Managers Index (Index value);  $a_1$ , constant term;  $b_{11}$  and  $b_{12}$ , coefficients;  $u_{1t}$ , error term;  $t-1$ , time;  $j=p$ , lag value.

The natural log of the first difference in real GDP, dRealGDP; the natural log of the first difference in the exchange rate, dexchange rate; VAR's output organises data by equation, with each "equation" corresponding to a dependent variable. Therefore, equations were developed for dRealGDP, a dexchange rate and the PMI. The matrix of covariance that signified the residuals from the VAR was held by  $e(\Sigma)$ .

Plots of the time series of variables are depicted in Fig. 2. The values on the left represent the exchange rate. The exchange rate variables have an upward rising behaviour. Figure 2's time series of changes shows behaviour that is defined as irregular ups and downs or fluctuations. It is worth noting that changes in exchange rate variables tend to fluctuate around with a constant value. Furthermore, the Phillips–Perron test was performed to determine if the variables were stationary or non-stationary as demonstrated in Tables 4





**Fig. 2** Non-stationary and stationary time series. *Source:* Authors' calculation

and 5, and the results indicated that the exchange rate is non-stationary Table 5, whereas Table 4 reveals Real GDP and PMI are stationary as well as the first difference of exchange rate represented in Table 6 named as dExchange rate. Even though Real GDP is stationary researchers had to check the first difference for Real GDP since when the researchers used Real GDP without checking the first difference Table 9 revealed that at least one eigenvalue is greater than 1.0, as a result, the VAR model does not satisfy the stability criteria. Table 10 indicates the test for lag length also, researchers were advised to employ zero lags by all three lag criteria Akaike information criteria (AIC) and Hannan–Quinn information criteria (HQIC) and Schwarz Bayesian Information Criteria (SBIC). Although the result indicated to apply zero lags for the study but to identify the impact towards economic growth while using more lags with the VAR model researchers generated the first difference of real GDP which appears in Table 7 with a value of 0.0000. Furthermore, researchers were advised to employ two lags by AIC and HQIC, while SBIC supported utilising one lag on behalf of HQIC and AIC as shown in Table 11. Furthermore, the identification of the model that meets the stability condition is represented in Table 8. The VAR model met the stability criteria because the values were less than one. As indicated in Table 8, the entire data set was summarised for objective, with a mean of  $-0.0005882$ . The summarised error of the dataset was represented by the graph in Fig. 3. The graph depicted the behaviour of the error term, which was compared to error relations from past and current quarters. There was, however, no correlation between error and quarters. The auto-correlation test is demonstrated in Table 8, and the outcome is shown as no auto-correlation.

As explained, the behaviour of variables in the data methodology, the result and discussion was carried out in according to prove the impact towards economic growth based on previous literature.

## 4 Results and discussion

In general, the purpose of this study was to determine the impact of the exchange rate and the PMI on economic growth in Sri Lanka. Using the Phillips–Perron test, determine whether each time series variable has a unit root. The study examined the autocorrelation of the exchange rate and the PMI and whether it has a positive or negative impact on

economic growth in Sri Lanka. Table 2 shows the major outcome of the VAR model when all three variables are duly considered.

The estimation of the VAR model is presented in Table 2. As observed from the VAR estimate, the lagged values of *economic growth* ( $-0.6367095$ ) significantly influenced and have a negative impact on the *economic growth*. This indicates that *the exchange rate* ( $1.09e-06$ ) has a significant positive impact on the *economic growth* at 10% level while the *purchasing manager index* ( $-1.14e-07$ ) has a significant negative effect on the *economic growth*.

The major findings of the study revealed that the exchange rate had a statistically significant positive influence on economic growth, whilst the PMI and economic growth both had a statistically significant positive impact on economic growth. In the Sri Lankan context, Aslam (2016) demonstrate that the exchange rate has a positive impact on economic growth at a 1% significance level. Our study also applied time series data and focussed only on Sri Lankan data. In this regard, the conclusion provides strong evidence of the exchange rate, which states that a high exchange rate encourages economic growth in a respective country's economy. Findings of another study also proved that the exchange rate is positively affecting the economic growth using a simultaneous equation model. Two-stage least square and three-stage least square techniques were used by Aman et al. (2017) in a study conducted in Pakistan.

#### 4.1 Granger causality Wald tests

The Granger causality tests were calculated using time series data, and the results are presented in Table 3. Individual Granger causality tests for each variable are also included in Table 3. The VAR Granger causality test looks into the granger causality of each VAR variable independently for each equation, then assesses the granger causality of all additional variables combined.

The Granger causality tests for the following equations are depicted in Table 3, with dRealGDP, PMI, and dExchangerate. The Granger causality wald test assessed how one

**Table 2** Estimation of the VAR model. *Source:* Authors' calculation

Variables	Coef	SE	Z	P> z
dRealGDP				
dRealGDP				
L2	-.6367095***	.1553391	-4.10	0.000
dExchangerate				
dRealGDP				
L2	1.09e-06*	2.35e-06	0.46	0.644
PMI				
dRealGDP				
L2	-1.14e-07*	3.56e-06	-0.03	0.974

In Table 10, the VAR results for 22 data from 2015q2 to 2021q2 are presented. The likelihood ratio is  $-400.2639$ ; is the lag order determined by the criterion; FPE denotes the final prediction error, which is  $9.21e+12$ ; HQIC is  $38.54205$ ; and AIC is  $38.29672$ . L2 denotes the first two lags

\*\*\*At the 1% level, \*\*at the 5% level, and \* at the 10% level, significance is \*\*\*, \*\*, and \* respectively

**Table 3** Granger causality Wald tests. *Source:* Authors' calculation

Equation	Hypothesis	Excluded	chi2	Prob > chi2
dExchangerate	H <sub>1</sub>	dRealGDP	.87965	0.644
PMI	H <sub>2</sub>	dRealGDP	3.8778	0.144

variable's lag value helped predict another variable in the model. Other factors help forecast the specifically targetted variable when the p-value is less than 0.05.

The causality wald test exchange rate (0.644) and PMI (0.144) had not helped to predict the exchange rate because the p-value was greater than 0.05, validating the conclusions of Granger. H<sub>1</sub> (0.644, > 0.05) and H<sub>2</sub> (0.144, > 0.05) are two hypotheses in this study. Researchers cannot reject the null hypothesis for H<sub>1</sub> and H<sub>2</sub> since the probability is higher than the critical value. These results indicate that dExchangerate and the PMI do not influence the exchange rate since the probability is higher than the critical value (0.05).

The findings of this study indicated that there are dExchange rates that do not affect the country's economic growth since the probability is greater than the critical value. In contrast, Karahan (2020) the findings of the Granger causality test conducted on quarterly data, emphasised the impact of exchange rate changes on economic growth concerning the Turkish economy. The findings demonstrate a valid reason to reject the null hypothesis that the exchange rate does not granger cause economic growth rate. As a result, the data show that causality exists from the exchange rate to economic growth, but the reverse is not proven. Consequently, the conclusions were based on data from the Turkish economy which is a developing nation, rather than data from the other developing countries. Hence, it is reasonable to assume that the study concentrated on specific economic factors pertaining of developing countries. Similarly, Meyer and Habanabakize (2019) demonstrated that the key results of the Granger causality technique to establish the short and long-run correlations among the variables. Findings showed that bi-directional causation existed between both the PMI and GDP because the study was based on South African data. In doing so, the study encompassed three variables such as the PMI, economic growth, and CPI, and as such, it is reasonable to draw a difference between empirical findings.

As noted previously, Karahan (2020) evaluated the impact of exchange rate changes on economic growth in the Turkish economy using the Granger causality test based on quarterly data. The findings demonstrated that the null hypothesis can be rejected as the exchange rate does not granger cause economic growth. On the contrary, the findings of this study indicated some dExchange rates do not affect the country's economic growth since the probability is greater than the critical value.

Vargranger tests for Granger causality when each variable is considered as independent, thus calculated separately for each equation, thereafter, tests for Granger causality when all additional variables are taken collectively. This statistical test is widely used to determine if lagged values of one variable can be used to predict the future values of another variable by using the other variable's lagged values. It is evident in some VAR that there is a causal relationship between the PMI, the exchange rate as well as the rate of economic growth. Therefore, it was demonstrated that economic growth in GDP Granger is responsible for the rate of influence on PMI and exchange rate fluctuations. Having said that, the impact (exchange rate growth and PMI) would not be influenced by the cause's past levels (as was the case in the preceding example) (growth rate in GDP). As long as the effect had previous values (i.e., increase in GDP), the past values of the cause (i.e., GDP growth rate) are unable to be used to determine the present value of the influence (exchange rate and PMI).

In the VAR result, calculations are identified by the dependant variable. Vargranger analyses for Granger causality of each variable separately in each equation, then tests for Granger causality of all added variables together. This statistical test is commonly used to examine if lagged values of one variable may assist predict the future values of the other variable. There is searched some indication in VAR that there is some causality going from PMI and exchange rate towards the economic growth rate in general. The results have proven that the economic growth in GDP Granger drives the rate of impact in the PMI and exchange rate. Having stated that, the impact (exchange rate growth and PMI) would not be dependent on the cause's previous values (growth rate in GDP). In the existence of prior values of the effect, the past values of the cause (growth rate in GDP) are unable to depend on aid in determining the present value of the impact (exchange rate and PMI).

## 5 Conclusion and policy recommendations

The objective is to identify the impact of exchange rate and PMI on economic growth. In conclusion, the study attempts to determine the behaviour of specific variables such as the exchange rate, GDP, and the PMI concerning economic growth in Sri Lanka. To accomplish the above-mentioned objectives, the secondary data was gathered quarterly through the CBSL reports and the DCS of Sri Lanka from 2015 to 2021. The VAR model was used to recognise the impact and obtain a reliable picture of exchange rate and the PMI on economic growth. The VAR model demonstrates that both economic growth and the PMI have a significant negative impact on economic growth, whereas the exchange rate has a significant positive impact on economic growth.

The PMI provides details that can be useful for various actors and stakeholders such as buying experts, corporate decision-makers, and economic analysts for effective decision making with up-to-date data that will aid in overall understanding of industry circumstances. This is critical since the indexes' utility for economic forecasting, policy formulation, and corporate planning is contingent on the notion that they predict aggregate economic circumstances.

The PMI being a leading indicator of a country's economy provides reliable information on current business conditions within the prevailing circumstances of the economy. Hence, the PMI assists decision-makers in firms, buying managers, and analysts. Given that PMI sub-indices are closely related to the elements that contribute to GDP for policymakers and regulatory authorities, it is relevant to analyse the PMI's representativeness for economic growth. It is reasonable to assume that the PMI helps identify the direction of the economic growth, where related fiscal policies can be designed much effective than before. Employing these kinds of yardsticks, past incidents such as forex losses (on fuel imports) incurred by loss-making state-owned enterprises, borrowing in foreign loans denominated in USD etc., can then be minimised to a greater extent. Resultantly, the loss incurred by the government treasury under tight budgetary constraints can also be minimised.

Sri Lanka being a developing country, its export mix generates inflows that is well below the outflows. Hence, buying experts and controllers using the PMI will provide those firms involved in import and export trade to decide on pricing on raw material and final products, buffer stocks, gauge the risk profile on exchange rate risk, import–export volumes and get a meaningful understanding about the sensitivity of exchange rate volatility and its impact to their respective business or trade.

The study suggests that the country must evaluate concerning regarding the exchange rate, allowing for a larger margin in identifying the targetted exchange rate. At present, Sri Lanka can recognise a reasonable local currency depreciation technique between supply–demand concerning how the economy is managed. This is of paramount given the economic crisis currently experienced by Sri Lanka.

The study contains limitations and flaws. First, because the PMI was introduced to Sri Lanka monthly in 2015, the sample size is rather small for producing meaningful data. Second, the time interval for the calculation of GDP and the PMI is not consistent; the GDP is not published monthly while the exchange rate and the PMI are employed as quarterly data. As a result, identifying the impact of the PMIs are limited to an annual basis which is the common time interval. However, this study can act as a guide to widen the research approach in future studies for projecting the Sri Lankan economy by introducing new concepts and methodologies. The findings provide a framework for future study in this area, and they point the way forward. In the end, it was discovered that creating separate models for various phases of the business cycle or different rates of economic development are t likely to be the most appropriate method.

## Appendix

See Fig. 3 and Tables 4, 5, 6, 7, 8, 9, 10 and 11.

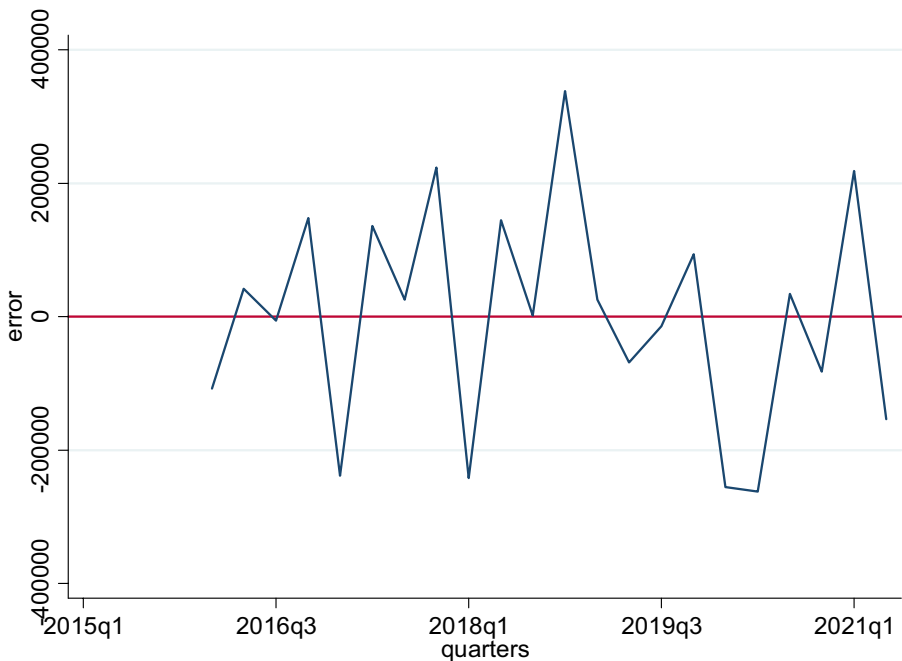


Fig. 3 Summarised error. *Source:* Authors' demonstration

**Table 4** Stationary variables. *Source:* Authors' calculation

Phillips-Perron test for unit root		No. of observation = 24	
Interpolated Dickey-Fuller		Newey-West lags = 2	
Test statistic	1% critical value	5% critical value	10% critical value
RealGDP—MacKinnon approximate $p$ -value for $Z(t) = 0.0007$			
Z(rho)	-17.180	-17.200	-12.500
Z(t)	-4.190	-3.750	-3.000
PMI—MacKinnon approximate $p$ -value for $Z(t) = 0.0000$			
Z(rho)	-25.571	-17.200	-12.500
Z(t)	-6.416	-3.750	-3.000

**Table 5** Non-stationary variables. *Source:* Authors' calculation

Phillips-Perron test for unit root		No. of observation = 24	
Interpolated Dickey-Fuller		Newey-West lags = 2	
Test statistic	1% critical value	5% critical value	10% critical value
Exchange Rate—MacKinnon approximate $p$ -value for $Z(t) = 0.9609$			
Z(rho)	0.029	-17.200	-12.500
Z(t)	-3.750	-3.000	-2.630

**Table 6** Generated non-stationary variables into stationary variables. *Source:* Authors' calculation

Phillips-Perron test for unit root		No. of observation = 23	
Interpolated Dickey-Fuller		Newey-West lags = 2	
Test statistic	1% critical value	5% critical value	10% critical value
dExchangerate—MacKinnon approximate $p$ -value for $Z(t) = 0.0063$			
Z(rho)	-17.259	-17.200	-12.500
Z(t)	-3.574	-3.750	-3.000

**Table 7** Generated first difference for Real GDP. *Source:* Authors' calculation

Phillips-Perron test for unit root		No. of observation = 23	
Interpolated Dickey-Fuller		Newey-West lags = 2	
Test statistic	1% critical value	5% critical value	10% critical value
dRealGDP—MacKinnon approximate $p$ -value for $Z(t) = 0.0000$			
Z(rho)	-18.861	-17.200	-12.500
Z(t)	-5.617	-3.750	-3.000

**Table 8** Eigenvalue stability condition Summaries error and autocorrelation test. *Source:* Authors' calculation

Eigenvalue	Modulus	
.00439032	+ .8217848i	.821797
.00439032	- .8217848i	.821797
.1457475	+ .4123998i	.437397
- .1457475	.4123998i	.437397
- .3004723	+ .2571055i	.395458
- .3004723	.2571055i	.395458

All the eigenvalues lie inside the unit circle  
 VAR satisfies stability condition

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Summarise error

Variable	Observation	Mean	Std. Dev	Min	Max
Error	22	- .0005882	166,598.5	- 262,048	338,276.8

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Varlmar autocorrelation test

Lag	chi2	df	Prob > chi2
1	6.6709	9	0.67134
2	9.6594	9	0.37876

H0: no autocorrelation at lag order

**Table 9** Eigenvalue stability condition test. *Source:* Authors' calculation

Eigenvalue	Modulus	
.02076358	+ 1.012616i	1.01283
.02076358	- 1.012616i	1.01283
- .880142	+ .1430294i	.891688
- .880142	- .1430294i	.891688
.5605668	+ .6426792i	.852802
.5605668	- .6426792i	.852802
- .4237533	+ .6037484i	.737617
- .4237533	- .6037484i	.737617
.677868	+ .1058619i	.686084
.677868	- .1058619i	.686084
.07831477	+ .5256244i	.531427
.07831477	- .5256244i	.531427

At least one eigenvalue is at least 1.0. VAR does not satisfy stability condition

**Table 10** VAR optimum lag selection criteria. *Source:* Authors' calculation

Selection-order criteria								
Sample: 2016 q1–2021q2						Number of obs = 22		
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	−424.229				1.5e+13	38.839	38.874	38.9878*
1	−416.596	15.267	9	0.084	1.7e+13	38.9632	39.1034	39.5583
2	−400.264	32.663	9	0.000	9.2e+12*	38.2967*	38.5421	39.3382

Endogenous: RealGDP dExchangerate PMI

**Table 11** VAR optimum lag selection criteria with first difference for realGDP. *Source:* Authors' calculation

Selection-order criteria								
Sample: 2016 q1—2021q2						Number of obs = 22		
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	−415.983				7.0e+12*	38.0894*	38.1244*	38.2381*
1	−411.603	8.7609	9	0.460	1.1e+13	38.6495	38.6495	39.1044
2	−400.18	22.845	9	0.007	9.1e+12	38.5344	38.5344	39.3306

Endogenous: RealGDP PMI dExchangerate

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