EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 8/ November 2014

ISSN 2286-4822
www.euacademic.org

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

Modeling and Forecasting Foreign Trade of the Philippines Using Time Series SARIMA Model

JACKIE D. URRUTIA
ELIZA MAE D. ALANO
PRECIOUS MARJON R. ANININPOT
KHRISTINE A. GUMAPAC
JOCELYN Q. QUINTO
Polytechnic University of the Philippines
The Philippines

Abstract:

Foreign Trade plays an important role in economic development of a country. It encourages local investment and increases foreign investments by providing incentives to foreign investors. Foreign Trade also brings price stability and increases national income of the country. Therefore, it is very essential to monitor the trend of Foreign Trade of the Philippines. The researchers identified the determinants of Imports and Exports using Stepwise Regression Analysis and forecasted Foreign Trade of the Philippines using time series statistical forecasting process, Seasonal Autoregressive Integrated Moving Average (SARIMA). Correspondingly, Pairwise Granger Causality was utilized in order to verify the causal relationship between the different economic variables. The study examined twenty three years monthly data from 1990 up to 2013. The bases of gathered data were from National Statistical Coordination Board, Department of Labor and Employment, and Banko Sentral ng Pilipinas. The study showed that all of the Independent variables: Exchange Rate (x_1), Monthly Domestic Crude Oil Prices (x_2), Inflation Rate (x_3) and Interest Rate (x_4) are significant, thus, can actually *predict Imports (y_1). On the other hand, there are only three significant factors in dependent variable – Exports (y_2). These are: Exchange Rate (x_1), Monthly Domestic Crude Oil Prices (x_2) and Inflation Rate (x_3). In addition, Pairwise Granger Causality Test indicated that Domestic Crude Oil have uni- directional Granger causal relationship with Import and Export. The best fitted models used in generating a 7- year forecast of Imports and Exports are SARIMA (5, 0, 8) x $(0, 1, 1)_{12}$ and SARIMA (7, 2, 3) x $(0, 1, 1)_{12}$ respectively for it achieved 95.63% and 88.34% variability. And to test the significance of the actual and predicted value, Paired t- test was used, signifying that there is no significant difference between actual and predicted value. This study will be of significance in estimating future Foreign Trade of the Philippines in order to prepare for the expected changes and to bring accurate and realistic decisions.*

Key words: Imports, Exports, SARIMA, Stepwise Regression Analysis, Forecasting

Introduction

Gross Domestic Product (GDP) is one way to measure the economic performance of a country. According to expenditure method, it constitutes Consumer Spending, Capital Investment, Government Spending and Net Exports which represents Exports minus Imports. Foreign trade has a big impact in the development of the economy of every country as can be gauged in the components of GDP

Exports are products shipped from a country to foreign destinations. It represents inflow of funds into the country. Rising Exports boost the economy by providing higher foreign exchange earnings which improves nation's purchasing capacity in international market. In addition, higher foreign demand favorably affects national income and reduces unemployment since the level of production increases. Conversely, Imports are overseas products. Unlike Exports, Imports represent outflow of funds from a country. Imports contribute to the economic growth of a country if these will improve long run economic productivity thus enhancing Exports.

There are several factors which affects Imports and Exports. The researchers consider four (4) explanatory variables. These are: Exchange Rate (x_1), Monthly Domestic Crude Oil Prices (x_2), Inflation Rate (x_3) and Interest Rate (x_4).

This study will be of significance in determining significant factors of both Imports and Exports and estimating future Imports and Exports of the Philippines. Accuracy of estimated imports and exports is very much important in order to prepare for the expected changes and to bring accurate and realistic decisions. Fluctuations of exports introduce uncertainties in an economy which influence economic behavior by adversely affecting the level and efficiency of investment and in turn have a negative effect on growth. Instability of exports also leads to raising borrowing costs and Inflation. On the other hand, Rising Imports also have a negative effect on the level of domestic currency versus foreign currency, or the exchange rate.

Objective of the Study

The main objective of the study is to forecast Monthly Imports and Exports of the Philippines from 2014-2020 by applying Seasonal Autoregressive Integrated Moving Average that may be used by the decision makers of the country to prepare for the expected changes and to maintain and/or improve the status quo of the balance of trade. This present study also aims to identify which of the independent variables: Current Exchange Rate, Domestic Crude Oil Price, Inflation Rate and Interest rate can actually predict the dependent variables: Imports and Exports through Stepwise Multiple Linear Regression that would help the government to decide what economic variables they should focus on. Moreover, Pairwise Granger Causality Test has been used to test causation between variables.

Statement of the Problem

The study aims to forecast the Import and Export of the Philippines for the next 7 years (2014-2020) using SARIMA time series model and identify its determinants by means of Stepwise Multiple Regression with the application of Eviews software. The purpose of the study is to answer the following questions:

1. What is the behavior of graph of the following variables?

    1.1 Current Exchange Rate (x_1)
    1.2 Domestic Crude Oil Prices (x_2)
    1.3 Inflation Rate (x_3)
    1.4 Interest Rate (x_4)
    1.5 Import y_1
    1.6 Export y_2

2. Is there a significant relationship between the Dependent and the Independent variable?
3. What are the significant factor(s) that can actually predict the Import and Export?
4. What will be the best fitted SARIMA model for Import and Export?
5. What are the Forecasted Values for the Year 2014-2020?

    5.1 Import
    5.2 Export

6. Is there a significant difference between the Actual and Predicted value?
7. Is there Granger Causality between the following variables?

7.1 Current Exchange Rate (x_1)
7.2 Domestic Crude Oil Prices (x_2)
7.3 Inflation Rate (x_3)
7.4 Interest Rate (x_4)
7.5 Import y_1
7.6 Export y_2

Significance of the Study

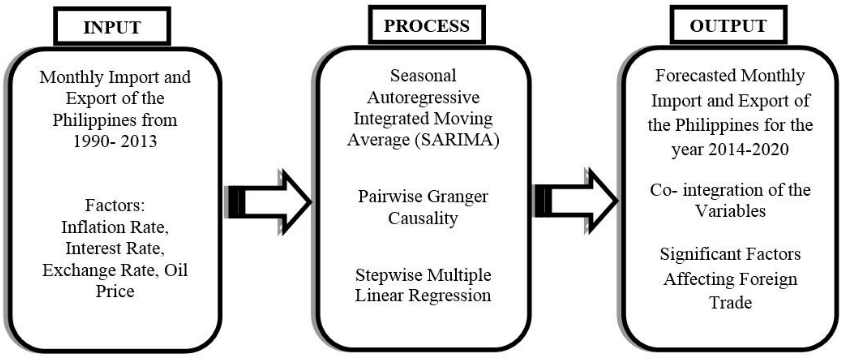
This research focuses on further monitoring foreign trade of the Philippines through forecasting and identifies its determinants using regression analysis. The results of this study may be used by the decision makers of the country to maintain and/or improve the status quo of the balance of trade. It could also influence the investors to increase their investments if the foreign trade of the Philippines shows a very favorable result, therefore may increase the production of goods and services which may affect unemployment, price stability, national income and the development of the country.

Scope and Delimitation

The researchers limit this study for 23 years. It considered years from 1990 up to 2013 for a total of 256 observations. The data were gathered from National Statistical Coordination Board, Department of Labor and Employment, and Banko Sentral ng Pilipinas. The researchers applied multiple linear regression using stepwise in order to determine the significant factors (independent variables) that can affect the dependent variables. Those variables are Current Exchange Rate (x_1), Domestic Crude Oil Prices (x_2), Inflation Rate (x_3), Interest Rate (x_4), Import (y_1) and Export (y_2).

Framework

Research Paradigm



Review of Related Literature

This area presents a review of related literatures that would be beneficial to the study summarized from previous writings and studies, revealing facts stated by people and pioneer in this field of study.

Ranjit Kumar Paul, et. al (2013), believe that in order to reveal the hidden trends and seasonal patterns of a time-series, time- series analysis must be used. Also, it is an essential tool for management and decision-making. The most widely used technique for analyzing time- series is the Box-Jenkins autoregressive integrated moving average (ARIMA) methodology. It has been successful in describing and forecasting of a wide variety of observations in the past. There is also an ARIMA process to control a seasonal time- series called SARIMA models. The study has revealed that the SARIMA model being stochastic in nature, could be used successfully for modeling as well as forecasting of monthly export of meat and meat preparations from India. It has been found that there is a significant increasing trend in the meat export from India. [1]

Tatiporn Pattranurakyothin and Kanchana Kumnungkit (2012), consider that in practice, many time series data contain a seasonal periodic component, which repeat every observation. To deal with seasonality, the ARIMA model is extended to a general multiplicative seasonal ARIMA (p ,d ,q)(P ,D ,Q)$_s$ model. This paper attempts to find the best mathematical model to predict monthly export values of para rubber in thailand [2]

According to Chinn (2008) "AN INVESTIGATION ON THE EFFECT OF REAL EXCHANGE RATE MOVEMENTS ON OECD BILATERAL EXPORTS" uses US data and investigates the effect of three measures of the real effective exchange rate on real aggregate exports for goods and services. Results indicate that the real appreciation of the domestic currency against other major currencies has a strong negative effect on export volumes, with elasticity close to minus 2.This empirical literature relies on the use of real effective exchange rates, which provide less information than bilateral real exchange rate, and do not enable to determine whether country pair characteristics can distort the effect of the real exchange rate movements on bilateral exports. According to Baldwin and Krugman, the study also shows that the existence of a sunk entry cost into the export market generates a persistent effect of real exchange rate movements on bilateral exports. The model also suggests that a larger sunk entry cost generates a more persistent effect, or equivalently a lower reaction of exports to real exchange rate movements. [3]

Joynson (2003) provides some preliminary analysis. This paper found domestic demand to be the dominant influence on imports in Fiji. Movements in the real effective exchange rate were also found to play an important role. The study shows imports and domestic demand move contemporaneously in the short-run in an almost one-for-one fashion. The real effective exchange rate is also found to be a strong determinant of imports in the short-term .[5]

Willem Thorbecke and Atsuyuki Kato (2011) "The Effect of Exchange Rate Changes on Japanese Consumption Exports" find out a 10% appreciation of the yen would reduce Japan's consumption goods exports by 9%. These results indicate that the large swings in the value of the yen over the last decade have caused large swings in the volume of Japanese exports. [27]

ElnurAslanov et al. (2010)"Analysis of Economic Factors Affecting Export and Import in the Countries of the South Caucasus" In our preliminary findings, the results at this stage indicate that the relationship between GDP, inflation and the exports and imports were highly significant for three South Caucasus countries. The analysis of the relationship between inflation and exports revealed the following: in Azerbaijan and Georgia inflation has an influence to exports. It means that Azerbaijan and Georgia export goods are very sensitive to prices changes in the world market, as increase of inflation enables them to be sold cheaper in the international markets while strong AZN and Lari causes the lost of interest in exporters. [6]

Akira YANAGISAWA (2012) "Impact of Rising Oil Prices on the Macro Economy" Given oil's strong characteristic as a vital commodity, demand, particularly in the short term, is inelastic versus price. This is why, when oil prices rise, the value of oil imports by importing nations will increase at about the same rate as the rise in price. In oil exporting nations, a rise in oil prices has the opposite effect of a rise for importing nations, working to expand the economy. In other words, an increase in the value of exports brings increased profits and wages. And, because domestic oil prices in oil exporting nations are typically heavily subsidized, a rise in international prices has only a limited impact. [7]

George Alessandria, et. al. (2007) "Export Dynamics in Large Devaluations" found out that controlling for changes in relative prices, interest rate movements tend to reduce exports. [8]

Methodology

Monthly data of Foreign Trade of the Philippines from 1990-2013 were gathered to formulate a mathematical model using Seasonal Autoregressive Integrated Moving Average. And to determine the factors affecting import and export of the Philippines using Stepwise Multiple Linear Regression, monthly data of Inflation Rate, Interest Rate, Exchange Rate and Oil Price were collected. Also, the researchers made use of Pairwise Granger Causality Test to distinguish whether the variables Granger cause each other.

Research Design

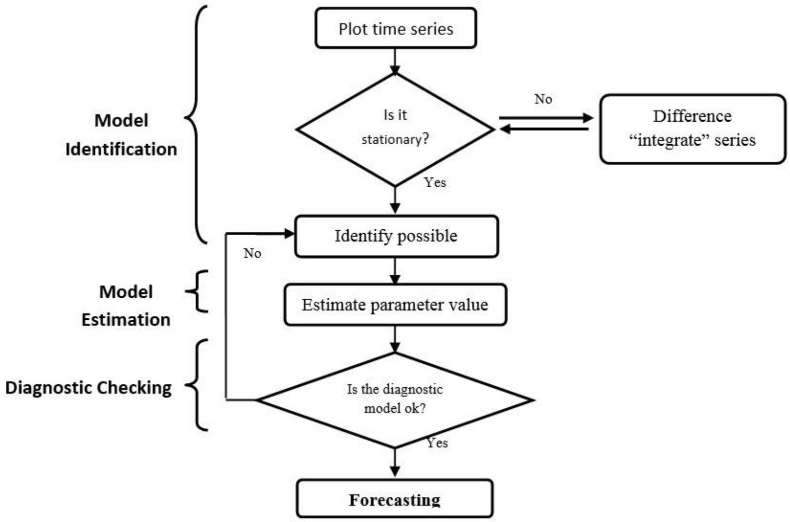
Historical research design is used for this study for the purpose of collecting and verifying data. Also it is commonly suited for trend analysis because historical records help to fully understand and interpret research problems. [9]

Materials and Methods

Statistical Treatment

The statistical spreadsheet software Econometrics Views 7 (EViews 7) and Statistical Package for the Social Sciences (SPSS) was used in analyzing the problem in order to come up with the best fitted models and to identify the significant factors can actually affect the dependent variables

Box Jenkins Methodology [10]



Box-Jenkins is an important forecasting method that can generate more accurate forecasts than other time series methods for certain types of data.

The Box Jenkins Methodology consists of four steps: [11]

The first step is the Model Identification. Checking for stationarity in data series is the foremost step in modelling process. And to check whether to difference a data, Augmented Dickey Fuller was utilized. The null hypothesis for ADF test is (H_o: $\delta = 0$) time series has unit root that is non- stationary then data is need to be differenced versus the alternative hypothesis H_a: $\delta \neq 0$ which is the time series has no unit root and stationary and doesn't need to be differenced. [16]
It takes the equation: [17]

$$\Delta y_t = \alpha + \beta t + \delta y_{t-1} + \gamma_i \sum \Delta y_{t-I} - e_t$$

where: t: the time index
α: an intercept constant
βt: the coefficient on a time trend
γ: the coefficient presenting process root
e_t: the residual term.

The next step in identification process is Model Estimation. Possible models were identified and the parameter values were estimated to come up with the best fitted model. By using the seasonal autoregressive notation (P) and a seasonal moving average notation (Q) the model will form the multiplicative process of SARIMA as

$$(p,d,q) \text{ x } (P,D,Q)_s. \text{ [13]}$$

Where :(p , d, q) :non-seasonal part of the model
(P, D, Q) :seasonal part of the model
s :number of periods per season [13]

The general form of seasonal model SARIMA (p, d, q)(P, D, Q)$_s$ is formulated as: [14]

$$\boldsymbol{\Phi_P(B^s)\phi(B)\nabla_s^D\nabla^d x_t = \Theta_Q(B^s)\theta(B)w_t}$$

where: w_t : non-stationary time series
s : period of time series
$\phi(B)$: ordinary autoregressive component (p)
θ (B) : ordinary moving average component (q)
$\Phi_P(B^s)$: seasonal autoregressive component (P)
$\Theta_Q(B^s)$: seasonal moving average component
∇^d : ordinary difference
∇_s^D : seasonal difference
B : backshift operator

Model Estimation is the third step in process of modeling. To ensure the variability of the model, the following tests were used:

a. R- squared - To determine how well the regression line fits the data.

b. Durbin Watson Stat –to determine if residuals are uncorrelated.

c. Normality Test- to check if the data are normally distributed.

d. Heteroskedasticity Test (White Test) – to test if the variance of the error terms differ across observations

After checking the goodness-of-fit and forecasting ability of the model you can now use the model to forecast over a future time horizon. Using the data obtained from January-1990 to December 2013, best fitted SARIMA model was used to forecast monthly Imports and Exports for Jan.- 2014 to Dec.- 2020.Forecasting Performance of the chosen SARIMA model is measured using Paired T-test. Paired T- test compares the means between two related samples on the same continuous dependent variable in order to determine whether they vary from each other in a significant way under the assumptions that the paired differences are independent and identically normally distributed. [22]

It takes the equation:

$$t = \frac{\bar{d} - \mu_d}{\frac{S_d}{\sqrt{n}}}, \ \mathrm{df} = n - 1$$

where: $\bar{d}$: the mean of the paired difference

μ_d: the hypothesized difference

S_d: the standard deviation of the paired difference,

n: the size of the time series [23]

In order to determine different factors affecting Imports and Exports of the Philippines, Stepwise Multiple Linear Regression was used and monthly data of Exchange Rate, Oil Price , Inflation Rate and Interest Rate were collected.

Multiple Linear Regressions (MLR) is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. It is often used to determine how many explanatory variables influence the response variable. [24] The method of research used by the researchers in Multiple Linear Regression using stepwise is the t-statistics probability to have statistical evidence that the coefficients are significant.

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots \beta_p x_{ip} + \varepsilon_i \text{ for } i = 1,2, \ldots n. \text{ [25]}$$

The researchers also used Pairwise Granger Causality test to determine if one time series is useful in forecasting another. It claims to move beyond correlation to test for causation. [26] Before conducting Pairwise Granger Causality test, it is necessary to verify that time series data is co-integrated by the use of Johansen Co integration Test. Also to test if all the variables are stationary by means of Unit Root Test using Augmented Dickey Fuller method. Lag Structure using Akaike Information Criterion (AIC) is used to identify the best lag length to include. Therefore a lag length of 2 was used. Pairwise causality test was used to verify that when time series data are co-integrated, there should be either bi-directional or uni-directional granger causality among them.

Results and Discussion

The behavior of the graph of Current Exchange Rate is presented in Figure 1(see Appendices Figure 1). It showed that there was an increased in Current Exchange Rate from month of December 1990 to January 1991 at around 29%, because the margins for spot buying and selling rates for commercial reference transactions around the official reference rate were eliminated. It was also increased by approximately 25% between December 1997 and January 1998, because the authorities allowed the Peso to float more freely against the dollar by lifting the volatility bank system. Conversely, in year 2000, Exchange rate decreased at about 12% from May to June.

The graph of Domestic crude Oil Price (see Appendices Figure 2) illustrates that Domestic Crude Oil Price fell by 40% in year 2000 from November to December and by 88% from August to September 2002 then rose between May and June 2008 at about 13%.Domestic Crude Oil Price reached its peak at approximately $250 per barrel on July 2008 then fell down to $77.71 per barrel at the end of year. It goes up in a faster pace in year 2009 and reached its second highest level of $222.03 per barrel on 3rd month of 2012.

Inflation Rate (see Appendices Figure 3) on the other hand reached a peak of 21.1% on 8th month of 1991.It remained decreasing from August 1991 up to April 1992. Inflation Rate also had a major decreased of 65% from last month of 1993 to January of the following year. Higher inflation rate was also experienced in 2008 because of global economic crisis. During that time, almost all countries suffered due to the economic problems that struck the US and other big economies in the world. It touched the bottom rate of 1.7 on the 8th month in year 2009. [4]

Interest rate fluctuated in early 90's. It declined continuously from August 1998 to April 2000.It remained steady at 7% from April 2000 to June 2003, 6.75% from August 2003 to March 2005,6.5% from November 2005 to June 2007 and at 4% between August 2009 and February 2011. Inflation Rates were also kept steady from October 2012 until 2013. (see Appendices Figure 4)

The graph of Imports (see Appendices Figure 5) illustrates that Imports started at its lowest level. Imports increased in year 1995 from the month of May to June at around 14% while an increase of 35% from February to March of 2002. It reached its highest level of 5,882,357,556 pesos in July 2008 then decreased at about 12% from May to June of the year 2010.

Exports begun at its lowest level like Imports. It goes up from February to March of the year 1992 at approximately 26% then followed by a decrease of the same rate on the next month. Exports went up again from February to March of the year 2006 at about 21%. Exports reached its peak in September 2010. (see Appendices Figure 6)

Relationships of the Independent and Dependent Variable(s)

The relationships of the Independent Variables to Imports (y_1) and Exports (y_2) using original data (see Appendices Table 18 and 19) were ascertained by Pearson's coefficient of correlation, as shown in the table below.

	Exchange Rate (X_1)	**Domestic Crude Oil Price (X_2)**	**Inflation Rate (X_3)**	**Interest Rate (X_4)**
Import (y_1)	0.600870	0.862964	-0.580180	-0.662250
p-value	0.000000	0.000000	0.000000	0.000000
Export (y_2)	0.726617	0.786668	-0.568310	-0.659330
p-value	0.000000	0.000000	0.000000	0.000000

The scatter diagram (see Appendices Figure 20) shows that there is a strong positive relationship between Imports (y_1) and Independent Variables: Current Exchange Rate (x_1) and Domestic Crude Oil Prices(x_2) given that as Current Exchange Rate (x_1) and Domestic Crude Oil Prices(x_2) increases, Imports (y_1) also increases. Conversely, there is a strong negative relationship between Imports (y_1) and Independent Variables:

Inflation Rate (x_3) and Interest Rate (x_4) because as Inflation and Interest rate increases, Imports (y_1) also decreases whereas in the scatter diagram (see Appendices Figure 21) shows that there is a Very strong positive relationship between Exports (y_2) and Independent Variables: Current Exchange Rate (x_1) and Domestic Crude Oil Prices(x_2) given a very high positive Pearson coefficient. On the contrary, there is a strong negative relationship between Exports (y_2) and Independent Variables: Inflation Rate (x_3) and Interest Rate (x_4).

On the other hand, Exchange Rate (x_1) has a p-value of 0.0000, Monthly Crude Oil Price (x_2) with p-value of 0.0000, p-value of 0.0000 for Inflation Rate (x_3) and 0.0098 for Interest Rate (x_4). Thus, all of the Independent variables are significant. (see Appendices Table 18) While in Table 19 (see Appendices Table 19) , Exchange Rate (x_1) has a p-value of 0.0000, Monthly Crude Oil Price (x_2) with p-value of 0.0000, p-value of 0.0000 for Inflation Rate (x_3) and 0.1732 for Interest Rate (x_4). Thus, there are three Independent Variables which are significant._

Furthermore, in developing a SARIMA model, the first step is to determine if the data is stationary and have seasonality. To verify the assumption, Augmented Dickey Fuller (ADF) was used. In this case, both Imports and Export have seasonality hence, seasonal differencing is required. Having the data deseasonalized, its unit root was checked confirming that only Exports have unit root thus regular differencing should be applied. And after satisfying all the assumptions, proceed to model estimation. (see Appendices Table 1-4)

Out of 3000 verified SARIMA models for Import, 14 models were candidate (see Appendices Table 5) and *AR(1) AR(2) AR(5) AR(10) AR(25) MA(1) MA(2) MA(3) MA(4) MA(5)*

MA(6) MA(7) MA(11) SMA(132) is the chosen best fitted model and most significant because it satisfied all the assumption of a SARIMA model and it has R-squared value and p- value of 0.956291 and 0.00000 respectively. On the other hand, 23 out of 3000 verified SARIMA models for Export were candidate (see Appendices Table 6) and *AR(1) AR(2) AR(3) AR(6) AR(7) AR(10) AR(99) MA(1) MA(2) MA(58) SMA(12)* is the chosen best fitted model and most significant since it satisfied all the assumption of a SARIMA model and it has R-squared value and p- value of 0.883599 and 0.000000 respectively. Correspondingly, the coefficients were obtained using Eviews. Therefore, Imports and Exports can be computed using the SARIMA equation:

1. Import

$$\mathbf{Y_t} = \alpha_0 + \boldsymbol{\alpha_1} \mathbf{Y_{t-1}} + \boldsymbol{\alpha_2} \mathbf{Y_{t-2}} + \boldsymbol{\alpha_3} \mathbf{Y_{t-5}} + \boldsymbol{\alpha_4} \mathbf{Y_{t-10}} + \boldsymbol{\alpha_5} \mathbf{Y_{t-25}} + \boldsymbol{\Phi_1} \boldsymbol{\varepsilon}_{t-12} + \boldsymbol{\beta_1} \boldsymbol{\varepsilon}_{t-1} + \boldsymbol{\beta_2} \boldsymbol{\varepsilon}_{t-2} + \boldsymbol{\beta_3} \boldsymbol{\varepsilon}_{t-3} + \boldsymbol{\beta_4} \boldsymbol{\varepsilon}_{t-4} + \boldsymbol{\beta_5} \boldsymbol{\varepsilon}_{t-5} + \boldsymbol{\beta_6} \boldsymbol{\varepsilon}_{t-6} + \boldsymbol{\beta_7} \boldsymbol{\varepsilon}_{t-7} + \boldsymbol{\beta_8} \boldsymbol{\varepsilon}_{t-11}$$

$$\mathbf{Y_t} = 3395201357.19438 - 0.2836804616898548\ \mathbf{Y_{t-1}} + 0.5312589976742118\ \mathbf{Y_{t-2}} + 0.4100712871377718\ \mathbf{Y_{t-5}} + 0.3398521273394901\ \mathbf{Y_{t-10}} + 0.0193362881114014\ \mathbf{Y_{t-25}} + 0.4431598216088257\ \boldsymbol{\varepsilon}_{t-12} + 1.063597153785007\ \boldsymbol{\varepsilon}_{t-1} + 0.3274250545092606\ \boldsymbol{\varepsilon}_{t-2} + 0.4204370511522189\ \boldsymbol{\varepsilon}_{t-3} + 0.6040428131079669\ \boldsymbol{\varepsilon}_{t-4} - 0.2354392400690822\ \boldsymbol{\varepsilon}_{t-5} - 0.06695447240005347\ \boldsymbol{\varepsilon}_{t-6} + 0.3281767055927076\ \boldsymbol{\varepsilon}_{t-7} - 0.01335832897242762\ \boldsymbol{\varepsilon}_{t-11}$$

2. Export

$$\mathbf{Y_t} = \alpha_0 + \boldsymbol{\alpha_1} \mathbf{Y_{t-1}} + \boldsymbol{\alpha_2} \mathbf{Y_{t-2}} + \boldsymbol{\alpha_3} \mathbf{Y_{t-3}} + \boldsymbol{\alpha_4} \mathbf{Y_{t-6}} + \boldsymbol{\alpha_5} \mathbf{Y_{t-7}} + \boldsymbol{\alpha_6} \mathbf{Y_{t-10}} + \boldsymbol{\alpha_7} \mathbf{Y_{t-99}} + \boldsymbol{\Phi_1} \boldsymbol{\varepsilon}_{t-12} + \boldsymbol{\beta_1} \boldsymbol{\varepsilon}_{t-1} + \boldsymbol{\beta_2} \boldsymbol{\varepsilon}_{t-2} + \boldsymbol{\beta_3} \boldsymbol{\varepsilon}_{t-58}$$

$$\mathbf{Y_t} = 5164862723.497082 + 0.9991305197412358\ \mathbf{Y_{t-1}} - 0.8921015645195819\ \mathbf{Y_{t-2}} + 0.6395868714107652\ \mathbf{Y_{t-3}} - 0.09717721183546884\ \mathbf{Y_{t-6}} - 0.142446067776473\ \mathbf{Y_{t-7}} + 0.07027030666694535\ \mathbf{Y_{t-10}} + 0.218296809345612\ \mathbf{Y_{t-99}} + 0.2645361597602994\ \boldsymbol{\varepsilon}_{t-12} - 0.3470275319750756\ \boldsymbol{\varepsilon}_{t-1} + 1.132424022781886\ \boldsymbol{\varepsilon}_{t-2} - 0.2599279320552618\ \boldsymbol{\varepsilon}_{t-58}$$

The selected models SARIMA (5, 0, 8) x (0, 1, 1) $_{12}$ for Import and SARIMA (7, 2, 3) x (0, 1, 1) $_{12}$ for Export were used to forecast monthly Imports and Exports of the Philippines from January 2014 to December 2020 (see Appendices Table 13 & 14). The forecasted data were compared with the actual data by utilizing Paired t- test. The result indicated that there is no significant difference between the actual and predicted values since it resulted to a p- value of 0.1287 for Import and 0.8906 for Export. (see Appendices Table 11 & 12)

In addition, to verify the causal relationship between the different economic variables, Granger Causality Test was utilized (see Appendices Table 16). It was validated that only Domestic Crude Oil has uni- directional Granger causal relationship with Import and Export and No causality exists between the other economic variables such as Current Exchange Rate, Inflation Rate and Interest Rate.

Conclusion and Recommendation

The researchers were able to develop a SARIMA Model for a 7-year forecast of import and export of the Philippines after considering all the assumptions in SARIMA modeling. The following models are SARIMA (5, 0, 8) x (0, 1, 1) $_{12}$ for import and SARIMA (7, 2, 3) x (0, 1, 1) $_{12}$ for export. Moreover, Paired t-test was used to test the forecasting performance of the model and it shows that there's no significant difference between the Actual and Predicted value signifying that the models can actually predict Foreign Trade of the Philippines. On the other hand, Stepwise Multiple Linear Regression was utilized and the researchers identified the determinants of foreign trade of the Philippines. Based on the results gathered, there are four significant factors that can actually predict the Imports (y_1). These are: Exchange Rate (x_1), Monthly Crude Oil Prices (x_2), Inflation Rate (x_3) and Interest Rate (x_4). Significant factors of Exports are the same with Imports except Interest Rate (x_4). Correspondingly, the researchers made use of Granger Causality Test to verify the causal relationship between the factors affecting foreign trade and they found out that only Domestic Crude Oil has uni- directional Granger causal relationship with Import and Export and No causality exists between the other factors. The researchers propose looking for more independent variables such as: Foreign Direct Investment (FDI), Tariff Rate, Transportation costs, and Number of Employed in Electronic Industry.

BIBLIOGRAPHY

[1] Ranjit Kumar Paul, et. al (2013). Modelling and Forecasting of Meat Exports from India. *Agricultural Economics Research Review Vol. 26 (No.2) July-December 2013 pp 249-255*

[2] Tatiporn Pattranurakyothin and Kanchana Kumnungkit (2012). Forecasting Model for Para Rubber's Export Sales. *KMITL Sci. Tech. J. Vol. 12 No. 2 Jul.- Dec. 2012*

[3] http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp920.pdF

[4]http://learninterestrates.com/inflation-rate-in-the-philippines-from-2007-to-2011/

[5] http://www.reservebank.gov.fj/docs/wp2000-03.pdf

[6]http://www.iset.ge/files/submission_aslanov__isayeva__gasimova.pdf

[7] https://eneken.ieej.or.jp/data/4338.pdf

[8] George Alessandria et al (n.d.). *Export Dynamics in Large Devaluations.* Retrieved from http://www.decon.edu.uy/lacea/papersaceptadosLACEA/ALESSANDRIA_Export%20dynamics%20in%20large%20devaluations.pdf

[9] University of Southern California. (n.d.). *Types of Research Design*. Retrieved from http://libguides.usc.edu/content.php?pid=83009&sid=818072

[10] Hepsen A., & Vatansever M. (2011). Forecasting future trends in Dubai housing market by using Box-Jenkins autoregressive integrated moving average. *International Journal of Housing Markets and Analysis, 4(*3), 210 – 223. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2013943

[11] Sävås , F. N. (2013). *Forecast Comparison of Models Based on SARIMA and the Kalman Filter for Inflation*. Independent Thesis Advanced Level, Uppsala University, Uppsala, Sweden. Retrieved from http://www.diva-portal.org/smash/get/diva2:631413/FULLTEXT01.pdf

[12] Mečiarová, Z. (2007). Modeling and Forecasting Seasonal Time Series. *Journal of Information, Control and Management Systems, 5.* 73-80. Retrieved from http://kifri.fri.uniza.sk/ojs/index.php/JICMS /article/download/982/362

[13] Mina Mahbub Hossain and Mehdi Rajeb. Toward Bracketing The Seasonal Export-Import Of Bangladesh: A Time Series Analytical Approach. *Daffodil International University, University of Liberal Arts Bangladesh, Dhaka, Bangladesh.*

[14] Xinghua, C., Meng, G., Yan, W., & Xiyong, H. (2012). SEASONAL AUTOREGRESSIVE INTEGRATED MOVING AVERAGE MODEL FOR PRECIPITATION TIME SERIES. *Journal of Mathematics and Statistics, 8(4),* 500-505. doi:10.3844/jmssp.2012.500.505

[15]http://economics.about.com/cs/economicsglossary/g/augmented.htm

[16] Adhistya Erna Permanasari, et. al (2009). Prediction of Zoonosis Incidence in Human using Seasonal Auto Regressive Integrated Moving Average (SARIMA). *(IJCSIS) International Journal of Computer Science and Information Security, Vol. 5, No. 1, 2009*

[17] FinMath User Guide. (n.d.). *Augmented Dickey-Fuller (ADF) Test*. Retrieved from https://www.rtmath.net/help/html/93a7b7b9-e3c3-4f19-8a57-49c3938d607d.htm

[18]http://www.wright.edu/~thaddeus.tarpey/ES714timeseries.pdf

[19] http://www.encyclo.co.uk/define/Correlogram

[20] IBM Knowledge Center. (n.d.). *Autocorrelation and Partial Autocorrelation Functions*. Retrieved from http://pic.dhe.ibm.com/infocenter/spssmodl/v15r0m0/index.jsp?topic=%2Fcom.ibm.spss.modeler.help%2Ftimeseries_acf_pacf.htm

[21] *Correlogram*. (n.d). Retrieved from http://www.zaitunsoftware.com/book/export/html/46

[22] https://statistics.laerd.com/spss-tutorials/dependent-t-test-using-spss-statistics.php

[23] *Paired t-testing*. (n.d.). Retrieved from http://mips.stanford.edu/courses/stats_data_analsys/lesson_5/234_7_e.html

[24] http://www.investopedia.com/terms/m/mlr.asp

[25] http://www.stat.yale.edu/Courses/1997-98/101/linmult.htm

[26]http://yct.ncku.edu.tw/site2/ocwCoursePPT/125Group%20No%207%20Mid%20Term%20Presentation.pdf

[27]http://www.adbi.org/files/2011.07.26.wp298.effect.exchange.rate.changes.japan.exports.pdf

APPENDICES

APPENDIX A

Table 1 DATA

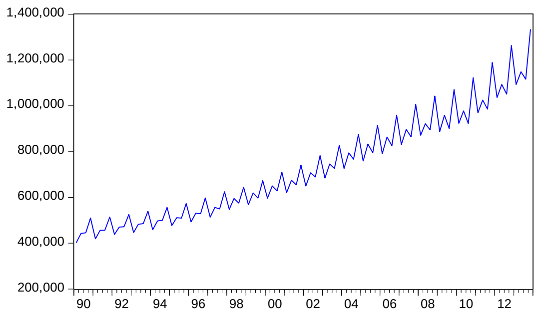
Consumer's Spending (in millions)	Government Spending (in millions)	Capital Formation (in millions)	Exports (in millions)	Imports (in millions)	Real GDP (in millions)
402,636	88,276	170,539	215,451	222,047	640,657
442,681	87,532	170,033	219,969	251,103	657,625
445,842	88,029	136,211	227,459	249,934	648,652
510,200	89,122	190,807	214,004	225,084	753,139
418,806	86,931	152,160	221,565	218,074	639,777
456,533	85,797	123,804	237,066	233,188	649,349
456,701	86,223	120,434	225,061	240,752	636,349
514,333	87,292	157,055	249,439	247,747	758,983
438,275	86,855	152,480	240,071	235,807	653,942
470,674	85,972	140,009	224,839	261,586	647,652
471,543	83,048	137,888	242,659	263,542	638,728
525,643	87,261	166,300	272,987	260,296	753,199
446,891	89,115	149,798	242,057	245,122	658,266
482,971	92,367	142,818	245,362	279,546	664,062
485,128	88,887	160,817	256,070	299,304	655,804
539,332	92,090	187,015	295,355	309,053	772,392
458,686	93,091	165,101	279,158	306,092	682,285
496,760	96,644	173,970	299,054	329,205	694,873
499,815	94,292	143,880	316,903	307,831	689,118
556,031	97,643	207,527	338,848	344,156	804,930
477,228	97,947	181,783	289,468	327,022	715,108
511,308	101,727	164,475	321,301	387,221	724,721
509,669	99,265	151,051	368,664	368,662	730,559
573,136	100,748	211,668	392,178	398,652	835,153
493,084	101,073	197,034	331,761	385,676	752,187
531,363	106,382	191,154	362,873	435,087	772,415
528,503	101,714	183,965	429,071	446,002	774,943
597,523	103,824	219,012	447,281	449,497	881,696
513,584	104,801	224,370	406,303	428,259	790,341
555,945	113,667	203,715	424,723	468,030	819,144
549,565	107,013	199,115	475,960	518,392	811,693
624,555	103,946	250,962	526,240	520,915	925,022
548,077	101,289	222,600	416,873	476,147	804,896
595,195	115,013	187,903	344,223	436,412	812,225
574,956	108,466	199,193	363,507	440,492	813,517
644,163	103,798	138,649	343,551	327,503	896,264
568,126	103,883	150,457	414,655	421,324	809,236
619,240	110,281	194,114	377,943	457,528	837,649
597,066	102,486	172,777	431,078	468,877	842,740
673,123	96,356	133,210	393,746	361,377	939,809
596,572	96,855	175,414	457,145	475,913	842,436

650,216	109,067	163,795	430,439	477,232	874,688
628,112	105,034	166,303	484,257	503,317	889,137
710,376	98,092	152,179	467,547	454,228	974,474
620,394	96,380	168,807	470,922	484,730	863,259
674,991	109,856	250,376	402,181	537,675	900,956
654,713	102,187	209,552	444,955	501,354	913,039
740,777	94,073	186,640	391,361	410,064	1,007,086
649,260	90,358	195,147	449,557	489,534	890,693
707,495	109,021	268,382	434,919	592,408	936,709
689,143	100,649	216,971	487,675	556,661	937,391
782,442	86,480	262,587	416,965	489,780	1,053,874
684,183	95,267	246,836	470,199	562,947	933,194
745,670	106,066	274,570	440,666	594,917	981,777
726,129	106,922	183,824	499,212	526,288	986,863
827,758	92,187	233,635	459,741	500,243	1,106,635
726,539	100,922	239,870	521,996	584,475	1,001,203
794,140	107,851	284,709	505,922	639,902	1,057,384
766,488	105,721	169,042	576,579	563,212	1,044,249
874,724	93,974	224,254	503,908	532,108	1,174,104
759,157	101,503	237,872	532,960	576,928	1,045,576
832,560	121,375	291,090	520,478	665,134	1,111,438
795,184	101,614	184,024	620,421	611,016	1,089,848
914,889	92,378	232,037	538,964	542,147	1,234,417
790,939	111,283	192,376	598,785	600,758	1,101,758
863,715	131,401	241,991	642,284	702,859	1,169,901
826,002	116,677	152,083	680,453	622,243	1,143,289
959,219	101,748	215,663	570,062	552,593	1,301,183
831,284	125,198	185,713	663,818	625,955	1,171,255
896,897	143,697	204,703	678,885	675,435	1,258,385
864,485	113,988	159,226	714,363	629,951	1,215,811
1,005,778	110,065	248,687	602,645	589,800	1,382,837
871,347	122,357	216,406	606,672	602,789	1,217,869
921,752	139,480	226,417	712,068	675,907	1,313,024
895,037	122,567	205,072	731,958	674,035	1,280,042
1,042,724	109,965	336,915	537,850	608,758	1,426,165
887,468	129,416	185,960	560,147	525,059	1,229,618
959,004	155,725	211,258	629,440	621,545	1,334,449
900,681	137,504	178,709	678,236	606,541	1,286,674
1,070,755	125,652	323,405	517,988	600,965	1,446,499
923,065	157,087	245,325	665,317	652,376	1,333,040
977,453	167,182	291,433	780,446	758,904	1,453,390
922,575	128,518	240,350	835,162	740,657	1,380,231
1,122,734	117,421	406,541	605,208	732,342	1,534,877
969,538	133,653	315,939	700,348	715,160	1,393,979
1,025,090	179,168	254,757	778,938	744,283	1,499,915
985,430	141,539	281,487	744,719	719,921	1,422,219
1,188,852	127,739	354,579	581,411	674,823	1,592,887
1,035,983	162,111	216,940	768,687	701,245	1,484,821
1,092,699	192,079	263,980	863,274	806,318	1,594,682
1,051,037	159,013	299,035	790,719	770,330	1,526,622
1,262,804	139,865	388,432	631,391	728,483	1,705,545
1,092,750	183,505	313,499	710,211	715,220	1,599,239
1,148,368	226,647	311,522	804,289	782,592	1,716,269
1,116,046	166,334	345,681	891,657	896,337	1,632,288

1,333,896	132,623	410,555	671,827	742,175	1,815,972

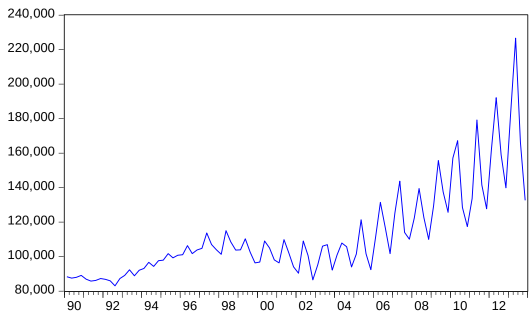
APPENDIX B

Figure 1



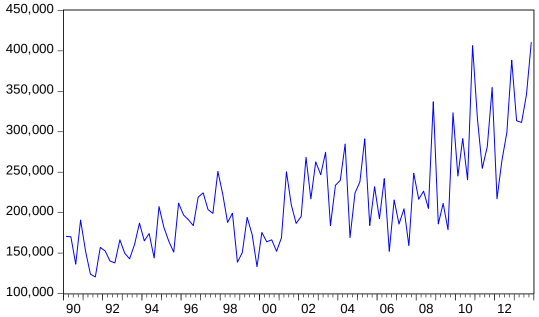
Consumer Spending

Figure 2



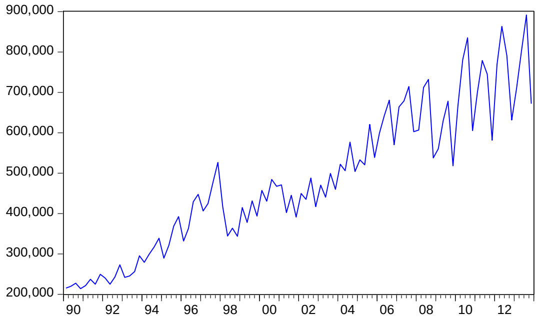
Government Spending

Figure 3



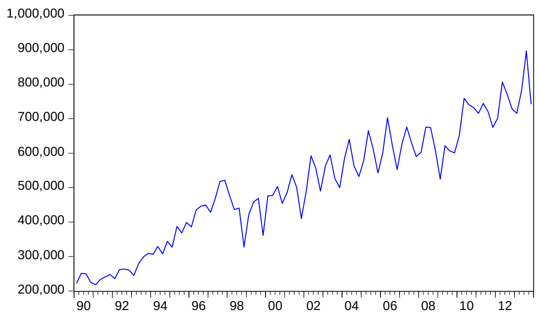
Capital Formation

Figure 4



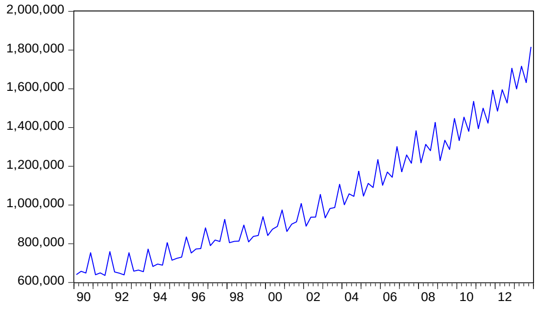
Exports

Figure 5



Imports

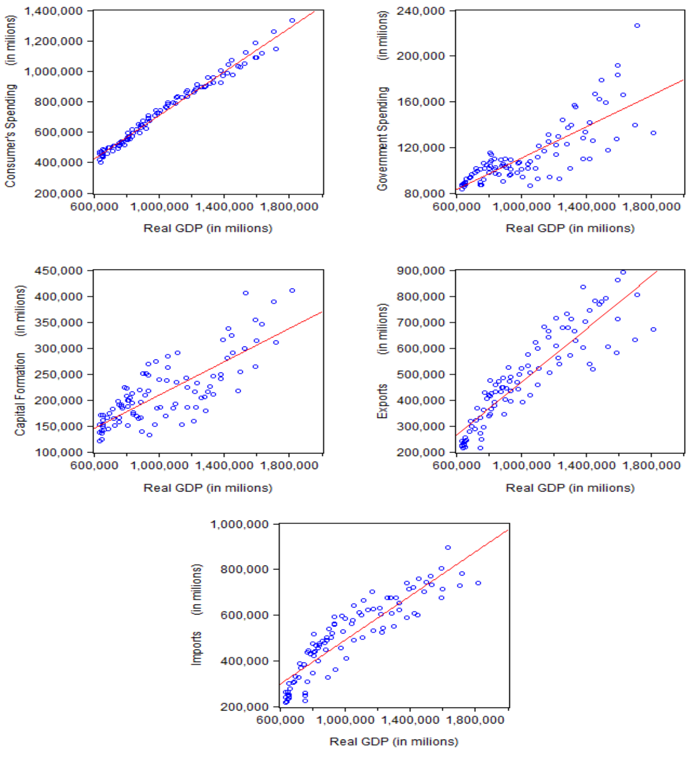
Figure 6



Real Gross Domestic Product

APPPENDIX C

Figure 7



Scatter Diagram of Independent Variable

Figure 7 displays the scatter plots between Dependent Variable Real Gross Domestic Product (y) and Independent variables: Government Spending (x_2) and Capital Formation (x_3).

Table 2 Correlation Table

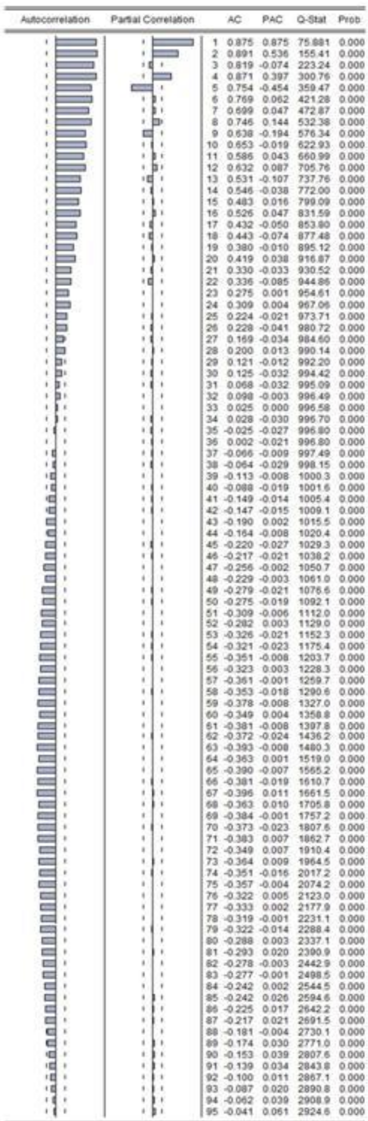
	Pearson Correlation Real Gross Domestic Product (y)	**p-value (2-tailed)**	**N**
Consumer Spending (x_1)	0.992*	0.000	96
Government Spending (x_2)	0.804*	0.000	96
Capital Formation (x_3)	0.790*	0.000	96
Exports (x_4)	0.900*	0.000	96
Imports (x_5).	0.903*	0.000	96
Real Gross Domestic Product (y)	1*	0.000	96

* Correlation is significant at the 0.01 level (2-tailed)

Table 2 displays the correlation table that shows the correlation coefficients (Pearson Correlation), significant values (Sig.) and the number of quarterly data (N). The correlation coefficient measures the strength and nature of the linear relationship between the Dependent Variable Real Gross Domestic Product (y) and Independent Variables: Consumer Spending (x_1), Government Spending (x_2), Capital Formation (x_3), Exports (x_4) and Imports (x_5).

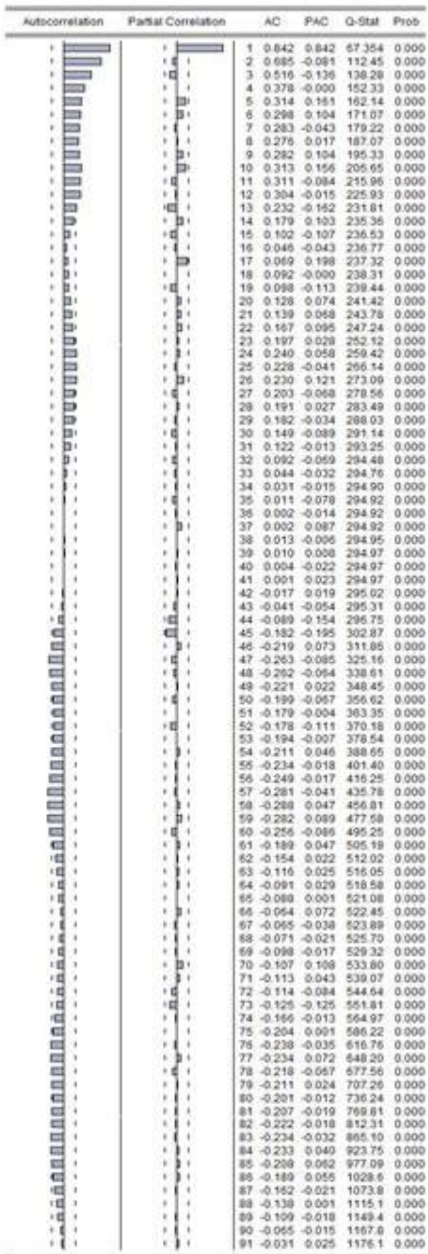
APPENDIX D

Figure 8 Correlogram of Original Time Series



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.875	0.875	75.881	0.000
		2	0.891	0.536	155.41	0.000
		3	0.819	-0.074	223.24	0.000
		4	0.871	0.397	300.76	0.000
		5	0.754	-0.454	359.47	0.000
		6	0.769	0.062	421.28	0.000
		7	0.699	0.047	472.87	0.000
		8	0.746	0.144	532.38	0.000
		9	0.638	-0.194	576.34	0.000
		10	0.653	-0.019	622.93	0.000
		11	0.586	0.043	660.99	0.000
		12	0.632	0.087	705.76	0.000
		13	0.531	-0.107	737.76	0.000
		14	0.546	-0.038	772.00	0.000
		15	0.483	0.016	799.09	0.000
		16	0.526	0.047	831.59	0.000
		17	0.432	-0.050	853.80	0.000
		18	0.443	-0.074	877.48	0.000
		19	0.380	-0.010	895.12	0.000
		20	0.419	0.038	916.87	0.000
		21	0.330	-0.033	930.52	0.000
		22	0.336	-0.085	944.86	0.000
		23	0.275	0.001	954.61	0.000
		24	0.309	0.004	967.06	0.000
		25	0.224	-0.021	973.71	0.000
		26	0.228	-0.041	980.72	0.000
		27	0.169	-0.034	984.60	0.000
		28	0.200	0.013	990.14	0.000
		29	0.121	-0.012	992.20	0.000
		30	0.125	-0.032	994.42	0.000
		31	0.068	-0.032	995.09	0.000
		32	0.098	-0.003	996.49	0.000
		33	0.025	0.000	996.58	0.000
		34	0.028	-0.030	996.70	0.000
		35	-0.025	-0.027	996.80	0.000
		36	0.002	-0.021	996.80	0.000
		37	-0.066	-0.009	997.49	0.000
		38	-0.064	-0.029	998.15	0.000
		39	-0.113	-0.008	1000.3	0.000
		40	-0.088	-0.019	1001.6	0.000
		41	-0.149	-0.014	1005.4	0.000
		42	-0.147	-0.015	1009.1	0.000
		43	-0.190	0.002	1015.5	0.000
		44	-0.164	-0.008	1020.4	0.000
		45	-0.220	-0.027	1029.3	0.000
		46	-0.217	-0.021	1038.2	0.000
		47	-0.256	-0.002	1050.7	0.000
		48	-0.229	-0.003	1061.0	0.000
		49	-0.279	-0.021	1076.6	0.000
		50	-0.275	-0.019	1092.1	0.000
		51	-0.309	-0.006	1112.0	0.000
		52	-0.282	0.003	1129.0	0.000
		53	-0.326	-0.021	1152.3	0.000
		54	-0.321	-0.023	1175.4	0.000
		55	-0.351	-0.008	1203.7	0.000
		56	-0.323	0.003	1228.3	0.000
		57	-0.361	-0.001	1259.7	0.000
		58	-0.353	-0.018	1290.6	0.000
		59	-0.378	-0.008	1327.0	0.000
		60	-0.349	0.004	1358.8	0.000
		61	-0.381	-0.008	1397.8	0.000
		62	-0.372	-0.024	1436.2	0.000
		63	-0.393	-0.008	1480.3	0.000
		64	-0.363	0.001	1519.0	0.000
		65	-0.390	-0.007	1565.2	0.000
		66	-0.381	-0.019	1610.7	0.000
		67	-0.396	0.011	1661.5	0.000
		68	-0.363	0.010	1705.8	0.000
		69	-0.384	-0.001	1757.2	0.000
		70	-0.373	-0.023	1807.6	0.000
		71	-0.383	0.007	1862.7	0.000
		72	-0.349	0.007	1910.4	0.000
		73	-0.364	0.009	1964.5	0.000
		74	-0.351	-0.016	2017.2	0.000
		75	-0.357	-0.004	2074.2	0.000
		76	-0.322	0.005	2123.0	0.000
		77	-0.333	0.002	2177.9	0.000
		78	-0.319	-0.001	2231.1	0.000
		79	-0.322	-0.014	2288.4	0.000
		80	-0.288	0.003	2337.1	0.000
		81	-0.293	0.020	2390.9	0.000
		82	-0.278	-0.003	2442.9	0.000
		83	-0.277	-0.001	2498.5	0.000
		84	-0.242	0.002	2544.5	0.000
		85	-0.242	0.026	2594.6	0.000
		86	-0.225	0.017	2642.2	0.000
		87	-0.217	0.021	2691.5	0.000
		88	-0.181	-0.004	2730.1	0.000
		89	-0.174	0.030	2771.0	0.000
		90	-0.153	0.039	2807.6	0.000
		91	-0.139	0.034	2843.8	0.000
		92	-0.100	0.011	2867.1	0.000
		93	-0.087	0.020	2890.8	0.000
		94	-0.062	0.039	2908.9	0.000
		95	-0.041	0.061	2924.6	0.000

Figure 9 Correlogram of Deseasonalised Time Series



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.842	0.842	67.354	0.000
		2	0.685	-0.081	112.45	0.000
		3	0.516	-0.136	138.28	0.000
		4	0.378	-0.000	152.33	0.000
		5	0.314	0.161	162.14	0.000
		6	0.298	0.104	171.07	0.000
		7	0.283	-0.043	179.22	0.000
		8	0.276	0.017	187.07	0.000
		9	0.282	0.104	195.33	0.000
		10	0.313	0.156	205.65	0.000
		11	0.311	-0.084	215.96	0.000
		12	0.304	-0.015	225.93	0.000
		13	0.232	-0.162	231.81	0.000
		14	0.179	0.103	235.36	0.000
		15	0.102	-0.107	236.53	0.000
		16	0.046	-0.043	236.77	0.000
		17	0.069	0.198	237.32	0.000
		18	0.092	-0.000	238.31	0.000
		19	0.098	-0.113	239.44	0.000
		20	0.128	0.074	241.42	0.000
		21	0.139	0.068	243.78	0.000
		22	0.167	0.095	247.24	0.000
		23	0.197	0.028	252.12	0.000
		24	0.240	0.058	259.42	0.000
		25	0.228	-0.041	266.14	0.000
		26	0.230	0.121	273.09	0.000
		27	0.203	-0.068	278.56	0.000
		28	0.191	0.027	283.49	0.000
		29	0.182	-0.034	288.03	0.000
		30	0.149	-0.089	291.14	0.000
		31	0.122	-0.013	293.25	0.000
		32	0.092	-0.069	294.48	0.000
		33	0.044	-0.032	294.76	0.000
		34	0.031	-0.015	294.90	0.000
		35	0.011	-0.078	294.92	0.000
		36	0.002	-0.014	294.92	0.000
		37	0.002	0.087	294.92	0.000
		38	0.013	-0.006	294.95	0.000
		39	0.010	0.008	294.97	0.000
		40	0.004	-0.022	294.97	0.000
		41	0.001	0.023	294.97	0.000
		42	-0.017	0.019	295.02	0.000
		43	-0.041	-0.054	295.31	0.000
		44	-0.089	-0.154	296.75	0.000
		45	-0.182	-0.195	302.87	0.000
		46	-0.219	0.073	311.86	0.000
		47	-0.263	-0.085	325.16	0.000
		48	-0.262	-0.064	338.61	0.000
		49	-0.221	0.022	348.45	0.000
		50	-0.199	-0.067	356.62	0.000
		51	-0.179	-0.004	363.35	0.000
		52	-0.178	-0.111	370.18	0.000
		53	-0.194	-0.007	378.54	0.000
		54	-0.211	0.046	388.65	0.000
		55	-0.234	-0.018	401.40	0.000
		56	-0.249	-0.017	416.25	0.000
		57	-0.281	-0.041	435.78	0.000
		58	-0.288	0.047	456.81	0.000
		59	-0.282	0.089	477.58	0.000
		60	-0.256	-0.086	495.25	0.000
		61	-0.189	0.047	505.19	0.000
		62	-0.154	0.022	512.02	0.000
		63	-0.116	0.025	516.05	0.000
		64	-0.091	0.029	518.58	0.000
		65	-0.080	0.001	521.08	0.000
		66	-0.064	0.072	522.45	0.000
		67	-0.065	-0.038	523.89	0.000
		68	-0.071	-0.021	525.70	0.000
		69	-0.098	-0.017	529.32	0.000
		70	-0.107	0.108	533.80	0.000
		71	-0.113	0.043	539.07	0.000
		72	-0.114	-0.084	544.64	0.000
		73	-0.125	-0.125	551.81	0.000
		74	-0.166	-0.013	564.97	0.000
		75	-0.204	0.001	586.22	0.000
		76	-0.238	-0.035	616.76	0.000
		77	-0.234	0.072	648.20	0.000
		78	-0.218	-0.067	677.56	0.000
		79	-0.211	0.024	707.26	0.000
		80	-0.201	-0.012	736.24	0.000
		81	-0.207	-0.019	769.61	0.000
		82	-0.222	-0.018	812.31	0.000
		83	-0.234	-0.032	865.10	0.000
		84	-0.233	0.040	923.75	0.000
		85	-0.208	0.062	977.09	0.000
		86	-0.189	0.055	1028.6	0.000
		87	-0.162	-0.021	1073.8	0.000
		88	-0.138	0.001	1115.1	0.000
		89	-0.109	-0.018	1149.4	0.000
		90	-0.065	-0.015	1167.8	0.000
		91	-0.031	0.025	1176.1	0.000

Table 3 Augmented-Dickey Fuller Test of Deseasonalised Time Series

At Intercept:

Null Hypothesis: SDRGDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.222273	0.2000
Test critical values:	1% level	-3.503879	
	5% level	-2.893589	
	10% level	-2.583931	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SDRGDP)
Method: Least Squares
Date: 08/27/14 Time: 13:53
Sample (adjusted): 1991Q2 2013Q4
Included observations: 91 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SDRGDP(-1)	-0.116887	0.052598	-2.222273	0.0288
C	6301.029	2828.348	2.227813	0.0284

R-squared	0.052572	Mean dependent var	1223.154
Adjusted R-squared	0.041926	S.D. dependent var	16244.86
S.E. of regression	15900.67	Akaike info criterion	22.20784
Sum squared resid	2.25E+10	Schwarz criterion	22.26303
Log likelihood	-1008.457	Hannan-Quinn criter.	22.23011
F-statistic	4.938499	Durbin-Watson stat	1.897342
Prob(F-statistic)	0.028800		

At Trend and Intercept:

Null Hypothesis: SDRGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.728176	0.0253
Test critical values:	1% level	-4.062040	
	5% level	-3.459950	
	10% level	-3.156109	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SDRGDP)
Method: Least Squares
Date: 08/27/14 Time: 13:57
Sample (adjusted): 1991Q2 2013Q4
Included observations: 91 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SDRGDP(-1)	-0.280213	0.075161	-3.728176	0.0003
C	97.56068	3441.310	0.028350	0.9774
@TREND(1990Q1)	265.9746	90.67590	2.933245	0.0043

R-squared	0.136953	Mean dependent var	1223.154
Adjusted R-squared	0.117339	S.D. dependent var	16244.86
S.E. of regression	15262.06	Akaike info criterion	22.13654
Sum squared resid	2.05E+10	Schwarz criterion	22.21931
Log likelihood	-1004.213	Hannan-Quinn criter.	22.16993
F-statistic	6.982179	Durbin-Watson stat	1.775021
Prob(F-statistic)	0.001533		

At None:

Null Hypothesis: SDRGDP has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.701542	0.4103
Test critical values:	1% level	-2.590622	
	5% level	-1.944404	
	10% level	-1.614417	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SDRGDP)
Method: Least Squares
Date: 08/27/14 Time: 13:58
Sample (adjusted): 1991Q2 2013Q4
Included observations: 91 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SDRGDP(-1)	-0.022220	0.031673	-0.701542	0.4848

R-squared	-0.000262	Mean dependent var	1223.154
Adjusted R-squared	-0.000262	S.D. dependent var	16244.86
S.E. of regression	16246.99	Akaike info criterion	22.24013
Sum squared resid	2.38E+10	Schwarz criterion	22.26772
Log likelihood	-1010.926	Hannan-Quinn criter.	22.25126
Durbin-Watson stat	1.975216		

Table 4 Augmented-Dickey Fuller Test of Deseasonalised Time Series at Second Differencing

At Intercept:

Null Hypothesis: DDSRGDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.77403	0.0001
Test critical values:	1% level	-3.506484	
	5% level	-2.894716	
	10% level	-2.584529	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DDSRGDP)
Method: Least Squares
Date: 08/17/14 Time: 14:40
Sample (adjusted): 1992Q1 2013Q4
Included observations: 88 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DDSRGDP(-1)	-1.931126	0.179239	-10.77403	0.0000
D(DDSRGDP(-1))	0.283852	0.103846	2.733399	0.0076
C	-192.6281	2081.853	-0.092527	0.9265

R-squared	0.773614	Mean dependent var	-16.97279
Adjusted R-squared	0.768287	S.D. dependent var	40569.91
S.E. of regression	19528.95	Akaike info criterion	22.63068
Sum squared resid	3.24E+10	Schwarz criterion	22.71513
Log likelihood	-992.7499	Hannan-Quinn criter.	22.66470
F-statistic	145.2326	Durbin-Watson stat	2.048833
Prob(F-statistic)	0.000000		

At Trend and Intercept:

Null Hypothesis: DDSRGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.70708	0.0000
Test critical values:	1% level	-4.065702	
	5% level	-3.461686	
	10% level	-3.157121	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DDSRGDP)
Method: Least Squares
Date: 08/17/14 Time: 14:43
Sample (adjusted): 1992Q1 2013Q4
Included observations: 88 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DDSRGDP(-1)	-1.930949	0.180343	-10.70708	0.0000
D(DDSRGDP(-1))	0.283786	0.104471	2.716406	0.0080
C	-383.8847	4735.053	-0.081073	0.9356
@TREND(1990Q1)	3.713801	82.46346	0.045036	0.9642

R-squared	0.773620	Mean dependent var	-16.97279
Adjusted R-squared	0.765535	S.D. dependent var	40569.91
S.E. of regression	19644.61	Akaike info criterion	22.65338
Sum squared resid	3.24E+10	Schwarz criterion	22.76599
Log likelihood	-992.7488	Hannan-Quinn criter.	22.69875
F-statistic	95.68563	Durbin-Watson stat	2.049094
Prob(F-statistic)	0.000000		

At None:

Null Hypothesis: DDSRGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.70708	0.0000
Test critical values:	1% level	-4.065702	
	5% level	-3.461686	
	10% level	-3.157121	

*MacKinnon (1996) one-sided p-values.

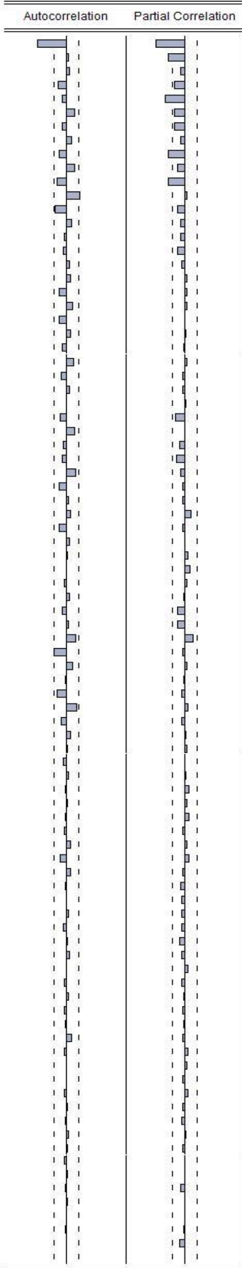
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DDSRGDP)
Method: Least Squares
Date: 08/17/14 Time: 14:43
Sample (adjusted): 1992Q1 2013Q4
Included observations: 88 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DDSRGDP(-1)	-1.930949	0.180343	-10.70708	0.0000
D(DDSRGDP(-1))	0.283786	0.104471	2.716406	0.0080
C	-383.8847	4735.053	-0.081073	0.9356
@TREND(1990Q1)	3.713801	82.46346	0.045036	0.9642

R-squared	0.773620	Mean dependent var	-16.97279
Adjusted R-squared	0.765535	S.D. dependent var	40569.91
S.E. of regression	19644.61	Akaike info criterion	22.65338
Sum squared resid	3.24E+10	Schwarz criterion	22.76599
Log likelihood	-992.7488	Hannan-Quinn criter.	22.69875
F-statistic	95.68563	Durbin-Watson stat	2.049094
Prob(F-statistic)	0.000000		

Figure 10 Correlogram of Deseasonalised and Stationary Time Series

Date: 08/17/14 Time: 14:37
Sample: 1990Q1 2013Q4
Included observations: 90



	AC	PAC	Q-Stat	Prob
1	-0.500	-0.500	23.304	0.000
2	0.039	-0.282	23.449	0.000
3	0.063	-0.076	23.832	0.000
4	-0.143	-0.183	25.795	0.000
5	-0.072	-0.344	26.304	0.000
6	0.144	-0.188	28.343	0.000
7	-0.079	-0.180	28.963	0.000
8	0.096	-0.070	29.884	0.000
9	-0.124	-0.280	31.454	0.000
10	0.146	-0.126	33.670	0.000
11	-0.169	-0.291	36.679	0.000
12	0.238	0.027	42.675	0.000
13	-0.191	-0.139	46.586	0.000
14	0.091	-0.073	47.495	0.000
15	-0.030	-0.070	47.593	0.000
16	-0.064	-0.125	48.046	0.000
17	0.045	-0.050	48.279	0.000
18	0.081	0.031	49.034	0.000
19	-0.117	0.036	50.627	0.000
20	0.105	0.030	51.933	0.000
21	-0.120	-0.008	53.673	0.000
22	0.079	0.013	54.426	0.000
23	-0.079	-0.019	55.189	0.000
24	0.120	0.029	56.997	0.000
25	-0.095	-0.043	58.137	0.000
26	0.062	-0.035	58.640	0.000
27	-0.003	0.018	58.641	0.000
28	-0.102	-0.157	60.025	0.000
29	0.133	-0.005	62.439	0.000
30	-0.050	-0.090	62.790	0.000
31	-0.081	-0.141	63.709	0.000
32	0.169	-0.079	67.784	0.000
33	-0.129	-0.035	70.183	0.000
34	0.037	-0.037	70.387	0.000
35	0.066	0.107	71.042	0.000
36	-0.128	-0.034	73.559	0.000
37	0.050	0.001	73.951	0.000
38	0.013	0.044	73.980	0.000
39	-0.005	0.097	73.983	0.001
40	-0.035	0.031	74.186	0.001
41	0.059	-0.016	74.781	0.001
42	-0.070	-0.133	75.617	0.001
43	0.031	-0.130	75.787	0.001
44	0.165	0.150	80.695	0.001
45	-0.213	-0.046	89.077	0.000
46	0.114	0.039	91.515	0.000
47	-0.020	-0.019	91.596	0.000
48	-0.170	-0.065	97.292	0.000
49	0.188	0.041	104.40	0.000
50	-0.093	-0.050	106.19	0.000
51	0.069	0.016	107.20	0.000
52	0.017	0.031	107.26	0.000
53	-0.061	-0.005	108.10	0.000
54	0.030	0.024	108.30	0.000
55	-0.012	0.068	108.33	0.000
56	0.024	0.036	108.47	0.000
57	-0.019	0.070	108.56	0.000
58	-0.034	-0.047	108.85	0.000
59	0.070	0.030	110.16	0.000
60	-0.100	0.076	112.93	0.000
61	0.082	-0.040	114.83	0.000
62	-0.022	-0.066	114.97	0.000
63	0.002	-0.062	114.98	0.000
64	0.026	-0.055	115.19	0.000
65	-0.064	-0.056	116.56	0.000
66	0.024	-0.097	116.77	0.000
67	0.044	-0.063	117.45	0.000
68	-0.007	0.041	117.47	0.000
69	-0.048	-0.060	118.38	0.000
70	0.036	-0.023	118.93	0.000
71	-0.038	-0.040	119.56	0.000
72	-0.018	-0.011	119.72	0.000
73	0.091	-0.035	123.72	0.000
74	-0.042	0.046	124.65	0.000
75	0.003	0.034	124.66	0.000
76	0.008	-0.034	124.69	0.000
77	-0.026	0.055	125.10	0.000
78	0.010	-0.038	125.17	0.001
79	-0.022	-0.064	125.55	0.001
80	0.028	0.010	126.19	0.001
81	0.009	-0.033	126.27	0.001
82	-0.025	-0.003	126.90	0.001
83	0.020	-0.007	127.39	0.001
84	-0.017	-0.073	127.76	0.001
85	0.016	0.001	128.19	0.002
86	-0.004	-0.005	128.21	0.002
87	-0.015	-0.021	128.80	0.002
88	0.008	-0.082	129.06	0.003
89	0.001	-0.003	129.07	0.004

Table 5 Candidate Models

MODELS	R- Squared	Durbin Coeeficient	p-value
ar(1) ar(2) ar(5) ar(9) ar(11) ma(1) ma(12) sma(12)	0.986966	1.967861	0.000
ar(1) ar(2) ar(5) ar(9) ma(12) ma(45) sma(12)	0.982866	2.077189	0.000
ar(1) ar(2) ar(5) ar(9) ar(11) ma(1) sma(12)	0.989052	2.165376	0.000
ar(1) ar(2) ar(5) ar(9) ar(11) ma(1) sma(12)	0.989052	2.165376	0.000*
ar(1) ar(2) ar(5) ar(9) ar(11) ma(1) sma(12)	0.989052	2.165376	0.000
ar(2) ar(11) ma(1) ma(12) ma(45) sma(12)	0.988182	1.693115	0.000
ar(2) ar(5) ma(1) ma(12) ma(45) sma(12)	0.985764	2.136904	0.000
ar(2) ar(5) ar(9) ma(12) ma(45) sma(12)	0.979557	1.683147	0.000
ar(2) ar(5) ma(1) sma(12)	0.990974	2.097179	0.000
ar(2) ar(11) ma(1) sma(12)	0.989147	2.010003	0.000
ar(1) ar(5) ma(1) sma(12)	0.985615	2.426297	0.000
ar(2) ar(5) ar(9) ma(1) sma(12)	0.989994	2.139506	0.000
ar(1) ar(2) ar(9) ma(1) ma(12)	0.985726	2.006929	0.000
ar(1) ar(2) ar(9) ma(1)	0.978045	1.933547	0.000
ar(1) ar(2) ar(9) ma(12)	0.985624	2.031256	0.000
ar(2) ar(9) ma(1) sma(12)	0.990258	1.993462	0.000
ar(1) ar(2) ar(9) ma(1) sma(12)	0.987795	1.641806	0.000
ar(2) ma(1) sma(12)	0.990289	1.974515	0.000

Decision:
The asterisk (*) indicates the best fitted model formulated through SARIMA.

APPENDIX E

Table 6 Result of Regression Analysis

	T-statistics	p-value
Constant	-6.252	0.000
Consumer Spending (x_1)	71.901	0.000*
Government Spending (x_2)	13.913	0.000*
Capital Formation (x_3)	20.973	0.000*
Exports (x_4)	-19.485	0.000*
Imports (x_5).	16.684	0.000*

Decision:
The asterisk (*) indicates that the variable is a significant factor of the Dependent Variable: Real Gross Domestic Product (y) at 1 percent level of

Table 6 shows that the five (5) Independent Variables displayed corresponding p-values (Sig.) of 0.000. Since the p-values are all less than 0.01, we can conclude that all the five Independent

Variables: Consumer Spending (x_1) , Government Spending (x_2), Capital Formation (x_3) , Exports (x_4) and Imports (x_5) are significant factors of Dependent Variable Real Gross Domestic Product(y).

APPENDIX F

Table 7 Actual and Predicted Values of RGDP

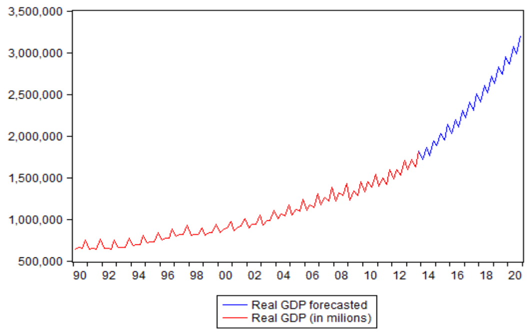
Actual Value	Predicted Value	Actual Value	Predicted Value	Actual Value	Predicted Value	Actual Value	Predicted Value
693325.4	753198.5	859337.5	804895.9	962236.8	986863	1418875	1426165
708606.6	658265.7	852926.9	812225.4	1056274	1106635	1281921	1229618
670339.2	664061.7	777462.1	813516.5	1039671	1001203	1352611	1334449
629938.7	655804.4	862485.2	896264.1	1093012	1057384	1248329	1286674
745659	772391.9	855178.2	809235.9	1029249	1044249	1425178	1446499
759161.7	682284.5	831798.9	837649.2	1125910	1174104	1319447	1333040
700668.6	694873	806320.4	842739.8	1092561	1045576	1475060	1453390
671743.4	689118.4	909875.9	842436	1114980	1111438	1369819	1380231
772110.2	804930.4	877560.1	874688	1067838	1089848	1525502	1534877
732376.3	715107.7	842185.4	889137	1209086	1234417	1393034	1393979
755744.1	724721.5	969737.1	974474	1163071	1101758	1517613	1499915
703767.5	730558.6	878571.2	863259	1179242	1169901	1429233	1422219
839220.6	835153.5	896946.7	900956	1116805	1143289	1568756	1592887
737341.6	752186.9	877937.9	913039	1279617	1301183	1437808	1484821
818627.6	772414.6	1000219	1007086	1193163	1171255	1617696	1594682
743629.2	774943.5	916717.9	890693	1254579	1258385	1523183	1526622
855237.2	881696.4	969359.6	936709	1191028	1215811	1685378	1705545
760887.5	790341	910096	937391	1364870	1382837	1614337	1599239
859732.4	819144.2	1015627	1053874	1259096	1217869	1737400	1716269
782789.1	811692.9	940025.1	933194	1344430	1313024	1626625	1632288
899674.6	925022.2	1011762	981777	1239616	1280042	1792465	1815972

Table 8 Result of Paired T-Test

Method	Value	Probability
t-statistics	0.422888	0.6735

Table 8 displays the result of Paired T-Test that shows the value and probability of the t-statistics.

Figure 11 Actual and Forecasted Values of the Real Gross Domestic



Product

Figure 11 displays the line graph for the actual and forecasted values of the Real Gross Domestic Product (RGDP). The red line indicates the actual values of the RGDP from the First Quarter of 1990 to Fourth Quarter of 2013 while the blue line indicates the forecasted value of the RGDP from the First Quarter of 2014 to Fourth Quarter of 2020. Both of the actual and predicted values exhibit an increasing trend and seasonal pattern.

APPENDIX G

Table 9 Result of Johansen's Cointegration Test – Trace Test

Unrestricted Cointegration Rank Test (Trace)	
Hypothesized No. of Cointegration Equation(s)	**Prob. ****
None *	0.0017
At most 1	0.1005
At most 2	0.1594
At most 3	0.2695
At most 4	0.2178
At most 5	0.1876

Decision:
The asterisk (*) denote the rejection of the null hypothesis.

TABLE 10 Result of Johansen's Cointegration Test – Maximum Eigenvalue

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)	
Hypothesized No. of Cointegration Equation(s)	**Prob. ****
None *	0.0055
At most 1	0.4694
At most 2	0.3814
At most 3	0.5835
At most 4	0.2729
At most 5	0.1876

Decision:
The asterisk (*) denote the rejection of the null hypothesis.

APPENDIX H

Table 11 Pairwise Granger Causality Test

Null Hypothesis:	F-Statistics	Probability
CONSUMER SPENDING does not Granger Cause REALGDP	2.18810	0.0776
REALGDP does not Granger Cause CONSUMER SPENDING	2.05239	0.0947
GOVERNMENT SPENDING does not Granger Cause REALGDP	1.13869	0.3443
REALGDP does not Granger Cause GOVERNMENT SPENDING	4.73502	0.0017*
CAPITAL does not Granger Cause REALGDP	1.21874	0.3093
REALGDP does not Granger Cause CAPITAL	2.48473	0.0500
EXPORTS does not Granger Cause REALGDP	3.13354	0.0189
REALGDP does not Granger Cause EXPORTS	2.83662	0.0295
IMPORTS does not Granger Cause REALGDP	1.83110	0.1308
REALGDP does not Granger Cause IMPORTS	4.19692	0.0039*

Decision:
The asterisk (*) denote the rejection of the null hypothesis.