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Forecasting the Philippine Stock Exchange Index using Time Series Analysis Box-Jenkins

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Abstract:

This paper aims to determine and forecast the stock price in the Philippines using time series analysis specifically Box-Jenkins. The authors used daily stock prices from March 1, 2012 to March 1, 2015 of the Philippines as a basis to determine the best model that can predict the Philippine Stock Exchange index by using Box-Jenkins / Autoregressive Integrated Moving Average (ARIMA). This includes the discussion of the assumption and the three-stage process namely identification stage, estimation stage and diagnostic checking. These are the following candidates of AR and MA that can predict the future values of PSEi. AR(3), AR(12), AR(23), MA(1), MA(3), MA(9) and MA(12) given that the variable PSEi was transpose in to 2nd differencing of log.

Key words: Philippine Stock Exchange Index, Time Series Analysis Box-Jenkins

1. Introduction

The PSE Composite Index, commonly known previously as the PHISIX and presently as the PSEi, is a stock market index of the Philippine Stock Exchange consisting of 30 companies. A stock index or stock market index is a measurement of the value of a section of the stock market, it is a tool used by investors and financial managers to describe the market and to compare the return on specific investments. The Philippine Stock Exchange or PamilihangSalapingPilipinas is the National Stock Exchange of the Philippines. It has been in a continuous operation since its inception in 1927, making it one of the oldest stock exchanges in Southeast Asia.

Investing in stocks may seem hard at first and may sound too complicated specially for first timers but as you go on you will find it easier and easier. Some ideal steps to start investing in the stock market are as follows:

- ✓ Set your financial goals
- ✓ Determine your risk tolerance
- ✓ Learn about the market
- ✓ Formulate your expectations for the stock market
- ✓ Focus your thinking
- ✓ Determine your asset allocations
- ✓ Purchase your stock
- ✓ Establish benchmarks
- ✓ Compare performance to expectations
- ✓ Be vigilant and update your expectations

Philippine Stock Exchange is said to be a good way to diversify your assets. It is a way to make your assets grow in a certain period of time. The Philippine stock Exchange aims to give chances to businessmen and to common people to play with what they have. When this matter is very fragile and unstable for the stock prices is changing over time, this should be a focus of a study specially nowadays that Philippines is going through a progressive path by investing to businesses.

According to Harry Hooper (**2005**) wrote an article titled "*Why do Stock Prices go Up and Down?*" He stated four thibgsthag affects truth the prices of a market's equities.

Concisely, the stocks go up because more people want to buy than sell. When this happens, they begin to bid higher prices than the stock has been currently trading. On the other side of the same coin, stocks go down because more people want to sell than buy. In order to quickly sell their shares, they are willing to accept a lower price. In a broader explanation, the reason why the prices of stocks fluctuate are due to four things that affect the constantly changing price of an equity: internal events, external events, market pressure, and hype.

Gabe J. de Bondt (**2008**) wrote an article to titled "*Determinants of Stock Prices"*. The author presented a simple stock price model for major country economies. The model assumed a long-run fair stock market value and short- run deviations from fair value. In the long run, only fundamentals matter. In addition to the discussion of earnings and the risk-free interest rate, the author considered a proxy for the long-run equity risk premium. In the short run, other factors might determine stock prices, such as the exchange rate, commodity prices, momentum, and seasonality. Out of-sample forecasting statistics indicated that the stock price model clearly outperforms a random walk model. Exploiting the forecasting accuracy in practice is difficult, however, because the stock price determinants, especially the short-run risk premium, are difficult to predict. By contrast, the long-run stock price model reliably guides investors about the degree of over or undervaluation of stock markets from their long-run fair fundamental levels. Two different investment strategies illustrate the ability of the long-run stock price model to generate excess returns.

Given the motion that stock market changes overnight we must forecast its future values through appropriate statistical models and tools that shall be discuss by the authors later on. Forecasting its present values could give a big help to beginners in the stock market and could give insights to the investors on where and to what they should invest next time.

One of the methodology in determining the present and future values is called univariate analysis using Box-Jenkins. This method will help to create a best model and determine whether this method can be used in predicting the future values.

2. Methodology

The Box-Jenkins method named after the statisticians George Box and Gwilyn Jenkins applies Autoregressive Moving Average (ARMA) or (ARIMA) models to find the best fit of a time series model to past values of a time series. In statistics and in econometrics, particularly in time series analysis an autoregressive integrated moving average (ARIMA) model is a generalization of an autoregressive moving average (ARMA). These models are fitted to the time series data either to better understand the data or to predict future points in the series (Forecasting). They are applied in some cases where data show evidence of non-stationary where an initial differencing step can remove the non-stationary also estimating the best model that will forecast and fit to its past values.

The authors also gather data from the website of Philippine Stock Exchange Commission. After gathering data, the authors put the data in the Microsoft Excel and run in the Eviews.

3. Results and Discussion

Box-Jenkins Approach on Estimating an ARIMA Model.

After conducting a series of differencing, in the second and third differencing, the non-stationarity of the data has been corrected in order to be able to conduct an ARIMA modeling. The researchers have chosen which model will best fit the data series by following the criteria of certain tests that will be discussed on the latter part of this chapter.

A. Identification Stage – in this stage, the researchers will ensure that the series is sufficiently stationary, and will specify the appropriate number of autoregressive terms, *p*, and moving average terms, *q*.

A.1) Correction of non-stationarity, test for unit Root, and simple and partial autocorrelation.

Figure 1 shows that the data has a trend and seasonality. This indicates that we need to treat the non-stationary of data. Table 1, 2, 3 shows the formal way in determining the stationarity of the data. In order to statistically test whether the data series is stationary or not, the researchers has conducted the Augmented Dickey-Fuller Unit Root Test, which is a test that used to determine if the data is stationary. Unit root is a feature of processes that evolve though time than can cause problems in statistical inference involving time series models. A linear random process," has a unit root of 1," is a root of the process's characteristic equation, which is non-stationary. Therefore, in order for a data series to be stationary, it must not possess a unit root.

The hypothesis for the Dickey-Fuller Unit Root Test is the following:

H_0: ∂=0; (PSEi) has a unit root

H_a: $\partial \neq 0$; (PSEi) has no unit root

The decision rule for the Dickey-Fuller Unit Root Test is:

Reject Ho if the computed p-value is less than to assigned level of significance, which is 0.05.Otherwise, Fail to reject Ho

Based on the given hypothesis and decision rule, since the computed p-value is greater than to 0.05, therefore we decide do not have sufficient evidence to reject the null hypothesis and conclude that the PSEi has a unit root or the data is non-stationary.

Figure 2 shows the correlogram of the original series of PSEi. In order to determine whether the data is series is stationary, another requirement is that the Simple Autocorrelation Correlogram (AC) and the Partial Autocorrelation Correlogram (PAC) at k=1 must be negative figures, respectively. It is observed in the data that the values of AC and PAC at k=1 is positive, which further supports the non-stationarity of the data series.

Figure 1.0 –Philippine Stocks Exchange Index (PSEi) from March 1, 2012 to March 1, 2015.

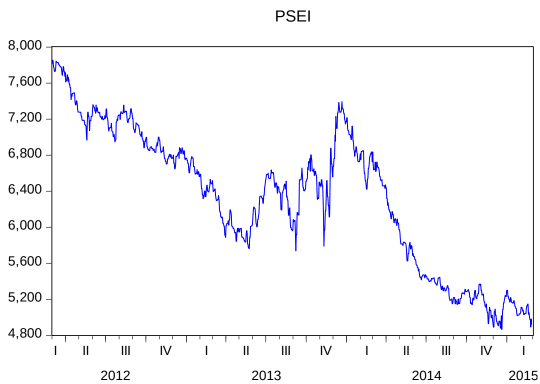


Table 1 – Augmented Dickey-Fuller Unit Root Test on PSEi wherein *Intercept* is included in the equation.

Null Hypothesis: PSEI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.434736	0.5664
Test critical values:	1% level	-3.436105	
	5% level	-2.863969	
	10% level	-2.568115	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PSEI)
Method: Least Squares
Date: 06/06/15 Time: 13:42
Sample (adjusted): 3/02/2012 3/01/2015
Included observations: 1095 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PSEI(-1)	-0.003103	0.002163	-1.434736	0.1516
C	17.02810	13.77271	1.236365	0.2166

R-squared	0.001880	Mean dependent var	-2.585160
Adjusted R-squared	0.000967	S.D. dependent var	55.50361
S.E. of regression	55.47678	Akaike info criterion	10.87163
Sum squared resid	3363896.	Schwarz criterion	10.88076
Log likelihood	-5950.218	Hannan-Quinn criter.	10.87509
F-statistic	2.058468	Durbin-Watson stat	1.916565
Prob(F-statistic)	0.151648		

Table 2 –Augmented Dickey-Fuller Unit Root Test on PSEi wherein *Trend and Intercept* is included in the equation.

Null Hypothesis: PSEI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.431350	0.3629
Test critical values:	1% level	-3.966450	
	5% level	-3.413922	
	10% level	-3.129046	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PSEI)
Method: Least Squares
Date: 06/06/15 Time: 13:45
Sample (adjusted): 3/02/2012 3/01/2015
Included observations: 1095 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

PSEI(-1)	-0.010369	0.004265	-2.431350	0.0152
C	74.28171	32.07466	2.315900	0.0207
@TREND(3/01/2012)	-0.020665	0.010459	-1.975909	0.0484

R-squared	0.005436	Mean dependent var	-2.585160
Adjusted R-squared	0.003614	S.D. dependent var	55.50361
S.E. of regression	55.40322	Akaike info criterion	10.86989
Sum squared resid	3351912.	Schwarz criterion	10.88358
Log likelihood	-5948.264	Hannan-Quinn criter.	10.87507
F-statistic	2.984077	Durbin-Watson stat	1.909503
Prob(F-statistic)	0.050999		

Table 3 –Augmented Dickey-Fuller Unit Root Test on PSEi wherein no *Trend and Intercept* is included in the equation.

Null Hypothesis: PSEI has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.704763	0.0836
Test critical values:	1% level	-2.567076	
	5% level	-1.941113	
	10% level	-1.616505	

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

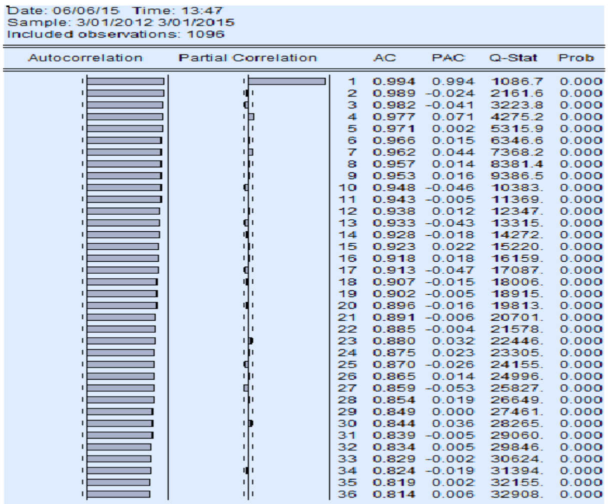
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PSEI)
Method: Least Squares
Date: 06/06/15 Time: 13:46
Sample (adjusted): 3/02/2012 3/01/2015
Included observations: 1095 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PSEI(-1)	-0.000449	0.000263	-1.704763	0.0885

R-squared	0.000484	Mean dependent var	-2.585160
Adjusted R-squared	0.000484	S.D. dependent var	55.50361
S.E. of regression	55.49018	Akaike info criterion	10.87120
Sum squared resid	3368601.	Schwarz criterion	10.87577

Log likelihood	-5950.983	Hannan-Quinn criter.	10.87293
Durbin-Watson stat	1.918972		

Figure 2 – The figure shows the correlogram of the original series of PSEi.



Date: 06/06/15 Time: 13:47
Sample: 3/01/2012 3/01/2015
Included observations: 1096

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.994	0.994	1086.7	0.000
		2	0.989	-0.024	2161.6	0.000
		3	0.982	-0.041	3223.8	0.000
		4	0.977	0.071	4275.2	0.000
		5	0.971	0.002	5315.9	0.000
		6	0.966	0.015	6346.6	0.000
		7	0.962	0.044	7368.2	0.000
		8	0.957	0.014	8381.4	0.000
		9	0.953	0.016	9386.5	0.000
		10	0.948	-0.046	10383.	0.000
		11	0.943	-0.005	11369.	0.000
		12	0.938	0.012	12347.	0.000
		13	0.933	-0.043	13315.	0.000
		14	0.928	-0.018	14272.	0.000
		15	0.923	0.022	15220.	0.000
		16	0.918	0.018	16159.	0.000
		17	0.913	-0.047	17087.	0.000
		18	0.907	-0.015	18006.	0.000
		19	0.902	-0.005	18915.	0.000
		20	0.896	-0.016	19813.	0.000
		21	0.891	-0.006	20701.	0.000
		22	0.885	-0.004	21578.	0.000
		23	0.880	0.032	22446.	0.000
		24	0.875	0.023	23305.	0.000
		25	0.870	-0.026	24155.	0.000
		26	0.865	0.014	24996.	0.000
		27	0.859	-0.053	25827.	0.000
		28	0.854	0.019	26649.	0.000
		29	0.849	0.000	27461.	0.000
		30	0.844	0.036	28265.	0.000
		31	0.839	-0.005	29060.	0.000
		32	0.834	0.005	29846.	0.000
		33	0.829	-0.002	30624.	0.000
		34	0.824	-0.019	31394.	0.000
		35	0.819	0.002	32155.	0.000
		36	0.814	0.006	32908.	0.000

Figure 3 shows a sufficient degree of stationarity. This will be supported by the statistical tests conducted below. Table 4, 5, 6 shows the formal way in determining the stationarity of the data.

The hypothesis for the Dickey-Fuller Unit Root Test is the following:

H_0: $\partial=0$; (PSEi) has a unit root

H_a: $\partial\neq0$; (PSEi) has no unit root

The decision rule for the Dickey-Fuller Unit Root Test is:

Reject Ho if the computed p-value is less than to assigned level of significance, which is 0.05.Otherwise, Fail to reject Ho

Based on the given hypothesis and decision rule, since the computed p-value is less than to 0.05, therefore we have sufficient evidence to reject the null hypothesis and conclude that the PSEi has no unit root or the data is stationary.

Figure 4 shows the correlogram of the original series of PSEi. In order to determine whether the data is series is stationary, another requirement is that the Simple Autocorrelation Correlogram (AC) and the Partial Autocorrelation Correlogram (PAC) at k=1 must be negative figures, respectively. It is observed in the data that the values of AC and PAC at k=1 is negative, which finally supports the stationarity of the data series based on the results of the ADF Test Statistics conducted below.

Figure 3. Philippine Stocks Exchange Index (PSEi) from March 1, 2012 to March 1, 2015, where a second differencing step is applied.

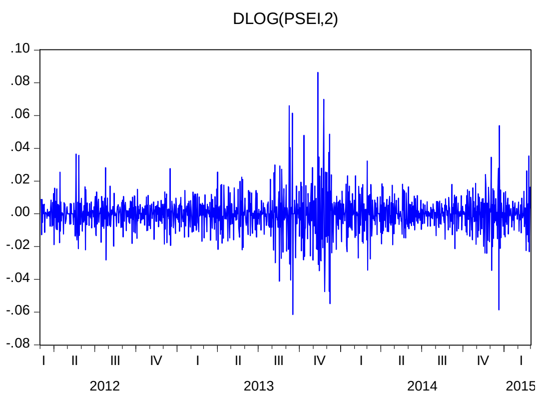


Table 4. The table shows the unit root test for the second difference series of data using the Augmented Dickey-Fuller Unit Root Test on PSEi wherein *Intercept* is included in the equation.

Null Hypothesis: DLOG(PSEI,2) has a unit root
Exogenous: Constant
Lag Length: 15 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.54693	0.0000
Test critical values:	1% level	-3.436199	
	5% level	-2.864011	
	10% level	-2.568137	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLOG(PSEI,2))
Method: Least Squares
Date: 06/06/15 Time: 14:11
Sample (adjusted): 3/19/2012 3/01/2015
Included observations: 1078 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(PSEI(-1),2)	-10.25666	0.659723	-15.54693	0.0000
D(DLOG(PSEI(-1),2))	8.346243	0.646971	12.90048	0.0000
D(DLOG(PSEI(-2),2))	7.545943	0.625297	12.06777	0.0000
D(DLOG(PSEI(-3),2))	6.678616	0.596387	11.19847	0.0000
D(DLOG(PSEI(-4),2))	5.862806	0.559404	10.48046	0.0000
D(DLOG(PSEI(-5),2))	5.056188	0.515854	9.801590	0.0000
D(DLOG(PSEI(-6),2))	4.254153	0.467791	9.094127	0.0000
D(DLOG(PSEI(-7),2))	3.476074	0.415892	8.358121	0.0000
D(DLOG(PSEI(-8),2))	2.719208	0.361026	7.531894	0.0000
D(DLOG(PSEI(-9),2))	2.115771	0.305912	6.916275	0.0000
D(DLOG(PSEI(-10),2))	1.575453	0.251928	6.253588	0.0000
D(DLOG(PSEI(-11),2))	1.106603	0.200015	5.532611	0.0000
D(DLOG(PSEI(-12),2))	0.784281	0.150776	5.201623	0.0000
D(DLOG(PSEI(-13),2))	0.545739	0.105243	5.185518	0.0000
D(DLOG(PSEI(-14),2))	0.315012	0.065990	4.773660	0.0000
D(DLOG(PSEI(-15),2))	0.091668	0.030908	2.965844	0.0031
C	-4.99E-06	0.000273	-0.018311	0.9854

R-squared	0.827076	Mean dependent var	4.29E-06
Adjusted R-squared	0.824468	S.D. dependent var	0.021372
S.E. of regression	0.008954	Akaike info criterion	-6.577734
Sum squared resid	0.085069	Schwarz criterion	-6.499155
Log likelihood	3562.399	Hannan-Quinn criter.	-6.547978
F-statistic	317.1649	Durbin-Watson stat	2.008906
Prob(F-statistic)	0.000000		

Table 5. Augmented Dickey-Fuller Unit Root Test on PSEi wherein *Trade and Intercept* is included in the equation.

Null Hypothesis: DLOG(PSEI,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 15 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.53916	0.0000
Test critical values:	1% level	-3.966583	
	5% level	-3.413987	
	10% level	-3.129084	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLOG(PSEI,2))
Method: Least Squares
Date: 06/06/15 Time: 14:12
Sample (adjusted): 3/19/2012 3/01/2015
Included observations: 1078 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(PSEI(-1),2)	-10.25653	0.660044	-15.53916	0.0000
D(DLOG(PSEI(-1),2))	8.346119	0.647287	12.89400	0.0000
D(DLOG(PSEI(-2),2))	7.545824	0.625602	12.06170	0.0000
D(DLOG(PSEI(-3),2))	6.678503	0.596677	11.19283	0.0000
D(DLOG(PSEI(-4),2))	5.862700	0.559676	10.47516	0.0000
D(DLOG(PSEI(-5),2))	5.056093	0.516105	9.796638	0.0000
D(DLOG(PSEI(-6),2))	4.254069	0.468018	9.089534	0.0000
D(DLOG(PSEI(-7),2))	3.476002	0.416093	8.353901	0.0000
D(DLOG(PSEI(-8),2))	2.719148	0.361200	7.528089	0.0000
D(DLOG(PSEI(-9),2))	2.115723	0.306059	6.912785	0.0000
D(DLOG(PSEI(-10),2))	1.575419	0.252049	6.250457	0.0000
D(DLOG(PSEI(-11),2))	1.106580	0.200110	5.529859	0.0000
D(DLOG(PSEI(-12),2))	0.784268	0.150848	5.199061	0.0000
D(DLOG(PSEI(-13),2))	0.545732	0.105293	5.183005	0.0000
D(DLOG(PSEI(-14),2))	0.315010	0.066021	4.771372	0.0000
D(DLOG(PSEI(-15),2))	0.091667	0.030923	2.964400	0.0031
C	-2.12E-05	0.000559	-0.037911	0.9698
@TREND(3/01/2012)	2.91E-08	8.77E-07	0.033201	0.9735

R-squared	0.827076	Mean dependent var	4.29E-06
Adjusted R-squared	0.824303	S.D. dependent var	0.021372
S.E. of regression	0.008958	Akaike info criterion	-6.575880
Sum squared resid	0.085069	Schwarz criterion	-6.492678
Log likelihood	3562.399	Hannan-Quinn criter.	-6.544373
F-statistic	298.2272	Durbin-Watson stat	2.008910
Prob(F-statistic)	0.000000		

Table 6. Augmented Dickey-Fuller Unit Root Test on PSEi wherein no *Trade and Intercept* is included in the equation.

Null Hypothesis: DLOG(PSEI,2) has a unit root
Exogenous: None
Lag Length: 15 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.55441	0.0000
Test critical values:	1% level	-2.567109	
	5% level	-1.941117	
	10% level	-1.616502	

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

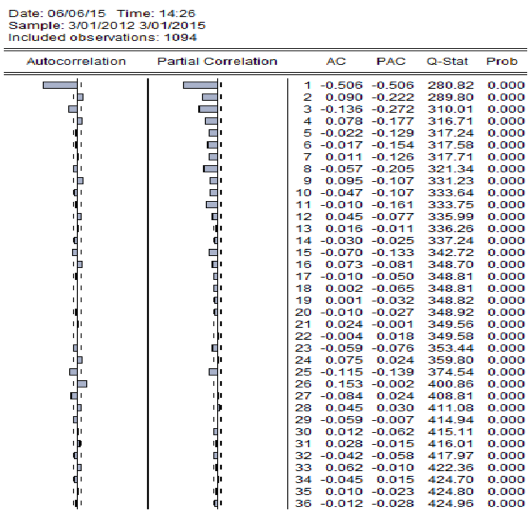
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLOG(PSEI,2))
Method: Least Squares
Date: 06/06/15 Time: 14:24
Sample (adjusted): 3/19/2012 3/01/2015
Included observations: 1078 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(PSEI(-1),2)	-10.25659	0.659401	-15.55441	0.0000
D(DLOG(PSEI(-1),2))	8.346173	0.646656	12.90667	0.0000
D(DLOG(PSEI(-2),2))	7.545876	0.624992	12.07355	0.0000
D(DLOG(PSEI(-3),2))	6.678553	0.596096	11.20383	0.0000
D(DLOG(PSEI(-4),2))	5.862748	0.559131	10.48546	0.0000
D(DLOG(PSEI(-5),2))	5.056136	0.515603	9.806255	0.0000
D(DLOG(PSEI(-6),2))	4.254108	0.467564	9.098441	0.0000
D(DLOG(PSEI(-7),2))	3.476036	0.415691	8.362069	0.0000
D(DLOG(PSEI(-8),2))	2.719179	0.360852	7.535434	0.0000
D(DLOG(PSEI(-9),2))	2.115749	0.305766	6.919513	0.0000
D(DLOG(PSEI(-10),2))	1.575439	0.251808	6.256507	0.0000
D(DLOG(PSEI(-11),2))	1.106595	0.199920	5.535190	0.0000
D(DLOG(PSEI(-12),2))	0.784277	0.150705	5.204050	0.0000
D(DLOG(PSEI(-13),2))	0.545737	0.105193	5.187946	0.0000
D(DLOG(PSEI(-14),2))	0.315012	0.065959	4.775899	0.0000
D(DLOG(PSEI(-15),2))	0.091668	0.030894	2.967233	0.0031

R-squared	0.827076	Mean dependent var	4.29E-06
Adjusted R-squared	0.824633	S.D. dependent var	0.021372
S.E. of regression	0.008950	Akaike info criterion	-6.579589

Sum squared resid	0.085069	Schwarz criterion	-6.505632
Log likelihood	3562.399	Hannan-Quinn criter.	-6.551583
Durbin-Watson stat	2.008908		

Figure 4. – Correlogram of the second level differenced series of PSEi.


Date: 06/06/15 Time: 14:26
Sample: 3/01/2012 3/01/2015
Included observations: 1094

	AC	PAC	Q-Stat	Prob
1	-0.506	-0.506	280.82	0.000
2	0.090	-0.222	289.80	0.000
3	-0.136	-0.272	310.01	0.000
4	0.078	-0.177	316.71	0.000
5	-0.022	-0.129	317.24	0.000
6	-0.017	-0.154	317.58	0.000
7	0.011	-0.126	317.71	0.000
8	-0.057	-0.205	321.34	0.000
9	0.095	-0.107	331.23	0.000
10	-0.047	-0.107	333.64	0.000
11	-0.010	-0.161	333.75	0.000
12	0.045	-0.077	335.99	0.000
13	0.016	-0.011	336.26	0.000
14	-0.030	-0.025	337.24	0.000
15	-0.070	-0.133	342.72	0.000
16	0.073	-0.081	348.70	0.000
17	-0.010	-0.050	348.81	0.000
18	0.002	-0.065	348.81	0.000
19	0.001	-0.032	348.82	0.000
20	-0.010	-0.027	348.92	0.000
21	0.024	-0.001	349.56	0.000
22	-0.004	0.018	349.58	0.000
23	-0.059	-0.076	353.44	0.000
24	0.075	0.024	359.80	0.000
25	-0.115	-0.139	374.54	0.000
26	0.153	-0.002	400.86	0.000
27	-0.084	0.024	408.81	0.000
28	0.045	0.030	411.08	0.000
29	-0.059	-0.007	414.94	0.000
30	0.012	-0.062	415.11	0.000
31	0.028	-0.015	416.01	0.000
32	-0.042	-0.058	417.97	0.000
33	0.062	-0.010	422.36	0.000
34	-0.045	0.015	424.70	0.000
35	0.010	-0.023	424.80	0.000
36	-0.012	-0.028	424.96	0.000

A.2) Specification of the Appropriate Number of Auto-regressive terms, *p*, and Moving Average terms, *q*.

Determining Candidate the AR and MA Terms:
At second Differencing Level: d = 2, based on **Figure 4.**
Table 7 shows the candidate AR (p) and MA (q) terms.

AR (p) Terms	MA (q) Terms
1,3,8,11,12,15, 18, 20, 23, 25, 28, 30,32	1,3,5, 9,12, 15,16, 25, 26, 31,33

In this model, **"AR"** stands for the autoregressive part of the model (p), **"I"** stands for the integrated part (d) and **"MA"** stands for the moving average part.

B. Estimation Stage – in this stage the researchers will estimate the parameters of the specified numbers, *p and q*, of autoregressive and moving average terms.

Using eEviews, a series of regression by ordinary least squares method is conducted in order to determine and estimate the model that will best fit the values of the data series and the best model that will forecast future values of PSEi. The AR (p) and MA (q) candidates that are included in the candidate models above are regressed by OLS method.

From the selected candidates of AR and MA in table 7, the authors come up with this model, which is available in table 8. We notice that the results of the p-value of the candidates is less than 0.05. This implies that these are the following AR and MA models that can predict the future values of PSEi. We can see the below the best model that can predict the PSEi.

Table 8 shows the regression of (PSEi) at Second Difference with the candidate AR (p) and MA (q) Terms.

Dependent Variable: DLOG(PSEI,2)
Method: Least Squares
Date: 06/06/15 Time: 15:14
Sample (adjusted): 3/26/2012 3/01/2015
Included observations: 1071 after adjustments
Convergence achieved after 14 iterations
MA Backcast: 3/14/2012 3/25/2012

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.86E-08	1.15E-06	0.042435	0.9662
AR(3)	-0.076319	0.033273	-2.293749	0.0220
AR(12)	0.090780	0.030929	2.935061	0.0034
AR(23)	-0.062943	0.030727	-2.048447	0.0408
MA(1)	-0.960953	0.022167	-43.35082	0.0000
MA(3)	-0.080783	0.027301	-2.958913	0.0032
MA(9)	0.083152	0.024378	3.410908	0.0007
MA(12)	-0.038330	0.018326	-2.091530	0.0367

R-squared	0.498534	Mean dependent var	7.35E-06
Adjusted R-squared	0.495232	S.D. dependent var	0.012351
S.E. of regression	0.008775	Akaike info criterion	-6.626354

Sum squared resid	0.081854	Schwarz criterion	-6.589182
Log likelihood	3556.412	Hannan-Quinn criter.	-6.612273
F-statistic	150.9693	Durbin-Watson stat	2.010013
Prob(F-statistic)	0.000000		

Inverted AR Roots	.88+.11i	.88-.11i	.81+.37i	.81-.37i
	.69-.55i	.69+.55i	.51-.74i	.51+.74i
	.31-.83i	.31+.83i	.06+.90i	.06-.90i
	-.17-.86i	-.17+.86i	-.42+.79i	-.42-.79i
	-.59-.64i	-.59+.64i	-.77+.46i	-.77-.46i
	-.84+.24i	-.84-.24i	-.91	
Inverted MA Roots	1.00	.76-.18i	.76+.18i	.48-.65i
	.48+.65i	.00+.76i	.00-.76i	-.31+.59i
	-.31-.59i	-.58-.42i	-.58+.42i	-.75

Estimation Command:
=========================
LS DLOG(PSEI,2) C AR(3) AR(12) AR(23) MA(1) MA(3) MA(9) MA(12)

Estimation Equation:
=========================
DLOG(PSEI,2) = C(1) + [AR(3)=C(2),AR(12)=C(3),AR(23)=C(4),MA(1)=C(5),MA(3)=C(6),MA(9)=C(7),MA(12)=C(8),BACKCAST=3/26/2012,ESTSMPL="3/26/2012 3/01/2015"]

Substituted Coefficients:
=========================
DLOG(PSEI,2) = 4.86412664293e-08 + [AR(3)=-0.0763192243926,AR(12)=0.0907795969673,AR(23)=-0.0629433217101,MA(1)=-0.960952980007,MA(3)=-0.0807827019267,MA(9)=0.0831520483096,MA(12)=-0.0383302190791,BACKCAST=3/26/2012,ESTSMPL="3/26/2012 3/01/2015"]

Conclusion

This study was trying to prove that the Box-Jenkins process is useful to predict the values of Philippine Stock Exchange index. Stock prices may be shocked by fundamental information as well as exhibiting technical trending and mean reversion effects due to market participants. Differencing of the transformation log is one of the useful method to treat the non-stationary of the data.

Recommendation

The researchers recommends to use other method in forecasting the Philippine Stock Exchange index such as Ordinary Least Square Regression, Census X-12, Tramo/Seats, X-11and exponential smoothing to compare the results of the model. Also, determine the factors affecting the PSEi and compare the results of the model developed. Furthermore, we recommends to use same method in forecasting values but different topics for us to determine whether the Box-Jenkins is useful in forecasting future values.