CHAPTER IV

RESEARCH RESULT

A. General Overview

1. United Kingdom of Great Britain and Northern Ireland (UK)

United Kingdom is situated north-west of the European continent between the Atlantic Ocean and North Sea. It has total land area of 244,100 square kilometers which is nearly 99% is land and the remainder is inland water. Its widest the United Kingdom is 300 miles (500 km) across. From the northern tip of Scotland to the southern coast of England, it is about 600 miles (1000 km).

The official name of UK is United Kingdom of Great Britain and Northern Ireland. The name refers to the union of once four separate nations they are England, Scotland, Wales and Ireland but now only Northern Ireland is part of the UK. The United Kingdom is made of four countries with London as capital which is among the world's leading commercial, financial and culture center. Other major cities include Birmingham, Liverpool and Manchester in England, Belfast and Londonderry in Northern Ireland, Edinburgh and Glasgow in Scotland, Swansea and Cardiff in wales.

The adjective of British came into use at this time to refer all of the kingdom's people. The United Kingdom has made significant contributions to the world economy, especially in technology and industry. Since World War II, however, the United Kingdom's most prominent exports have been

cultural, including literature, theatre, film, television, and popular music that draw on all parts of the country. Perhaps Britain's greatest export has been the English language, now spoken in every corner of the world as one of the leading international mediums of cultural and economic exchange.

2. The Economic Relationship between United Kingdom with another Countries

In 1973, United Kingdom joined European Economic Community (ultimately succeeded by the European Union (EU)) membership and it helped the Economic of United Kingdom significantly after World War II. Economic growth rates growth in 1990 compared with those other top industrial countries. Manufacturing's contribution to Gross Domestic Product (GDP) has declined to about one-fifth of the total, with services provides the source of greatest growth.

The United Kingdom's chief trading ties have shifted from its former empire to other members of the EU, which account for more than half its trade in tangible goods. The United States is a major investment and trading partner, and Japan has become a significant investor in local production. American and Japanese companies often choose the United Kingdom as their European base. In addition, other fast-developing East Asian countries with export-oriented economies include the United Kingdom's open market among their important outlets. Britain will have to broker new arrangements with dozens of nations, including the United States, which accounts for 16.6 percent of its goods exports.

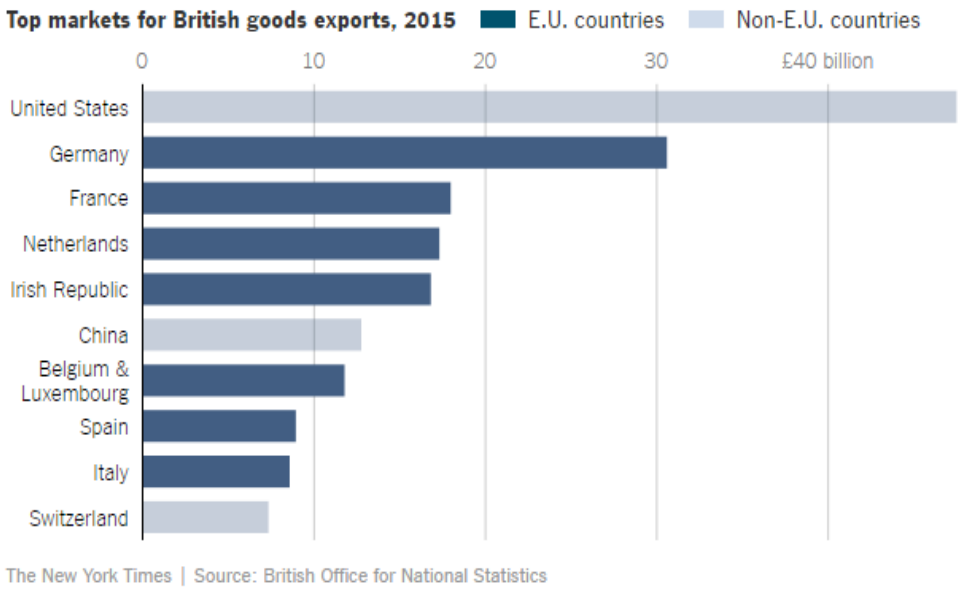

Figure 5 Top Market of British Goods Export 2015
Source: British office for National Statistic as citied at New York Times, June 2016

From figure 4 above, one of economic relationship can be seen. The multilateral relationship with another country will affect the decision making of United Kingdom. Example of export value above is cleared. The uncertainty condition of United Kingdom will make the value of Poundsterling will decrease and caused on the price of goods and will disturb income balance.

Britain's exit is a huge blow to the European Union. Britain represents about a sixth of the European Union's economy, roughly the same as California and Virginia make up in the United States. London has become a global financial hub, on a par with Wall Street. The industry is crucial to the British economy, with a trade surplus of 10.2 billion pounds, about $14.6

billion, in the first three months of the year. Financial firms have already indicated they could shift jobs out of Britain if it leaves the European Union.

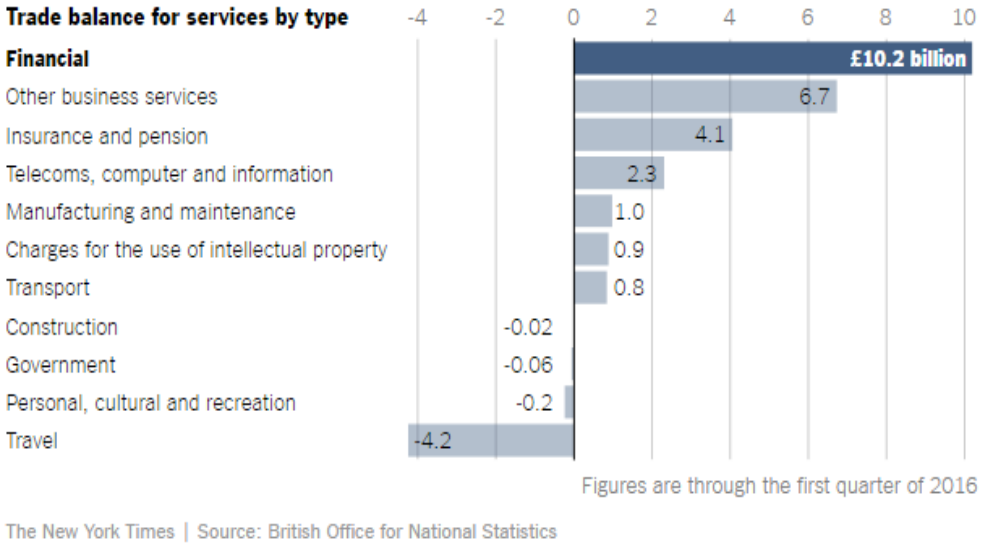

Figure 6 Trade Balance for Services by Type of Financial
Source: British office for National Statistic as citied at New York Times, June 2016

3. What is British Exit and the Impact of British Exit

British Exit is recent political happened in United Kingdom. The people of United Kingdom (British) voted to leave European Union. The people of United Kingdom (British) voted 52 percent or about 17.4 million versus 48 percent or about 16.1 million who voted to remain in European Union. This calculation came from figure below.

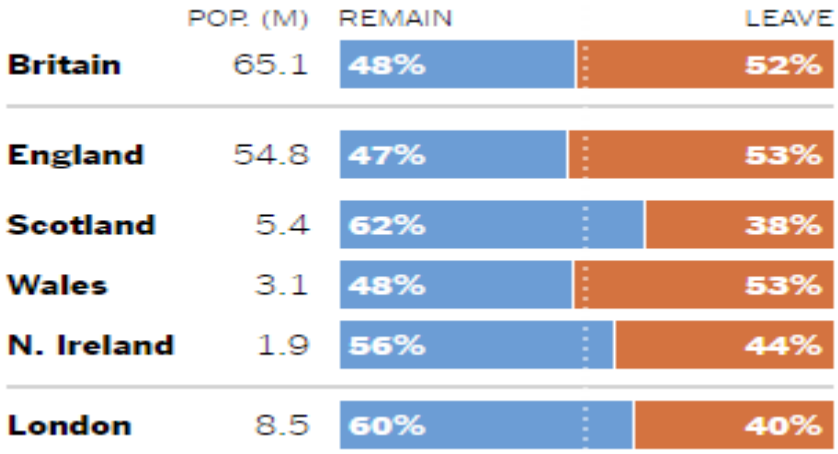

Figure 7 Result of Vote to Exit European Union
Source: New York Times, June 2016

According to center of economic of the London school of economic and political science:

a. In the long run, reduced trade lowers productivity. Factoring in these effects substantially increases the costs of Brexit to a loss of 6.3% to 9.5% of GDP (about £4,200 to £6,400 per household).
b. After Brexit, would the UK obtain better trade deals with non-EU countries? It would not have to compromise so much with other EU states, but the UK would lose bargaining power as its economy makes up only 18% of the EU's 'single market'.
c. The pound and the euro dropped amid concerns that the region's already fragile economies could be further undermined by the 'Brexit.' After the declaration of the result, the pound fell to its lowest level since 1985 and David Cameron resigned as Prime Minister.

Figure 8 Level of British pound on Dollar exchange rate
Source: New York Times, June 2016

d. According to express.co.uk (june, 2017) The Brexit victory sent economic shockwaves through global markets and Britain lost its top AAA credit rating. According to Bodie et al. (2014:468) the top rating is AAA or Aaa, a designation awarded to only about a dozen firms. Moody's modifies each rating class with a 1, 2, or 3 suffix (e.g., Aaa1, Aaa2, Aaa3) to provide a finer gradation of ratings. Debt rated Aaa and AAA has the highest rating. Capacity to pay interest and principal is extremely strong.

B. Descriptive Statistical Analysis

Descriptive statistical analysis is used to describe the data, which can be seen from maximum, minimum, mean and also deviation standard value of variables. The analysis of descriptive statistical analysis is using eviews program. This research is consist of two descriptive statistical analysis, first is descriptive

statistical analysis of Poundsterling (GBP) against US Dollar exchange rate and the second is descriptive analysis of US Dollar against Rupiah exchange rate.

1. **Descriptive Statistical Analysis of Poundsterling (GBP) against US Dollar**

Table 4 Descriptive statistical analysis of GBP on US Dollar

Poundsterling (GBP) against USD					
Mean	Median	Maximum	Minimum	Std. Deviation	N
1.381913	1.41140	1.48770	1.229800	0.068962	101

Source: Data processed by researcher, August 2017

Table 4 (see appendix 3 for statistical result) is provided the information about descriptive statistical analysis of Poundsterling (GBP) against US Dollar. Based on value which provided from the table, maximum value is 1.487700 and it shown the highest exchange rate happened in around the observation period. Where, the observation periods are fifty days before and after British Exit event (5 work days). The minimum value is about 1.229800 and it is means the lowest value of GBP on US Dollar exchange rate fifty days before and after British Exit event (5 work days).

According to average value on the table above shows that average of Poundsterling (GBP) against US Dollar exchange rate is about 1.381913 in fifty days before and after British Exit event (5 work days). This number is 0.11 lower than the maximum value in the table above. With the amount of total observation sample are 101. The value of

standard deviation of Poundsterling (GBP) against US Dollar exchange rate is 0.070282.

2. Descriptive Statistical Analysis of US Dollar against IDR (Rupiah)

The mean value of the US Dollar against Rupiah exchange rate is 13261.17 with the amount of observation sample are 101. This number means that average to get 1 dollar, people have to change with 13261.17 in fifty days before and after British Exit event (5 work days). The maximum value that happened in time of observation is about 13705.65 with the minimum value of US Dollar against Rupiah exchange rate is about 13056.90. The value of standard deviation is 164.6797. For more statistical result is in appendix 4.

Table 5 Descriptive statistical analysis of US Dollar against Rupiah

US Dollar against Rupiah					
Mean	Median	Maximum	Minimum	Std. Deviation	N
13261.17	13224.61	13705.65	13056.90	164.6797	101

Source: Data processed by researcher, August 2017

C. Event Study Method to Measures the Level of Political Event Effect

Even study method is the way to measure the effect of before and after British Exit event on exchange rate value. The instrument that is used to measure the effect is Paired test. Normality test is first step before doing a paired test.

1. Normality Test

Normality test has aim to know whether the data has normal distribution or not. The good model is the model that has normal distribution

in the data. The normality level of the data also determined the paired test that will be used in the next steps.

Table 6 Result of Normality test of GBP against USD and USD against IDR

Variable	P-Value	Meaning
GBP_USD	0.0000	Abnormal
USD_IDR	0.0350	Abnormal

Source: Data processed by researcher, August 2017

Table above (see appendix 5 and 6 for more statistical result) is provided the result of normality test. The result show that the data of GBP against US Dollar abnormal because the significance value is less than $\alpha = 5\%$ ($0.000 < 0.05$) and it is means rejected H_0 and H_1 is accepted. The data US Dollar against Rupiah also has abnormal distribution with the significance value is less than $\alpha = 5\%$ ($0.035 < 0.05$) and it is means that H_0 is rejected and H_1 is accepted.

2. Wilcoxon Paired Test

Wilcoxon paired test is used when the data has abnormal distribution. Poundsterling (GBP) against US Dollar and also USD against Rupiah have abnormal distribution and it should use wilcoxon paired test as instrument in order to explain the differences before and after British Exit. The result of the research is provided in the table below.

a. Poundsterling (GBP) Against US Dollar

The result of asymp.sig. (2-tailed) is 0.000 less than 0.05 and it is means that H_0 accepted and H_1 rejected. H_0 accepted means that there is

difference on GBP against US Dollar before and after British exit. The negative ranks for GBP against US Dollar before and after event shows that there are 43 data realize the decline before and after event with the average value decline is 27.48 and the sum of negative ranks is 1181.50.

The number 7 of positive N means of there is a data that realize increasing value with average is 13.36 before and after the event with the sum of positive rank is 93.50. Ties is similar value of exchange rate before and after the event and it means that there is no same value on exchange rate before and after exchange rate because ties value is 0. For more statistical result is in appendices (appendix 7).

Table 7 The Wilcoxon test result of GBP against US Dollar

Information		**N**	**Mean Ranks**	**Sum of Ranks**	**Z calc**	**Asymp. Sig. (2-tailed)**
Before and after Brexit	Negative ranks	43	27.48	1181.50	-5.251	0.000
	Positive ranks	7	13.36	93.50		
	Ties	0				
	Total	50				

Source: Data Processed by Researcher, August 2017

b. US Dollar Against Rupiah

The result of asymp.sig. (2-tailed) is 0.000 that is less than 0.05 and it is means that H_0 accepted and H_1 rejected. H_0 accepted means that

there is difference on US Dollar against Rupiah before and after British exit. The negative ranks for US Dollar against Rupiah before and after event shows that there are 42 data realize the decline before and after event with the average value decline is 28.10 and the sum of negative ranks is 1180.00.

The number 8 of positive N means of there is 8 data that realize increasing value before and after the event with the sum of positive ranks is 95.00 and the average of increasing value is 11.8. Ties is similar value of exchange rate before and after the event and it means that there is no same value on exchange rate before and after exchange rate because ties value is 0. The resume of wilcoxon paired test of USD against IDR is described at the table 4.5 below (see appendix 8 for more statistical result).

Table 8 Result of Wilcoxon paired test of USD against IDR

Information		**N**	**Mean Ranks**	**Sum of Ranks**	**Z calc**	**Asymp. Sig. (2-tailed)**
Before and after Brexit	Negative ranks	42	28.10	1180.00	-5.237	0.000
	Positive ranks	8	11.8	95.00		
	Ties	0				
	Total	50				

Source: Data Processed by researcher, August 2017

D. ARCH-GARCH Model Analysis to Explore the Exchange Rate Volatility

There are some steps of exploring the volatility of exchange rate by using ARCH-GARCH model estimation. ARCH-GARCH model is used to explore the residual variance of the data. By showing the stability of the residual variance, the researcher can conclude whether there are a volatility of the data or not. The steps are described below:

1. ARCH-GARCH Analysis on Poundsterling (GBP) against US Dollar

   Poundsterling (GBP) against US Dollar is first analysis that was done in this research. Some of steps should be done in carried out the ARCH-GARCH analysis. First step is examines the plot of time series, the second is stationary test and then analyze the ARCH-GARCH model. The steps are described below:

   a. Examining the Plot of Time Series on Poundsterling (GBP) against US Dollar

   According to plot of time series of Poundstreling (GBP) against US Dollar, it can be conclude that the movement of exchange rate in first period at 14th April, 2016 until 01th September, 2016 is moved up and down. Generally, the plot data of GBP against US Dollar shows the volatility. At 23th June, 2016 the movement of Poundsterling (GBP) against US Dollar moved descend until 27th, 2016 and moved up at 29th, 2016. The value of exchange rate is still realizes the decreased until 11th July, 2016. Based on plot of time series above, the exchange rate of

Poundsterling (GBP) against US Dollar has fluctuates plot and it has decrease trend.

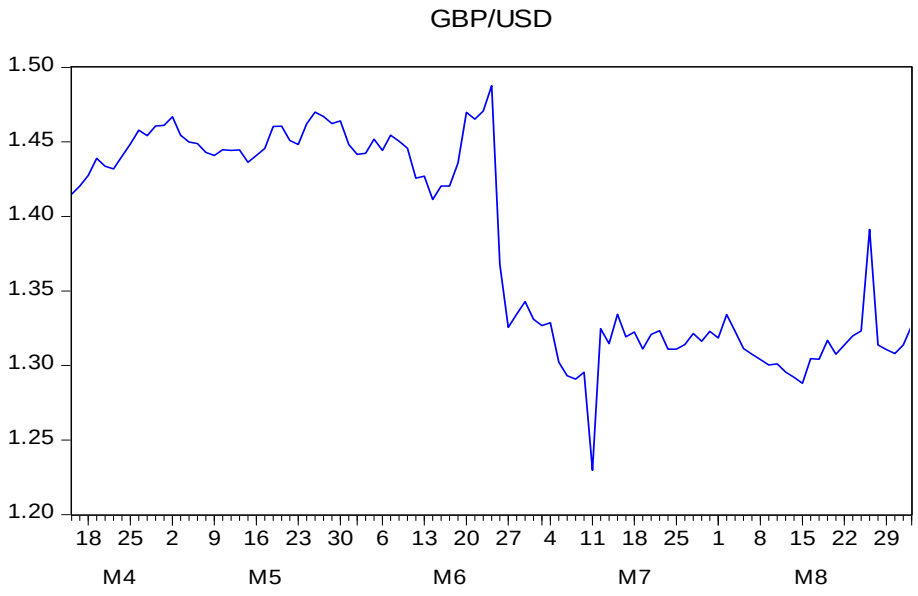

Figure 9 Plot of time series GBP against US Dollar data
Source: Data Processed by researcher, August 2017

b. Stasionary Test on Pondsterling (GBP) against US Dollar

According to unit root test level test below, it can be seen that the data is not stationer. This because the absolute value of augmented Dickey-Fuller test statistic is less than the test critical values in level α=1%, α=5% and α=10%. The value of augmented Dickey-Fuller test statistic is -1.537607 is less than test critical values which the values are -3.497029, -2.890623, -2.582353. So it is accepted H_0 and the data is not stationer.

Table 9 The unit root test result of GBP against US Dollar

Null Hypothesis: GBP_USD has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.537607	0.5106
Test critical values:	1% level	-3.497029	
	5% level	-2.890623	
	10% level	-2.582353	

*MacKinnon (1996) one-sided p-values.
Source: Data Processed by Researcher, August 2017

Because the data is not stationer, so the data will be tested with unit root test in first difference level. Based on unit root test in first difference level below showed that absolute value of augmented Dickey-Fuller test statistic is more than test critical values in level α=1%, α=5% and α=10%. The value of augmented Dickey-Fuller test statistic is -12.10668 which more than test critical values which are in level 1% is -3.497727, level 5% is -2.890926 and in the level of 10% is -2.582514. It is means rejected H_0 and the data is stationer.

Table 10 The unit root test level at first difference level of GBP against US Dollar

Null Hypothesis: D(GBP_USD) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.10668	0.0001
Test critical values:	1% level	-3.497727	
	5% level	-2.890926	
	10% level	-2.582514	

*MacKinnon (1996) one-sided p-values.
Source: Data Processed by Researcher, August 2017

c. Identifying ARMA-ARIMA model by Using Correlogram

1. Model Identification by using Correlogram

ARCH effect can be seen by using through correlogram from residual square pattern. If there is no ARCH effect on residual square pattern, so autocorrelation function (ACF) and partial autocorrelation function (PACF) are equal 0 (zero) from all of lag or it is not significant. On the contrary, if autocorrelation function (ACF) and partial autocorrelation function (PACF) are not equal 0, so the model is consist of ARCH effect.

Maximum value of AR order (p) is obtained when value of PAC cut off the line of lag. Maximum value of MA order (q) is obtained when the value of AC cut off the line of lag. The value of difference (d) is obtained from the level of stationer test data.

The result of unit root test of poundsterling (GBP) against US Dollar shows that data is stationer in first difference level. So the ARMA tentative model should consist of order difference (d). From the figure 4.6 is a result of correlogram test which is stationer in the difference level. The result of the correlogram test shows that the maximum value of AR order (p) is obtained at lag 1, lag 12 where this lag is cut off the line and the lag which is used by researcher is 24. MA order (q) is also obtained at lag 1 and lag 12 where this lag is cut off the line.

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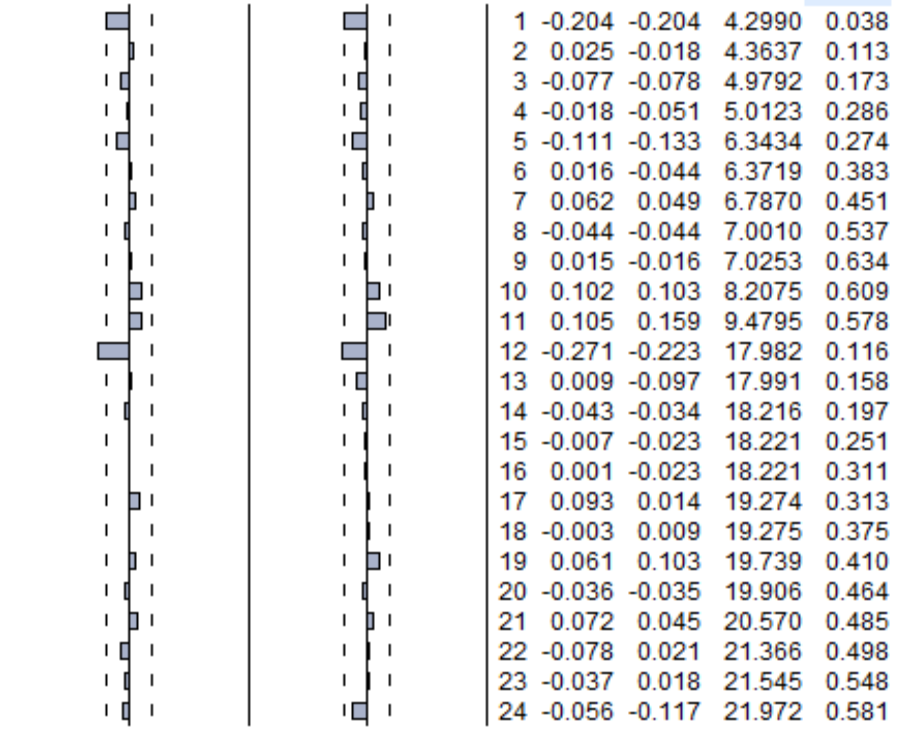
Sample: 4/14/2017 9/01/2017
Included observations: 100



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.204	-0.204	4.2990	0.038
		2	0.025	-0.018	4.3637	0.113
		3	-0.077	-0.078	4.9792	0.173
		4	-0.018	-0.051	5.0123	0.286
		5	-0.111	-0.133	6.3434	0.274
		6	0.016	-0.044	6.3719	0.383
		7	0.062	0.049	6.7870	0.451
		8	-0.044	-0.044	7.0010	0.537
		9	0.015	-0.016	7.0253	0.634
		10	0.102	0.103	8.2075	0.609
		11	0.105	0.159	9.4795	0.578
		12	-0.271	-0.223	17.982	0.116
		13	0.009	-0.097	17.991	0.158
		14	-0.043	-0.034	18.216	0.197
		15	-0.007	-0.023	18.221	0.251
		16	0.001	-0.023	18.221	0.311
		17	0.093	0.014	19.274	0.313
		18	-0.003	0.009	19.275	0.375
		19	0.061	0.103	19.739	0.410
		20	-0.036	-0.035	19.906	0.464
		21	0.072	0.045	20.570	0.485
		22	-0.078	0.021	21.366	0.498
		23	-0.037	0.018	21.545	0.548
		24	-0.056	-0.117	21.972	0.581

Figure 10 The result of correlogram test in difference level
Source: Data Processed by Researcher, August 2017

Based on figure above, the tentative model is obtained. The first model is ARIMA (1,1,1) and then ARIMA (1,1,0), ARIMA (0,1,1). The second mode is ARIMA (12,1,12), ARIMA (12,1,1), ARIMA (12,1,0). There are 6 tentative models obtained in step of ARMA-ARIMA analysis. This model will be regressed by using least square (NS and ARMA) and will be compared. The tentative model is measure by using ARMA least square estimation. The results of regression are describes below:

a. ARIMA (0,1,1)

Based on model ARIMA model identification, the first tentative model is ARIMA (0,0,1) with AR (0), d (1) and MA (1). Where the model can be formed into equation according to the least square estimation result as follows (see appendix 9.a for more statistical result):

Table 11 The result of ARIMA (0,1,1) estimate equation

Variable (0,1,1)	Coefficient	P-Value	R^2	Prob(F-stat)
MA (1)	-0.000936	0.0301	4.337% or 0.043374	0.037589

Source: Data Processed by Researcher, July 2017

The estimated can be decided as a good model if probability value of partial or simultaneous form each variable is less than 0.05 (Widarjono, 2005 : 305). Partial test and simultaneous test for MA (1) shows that the probability value is 0.0301 and it is less than 0.05. It means that there is effect of MA (1) on Y_t.

Adjusted R Squared obtained by 4.337% which means MA (1) can explain Y_t as amount of 4.337% while the rest is explained by other variables. The level of probability of MA (1) is good and supported by the value of simultaneous probability (F-statistic) that is 0.037589 which is less than 0.05.

b. ARIMA (1,1,0)

The second tentative model is ARIMA (1,1,0), where AR (1), d (1), MA (0). The result of estimation by using least square can be described as follows (see appendix 9.b for more statistical result):

Table 12 The result of ARIMA (1,1,0) estimate equation

Variable (1,1,0)	Coefficient	P-Value	R^2	Prob(F-stat)
AR (1)	-0.205111	0.0420	4.1937% or 0.041937	0.042021

Source: Data Processed by Researcher, August 2017

Partial test for AR (1) is obtained the significant value that is 0.0420 and it is less than 0.05, so it means that there is an effect of coefficient AR (1) on Y_t. Simultaneous test for coefficient AR (1) shows that the significant value equal 0.042021, so it can concluded that there is an effect of coefficient AR (1) on Y_t. The value of Adjusted R Squared is 4.19% which is means that coefficient of AR (1) explain Y_t in the 4.19% while the rest is explained by other variables.

c. ARIMA (1,1,1)

The third tentative model is ARIMA (1,1,1) which is consist of AR (1), d (1) , MA (1). This model is estimated by using least square equation and the result of estimation by using least square can be described as follows (see appendix 9.c for more statistical result):

Table 13 The result of ARIMA (1,1,1) estimate equation

Variable (1,1,1)	Coefficient	P-Value	R^2	Prob (F-stat)
AR (1)	0.914519	0.0000	19.6175% or 0.196175	0.000028
MA (1)	-1.122064	0.0000		

Source: Data Processed by Researcher, August 2017

The value of coefficient regression at AR (1) and MA (1) level is significant because 0.0000 is less than 0.05. Simultaneous test for coefficient AR (1) and MA (1) shows that the significant value equal 0.000028 and It is less than 0.05, so it can concluded that there is an effect of coefficient AR (1) on Y_t. The value of Adjusted R Squared is 19.61% which is means that coefficient of AR (1) and MA (1) explains Y_t in the 19.61% while the rest is explained by other variables.

d. ARIMA (12,1,1)

The fourth tentative model is ARIMA (12,1,1) where AR (12), d (1) and MA (1). This model can be formed into equation according to regression analysis by least square estimation, that is (see appendix 9.d for more statistical result):

Table 14 The result of ARIMA (12,1,1) estimate equation

Variable (12,1,1)	Coefficient	P-Value	R^2	Prob(F-stat)
AR (12)	-0.339306	0.0045	13.5597% or	0.002044

MA (1)	-0.213107	0.0000	0.135597	

Source: Data Processed by Researcher, August 2017

Partial test for AR (12) is obtained the probability value that is 0.0045 and it is less than 0.05, so it means that there is an effect of coefficient AR (12) on Y_t. The partial result of MA (1) is 0.0000 which is less than 0.05, so it means that there is an effect of coefficient MA (1) on Y_t. Simultaneous test for coefficient AR (12) and MA (1) shows that the significant value equal 0.002044, so it can concluded that there is an effect of coefficient AR (12) and MA (1) on Y_t. The value of Adjusted R Squared is 13.55% which is means that coefficient of AR (12) and MA (1) explains Y_t in the 13.55% while the rest is explained by other variables.

e. ARIMA (12,1,12)

The fifth tentative model is ARIMA (12,1,12) where AR (12), d (1) and MA (12). This model is estimated by using least square estimation and the model is described below (see appendix 9.e for more statistical result).:

Table 15 The result of ARIMA (12,1,12) estimate equation

Variable (12,1,12)	Coefficient	P-Value	R^2	Prob(F-stat)
AR (12)	0.189311	0.1433	24.7728% or 0.247728	0.000006
MA (12)	-0.842085	0.0000		

Source: Data Processed by Researcher, August 2017

The value of coefficient regression at AR (12) level is 0.1433 is more than 0.05 and it means that there is no effect of AR (12) on Y_t. The probability value of MA (12) is 0.0000 which is less than 0.05 and it means there is effect of MA (1) on Y_t. Simultaneous test for coefficient AR (12) and MA (12) shows that the significant value equal 0.000006 and it is less than 0.05, so it can concluded that there is an effect of AR (12) and MA (12) on Y_t. The value of Adjusted R Squared is 24.77% which is means that coefficient of AR (12) and MA (12) explains Y_t in the 24.77% while the rest is explained by other variables.

f. ARIMA (12,1,0)

The last tentative model is ARIMA (12,1,0). Where this mode is consist of AR (12), d (1) and MA (0). This model is estimated by using least square and the result is described below (see appendix 9f for more statistical result):

Table 16 The result of ARIMA (12,1,0) estimate equation

Variable (12,1,0)	Coefficient	P-Value	R^2	Prob(F-stat)
AR (12)	-0.353455	0.0031	9.73% or 0.097326	0.003087

Source: Data Processed by Researcher, August 2017

The result of AR (12) and MA (0) show that coefficient is significant. Because of the value of AR (12) is 0.0031 less than 0.05.

So it means that AR (12) has effect on Y_t. Simultaneous test for coefficient AR (12) and MA (0) shows that the significant value equal 0.003087 and it is less than 0.05, so it can concluded that there is an effect of AR (12) and MA (0) on Y_t. The value of Adjusted R Squared is 9.73% which is means that coefficient of AR (12) and MA (0) explains Y_t in the 9.73% while the rest is explained by other variables.

2. Selecting the Best of ARIMA Model

Before determining the ARCH-GARCH model, the several tentative models were prepared. Several tentative models is chosen by using correlogram analysis then selected. The selected model is determined by using some of criteria. The First criteria is the biggest R^2 value, and then the smallest AIC and SC. Table 4.11 shows the result of least square equation of ARIMA tentative model.

Table 17 Result of ARIMA tentative model by using least square equation

Model	R^2	AIC	SC
ARIMA (0,1,1)	0.043374	-4.80029	-4.74819
ARIMA (1,1,0)	0.041937	-4.78918	-4.73676
ARIMA (1,1,1)	0.196175	-4.94452	-4.86588
ARIMA (12,1,1)	0.135597	-4.76041	-4.67596
ARIMA (12,1,12)	0.247728	-4.89935	-4.81490
ARIMA (12,1,0)	0.097326	-4.73982	-4.68352

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o
urce: Data Processed by Researcher, August 2017

Based on table above, the biggest R squared are showed at ARIMA (1,1,1) and ARIMA (12,1,12). But, at ARIMA (12,1,12) there p-value which is not significance with the p-value of variable AR (12) is 0.143 and it is more than 0.05. The smallest AIC and SC is showed at ARIMA (1,1,1). But, at ARIMA (12,1,12) there p-value which is not significance with the p-value of AR (12) is 0.143 and it is more than 0.05. So the chosen model is ARIMA (1,1,1).

d. Detecting the Heteroskedasticity element by using ARCH-LM Test

Detecting the heteroskedasticity in ARIMA model was chosen, the ARCH-Lagrange Multiplier is used. If the data has heteroskedasticity element, so ARCH-GARCH model estimation is used to overcome the heteroskedasticity problem of ARIMA tentative model.

Table 18 Result of Heteroskedasticity test by using ARCH-LM

Heteroskedasticity Test: ARCH	
F-statistic	2.246995
Obs*R-squared	23.23466
Prob. F	0.0175
Prob. Chi-Square	0.0258

Source: Data Processed by Researcher, August 2017

Based on ARCH-Lagrange Multiplier test above shows that obs*R^2 calculation value is 23.2346, with the probability value is 0.0258. The probability value of chi square is less than 0.05. It is means that the value

is significance and H_0 is rejected. The existence of Heteroskedasticity element means that residua variance is not constant and model used contains of ARCH element. So the model should be estimated by using ARCH-GARCH model to overcome the Heteroskedasticity problem.

e. ARCH-GARCH Model Estimation by using Maximum Likelihood

The ARIMA (1,1,1) model that is used contains of Heteroskedasticity element. So Maximum Likelihood model estimation was needed. The output which is showed at Maximum Likelihood model estimation consists of two parts that are conditional mean calculation and conditional variance calculation.

Table 19 Result of ARCH (1) and GARCH (1) model estimation.

Conditional mean		
Variable	Coefficient	Probability Value
AR (1)	0.0588330	0.0000
MA (1)	-0.913013	0.0000
Conditional Variance		
ARCH (1)	1.186651	0.0004
GARCH (1)	0.342789	0.0050

Source: Data Processed by Researcher, August 2017

The result of Maximum Likelihood regression estimation shows that the probability value at ARCH (1) and GARCH (1) are significance (see appendix 11 for more statistical result). They are significance whether in conditional mean and also conditional variance. The probability value of

conditional variance is significance and it is means that there is volatility at exchange rate value in observation period within 50 days before British Exit event and 50 days after British Exit event. The residual variance of exchange rate value (ARCH) is affected by residual at the period before and lag of residual variance at the period before (GARCH).

The heteroskedasticity element that was detected in exchange rate value of Poundsterling (GBP) against Dollar means that the residual variance of the data is not constant and fluctuates from one period to another period. At conditional mean equation, all of independent variables which are AR(1) and MA(1) have significance value refer to probability value. The probability value for AR (1) is 0.0000 and MA (1) is 0.0000 and it less than 0.05, so the value is significance. The significance of AR(1) and MA(1) means that the exchange rate value of Poundsterling (GBP) against US Dollar is affected by exchange rate value the period before at lag 1.

Value of R^2 in the ARCH-GARCH (1,1) model is 0.0134 and it is relatively small because the aim of OLS estimation is maximize the value of R^2, but there is correction of heteroskedasticity caused on decreasing the value of R^2. The estimation of ARCH-GARCH model used Maximum Likelihood so the evaluation of regression line is based log likelihood not R^2.

f. Model Evaluation Test

The diagnostic model test should be done to analyze whether the data formed is good enough to modeling the data. To analyze if the data still contains of heteroskedasticity element or not, ARCH-LM test is used. The result of ARCH-LM of ARCH-GARCH model is below:

Table 20 Result of ARCH-LM test of GBP against USD

Heteroskedasticity Test: ARCH

F-statistic	0.338304	Prob. F(1,97)	0.9793
Obs*R-squared	4.524610	Prob. Chi-Square(1)	0.9720

Source: Data Processed by Researcher, August 2017

From the ARCH-GARCH model estimation before, the ARCH-LM test was done to analyze whether the data still contain of ARCH element or not. The result is described above. The value of X^2 (Obs*R-squared) is 4.524610 with the probability value is 0.9720 or 97.2% and it is more than 0.05. So it is means that H_0 accepted. The residual variance of the data is constant or the data has not contain of ARCH element.

2. ARCH-GARCH Analysis US Dollar Against Rupiah

US Dollar against Rupiah is the second analysis that was done in this research. Some of steps should be done in carried out the ARCH-GARCH analysis. First step is examines the plot of time series, the second is stationary test and then analyze the ARCH-GARCH model. The steps are are described below:

a. Examining the Plot of Time Series on US Dollar against Rupiah

The pattern of time series data on US Dollar against Rupiah above showed the significant movement from first period at 14th April, 2016 until 1th September, 2016. The significant increasing movement is happened in 4th May, 2016 and the lowest point in 4th July, 2016. Generally, the plot of US Dollar against Rupiah exchange rate shows the volatility movement. The data is fluctuates which the pattern shown the up movement and down movement continually.

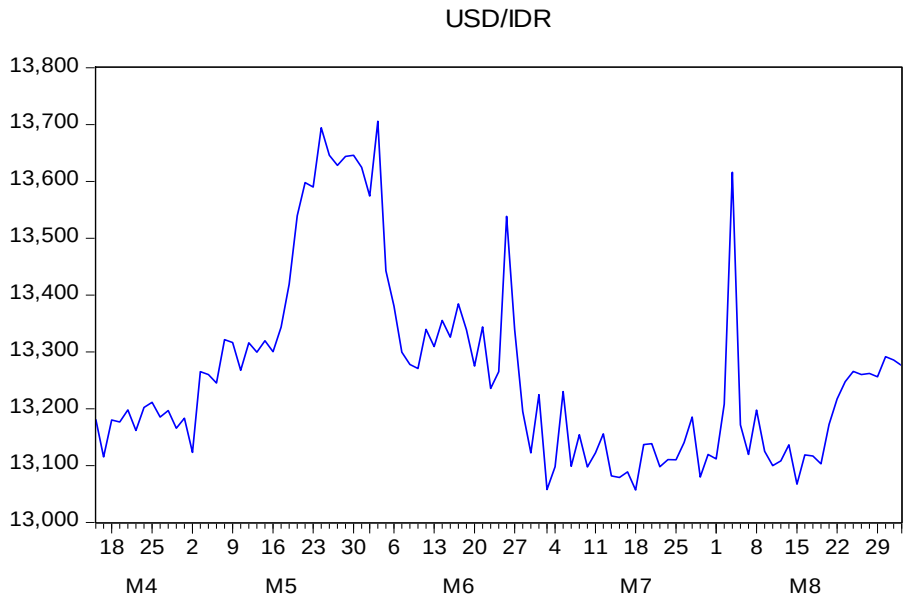


Figure 11 Plot of time series US Dollar against Rupiah
Source: Data Processed by Researcher, August 2017

b. Stasionary Test on US Dollar against Rupiah

According to unit root test level test of, it can be seen that the data is not stationer. This because the absolute value of augmented Dickey-Fuller test statistic is less than the test critical values in level α=1%, α=5% and α=10%. The value of augmented Dickey-Fuller test statistic is

-2.973526 is less than test critical values which the values are -3.497029, -2.890623, -2.582353. So it is accepted H_0 and which means data is not stationer. The p-value is 0.0409 and less than 0.05, but the value of augmented Dickey-Fuller less than critical value, so the data is not stationer.

Table 21 The unit root test result of US Dollar against Rupiah

Null Hypothesis: USD_IDR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.973526	0.0409
Test critical values:	1% level	-3.497029	
	5% level	-2.890623	
	10% level	-2.582353	

*MacKinnon (1996) one-sided p-values.
Source: Data Processed by researcher, August 2017

Because the data is not stationer yet, so the differences unit root test has to be done. The result of Unit root test in differences in first difference level is described below:

Table 22 The unit root test result of US Dollar against Rupiah in first difference level

Null Hypothesis: D(USD_IDR) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.01595	0.0000
Test critical	1% level	-3.498439	

values:	
5% level	-2.891234
10% level	-2.582678

*MacKinnon (1996) one-sided p-values.
Source: Data Processed by researcher, August 2017

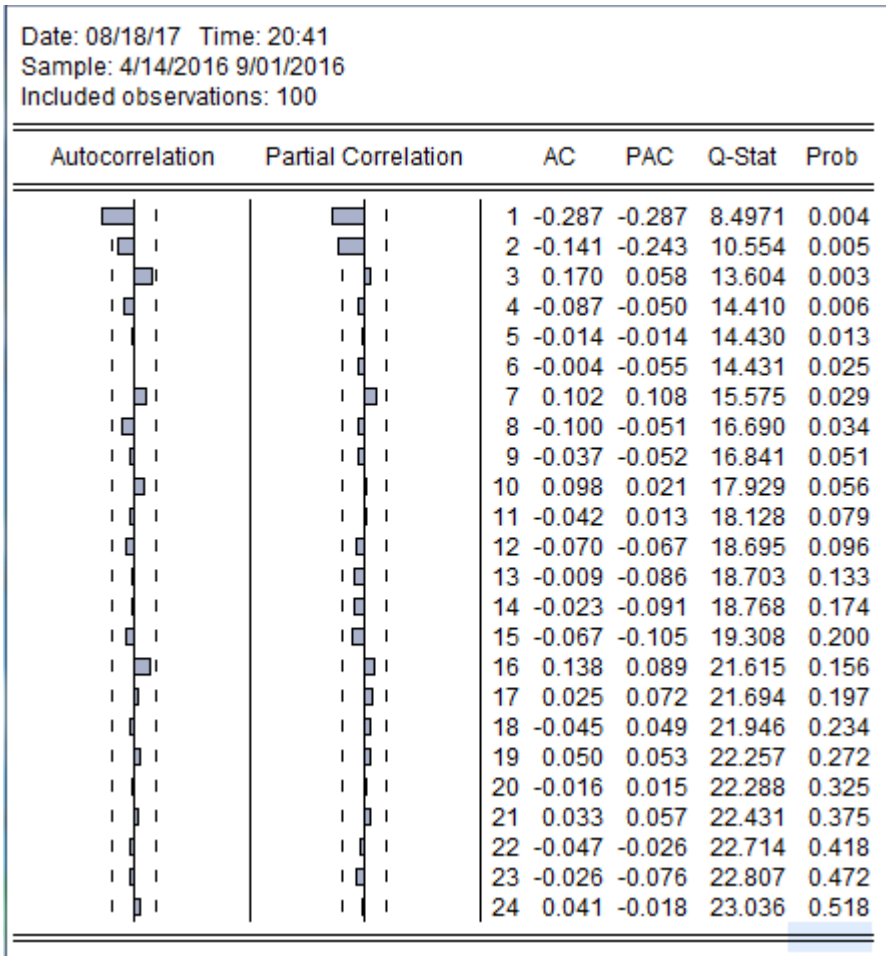
Based on unit root test in first difference level above showed that absolute value of augmented Dickey-Fuller test statistic is more than test critical values in level α=1%, α=5% and α=10%. The value of augmented Dickey-Fuller test statistic is -10.01595 which more than test critical values which are in level 1% is -3.498439, level 5% is -2.891234 and in the level of 10% is -2.582678. The probability value is 0.0000 less than 0.05 so it is means rejected H_0 and the data is stationer in first difference level.

c. Identify ARMA-ARIMA model by Using Correlogram

1. Model Identification by using Correlogram

The result of unit root test of US Dollar against Rupiah shows that data is stationer in first difference level. So the ARMA tentative model should consist of order difference (d). From the figure 11 is a result of correlogram test which is stationer in the dfference level. The result of the correlogram test shows that the maximum value of AR order (p) is obtained at lag 1 and lag 2 where this lag is cut off the line. MA order (q) is also obtained at lag 1, where this lag is cut off the line.

Based on figure below, the tentative model is obtained. The first model is ARIMA (1,1,1) and then ARIMA (1,1,0), ARIMA (0,1,1). The second model is ARIMA (2,1,0), ARIMA (2,1,1).



Date: 08/18/17 Time: 20:41
Sample: 4/14/2016 9/01/2016
Included observations: 100

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.287	-0.287	8.4971	0.004
		2	-0.141	-0.243	10.554	0.005
		3	0.170	0.058	13.604	0.003
		4	-0.087	-0.050	14.410	0.006
		5	-0.014	-0.014	14.430	0.013
		6	-0.004	-0.055	14.431	0.025
		7	0.102	0.108	15.575	0.029
		8	-0.100	-0.051	16.690	0.034
		9	-0.037	-0.052	16.841	0.051
		10	0.098	0.021	17.929	0.056
		11	-0.042	0.013	18.128	0.079
		12	-0.070	-0.067	18.695	0.096
		13	-0.009	-0.086	18.703	0.133
		14	-0.023	-0.091	18.768	0.174
		15	-0.067	-0.105	19.308	0.200
		16	0.138	0.089	21.615	0.156
		17	0.025	0.072	21.694	0.197
		18	-0.045	0.049	21.946	0.234
		19	0.050	0.053	22.257	0.272
		20	-0.016	0.015	22.288	0.325
		21	0.033	0.057	22.431	0.375
		22	-0.047	-0.026	22.714	0.418
		23	-0.026	-0.076	22.807	0.472
		24	0.041	-0.018	23.036	0.518

Figure 12 The result of Correlogram test in difference level
Source: Data Processed by Researcher, August 2017

There are 5 tentative models obtained in correlogram analysis. This model will be regressed and will be compared. The tentative model is measure by using ARMA least square estimation. The results of regression are describes below:

a. ARIMA (1,1,0)

Based on model ARIMA model identification, the first tentative model is ARIMA (1,1,0) with AR (1), d (1) and MA (0). Where the model can be formed into equation according to the least square estimation result as follows (see appendix 10.a for more statistical result):

Table 23 The result of ARIMA (1,1,0) estimate equation

Variable (1,1,0)	Coefficient	P-Value	R^2	Prob(F-stat)
AR (1)	-0.287225	0.0039	8.29% or 0.082913	0.003851

Source: Data Processed by Researcher, August 2017

The estimated can be decided as a good model if probability value of partial or simultaneous form each variable is less than 0.05. Partial test and simultaneous test for AR (1) shows that the probability value is 0.0039 and it is less than 0.05. It means that there is effect of AR (1) on Y_t.

Adjusted R Squared obtained by 8.29% which means AR (1) can explain Y_t as amount of 8.29% while the rest is explained by other variables. The level of probability of AR (1) is good and supported by the value of simultaneous probability (F-statistic) that is 0.003851 which is less than 0.05.

b. ARIMA (1,1,1)

The second tentative model is ARIMA (1,1,1) which is consist of AR (1), d (1) , MA (1). This model is estimated by using least square equation and the result of estimation by using least square can be described as follows (see appendix 10.b for more statistical result):

Table 24 The result of ARIMA (1,1,1) estimate equation

Variable (1,1,1)	Coefficient	P-Value	R^2	Prob(F-stat)
AR (1)	0.109573	0.6788	11.68% or 0.116803	0.002575
MA (1)	-0.474080	0.0449		

Source: Data Processed by Researcher, August 2017

The value of coefficient regression at AR (1) is 0.6788 is more than 0.05 so the value is not significant. MA (1) is 0.0449 and it is less than 0.05, so the probability value is significant. Simultaneous test (F-stat) for coefficient AR (1) and MA (1) shows that the significant value equal 0.002575 and it is less than 0.05, so it can concluded that there is an effect of coefficient AR (1) on Y_t. The value of Adjusted R Squared is 19.61% which is means that coefficient of AR (1) and MA (1) explains Y_t in the 11.68% while the rest is explained by other variables.

c. ARIMA (0,1,1)

Based on model ARIMA model identification, the third tentative model is ARIMA (0,0,1) with AR (0), d (1) and MA (1).

Where the model can be formed into equation according to the least square estimation result as follows (see appendix 10.c for more statistical result).:

Table 25 The result of ARIMA (0,1,1) estimate equation

Variable (0,1,1)	Coefficient	P-Value	R^2	Prob(F-stat)
MA (1)	-0.385606	0.0001	11.69% or 0.116986	0.000496

Source: Data Processed by Researcher, August 2017

The probability value of regression at MA (1) level is 0.0001 is less than 0.05 and it means that there is effect of MA (1) on Y_t. Simultaneous test for coefficient MA (1) shows that the significant value equal 0.000496 and it is less than 0.05, so it can concluded that there is an effect of MA (1) on Y_t. The value of Adjusted R Squared is 11.69% which is means that coefficient of AR (12) and MA (12) explains Y_t in the 11.69% while the rest is explained by other variables.

d. ARIMA (2,1,1)

The second tentative model is ARIMA (2,1,1), where AR (2), d (1) and MA (1). The result of estimation by using least square can be described as follows (see appendix 10.d for more statistical result):

Table 26 The result of ARIMA (2,1,1) estimate equation

Variable (2,1,1)	Coefficient	P-Value	R^2	Prob(F-stat)
AR (2)	-0.111513	0.2964	12.40% or 0.124052	0.001852
MA (1)	-0.338738	0.0011		

Source: Data Processed by Researcher, August 2017

Partial test for AR (2) is obtained the significant value that is 0.2964 and it is more than 0.05, so it means that there is no effect of coefficient AR (1) on Y_t. Test for MA (1) is 0.0011 and it is less than 0.05, so there is an effect of coefficient MA (1) on Y_t. Simultaneous test for coefficient AR (2) and MA (1) shows that the significant value equal 0.001852, so it can concluded that there is an effect of coefficient AR (1) and MA (1) on Y_t. The value of Adjusted R Squared is 12.40% which is means that coefficient of AR (1) explain Y_t in the 12.40% while the rest is explained by other variables.

e. ARIMA (2,1,0)

The last tentative model is ARIMA (2,1,0). Where this mode is consist of AR (2), d (1) and MA (0). This model is estimated by using least square and the result is described below (see appendix 10.e for more statistical result):

Table 27 The result of ARIMA (2,1,0) estimate equation

Variable (2,1,0)	Coefficient	P-Value	R^2	Prob(F-stat)

AR (2)	-0.140600	0.1653	1.99% or 0.019959	0.165266

Source: Data Processed by Researcher, August 2017

The result of AR (2) shows that coefficient is not significant. Because of the value of AR (2) is 0.1653 more than 0.05. So it means that AR (2) has no effect on Y_t. Simultaneous test for coefficient AR (2) shows that the significant value equal 0.165266 and it is more than 0.05, so it can concluded that there is no effect of AR (2) on Y_t. The value of Adjusted R Squared is 1.99% which is means that coefficient of AR (2) explains Y_t in the 1.99% while the rest is explained by other variables.

2. Selecting the Best of ARIMA Model

Before determine the ARCH-GARCH model, the several tentative models is prepared. Several tentative models is chosen by using correlogram analysis then selected. The steps of choosing the best model are same with GBP against USD. The selected model is determined by using some of criteria. The First criteria is the biggest R^2 value, and then the smallest AIC and SC. Table 4.11 shows the result of least square equation of ARIMA tentative model.

Table 28 Result of ARIMA tentative model by using least square equation

Model	R^2	AIC	SC
ARIMA (0,1,1)	0.116986	11.84183	11.89394
ARIMA (1,1,0)	0.082913	11.88501	11.93743

Table 28 (Continued)

ARIMA (1,1,1)	0.116803	11.86755	11.94619
ARIMA (2,1,1)	0.124052	11.86546	11.94459
ARIMA (2,1,0)	0.019959	11.95734	12.01009

Source: Data Processed by Researcher, August 2017

Based on table above, the biggest R squared are showed at ARIMA (0,1,1) and ARIMA (2,1,1). But, at ARIMA (2,1,1) there is p-value which not significance with the p-value of variable AR (2) is 0.2964 and it is more than 0.05. The smallest AIC and SC is showed at ARIMA (0,1,1) although the highest R^2 is in ARIMA (2,1,1), but, at ARIMA (12,1,12) there is p-value which is not significance with the p-value of AR (12) is 0.2964 and it is more than 0.05. So the chosen model is ARIMA (0,1,1).

d. Detecting the Heteroskedasticity element by using ARCH-LM Test

Detecting the heteroskedasticity in ARIMA model chosen, ARCH-Lagrange Multiplier is used. If the data has heteroskedasticity element, so ARCH-GARCH model estimation is used to overcome the heteroskedasticity problem of ARIMA tentative model.

Table 29 Result of Heteroskedasticity test by using ARCH-LM

Heteroskedasticity Test: ARCH	
F-statistic	12.24146
Obs*R-squared	11.09382

Prob. F	0.0007
Prob. Chi-Square	0.0009

Source: Data Processed by Researcher, August 2017

Based on ARCH-Lagrange Multiplier test above shows that obs*R^2 calculation value is 11.09382, with the probability value is 0.0009. The probability value of chi square is less than 0.05. It is means that the value is significance and H_0 is rejected. The existence of Heteroskedasticity element means that residua variance is not constant and model used contains of ARCH element. So the model should be estimated by using ARCH-GARCH model to overcome the Heteroskedasticity problem.

e. ARCH-GARCH Mode Estimation by using Maximum Likelihood

The ARIMA (0,1,1) model that is used contains of Heteroskedasticity element. So Maximum Likelihood model estimation is needed. The output which is showed at Maximum Likelihood model estimation consists of two parts that are conditional mean calculation and conditional variance calculation (see appendix 12 for more statistical result).

Table 30 Result of ARCH (1) and GARCH (1) model estimation.

Conditional mean		
Variable	Coefficient	Probability Value
MA (1)	-0.326290	0.0219

Table 30 (Continued)

Conditional Variance		
ARCH (1)	1.338500	0.0000
GARCH (1)	0.260482	0.0057

Source: Data Processed by Researcher, August 2017

The result of Maximum Likelihood regression shows that the probability value at ARCH(1) and GARCH(1) are significance. They are significance whether in conditional mean and also conditional variance. The probability value of conditional variance is significance and it is means that there is volatility at exchange rate value in observation period within 50 days before British Exit event and 50 days after British Exit event. The residual variance of exchange rate value (ARCH) is affected by residual at the period before and lag of residual variance at the period before (GARCH).

The Heteroskedasticity element that detected in exchange rate value of Poundsterling (GBP) against Dollar means that the residual variance of the data is not constant and fluctuates from one period to another period. At conditional mean equation, all of independent variables which is MA (1) have significance value refers to probability value. The probability value for MA (1) is 0.0219 and it less than 0.05, so the value is significance. The significance MA (1) means that the exchange rate value of US Dollar against Rupiah is affected by exchange rate value the period before at lag 1.

Value of R^2 in the ARCH-GARCH (1,1) model is 0.110476 and it is relatively small because the aim of OLS estimation is maximize the value of R^2, but there is correction of heteroskedasticity caused on decreasing the value of R^2. The estimation of ARCH-GARCH model used Maximum Likelihood so the evaluation of regression line is based log likelihood not R^2.

f. Model Evaluation Test

The diagnostic model test should be done to analyze whether the data formed is good enough to modeling the data. To analyze if the data still contains of heteroskedasticity element or not, ARCH-LM test is used. The result of ARCH-LM of ARCH-GARCH model is below:

Table 31 Result of ARCH-LM test of USD against Rupiah

Heteroskedasticity Test: ARCH

F-statistic	0.286019	Prob. F(1,97)	0.5940
Obs*R-squared	0.291058	Prob. Chi-Square(1)	0.5895

Source: Data Processed by Researcher, July 2017

From the ARCH-GARCH model estimation before, the ARCH-LM test was done to analyze whether the data still contain of ARCH element or not. The value of X^2 (Obs*R-squared) is 0.291058 with the probability value is 0.5895 or 58.95% and it is more than 0.05 or. So it is means that H_0 accepted. The residual variance of the data is constant or the data has not contains of ARCH element.

E. Limitation of Research

1. The observation period that long enough made result of research might be realize a bias. According to Affandi and Utama (1998) “when event period taking too long, there will be confounding effect from another event and causing bias effect”. But, the scope and the effect of this event are global, researcher decide to use the long-run observation period.
2. Many previous studies used return stock as samples in event study research. But, the research uses two instrument researches then the sample used in this research is daily closing price where researchers want to capture the difference of the closing price movements of Poundsterling (GBP) against US Dollar and US Dollar against Rupiah. This study refers to some previous studies that used daily closing price as sample with the same method.