CHAPTER 5

Empirical Results

This research aims to examine the best model using ARFIMAX (p,d,q,X) and (p,d,q,X)–GARCH (p,q) models to predict the daily closure of Thai Baht gold spot price with exchange rate volatility during the period from September 2001 to September 2011 and also to compare the results to determine the best forecasting model for both models. To examine the best model using ARFIMAX (p,d,q,X) and (p,d,q,X)–GARCH (p,q) models. All the results using the program to compute such as EViews, Spotfire S+ and Gretl program which it can be divided into 7 parts.

1. Correlation Analysis
2. Unit Root Test
3. Long Memory Test
4. ARFIMAX (p,d,q,X) Test
5. ARFIMAX (p,d,q,X)-GARCH (p,q) Test
6. Forecasting evaluation
7. Compare the best model between ARFIMAX (p,d,q,X) and (p,d,q,X)– GARCH (p,q) models

5.1 Correlation Analysis

Correlation analysis (r) which is analyzed relationship between two variances. The results of analysis can be positively correlated (more of one means more of another) or negatively correlated (more of one means less of another). The correlation results will always be between -1 and 1. If r = 1 means that positive correlation, if r = -1 means that negative correlation and r = 0 means that no correlation.

The data used from the period of September 2001 to September 2011, totally 2670 daily observations. The result shows the correlation analyzed for the growth rate of Thai Baht gold spot price 96.50% with the growth rate of exchange rate THB per USD is -0.03679 means that the data has negative correlation.

The result shows the correlation analyzed for the growth rate of Thai Baht gold spot price 99.99% with the growth rate of exchange rate THB per USD is 0.084608 means that the data has positive correlation.

5.2 The results of various tests for Unit Root Process

Table 5.1 shows the result of the Augmented Dickey-Fuller Test (ADF-Test) and Phillips Perron Test (PP-Test) for Thai Baht gold spot price 96.50%, Thai Baht gold spot price 99.99% and exchange rate of THB per USD.

Table 5.1: Results of the unit root test at level-trend and intercept.

Variables	ADF-Test Constant with trend		PP-Test Constant with trend	
Gold spot price 96.50%	-53.27998**	[0.0000]	-53.25652**	[0.0000]
Gold spot price 99.99%	-47.54131**	[0.0000]	-79.78021**	[0.0001]
Exchange Rate	-57.08512**	[0.0000]	-57.12410**	[0.0000]

*: significant at 5% level, **: significant at 1% level   **Source:** From computed

The variables used for test in ADF test and PP test that is the growth rate of the Thai Baht gold spot price 96.50%, the growth rate of the Thai Baht gold spot price 99.99% and the growth rate of exchange rate of THB per USD. The hypothesis for this test if H_0 is accepted then the Thai Baht gold spot price and exchange rate has unit root and non stationary but if H_0 is reject and accept H_1 means that the Thai Baht gold spot price and exchange rate has no unit root and stationary.

The results of the ADF test and PP test at level-trend and intercept show that the value of ADF test for the Thai Baht gold spot price 96.50% is -53.27998 and the PP test is -53.25625. The value of the ADF test for the Thai Baht gold spot price 99.99% is -47.54131 and the PP test is -79.78021. The value of the ADF test for the exchange rate of THB per USD is -57.08512 and the PP test is -57.12410 which all the value at this level less than Mackinnon Critical value at 1% level and 5% level. The statistics for all the data are significant at 1% level means that all the data have no unit root or the data has stationary process.

5.3 The results of various tests for Long Memory Process

The value of R/S Test, Modified R/S Test and GPH Test show that if the statistic values are significant at 1% level or 5% means the time series data has long-term dependence or long memory process. Otherwise, if the statistic values are not significant at 1% level or 5% level means the time series data has no long-term dependence or no long memory process.

Table 5.2: The results of the Thai Baht gold spot price 96.50% for Long Memory Process based on R/S Test, Modified R/S Test and GPH Test

Method	d	Hypothesis	Test Statistic
R/S Test		no long memory	5.8868**
Modified R/S Test		no long memory	3.78**
GPH Test	0.598	d=0	5.8711**

*: significant at 5% level, **: significant at 1% level   **Source:** From computed
Null Hypothesis: no long-term dependence or no long memory process.
For GPH test, null Hypothesis: d=0

Table 5.2, the results show test for long memory of Thai Baht gold spot price 96.50% that the R/S test for the hypothesis is no long term memory but in the test of statistic show that the data of Thai Baht gold spot price 96.50% has long memory and significant at 1% level. The Modified R/S test, the hypothesis is as the same of the R/S test but in the statistic show that the data has long memory and significant at 1% level. Finally, the hypothesis of the GPH test assumes that d=0 and the statistic shows the data has long memory significant at 1% level.

Therefore, the results of long memory process based on R/S Test, Modified R/S Test and GPH Test for the Thai Baht gold spot price 96.50% has long term memory and significant at 1% level which the R/S test is 5.8868, the modified R/S test is 3.78 and the GPH test is 5.8711.

Table 5.3: The results of the Thai Baht gold spot price 99.99% for Long Memory Process based on R/S Test, Modified R/S Test and GPH Test

Method	d	Hypothesis	Test Statistic
R/S Test		no long memory	3.4732**
Modified R/S Test		no long memory	2.5613**
GPH Test	0.1393	d=0	1.3675

*: significant at 5% level, **: significant at 1% level   **Source:** From computed
Null Hypothesis: no long-term dependence or no long memory process.
For GPH test, null Hypothesis: d=0

Table 5.3, the results show test for long memory of Thai Baht gold spot price 99.99% that the R/S test for the hypothesis is no long term memory but in the test of statistic show that the data of Thai Baht gold spot price 99.99% has long memory and significant at 1% level. The Modified R/S test, the hypothesis is as the same of the R/S test but in the statistic show that the data has long memory and significant at 1% level. Finally, the hypothesis of the GPH test assumes that d=0 and the statistic shows the data has no long memory.

Therefore, the results of long memory process based on R/S Test, Modified R/S Test for the Thai Baht gold spot price 99.99% has long term memory and significant at 1% level which the R/S test is 3.4732 and the modified R/S test is 2.5613.

Table 5.4: The results of the exchange rate of THB per USD for Long Memory Process based on R/S Test, Modified R/S Test and GPH Test

Method	d	Hypothesis	Test Statistic
R/S Test		no long memory	7.3413**
Modified R/S Test		no long memory	3.9527**
GPH Test	0.5535	d=0	5.4336**

*: significant at 5% level, **: significant at 1% level   **Source:** From computed
Null Hypothesis: no long-term dependence or no long memory process.
For GPH test, null Hypothesis: d=0

Table 5.4, the results show test for long memory of the exchange rate of THB per USD that the R/S test for the hypothesis is no long term memory but in the test of statistic show that the data of the exchange rate of THB per USD has long memory and significant at 1% level. The Modified R/S test, the hypothesis is as the same of the R/S test but in the statistic show that the data has long memory and significant at 1% level. Finally, the hypothesis of the GPH test assumes that d=0 and the statistic shows the data has long memory significant at 1% level.

Therefore, the results of long memory process based on R/S Test, Modified R/S Test and GPH Test for the exchange rate of THB per USD has long term memory and significant at 1% level which the R/S test is 7.3413, the modified R/S test is 3.9527 and the GPH test is 5.4336. All the results of the test can be confirmed that the data has long term memory process because the statistic values of R/S Test and Modified R/S Test are significant at 1% level.

5.4 The forecast models' based on concept of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC)

Table 5.5 and table 5.6 show forecasting models of Thai Baht gold spot price 96.50% with exchange rate THB per USD during the period of 2001 to 2011. The minimum statistic value of AIC and BIC used for selection the best of ARFIMAX (p, d, q, X) and ARFIMAX (p, d, q, X)-GARCH (p, q) models.

Table 5.5: The different forecasting models of Thai Baht gold spot price 96.50% with exchange rate of THB per USD during the period from 2001 to 2011 based on ARFIMAX (p, d, q, X) model.

	ARFIMAX(1,d,1)	ARFIMAX(1,d,0)	ARFIMAX(0,d,1)	ARFIMAX(0,d,0)	ARFIMAX(2,d,2)
Const	0.054921***	0.054918***	0.054906***	0.054909***	0.054880***
	[3.234764]	[3.196442]	[3.142934]	[3.078577]	[3.133290]
d	0.008769	-0.002966	-0.020925	-0.041679**	-0.017222
	[0.019192]	[-0.013467]	[-0.049147]	[-2.153336]	[-0.685666]
X	-0.090694**	-0.090678**	-0.090658**	-0.090432**	-0.082764**
	[-2.095239]	[-2.095703]	[-2.096812]	[-2.091618]	[-1.920758]
AR(1)	-0.032894	-0.038780			-1.027933***
	[-0.067937]	[-0.175952]			[-11.26561]
MA(1)	-0.017621		-0.020752		1.008366***
	[-0.020872]		[-0.048697]		10.15156
AR(2)					-0.827058***
					[-10.26100]
MA(2)					0.804070***
					[9.252790]
log-likelihood	-3563.089	-3563.090	-3563.930	-3563.932	-3549.856
AIC	2.675732	2.674983	2.674611	2.673862	2.668309
BIC	2.686772	2.683815	2.683440	2.680484	2.683770
HQ	2.679727	2.678179	2.677805	2.676259	2.673904

***: significant at 1% level, **: significant at 5% level,   **Source:** From computed

*: significant at 10% level

X: the number of the Exchange Rate of Thai Baht per US Dollar,

Endogenous Variable: Thai Baht gold spot price 96.50%

Table 5.5 shows the forecasting models of Thai Baht gold spot price 96.50% with exchange rate of THB per USD during the period from 2001 to 2011. The model of ARFIMAX (p, d, q, X) at the period of ARFIMAX (2, d, 2) which the value of constant is 0.054880, AR (1) is -1.027933 and AR (2) is -0.827058 means if change in AR(1) and AR(2) that change will be the opposite direction with the Thai Baht gold spot price 96.50%, MA(1) is 1.008366 and MA(2) is 0.804070 means if change in MA(1) and MA(2) that change will be the same direction with the Thai Baht gold spot price 96.50% which all the value are significant at 1% level, the exogenous (X) or the exchange rate of THB per USD is -0.082764 means that if there is a change in the exchange rate of THB per USD then the change will be in the opposite direction with the Thai Baht gold spot price 96.50%, this is because the gold price in global market has increased and the Thai Baht has depreciated when compared with the US dollar. Thailand imports gold from other countries so the Thai Baht gold spot price 96.50% will increase in the same direction with the gold price in the global market. The price of the Thai Baht gold spot price 96.50% will depend on the Gold Trader Association. The value of AIC is 2.668309 and BIC is 2.683770. The results show that the period of ARFIMAX (2, d, 2) is the minimum value of the AIC and BIC which is the best model.

Table 5.6: The different forecasting models of Thai Baht gold spot price 96.50% with exchange rate of THB per USD during the period of 2001 to 2011 based on ARFIMAX (p, d, q, X)-GARCH (p, q) model.

	ARFIMAX(1,d,2)-GARCH(1,1)	ARFIMAX(1,d,0)-GARCH(1,1)	ARFIMAX(0,d,1)-GARCH(1,1)	ARFIMAX(0,d,0)-GARCH(1,1)	ARFIMAX(0,d,2)-GARCH(1,1)
Const	0.067834***	0.065127***	0.067000***	0.064387***	0.067585***
	[3.992964]	[4.668548]	[3.980549]	[4.861970]	[3.890225]
d	-0.328426	-0.095532	-0.285728	-0.048666***	-0.343075
	[-1.384821]	[-0.558642]	[-0.654449]	[-2.534998]	[-0.824030]
X	-0.068590**	-0.070226**	-0.070290**	-0.069124**	-0.068949**
	[-2.098068]	[-2.087430]	[-2.100261]	[-2.058459]	[-2.063303]
AR(1)	-0.867658***	0.047873			
	[3.663274]	[0.280068]			
MA(1)	1.147874***		0.240203		0.295424
	[6291.400]		[0.548830]		[0.708381]
AR(2)					
MA(2)	0.239152*				-0.011896
	[1.765375]				[-0.645591]
Const	0.013538***	0.013468***	0.012267***	0.012231***	0.012269***
	[3.310275]	[3.344108]	[3.226184]	[3.222504]	[3.228507]
ARCH(1)	0.074406***	0.073813***	0.070133***	0.069816***	0.070010***
	[6.122262]	[6.206209]	[6.130850]	[6.123916]	[6.126314]
GARCH(1)	0.916293***	0.916421***	0.921210***	0.921522***	0.921335***
	[74.28324]	[75.36074]	[78.54991]	[78.77077]	[78.67232]
log-likelihood	-3165.367	-3166.169	-3165.796	-3166.124	-3165.615
AIC	2.381228	2.380329	2.379157	2.378654	2.379771
BIC	2.403307	2.397993	2.396816	2.394105	2.399637
HQ	2.389217	2.386721	2.385547	2.384245	2.386960

***: significant at 1% level, **: significant at 5% level,   **Source:** From computed

*: significant at 10% level

X: the number of the Exchange Rate of Thai Baht per US Dollar,

Endogenous Variable: Thai Baht gold spot price 96.50%

Table 5.6 shows the period of ARFIMAX (0, d, 0)-GARCH (1, 1) which the constant of ARFIMAX (0, d, 0) is 0.064387, the fractional integration parameter (d) is -0.048666, the constant of GARCH (1, 1) is 0.012231, ARCH (1) is 0.069816, GARCH (1) is 0.921522 which is significant at 1% level, the exogenous (X) or the exchange rate of THB per USD is -0.069124 means that if there is a change in the exchange rate of THB per USD then the change will be in the opposite direction with the Thai Baht gold spot price 96.50%, this is because the gold price in global market has increased and the Thai Baht has depreciated when compared with the US dollar.

Thailand imports gold from other countries so the Thai Baht gold spot price 96.50% will increase in the same direction with the gold price in the global market. The price of the Thai Baht gold spot price 96.50% depends on the Gold Trader Association. The value of AIC is 2.378654 and BIC is 2.394105. In this period is the best model for forecasting the Thai Baht gold spot price 96.50% with exchange rate of THB per USD because it has the minimum value of AIC and BIC.

Table 5.7: The best model for forecasting the Thai Baht gold spot price 96.50%.

	ARFIMAX(2,d,2)	ARFIMAX(0,d,0)-GARCH(1,1)
AIC	2.668309	2.378654
BIC	2.68377	2.394105
HQC	2.673904	2.384245

Source: From computed

Table 5.7 shows that the best model for forecasting the Thai Baht gold spot price 96.50% which is the ARFIMAX(2, d, 2) and ARFIMAX(0,d,0)-GARCH(1,1). The both models have the minimum value of AIC and BIC.

Table 5.8 and table 5.9 show the value of forecasting for the Thai Baht gold spot price 96.50% with exchange rate of THB per USD during a daily of 30 days based on ARFIMAX (2, d, 2) and ARFIMAX (0, d, 0)-GARCH (1, 1) and regard the result by the value of MAE and the MAPE (%). Thus, the MAPE (%) value is less than 10% which is a highly accurate forecast. The MAPE (%) value is between 10% and 20% which is a good forecast. The MAPE (%) value is between 20% and 50% which is a reasonable forecast. If the MAPE value is greater than 50% means that it is an inaccurate forecast.

Table 5.8: Forecast the Thai Baht gold spot price 96.50% with exchange rate of THB per USD based on ARFIMAX (2, d, 2).

daily/day	2011(Actual)	2011(Forecast)	MAE	MAPE (%)
1	0.072534233	-0.020951699	0.003116198	0.148732461
2	0.003524001	0.259848765	0.008544159	0.032881275
3	0.090053903	-0.101736296	0.006393007	0.062838995
4	0.058955591	0.0333645	0.000853036	0.025567186
5	-0.012148613	0.188710258	0.006695296	0.035479236
6	0.104719787	-0.077616189	0.006077866	0.078306677
7	0.06978171	0.063615327	0.000205546	0.003231079
8	0.00821291	0.135115325	0.00423008	0.031307185
9	0.09417084	-0.043687137	0.004595266	0.105185787
10	-0.080427894	0.086420082	0.005561599	0.064355403
11	0.038095755	0.099093629	0.002033262	0.020518599
12	0.107222005	-0.019487869	0.004223662	0.216732903
13	-0.117631128	0.09018929	0.006927347	0.076808979
14	0.094397957	0.078265545	0.000537747	0.006870802
15	-0.011728611	0.006256242	0.000599495	0.095823517
16	-0.114870744	0.084577784	0.006648284	0.078605562
17	0.25416812	0.051275957	0.006763072	0.131895579
18	0.043759571	0.014907549	0.000961734	0.064513225
19	-0.121972235	0.085011744	0.006899466	0.081158975
20	0.178802986	0.052165236	0.004221258	0.08092091
21	-0.063156182	0.030103637	0.003108661	0.103265285
22	-0.044373381	0.077915297	0.004076289	0.052316932
23	0.183652958	0.045928118	0.004590828	0.099956807
24	-0.088555049	0.03473204	0.00410957	0.11832215
25	0.086090326	0.05698924	0.000970036	0.017021392
26	0.425236671	0.029795113	0.013181385	0.442400921
27	-0.201711983	0.051912692	0.008454156	0.16285335
28	-0.115688355	0.072283643	0.006265733	0.086682588
29	0.377003242	0.031654822	0.011511614	0.363660676
30	-0.14525645	0.046168755	0.00638084	0.138206893
Total	**1.172861943**	**1.542821398**	**0.148736494**	**3.026421329**

Source: From computed

Table 5.8 shows the result of forecasting which is based on ARFIMAX (2, d, 2) that the value of MAE is 0.148736494 and the MAPE (%) is 3.026421329. Thus, the MAPE (%) value is less than 10% which is a highly accurate forecast.

Table 5.9: Forecast the Thai Baht gold spot price 96.50% with exchange rate of THB per USD based on ARFIMAX (0, d, 0)-GARCH (1, 1).

| daily/day	2011(Actual)	2011(Forecast)	MAE	MAPE (%)
1	0.072534233	0.050868532	0.00072219	0.014197186
2	0.003524001	0.047156379	0.001454413	0.03084233
3	0.090053903	0.044324899	0.0015243	0.034389253
4	0.058955591	0.049082285	0.00032911	0.006705275
5	-0.012148613	0.047360553	0.001983639	0.041883778
6	0.104719787	0.043070602	0.002054973	0.047711728
7	0.06978171	0.047406658	0.000745835	0.015732707
8	0.00821291	0.046711042	0.001283271	0.027472542
9	0.09417084	0.050962203	0.001440288	0.028261885
10	-0.080427894	0.054200957	0.004487628	0.082796109
11	0.038095755	0.04522484	0.000237636	0.00525455
12	0.107222005	0.051928939	0.001843102	0.035492776
13	-0.117631128	0.053384748	0.005700529	0.106781982
14	0.094397957	0.048219594	0.001539279	0.031922268
15	-0.011728611	0.05800088	0.002324316	0.040073812
16	-0.114870744	0.045967201	0.005361265	0.116632397
17	0.25416812	0.036725177	0.007248098	0.197360466
18	0.043759571	0.054473558	0.000357133	0.006556078
19	-0.121972235	0.04978659	0.005725294	0.114996712
20	0.178802986	0.04616742	0.004421186	0.095764189
21	-0.063156182	0.056884501	0.004001356	0.070341763
22	-0.044373381	0.045867403	0.003008026	0.065580912
23	0.183652958	0.046747501	0.004563515	0.097620518
24	-0.088555049	0.051801521	0.004678552	0.090316891
25	0.086090326	0.026929107	0.001972041	0.073230822
26	0.425236671	0.038437482	0.012893306	0.335435771
27	-0.201711983	0.066685109	0.00894657	0.134161433
28	-0.115688355	0.040945386	0.005221125	0.127514359
29	0.377003242	0.039351128	0.01125507	0.286016461
30	-0.14525645	0.058135723	0.006779739	0.116619158
Total	**1.172861943**	**1.442807919**	**0.114102786**	**2.47766611**

Source: From computed

Table 5.9 based on ARFIMAX (0, d, 0)-GARCH (1, 1) shows the value of MAPE (%) is 2.47766611. The MAPE (%) is less than 10%, so it is a highly accurate forecast.

Table 5.10: Compares the best model of the Thai Baht gold spot price 96.50% with exchange rate of THB per USD between ARFIMAX (2, d, 2) and ARFIMAX (0, d, 0)-GARCH (1, 1) models.

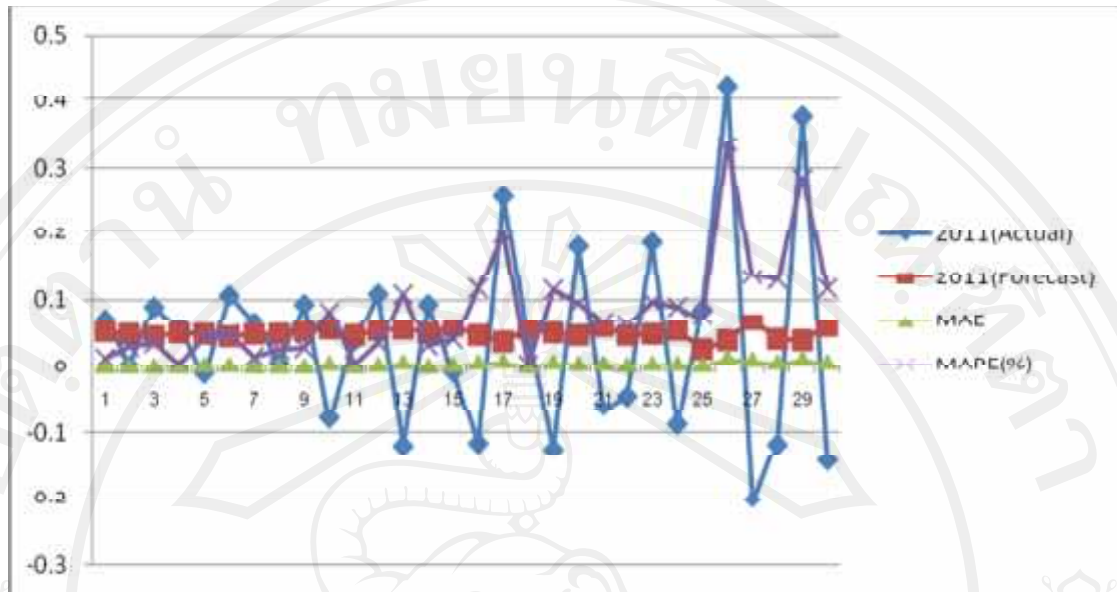|	**ARFIMAX (2, d, 2)**	**ARFIMAX (0, d, 0)-GARCH (1, 1)**
MAE	0.148736494	0.114102786
MAPE (%)	3.026421329	2.47766611

Source: From computed

Table 5.10 shows the model of ARFIMAX (0, d, 0)-GARCH (1, 1) which is best model to predict the Thai Baht gold spot price 96.50% with exchange rate of THB per USD because the both values of MAE and MAPE (%) is less than the model of ARFIMAX (2, d, 2).
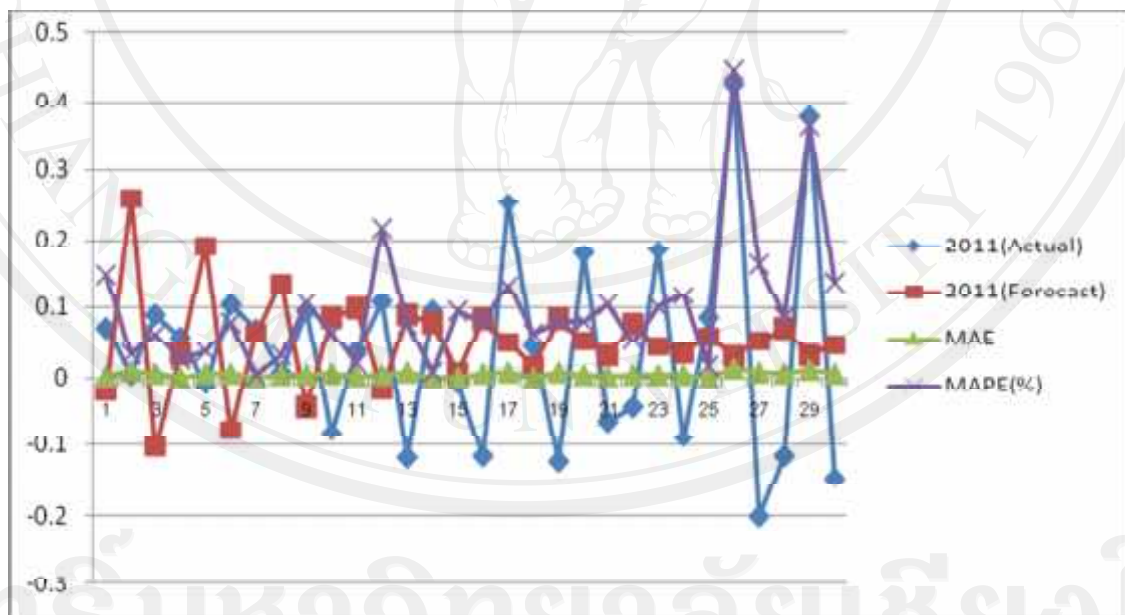
Source: From computed

Figure 5.1: The graph of the Thai Baht gold spot price 96.50% with exchange rate of THB per USD during the period of 2001 to 2011 based on ARFIMAX (2, d, 2).

Figure 5.2: The graph of the Thai Baht gold spot price 96.50% with exchange rate of THB per USD during the period of 2001 to 2011 based on ARFIMAX (0, d, 0)-GARCH (1, 1).

Figure 5.1 and figure 5.2 show the graphs of the Thai Baht gold spot price 96.50% with exchange rate of THB per USD based on ARFIMAX (2, d, 2) and ARFIMAX (0, d, 0)-GARCH (1, 1). The graph shows that the value of the actual price, forecasting price, the mean absolute error and the mean absolute percentage error during 30 days.

Table 5.11 and table 5.12 show the forecasting models of Thai Baht gold spot price 99.99% with exchange rate of THB per USD during the period from 2001 to 2011. The statistic value such as AIC and BIC used for selection the best of ARFIMAX (p, d, q, X) and ARFIMAX (p, d, q, X)-GARCH (p, q) models.

Table 5.11: The different forecasting models of Thai Baht gold spot price 99.99% with exchange rate of THB per USD during the period of 2001 to 2011 based on ARFIMAX (p, d, q, X) model.

	ARFIMAX(1,d,1)	ARFIMAX(1,d,0)	ARFIMAX(0,d,1)	ARFIMAX(0,d,0)	ARFIMAX(2,d,2)
Const	0.083732***	0.120787***	0.080666***	0.129518***	0.122768***
	[2.606123]	[2.591346]	[2.675543]	[2.664091]	[3.116821]
d	0.017198	-0.299224***	0.044257	-0.376290***	-0.338350***
	[0.138168]	[-2.814635]	[0.429943]	[-19.63048]	[-10.75529]
X	0.445835***	0.499177***	0.437203***	0.504338***	0.505209***
	[4.011910]	[4.250524]	[4.006076]	[4.283323]	[4.305772]
AR(1)	0.021136	-0.079897			-0.078730
	[0.341412]	[-0.745781]			[-0.279542]
MA(1)	-0.422697***		-0.431034***		0.034622
	[-4.418333]		[-4.317190]		[0.126379]
AR(2)					0.654474***
					[3.001999]
MA(2)					-0.692143***
					[-3.115881]
log-likelihood	-6231.423	-6234.323	-6233.362	-6236.635	6226.917
AIC	4.676733	4.678157	4.675684	4.677388	4.676607
BIC	4.687773	4.686989	4.684513	4.684010	4.692068
HQ	4.680728	4.681353	4.678879	4.679784	4.682202

***: significant at 1% level, **: significant at 5% level,   **Source:** From computed

*: significant at 10% level

X: the number of the Exchange Rate of Thai Baht per US Dollar,

Endogenous Variable: Thai Baht gold spot price 99.99%

Table 5.11 shows forecasting models of Thai Baht gold spot price 99.99% with exchange rate of THB per USD during the period of 2001 to 2011. The period of ARFIMAX (0, d, 1) which is the best model because in this period has the minimum value of AIC and BIC. The value of constant is 0.080666, the exogenous (X) or the exchange rate of THB per USD is 0.437203 means that if there is a change in the exchange rate of THB per USD then the change will be in the same direction with the Thai Baht gold spot price 99.99%, this is because the price of the gold spot price 99.99% was trading on the global market in real time when the price of gold in

the global market increased and the Thai Baht has appreciated then the Thai Baht gold spot price 99.99% will increase as the same direction with the gold price in the global market. MA (1) is -0.431034 means if change in MA (1) the change will be opposite direction with the Thai Baht gold spot price 99.99% which is significant at 1% level, the value of AIC is 4.675684 and BIC is 4.684513.

Table 5.12: The different forecasting models of Thai Baht gold spot price 99.99% with exchange rate of THB per USD during the period of 2001 to 2011 based on ARFIMAX (p, d, q, X)-GARCH (p, q) model.

	ARFIMAX(1,d,2)-GARCH(1,1)	ARFIMAX(1,d,0)-GARCH(1,1)	ARFIMAX(0,d,1)-GARCH(1,1)	ARFIMAX(0,d,0)-GARCH(1,1)	ARFIMAX(0,d,2)-GARCH(1,1)
Const	0.030491**	0.074459***	0.069650***	0.079542***	0.035682***
	[-0.155371]	[3.983140]	[3.654614]	[4.162946]	[2.508631]
d	0.397717***	-0.083448	-0.026810	-0.146499***	0.343088***
	[3.036625]	[-1.400426]	[-0.267425]	[-7.709214]	[2.698508]
X	0.162555***	0.172788***	0.180337***	0.160681***	0.173959***
	[3.036625]	[3.500264]	[3.680442]	[3.234499]	[3.787585]
AR(1)	-0.109212	-0.067288			
	[-0.484856]	[-1.089996]			
MA(1)	-0.440581**		-0.127444		-0.494827***
	[-2.121208]		[-1.217171]		[-3.854187]
AR(2)					
MA(2)	-0.155371				-0.081615***
	[-1.024139]				[-3.176910]
Const	0.088139***	0.088910***	0.087086***	0.087175***	0.086723***
	[5.759744]	[5.773797]	[5.741509]	[5.736553]	[5.731999]
ARCH(1)	0.135089***	0.133977***	0.132709***	0.132814***	0.134138***
	[7.266382]	[7.244673]	[7.241719]	[7.240784]	[7.263804]
GARCH(1)	0.829938***	0.830215***	0.832533***	0.832557***	0.831847***
	[51.78190]	[51.70017]	[52.45913]	[52.46012]	[52.44199]
log-likelihood	-4211.234	-4214.242	-4215.626	-4216.463	-4213.100
AIC	3.165530	3.166286	3.166137	3.166014	3.164992
BIC	3.187610	3.183950	3.183795	3.181465	3.184858
HQ	3.173520	3.172678	3.172526	3.171605	3.172181

***: significant at 1% level, **: significant at 5% level**,**   **Source:** From computed

*: significant at 10% level

X: the number of the Exchange Rate of Thai Baht per US Dollar,

Endogenous Variable: Thai Baht gold spot price 99.99%

Table 5.12 shows the period of ARFIMAX (0, d, 0)-GARCH (1, 1) which is the best model for forecasting Thai Baht gold spot price 99.99% with exchange rate of THB per USD. The constant value of ARFIMAX (0, d, 0) is 0.079542, the exogenous (X) or the exchange rate of THB per USD is 0.160681 means that if there is a change in the exchange rate of THB per USD then the change will be in the same direction with the Thai Baht gold spot price 99.99%, this is because the price of the gold spot price 99.99% was trading on the global market in real time when the price of gold in the global market increased and the Thai Baht has appreciated then the Thai Baht gold spot price 99.99% will increase in the same direction with the gold price in the global market. The constant value of GARCH (1, 1) is 0.087175, ARCH (1) is 0.132814 and GARCH (1) is 0.832557. In this period has the minimum value of AIC that is 3.166014, BIC is 3.181465 and HQC is 3.171605.

Table 5.13: The best model for forecasting the Thai Baht gold spot price 99.99%.

	ARFIMAX(0,d,1)	ARFIMAX(0,d,0)-GARCH(1,1)
AIC	4.675684	3.166014
BIC	4.684513	3.181465
HQC	4.678879	3.171605

Source: From computed

Table 5.13 shows that the best model for forecasting the Thai Baht gold spot price 99.99% which is the ARFIMAX(0, d, 1) and ARFIMAX(0,d,0)-GARCH(1,1). The both models have the minimum value of AIC and BIC.

Table 5.14 and table 5.15 show the value of forecasting for the Thai Baht gold spot price 99.99% with exchange rate of THB per USD during a daily of 30 days based on ARFIMAX (0, d, 1) and ARFIMAX (0, d, 0)-GARCH (1, 1) and regard the result by the value of MAE and the MAPE (%). Thus, the MAPE (%) value is less than 10% which is a highly accurate forecast. The MAPE (%) value is between 10% and 20% which is a good forecast. The MAPE (%) value is between 20% and 50%

which is a reasonable forecast. If the MAPE value is greater than 50% means that it is an inaccurate forecast.

Table 5.14: Forecast the Thai Baht gold spot price 99.99% with exchange rate of THB per USD based on ARFIMAX (0, d, 1).

daily/day	2011(Actual)	2011(Forecast)	MAE	MAPE (%)
1	0.035830106	0.154297017	0.003948897	0.025592828
2	0.086868065	-0.009374651	0.003208091	0.342209061
3	0.108175448	0.024555696	0.002787325	0.113510327
4	0.152961211	0.099186898	0.001792477	0.018071712
5	0.139892587	0.107045214	0.001094912	0.010228504
6	-0.083270278	0.177427671	0.008689932	0.048977319
7	0.049036883	0.46641427	0.01391258	0.029828803
8	0.21046925	0.320341074	0.003662394	0.011432796
9	0.205369464	-0.145497583	0.011695568	0.080383248
10	0.256177503	-0.307266097	0.018781453	0.061124392
11	0.11493102	-0.265473548	0.012680152	0.047764278
12	0.190699908	-0.051708045	0.008080265	0.156267078
13	0.255838395	-0.149515931	0.013511811	0.090370376
14	0.201388708	-0.518339445	0.023990938	0.046284223
15	0.185752636	-0.423365386	0.020303934	0.047958418
16	0.044603043	-0.204127258	0.00829101	0.040616869
17	0.009054925	0.027560988	0.000616869	0.022381954
18	0.095105712	0.151627155	0.001884048	0.012425532
19	0.137760499	-0.057052991	0.006493783	0.113820203
20	0.139274618	-0.011535412	0.005027001	0.435788597
21	0.129029473	-0.296053562	0.014169435	0.047861051
22	0.132353943	-0.365724117	0.016602602	0.045396519
23	0.186465523	-0.160982537	0.011581602	0.07194322
24	0.172519905	-0.080855756	0.008445855	0.104455833
25	-0.166700004	0.258400081	0.014170003	0.054837455
26	-0.050872734	1.344023615	0.046496545	0.034595036
27	0.336812772	0.889159707	0.018411565	0.020706701
28	0.129359196	-0.468660842	0.019934001	0.042533959
29	0.05771358	-0.208806737	0.008884011	0.042546571
30	0.101730123	-0.058176903	0.005330234	0.091621141
Total	**3.564331481**	**0.237522586**	**0.334479293**	**2.311534003**

Source: From computed

The result of table 5.14 based on ARFIMAX (0, d, 1) shows the value of MAE is 0.334479293 and the MAPE (%) is 2.311534003 which the value is less than 10%, so it is a highly accurate forecast.

Table 5.15: Forecast the Thai Baht gold spot price 99.99% with exchange rate of THB per USD based on ARFIMAX (0, d, 0)-GARCH (1, 1).

| daily/day	2011(Actual)	2011(Forecast)	MAE	MAPE (%)
1	0.035830106	0.243585902	0.006925193	0.028430189
2	0.086868065	-0.026478283	0.003778212	0.142690959
3	0.108175448	0.103772676	0.000146759	0.001414236
4	0.152961211	0.174679732	0.000723951	0.004144446
5	0.139892587	0.149737579	0.000328166	0.00219161
6	-0.083270278	0.238939694	0.010740332	0.044949971
7	0.049036883	0.573618218	0.017486044	0.030483768
8	0.21046925	0.245966271	0.001183234	0.004810554
9	0.205369464	-0.264747054	0.015670551	0.059190651
10	0.256177503	-0.247232561	0.016780335	0.067872676
11	0.11493102	-0.133025601	0.008265221	0.062132557
12	0.190699908	0.114239399	0.002548684	0.022310023
13	0.255838395	-0.114997997	0.012361213	0.107490681
14	0.201388708	-0.528884168	0.024342429	0.046026012
15	0.185752636	-0.228863679	0.013820544	0.060387668
16	0.044603043	-0.011468679	0.001869057	0.162970587
17	0.009054925	0.181288377	0.005741115	0.031668412
18	0.095105712	0.23376232	0.004621887	0.019771736
19	0.137760499	-0.085570202	0.007444357	0.086997068
20	0.139274618	0.081180261	0.001936479	0.023854057
21	0.129029473	-0.314991563	0.014800701	0.046987612
22	0.132353943	-0.259599263	0.013065107	0.050327981
23	0.186465523	0.024233514	0.005407734	0.223151026
24	0.172519905	0.02284615	0.004989125	0.218379248
25	-0.166700004	0.426064067	0.019758802	0.046375191
26	-0.050872734	1.648503314	0.056645868	0.034361998
27	0.336812772	0.540788174	0.00679918	0.012572723
28	0.129359196	-0.923161695	0.03508403	0.038004209
29	0.05771358	0.06123349	0.00011733	0.001916114
30	0.101730123	0.067007618	0.001157417	0.017272914
Total	**3.56433148**	**1.99242601**	**0.314539057**	**1.699136878**

Source: From computed

Table 5.15 shows the value of MAE is 0.314539057 and the MAPE (%) is 1.699136878 based on ARFIMAX (0, d, 0)-GARCH (1, 1). The value of the MAPE (%) is less than 10%, so it is a highly accurate forecast.

Table 5.16: Compares the best model of the Thai Baht gold spot price 99.99% with exchange rate of THB per USD between ARFIMAX (0, d, 1) and ARFIMAX (0, d, 0)-GARCH (1, 1) models.

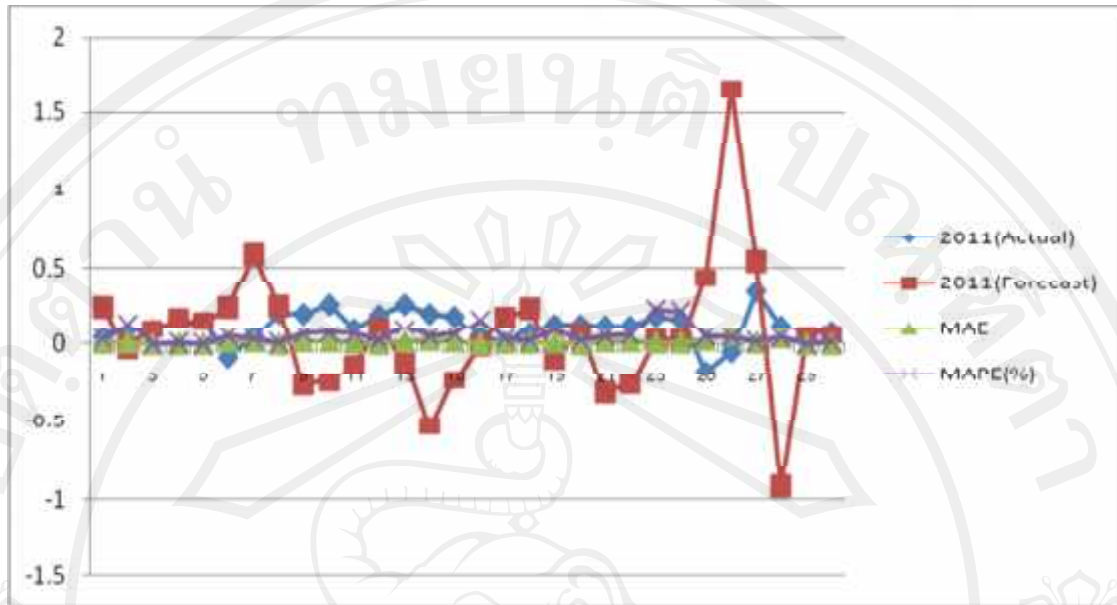|	ARFIMAX (0, d, 1)	ARFIMAX (0, d, 0)-GARCH (1, 1)
MAE	0.334479293	0.314539057
MAPE (%)	2.311534003	1.699136878

Source: From computed

Table 5.16 shows the model of ARFIMAX (0, d, 0)-GARCH (1, 1) is best model to predict the Thai Baht gold spot price 99.99% with exchange rate of THB per USD because the both values of MAE and MAPE (%) is less than the model of ARFIMAX (0, d, 1).
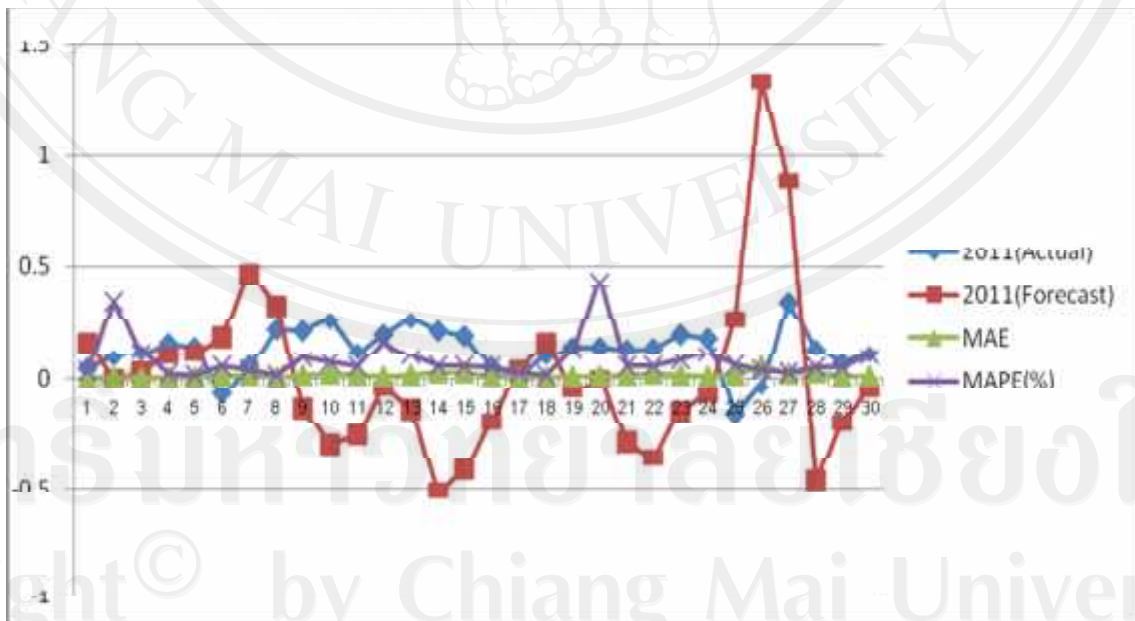
Source: From computed

Figure 5.3: The graph of the Thai Baht gold spot price 99.99% with exchange rate of THB per USD during the period of 2001 to 2011 based on ARFIMAX (0, d, 1).

Figure 5.4: The graph of the Thai Baht gold spot price 99.99% with exchange rate of THB per USD during the period of 2001 to 2011 based on ARFIMAX (0, d, 0)-GARCH (1, 1).

Figure 5.3 and figure 5.4 show the graphs of the Thai Baht gold spot price 99.99% with exchange rate of THB per USD based on ARFIMAX (0, d, 1).and ARFIMAX (0, d, 0)-GARCH (1, 1). The graph shows that the value of the actual price, forecasting price, the mean absolute error and the mean absolute percentage error during 30 days.