Chapter 4

Modeling the Volatility of Rubber Price Return with Exchanges

For this case study, we want using VARMA GARCH Model to model the volatility of rubber price return with six different exchange rates.

4.1 Introduction

The exchange rate is a very important economic variable in international trade that has been the focus of every national government and numerous economists. Prior to 1973, majority of countries utilized the fixed exchange rate system proposed by Bretton Woods. After 1973, however, countries no longer limited the volatility of the exchange rate; their respective national central banks no longer controlled the volatility of the exchange rate. The exchange rate of every country was then decided by the supply and demand in the exchange market. If the balance of payments was favorable, the foreign exchange supply was increased and the exchange rate depreciated. However, if the balance of payments was unfavorable, the foreign exchange rate demand was increased and the exchange rate appreciated. When the majority of countries adopted this flexible exchange rate system, the risk of exchange was shifted to the exporter. Due to the volatility of exchange rate affecting the export price, the volume of export products will be correspondingly affected. The volatility of the export price and the export volume will affect the competitiveness of export

products in the international market. Therefore, when the exporter sets up the contracts, in addition to cost factor, the volatility of exchange rate is another very important factor for earning maximum profit. If the investment comes from imports, the volatility of the exchange rate will reflect the cost. The influences of investment in imports have been increasing in recent years. The volatility of the exchange rate has performed as expected in the exchange market. Therefore, numerous factors affect the volatility of the exchange rate, and the risk of investment in exchange rate has increased. Much research has been conducted on the volatility of the exchange rate affected by trade volume, trade price, and investment cost after the application of the flexible exchange rate system.

Under the supply and demand model which involves one export supply and one import demand, Ethier (1973) and Hopper, et al. (1978) posited that the price of international products become unstable if the volatility of the exchange rate increases drastically under the floating exchange rate system. Due to the exchange risk caused by the volatility of normal exchange rate, the import and export firms conducting risk aversion will decrease the trade volume, regardless of whether the exchange rate risk is due to an exporter or importer. Some results in the literature revealed that the relationship between volatility of exchange rate and trade volume is not significant. Normally, firms decrease trade volume due to the instability of the real product price. This instability is caused not only by the volatility of the exchange rate, but also by the volatility of the product price in the home country and abroad. Further, the instability contributes to the lack of conclusive research on the effects of trade volume through the volatility of the exchange rate. Thailand, Malaysia, and Indonesia are the major producers and exporters of rubber in the world. The total rubber output of these

three countries is about 94% of the total world market in 2007, which amounts to approximately 8.32 million tons. The rubber industry is one of the most important economies in Thailand. The rubber plantations cover an area of 219,933 hectares, with an annual output of 3.056 million tons in 2007, of which approximately 2.772 million tons were exported (Office of the Rubber Replanting Aid Fund, 2008), as detailed in Table 4. The export of rubber constitutes nearly 90% of the total rubber output in Thailand. The Thai baht continued to appreciate and the demand for rubber increased, so the export price rose to 2.23 USD per kilogram in March 2007. A possible reason for this sudden increase in global rubber price is the increasing demand for rubber in the United States and China. However, the U.S. Department of State website lists the 2010 per capita income of Thailand at a mere 4,716 USD. Although Thailand has advantages in the rubber industry, its income seems to exhibit no improvement at all. The key to this contradiction is the farmers lack of knowledge of hedging the market.

The exchange rate becomes a crucial factor because trading in Thailand is highly dependent on the USA and Japan. Furthermore, other uncontrollable elements, such as tsunamis, floods, political environments, and so on, directly affect the exchange rate. At present, six major regions (Japan, China, USA, Malaysia, South Korea, and Europe) import rubber from Thailand. Therefore, we will focus on six variables (the relationship of exchange rates between six as mentioned above) in addition to the variable concerning the export price of rubber in Thailand.

Table 4.1 The export and output rubber in Thailand unit: ton

	Export								Total output
	Japan	China	U.S.A.	Malaysia	South Korea	Europe	Other	total	
2001	505,233	417,638	329,504	243,708	136,387	231,178	302,505	2,166,153	2,319,549
2002	435,453	368,114	302,174	296,989	139,295	233,390	266,664	2,042,079	2,615,104
2003	498,854	436,637	382,317	363,651	138,756	266,392	321,809	2,354,416	2,876,005
2004	542,837	650,898	278,693	365,486	165,832	294,239	275,465	2,573,450	2,984,293
2005	525,654	619,800	249,196	383,695	171,668	291,670	395,413	2,637,096	2,937,158
2006	540,485	573,385	237,858	403,506	185,308	281,090	410,766	2,632,398	3,136,993
2007	492,740	747,168	210,784	442,664	173,477	261,882	442,958	2,771,673	3,056,005
2008	405,599	827,369	213,080	413,049	151,824	262,182	430,659	2,703,762	3,089,751
2009	394,742	824,833	219,986	398,043	154,340	249,509	433,830	2,675,283	3,164,379
2010	346,302	1,128,553	177,859	443,000	171,530	268,693	330,510	2,866,447	3,252,135

Due to Thailand's place as the leading exporter of rubber in the world, and with agriculture being the most important industry in Thailand, this paper aims to discover the relationships between different exchange rate returns and rubber price returns. Our aims are twofold: (1) to study the relationship between rubber export price and six kinds of exchange rates, and (2) to use historical information to forecast the export price with different exchange rates, thus helping the Thai government set up a monetary policy for increasing the price of rubber.

4.2 Empirical Results

The results of data analysis in my first case study show that all series data are stationary in Table 4.2, which the estimated value of θ and the t-statistics of all the returns are significantly less than zero at the 1% level.

Table 4.2 The ADF Test of Unit Roots in Returns in First Case Study

Returns	Coefficient	t-statistic
PRICE	-0.5165	-11.1036
BAHT	-1.0347	-24.7531
CNY	-1.0040	-23.9896
EUR	-1.0676	-25.5970
JPY	-1.0232	-24.4772
KRW	-1.1833	-28.7615
MYR	-1.0503	-25.1073

Table 4.3 illustrates the descriptive statistics of the variables. In this study, the standard deviation of rubber price returns is higher than all values for the volatility of the exchange rate. The PRICE, BAHT, and KRW are negative; as such, they skew significantly to the left. In this study, all the variables for the excess kurtosis statistics are positive, indicating that the distribution of returns has larger, thicker tails than the normal distribution. Therefore, the assumption of skewed-t is more appropriate in this study.

Table 4.3 The Summary Statistics of First Case Study

	PRICE	BAHT	CNY	EUR	JPY	KRW	MYR
Mean	0.0003	-0.0002	0.0000	-0.0001	0.0000	0.0002	0.0000
SD	0.0107	0.0032	0.0067	0.0090	0.0098	0.0107	0.0072
Skewness	-0.4902	-0.3293	0.3519	0.0463	0.0019	-0.1363	0.2140
Kurtosis	8.7482	7.1771	121.4066	34.492	30.5565	34.6872	88.4493
Max	0.0463	0.0163	0.1194	0.1085	0.1191	0.1167	0.1171
Min	-0.0529	-0.0188	-0.1104	-0.1113	-0.1062	-0.1154	-0.1083
JB	816.0708	429.1715	920686.5000	65126.9600	49864.6900	65939.1600	479482.4000

We employed these methods because the time-varying volatility can be estimated, and the asymmetric effects of positive and negative shocks of equal magnitude and volatility spillovers can be tested. The results of VARMA-GARCH and VARMA-AGARCH are shown in Table 4.4. The number of volatility spillovers and asymmetric effects are summarized in Table 4.5. From the Table7, the t-value of Γ from VARMA-AGARCH model is only 0.9247 which indicates statistical significance at the 1% level is 1.96. Therefore, the table 4.5 shows that the result of asymmetric effects is "No". Therefore, table 4.5 further shows that the volatility spillovers are not evident in the VARMA-AGARCH model. Therefore, the VARMA-GARCH is superior to VARMA-AGARCH in examining the volatility of rubber price return. Table 4.4 also indicates that four kinds of exchange rate returns exhibit spillovers to the volatility of rubber price returns. This occurs not only in the VARMA-GARCH model, but also in the VARMA-AGARCH model, which covers the Thai Baht, the Euro, and the Malaysian Ringgit. For Chinese Yuan, the significance of result of VARMA-GARCH model is better than VARMA-AGARCH model. About the relationship between volatility of rubber price and exchange rate, the coefficients are positive between volatility of rubber price and two kinds of exchange rate, which are CNY and MYR and the coefficients are negative between volatility of rubber price and other two kinds of exchange rate, which are BAHT and EUR.

Table 4.4 Estimates of VARMA-GARCH Model in Case Study 1

Returns of rubber price	ω	α_{PRICE}	α_{BAHT}	α_{CNY}	α_{EUR}	α_{JPY}	α_{KRW}	α_{MYR}
VARMA-GARCH	**0.0000*****	**0.19727*****	**2.72806****	**-1.98220****	**-0.1345*****	**0.0150**	**0.0108**	**-0.4402****
	48.0720	**4.45952**	**2.48305**	**-2.24116**	**-2.6031**	**0.2880**	**0.4377**	**-1.9663**
VARMA-AGARCH	**0.0000*****	**0.16816****	**2.84640****	**-2.09856****	**-0.5700*****	**0.0053**	**0.0051**	**-0.1026***
	53.2316	**2.42505**	**2.34941**	**-2.07233**	**-3.2040**	**0.1022**	**0.2135**	**-1.8380**

Table 4.4 (Continued)

Returns of rubber price	Γ	β_{PRICE}	β_{BAHT}	β_{CNY}	β_{EUR}	β_{JPY}	β_{KRW}	β_{MYR}
VARMA-GARCH		**0.6268*****	**-1.6354*****	**1.1463*****	**-0.3188*****	**0.0427**	**0.051**	**0.5397*****
		26.1728	**-3.3775**	**2.9576**	**-3.2276**	**0.5478**	**1.6415**	**2.9496**
VARMA-AGARCH	**0.0930**	**0.6115*****	**-1.5487*****	**1.1115****	**-0.3893*****	**0.1066**	**0.0524***	**0.4809*****
	0.9247	**24.8285**	**-2.7376**	**2.3247**	**-3.4762**	**1.2550**	**1.6535**	**2.7582**

Notes: (1) The two entries for each parameter are their respective estimate and Bollerslev and Woodridge (1992) robust t-ratios.

(2) * indicates statistical significance at the 10% level; ** indicates statistical significance at the 5% level;*** indicates statistical significance at the 1% level

Table 4.5 Summary of Volatility Spillovers and Asymmetric Effects in Case Study 1

Returns	Number of volatility spillovers		Asymmetric effects
	VARMA-GARCH	VARMA-AGARCH	
Rubber Prices	5	5	NO

We used rolling windows to examine the time-varying conditional correlations using the VARMA-GARCH and VARMA-AGARCH models. The rolling window size was set at 1,000 for the exchange rate of six regions that import rubber from Thailand, and the results are shown in Figures 4.1 and 4.2, respectively. In the case of the VARMA-GARCH model, the correlations of six variables are not constant over time; as such, the assumption of constant conditional correlations may be too restrictive. However, the changes in the estimated correlations are minimal. The correlation between the volatility of rubber price returns and volatility of all the exchange rate returns are small (not more than 0.1). The result from the VARMA-AGARCH model is similar to that from the VARMA-GARCH model.

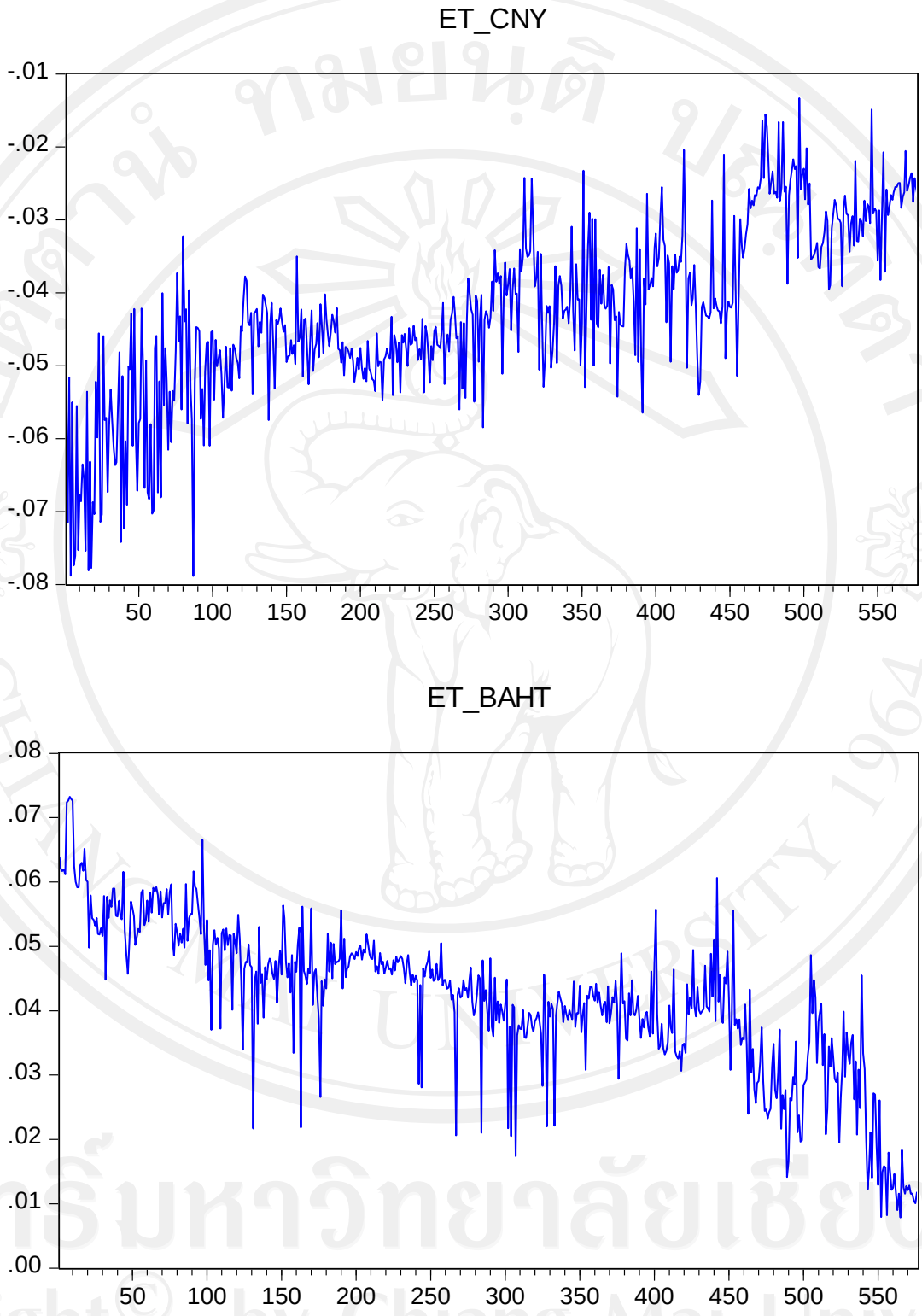


Figure 4.1 Dynamic VARMA-GARCH model in Case Study1

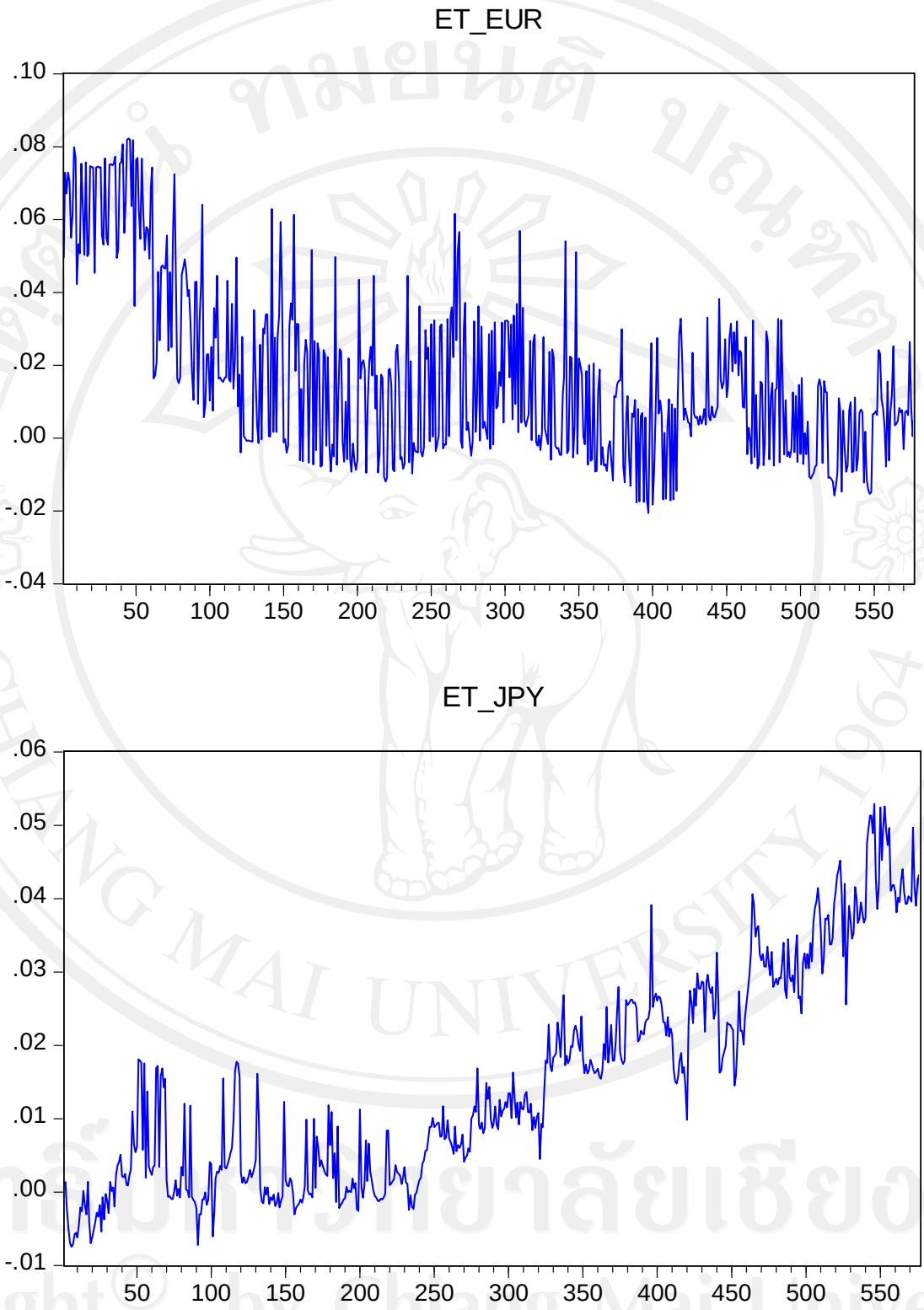


Figure 4.1 (Continue 1)

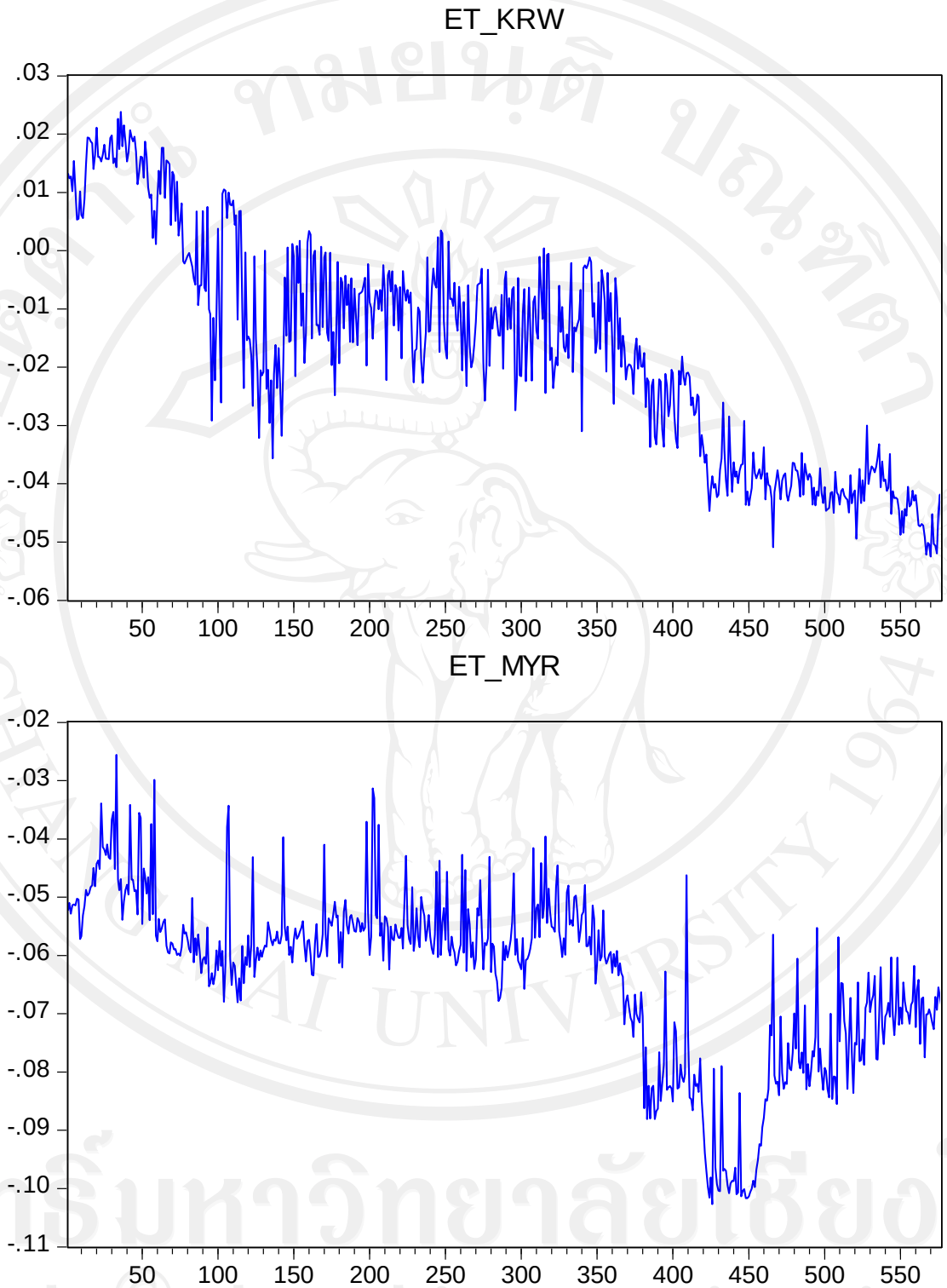


Figure 4.1 (Continue 2)

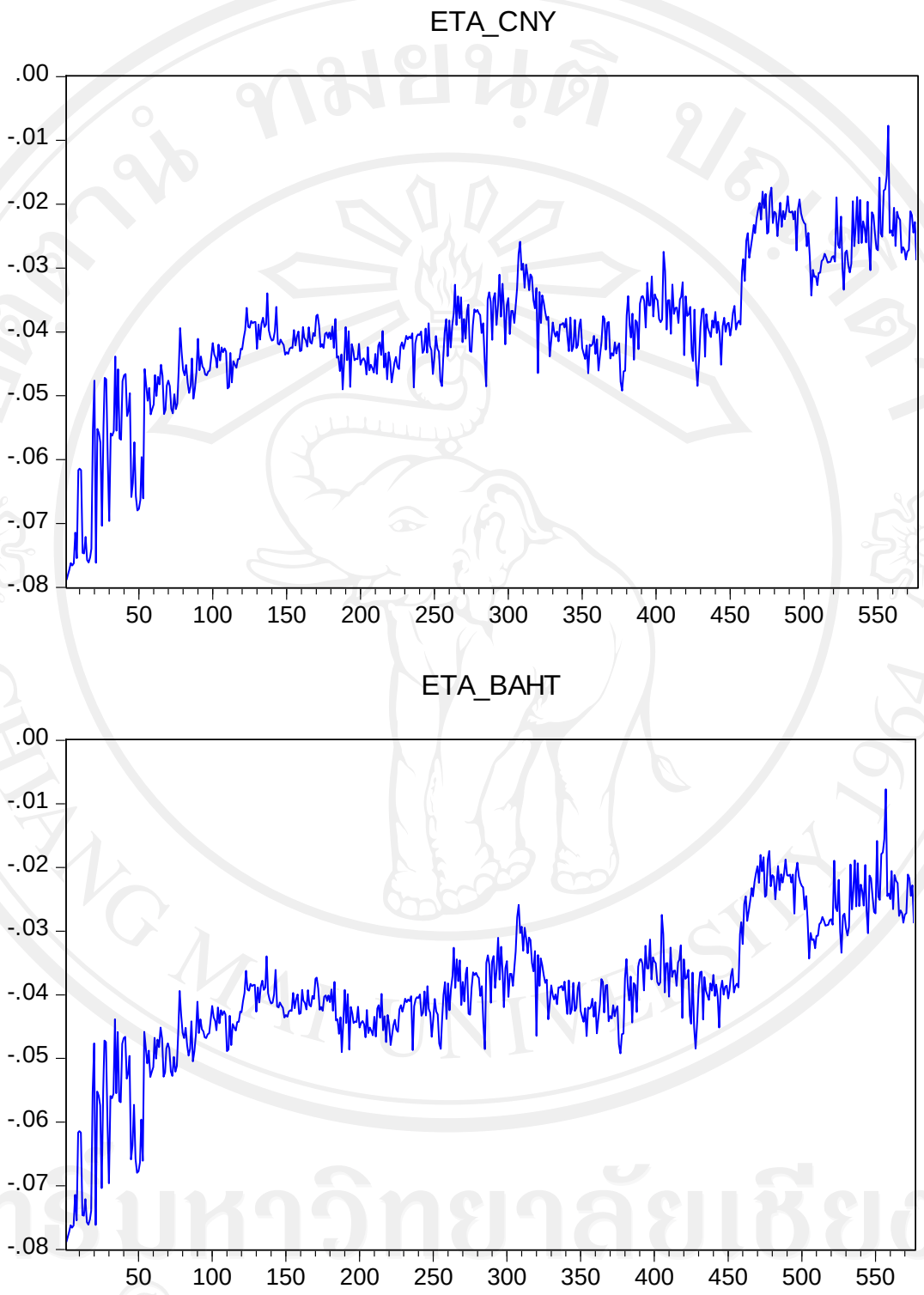
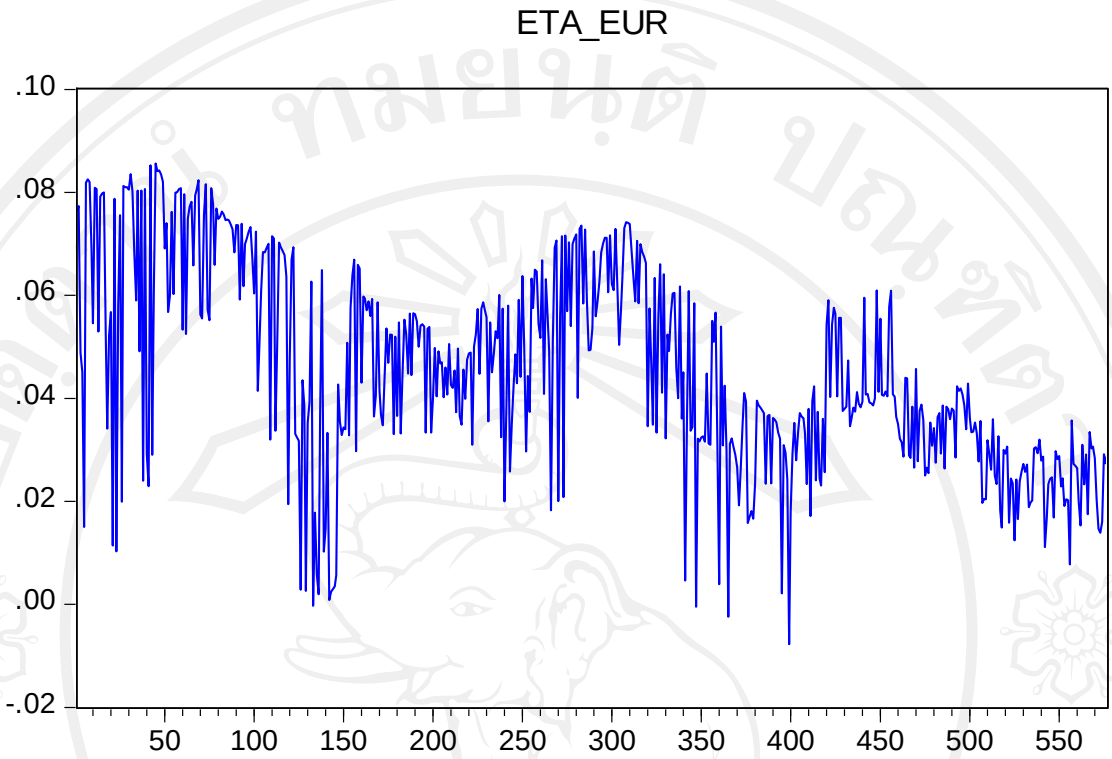


Figure 4.2 Dynamic VARMA-AGARCH model in Case Study1



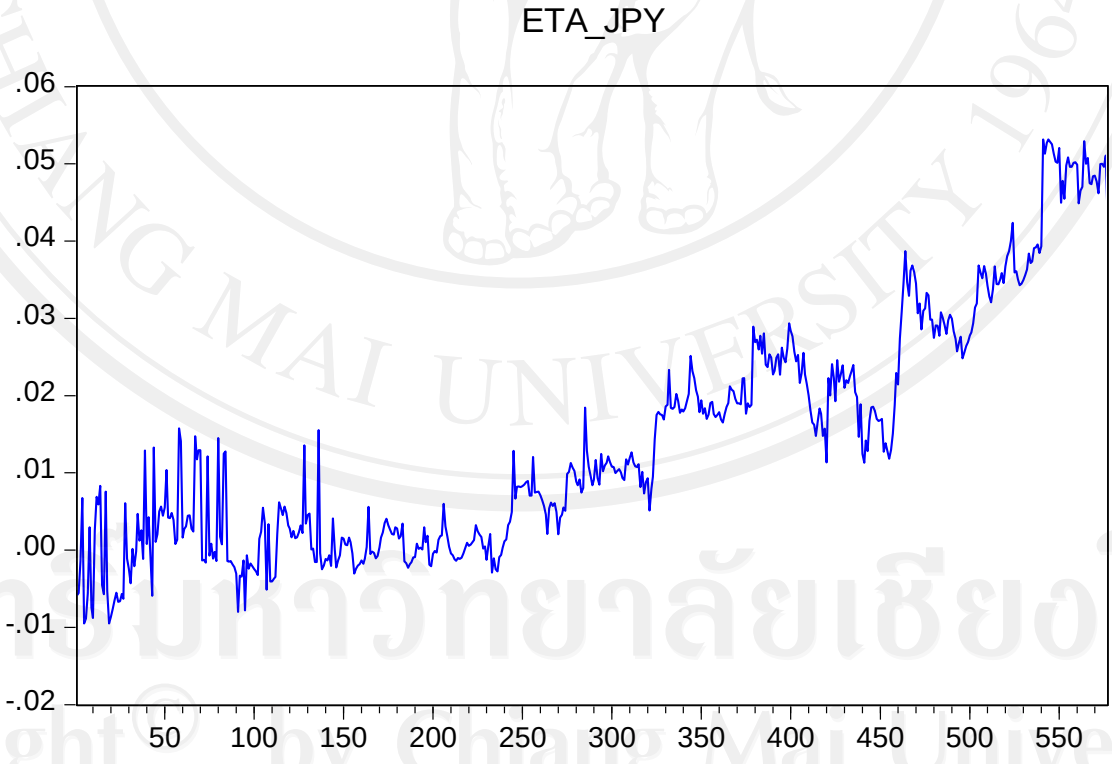
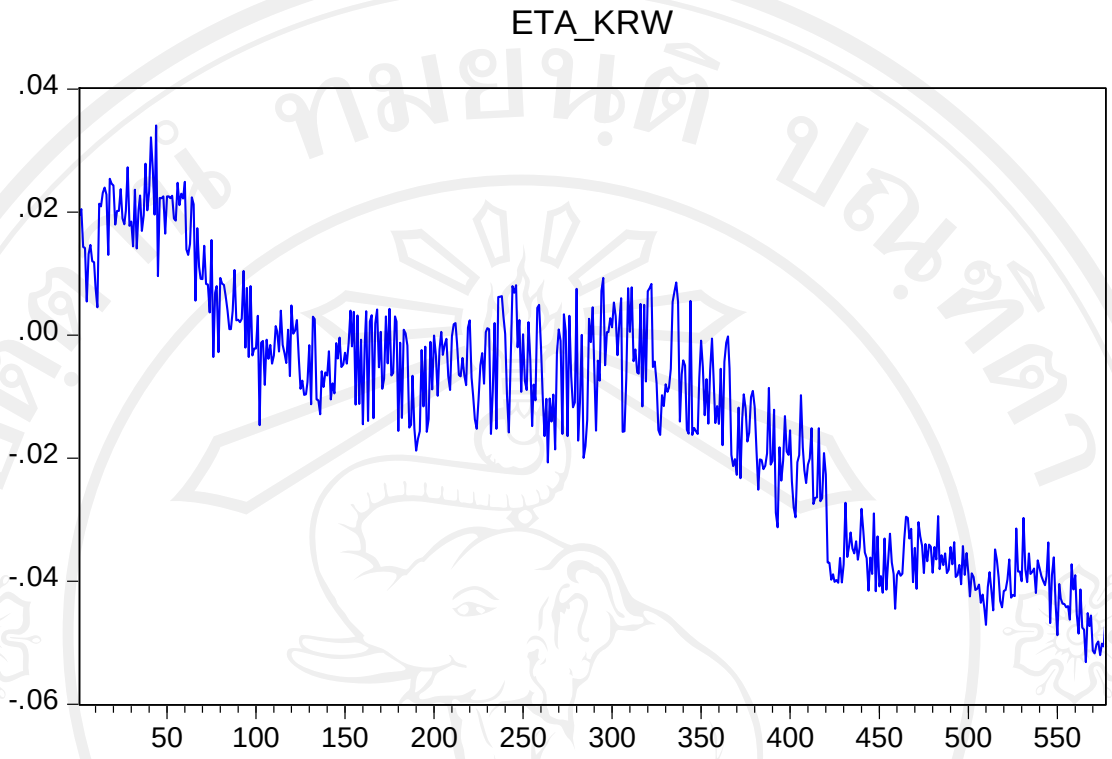


Figure 4.2 (Continue 1)



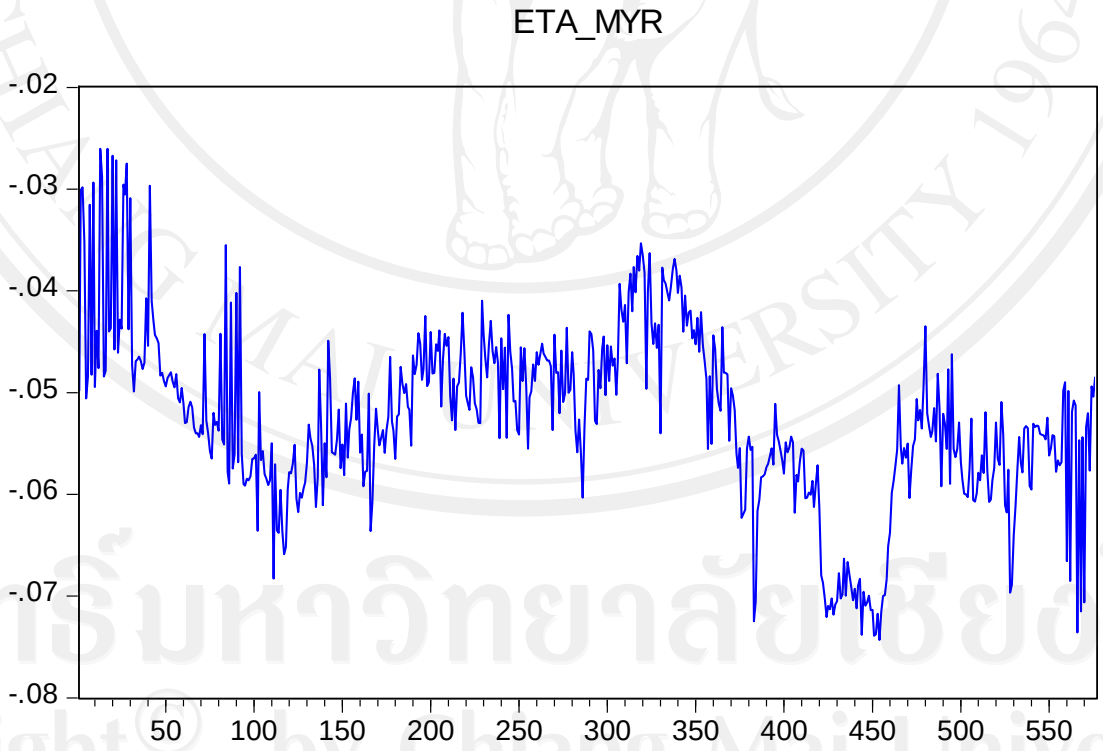


Figure 4.2 (Continue 2)

4.3 Concluding Remarks

This paper estimated the conditional volatility, covariance, and correlation volatility of rubber price returns via multivariate volatility models. The VARMA-GARCH model revealed that volatility spillovers were evident between the volatility of rubber price return and the volatility of four exchange rate returns in the model, namely, the Thai Baht, the Chinese Yuan, the Euro, and the Malaysian Ringgit. The VARMA-GARCH model exhibited the same results as the VARM-AGARCH model. As such, the volatility of rubber price return will be affected by these four volatilities of exchange rates in both models.

The coefficients of volatility in exchange rates in the Thai Baht, the Chinese Yuan, the Euro, and the Malaysian Ringgit are significant in both the models; as such, the respective exchange rates of these currencies are very important factors in the volatility of rubber price returns. Table 4 indicates that China, Malaysia, and Europe are the top three markets that import Thai rubber. The currencies of these regions can therefore affect the rubber price. The rolling window reveals that the correlation between the volatility of rubber price returns and all the values for the volatility of exchange rate returns is small (not more than 0.1). The result of the VARMA-AGARCH model is similar to that of the VARMA-GARCH model.

This study has observed that the exchange rate return of the Thai Baht can affect the rubber price return. Agriculture is the basic industry in Thailand. The large population of farmers is the mainstay of Thailand's economy, so the Thai government should cultivate the agricultural sector. Thailand has notable advantages in the rubber industry. Unfortunately, Thailand’s income enjoys no benefits. We therefore suggest

that the Thailand government set up agriculture policies for farmer. Table 4 reveals that the top two importers of Thai rubber are China and Malaysia; as such, the volatility of rubber price will be affected by the volatility of exchanges rate in the most important export countries. This finding further indicates that the trade volume is an important factor for the international product price.