CHAPTER 6

Co-movement of China outbound tourism demand: Singapore, Thailand and Malaysia

This chapter is developed from the original paper "Co-movement of China outbound tourism demand: Singapore, Thailand and Malaysia" by Tang and Sriboonchitta (2013) published at international journal of intelligent technologies and applied statistics. This paper is in the appendix C.

Abstract

This paper models the conditional volatility and co-movement (or dependence) of the growth rate of the monthly Chinese tourist arrival in Singapore, Thailand and Malaysia, using six kinds of copula-GARCH model. Monthly data from January 1998 to June 2012 are used in the empirical analysis. The empirical results suggest positive relationships exist between the conditional shocks in these three countries. Moreover, the variations in monthly Chinese tourist arrivals in Singapore market strong influence of Chinese tourist arrivals in Thailand, and vice-versa. This influence weakens in run between Singapore and Malaysia and between Thailand and Malaysia. Third, there is a more probably that an extremely more (less) monthly Chinese Tourist arrivals in Singapore is likely to accompany extremely more (less) monthly Chinese tourist arrivals in Thailand, and vice versa. Fourth, Singapore and Malaysia have a probably extremely increase at the same time. Last, the conditional dependence among three countries is not constant over time but time-varying.

6.1 Introduction

International tourist arrivals grow year by year. According to World Tourism Barometer (Advance Release, January 2012) reports that international tourist arrivals reach 1,035 million in 2012 (39 million more than in 2011), which is the first time in history. UNWTO's long-term outlook Tourism Towards 2030 is expected that international tourist arrivals will grow by average 3.8% per year between 2010 and 2020 despite ongoing economic challenges. Asian and the Pacific is the highest relative growth, which reach 232.9 million and the growth rate is 6.8%.

Among the world tourism, China outbound tourism industry is the most active and fastest growing travel market in the world and become the driving force of global tourism industry continues to boom. China outbound tourism occurred in the 80 years of the 20th century. In 1983, Hong Kong and Macau were prelude to outbound tourism of the Chinese citizens; this main purpose was to facilitate the mainland residents to Hong Kong and Macao to visit relatives. China outbound tourism market was open from the beginning of the Southeast Asian nations. In 1988, Thailand, except Hong Kong and Macao, became the first of China's outbound tourism destination. Since 1990, China's authorities began to appoint Singapore, Malaysia, the Philippines, South Korea, Australia (Australia), New Zealand as China outbound tourism destination countries. China's outbound tourism industry rapidly grew in the last two decades. Until 2011, the tourist destination for Chinese citizens has reached 140 countries and regions. In additional, according the National Bureau of Statistics of China, outbound travel has increased from 3.74 in 1993 million to 70.3 in 2011. This information highlights that China outbound tourism market competition could become increasingly fierce.

There is an extensive literature applying univariate and multivariate GARCH model to study tourism demand. Hoti, Leon and McAleer (2004) study international tourist arrivals to the Canary Islands by CCC-GARCH model. They find that the conditional correlations are generally positive, varying from small negative to large positive correlations in the monthly tourist arrivals shocks. Chan, Lim and McAleer (2005) use the symmetric CCC-MGARCH, symmetric VARMA-GARCH and asymmetric VARMA-GARCH to study Australia's tourism demand from the four leading source countries. They examine the presence of interdependent effects in the conditional variance between the four leading countries, and the asymmetric effect of shocks in two of the four countries. Shareef and McAleer (2006) apply the symmetric VARMA-GARCH model to research international tourism demand and uncertainty in Maldives and Seychelles. This study point out there is spillover effects between Maldives and

Seychelles. Shareef and McAleer (2007) study the Maldives inbound tourism demand by CCC-GARCH and VARMA-GARCH model, which find that static conditional correlations and the respective transformed series are significantly different from zero, but also relatively low among eight major tourist source countries (Italy, Germany, UK, Japan, France, Switzerland, Austria and the Netherlands). Álvares, Hoti and McAleer (2007) use CCC-GARCH model in Span domestic tourism market, it aims to research the correlation among five major Spanish destinations namely Canary Islands, Catalonia and the Community of Madrid. They find five destinations are substitutes and independent to shocks. Seo, Park and Yu (2009) apply the multivariate GARCH model to analyses of the relationships in Korea outbound tourism demand. It finds that conditional correlations among tourism demand were time-varying. Coşkun and Özer (2011) use BEKK-GARCH (1, 1) model to inbound tourism demand in Turkey. In this paper, authors get cross-country interdependent and dependent effects in the conditional correlations for Germany, France, United Kingdom and Netherlands. As far as we know, no study exists that study China outbound tourism demand market dependence or co-movements. In order to fill in the gap in literature, we introduce both static and dynamic copula-GARCH models in this study. The application of copula to analyze economic issues begins at the beginning of the twenty first century, but , recently, it becomes popular in analyzing economic studies, especial in financial (Patton (2006); Ning and Wirjanto (2009); Wang, Chen, and Huang (2011); Reboredo (2011)Wu, Chung, and Chang (2012); Zimmer (2012)). Generally speaking, copula based GARCH model has the following advantages in this study. First, the copula-GARCH model can capture the static and time-varying dependence (or co-movement) of China outbound tourism demand among Singapore, Thailand and Malaysia, as well as investigating the asymmetric and symmetric co-movement of China outbound tourism demand among three destinations. Second, it is to capture the behavior of Chinese's tourism arrival in different destination during extreme events, it measures the probability that extremely more (less) monthly tourist arrivals in a country accompany extremely more (less) monthly tourist arrivals in another country.

The purpose of the present study is to examine the volatility and conditional dependence structure (or co-movement) between tourism demands in three China outbound tourism markets. Where tourism demand is measured as the growth rate of monthly Chinese tourist arrivals, the conditional dependence of the standardized residuals make an accurate assessment how the variations in monthly Chinese tourist arrivals in one destination affect the monthly Chinese tourist arrivals in another tourist destination. To research volatility and dependence, we apply both marginal model (ARMAX-GARCH model) for Chinese tourist arrivals in each destination and a joint model (copula approach) for dependence. For the marginal model, we use ARMAX-GARCH model with error follow student-t distribution. For the joint model, we use several copula approach get different dependence structure: symmetric dependence (Gaussian copula with zero low and upper tail dependence; Student-t copula with low tail dependence equal to upper tail dependence); asymmetric dependence (Clayton copula with low tail dependence and zero upper tail dependence and Gumbel copula with upper tail dependence and zero low tail dependence); mixed dependence (symmetrized Joe-Clayton copula with asymmetric dependence and nest symmetry); dynamic dependence which can capture the time-varying dependence. The volatility and dependence structure can help the policy maker and tour operator.

6.2 Data Description

In this paper, we use the monthly data of China outbound tourism to estimate the co-movement of China outbound tourism demand. The sample period is from January 1998 to June 2012, which gives 174 observations for each country. China outbound tourism demand is the number of Chinese tourist arrivals to destinations: Singapore, Thailand, and Malaysia. The monthly data of tourist arrivals are obtained from the Singapore Tourism Board, Thailand office of Tourism development, and Tourism Malaysia, respectively. We plot the monthly series of China outbound tourist arrivals for the three destinations in figure 6.1. The figure exhibits that China outbound tourist arrivals increase over time in general, although it falls sharply around the time of SARS in year 2003 and the sub-prime crisis in year 2009. The figure also displays clear seasonal and cyclical movements. To measure the seasonality, we apply twelve month seasonal dummy variable in the ARMA-GARCH model. The data should be stationary for modeling time series, thus testing for unit roots is essential for time series analysis with ARMA-GARCH models. So the augmented Dickey-Fuller (ADF, Dickey and Fuller, 1979) and Phillips-Perron (PP, Phillips and Perron, 1988) are used unit root tests to test whether the data are stationary and present the results in Table 6-1. The table 1 shows that all of the levels of the series have unit roots at the 5% significance, there is strong evidence all of the levels of the series are not stationary. This demonstrates that all series need to be transformed to stationary processes to enable valid empirical estimates and inferences. Therefore, we conduct the logarithmic transformation of the data so that all series are stationary. Thereafter, we use $r_{s,t} = \mathrm{Log}(Y_{s,t}/Y_{s,t-1})$ to measure the growth rate of the monthly tourist arrivals, in which $Y_{s,t}$ is the tourist arrival at month t. We also use the augmented Dickey-Fuller (ADF, Dickey and Fuller, 1979) and Phillips-Perron (PP, Phillips and Perron, 1988) unit root tests to test whether the logarithmic transformation of the data are stationary and display the results in table 1. The table 1 shows the logarithm of the monthly arrival rate ($r_{s,t} = \mathrm{Log}(Y_{s,t}/Y_{s,t-1})$) are denote rejection of the null hypothesis at the 1% and 5% significance levels, which suggest that all series are stationary after transformation by logarithm. This show the logarithm of the monthly arrival rate can be conducted by ARMA-GARCH model.

Plot the growth rates of the tourist arrivals are given in figures 2. After transformation, the three series do not present trends and they all vary around zero. The growth rate of tourist arrival series to the three destinations vary substantially, with noticeable peaks over the sample period. The figures suggest that there are conditional variance processes in the three series, and thus, the GARCH model is appropriate for modeling the growth rate of tourist arrivals.

The descriptive statistics of the growth rates of monthly arrivals are given in Table 6.2. From the table, we find that the mean of Singapore (+0.0040), Thailand (+0.0027), and Malaysia (+0.0045) are positive, which show these all series are a positive trend of tourist growth for all three destinations. We also notice that the series of Singapore and Thailand's skewness are -0.9043 and -0.6930, respective, which indicates that the series of Singapore and Thailand are skew to the left. And the series of Malaysia's skewness is 0.0878, which shows it is skew to the right. All series are more than 3 in kurtosis, inferring that all series are fat-tailed and sharp in their peaks. In addition, the null hypothesis that the series are normally distributed is tested at the 1% level of significance; and the normality hypothesis for all series is rejected at the 1% significant level base on the statistic of the Jarque-Bera Lagrange multiplier test. These results make clear that the empirical of growth rates display fatter tails than normal distribution. Therefore, we introduce the student-t distribution in our study.

6.3 Empirical Results

6.3.1 Results for the Marginal Models

In this study, we estimate the ARMAX(p, q)—GARCH$(1,1)$ models with student-t of error distribution by using the maximum likelihood estimation method and considering different combinations of the values of parameters p and q ranging from zero to maximum lags of two. In addition, we adopt the AIC criterion to select the most suitable models. We report the result of the ARMA-GARCH model for the growth rate of tourist arrivals in Singapore, Thailand, and Malaysia in Table 6.3.

From the conditional mean estimates, we notice that the ARMA $(1,0)$—GARCH $(1,1)$ specification is the best model for Singapore and Malaysia, while ARMA (2,1)—GARCH (1,1) is more appropriate for Thailand. All of $\phi_{s,1}$ are high significant and the negative values of $\phi_{s,1}$ demonstrate that all tourism demand is negatively related with the previous one. Only Thailand tourism demand is significantly negatively related with the previous two implying by the significantly negative values of $\phi_{s,2}$. From the conditional variance estimates, it is observed that the estimate of the ARCH coefficient, α_s, is significant for Singapore and Thailand. This implies that, in general, given any unanticipated shocks to monthly growth rate of Chinese tourist arrivals to the Singapore and Thailand, the effect of that shock will last for a short period of time. On the other hand, the estimate of the GARCH coefficient, β_s, is not significant for Thailand, while it is significant for Singapore and Malaysia. This demonstrate that, in general, given any unanticipated shocks to monthly growth rate of Chinese tourist arrivals to the Malaysia, the effect of that shock will last for a considerable period of time. The results of the conditional variance equations are $\hat{\alpha} + \hat{\beta} = 0.9383$ and 0.9829 for Singapore and Malaysia, inferring that the volatilities of these two series are highly persistent. However, only Thailand does not have such persistence. There is strong evidence to suggest that China outbound tourism to the Singapore, Thailand and Malaysia are highly seasonal, with tourist arrivals being significantly concentrated in the peak tourist season. The degrees of freedom $\lambda_s$in the student-t distribution for all the series are significant, suggesting the error terms are not normal. This is consistent with the evidence reported in Table 6.2.

The probability integral transforms should be Uniform (0, 1) for modeling the marginal distribution, thus the marginal distribution test is essential and the copula model could be correctly specified. Hence, followed Patton (2006) test the marginal distribution in this paper. Test is divided into two steps. First, we use Ljung-Box (LB) test to examine the serial independence. To do so, we regress $(u_{s,t} - \bar{u}_i)^k$ on the first 10 lags of the variables. The results of LB test are given in Table 4. From the table 6-4, we know that that all series are not rejected at the 5% level significant which show all of them are serial independent at 5% level. Secondly, we use the Kolmogorow-Smirnov (KS) test to test whether the marginal distribution is from uniform (0, 1). The p-values of Kolmogorow-Smirnov (KS) tests are also given in Table 6.4. Overall, the LB test and KS test for our marginal distribution model show that these are not mis-specified. Hence, the copula model can correctly capture the dependence of growth rate of monthly tourist arrivals in three countries.

6.3.2 Results for the Copula Model

The results for the static copulas are given in Table 6.5 in which the dependency parameters are assumed to be constant over time. In the Gaussian copula, all the dependence parameters ρ are significantly and the dependence values of ρ are 0.7060, 0.4314, and 0.2493 for between Singapore and Thailand, between Singapore and Malaysia and between Thailand and Malaysia, respectively. In additional, the dependence parameters in the Student-t copulas are also significant and consistent close to the dependence values in Gaussian copula. These figures provide clear evidence that positive relationships exist between the conditional shocks in three destination countries. In three pairs, between Singapore and Thailand has the highest relationship. These results imply that the variations in monthly Chinese tourist arrivals in Singapore market strong influence of Chinese tourist arrivals in Thailand, and vice-versa. This influence weakens in run between Singapore and Malaysia and between Thailand and Malaysia. These results are mainly due to the following factors. First, Singapore, Thailand and Malaysia are in Southeast Asia and share similar geographical and environmental characteristics. But Singapore-Thailand and Singapore-Malaysia have different tourism resources. Hence, Singapore-Thailand and Singapore-Malaysia have complement effect in tourism market. Second, Singapore has a well-developed transportation conditions. Singapore holds tourism resources of neighboring countries in Southeast Asia as a favorable condition to develop his tourism, making it to develop into a transit point for Southeast Asia. For this reason, the tourist may travel Singapore first, after to travel Malaysia, Thailand or Indonesia and so on. The degrees of freedom for the Student-t range from 5 to 17, which are reasonably low. However, the degree of freedom is only significant in between Singapore and Thailand, indicating substantially extreme co-movements and tail dependence for between Singapore and Thailand. Tail dependence values for the Student-t copula, $\lambda_L = \lambda_R = 2t_{n+1}(-\sqrt{n+1}\sqrt{1-\rho}/\sqrt{1+\rho}$, are 0.1643, 0.0554 and 0.0016 for the Singapore-Thailand, Singapore-Malaysia and Thailand-Malaysia, respectively. This result shows that larger tail dependence or co-movement for the Singapore and Thailand tourism market, which is more tai dependence value than for the between Singapore and Malaysia tourism market and between Thailand and Malaysia tourism market which have lower tail dependence.

In order to study the asymmetric tail dependence, we use the Gumbel copula to capture the upper tail dependence and the Clayton copula to capture the low tail dependence. We note that there are the estimates of τ for the Gumbel copulas are significant and the dependence values are 1.8440, 1.3602, and 1.1702 for Singapore-Thailand, Singapore-Malaysia and Thailand-Malaysia, respectively. For the same pairs, the upper tail dependence values for the Gumbel copula, $\lambda_U = 2 - 2^{1/\tau}$, are 0.5437, 0.3354 and 0.1918, respectively. This show that there is a more probably that an extremely more Chinese tourist arrivals in Singapore is likely to accompany extremely more Chinese tourist arrivals in Thailand, and vice versa. But this probably decreases in run between Singapore and Malaysia and between Thailand and Malaysia. Moreover, in the Clayton copula, the dependence parameters τ are significantly and the dependence values of τ are 1.6751, 0.6547 and 0.2983 Singapore-Thailand, Singapore-Malaysia and Thailand-Malaysia, respectively, which low tail dependence values for the Clayton copula, $\lambda_L = 2^{-1/\tau}$, are 0.6611, 0.3469 and 0.0979 for the same pairs, respectively. Especially between Thailand and Malaysia, this probably is very low. This show that there is a more probably that an extremely less Chinese tourist arrivals in

Singapore is likely to accompany extremely less Chinese tourist arrivals in Thailand, and vice versa. But this probably decreases in run between Singapore and Malaysia and between Thailand and Malaysia. Moreover, we also estimated the SJC copula which has different upper and lower tail dependence values. The estimated values of λ_L and λ_U are only significant in the pair of Singapore-Thailand.

In additional, assumed the dependence is time varying, we turn to apply the dynamic copula function to examine the issue. The parameter estimates for the Student-t dependence structure are given in the Table 6.6. From the Table 6.6, we first find that α_c is positive but only significantly between Singapore and Thailand, inferring that there is intercept for ρ_t only between Singapore and Thailand. Secondly, the autoregressive parameter β_c is strongly significant at the 0.01 level for all pairs except Singapore-Malaysia. Our finding of high and significant β_c in the Student-t dependence structure infers that the dependence between Singapore and Thailand and between Thailand and Malaysia have high degree of persistence pertaining to the dependence from time t-1 to time t. Third, the latent parameter γ_c is not significant in three pairs being studied in our paper. The degrees of freedom n are significant and not very low (from 6 to 17), indicate extreme co-movement and tail dependence for all pairs.

In order to get a better picture of the dynamic dependence parameter estimates, we plot the dynamic dependence parameter estimates among three destinations, namely Singapore, Thailand and Malaysia over the sample period generated from GARCH-student-t copula model in Figures 6.3. From the figure 6.3, we can find that different pairs have different conditional dependence structure. The dynamic conditional dependence between the conditional shocks of the three countries is not constant over time. All conditional dependence between the selected countries is positive over the time, which implies the destinations are positive dependent on one or the other. Moreover, the conditional dependence between Singapore and Thailand is highest among three pairs, followed by Singapore and Malaysia. This result is consistent with the static copula result. From the figure, we find the dependence between we selected countries is higher during 2003 SARs and 2008 World Financial Crisis. Natural disasters and Financial Crisis have an impact on dependence.

6.4 Conclusions

This study examines the conditional volatility and dependence (or co-movement) among Singapore, Thailand and Malaysia from a new perspective by copula-GARCH model. To account for tail independence, tail dependence, time-invariant, and time-variant dependence, we apply the abroad family of copulas to model the logarithm of the monthly China tourist arrivals in three destinations, namely Singapore, Thailand and Malaysia, with a sample size of 174 observations from January 1998 to June 2012.

The empirical results provided evidence of volatility and dependence in the conditional variances among three countries. Through empirical analysis, our key finding can be summarized as follows. First, the volatility analysis show that given any unanticipated shocks to monthly growth rate of Chinese tourist arrivals to the Singapore and Thailand, the effect of that shock will last for a short period of time, while given any unanticipated shocks to monthly growth rate of Chinese tourist arrivals to the Malaysia, the effect of that shock will last for a considerable period of time. Second, the static dependence analysis infers that positive relationships exist between the conditional shocks in tourist destination countries. In three pairs, between Singapore and Thailand has the highest relationship. These results imply that the variations in monthly Chinese tourist arrivals in Singapore market strong influence of Chinese tourist arrivals in Thailand, and vice-versa. This influence weakens in run between Singapore and Malaysia and between Thailand and Malaysia. Third, the empirical of the asymmetric tail dependence result show there is a more probably an extremely more (less) Chinese tourist arrivals in Singapore is likely to accompany extremely more (less) Chinese tourist arrivals in Thailand, and vice versa. But this probably decreases in run between Singapore and Malaysia and between Thailand and Malaysia. But this probably decreases in run between Singapore and Malaysia and between Thailand and Malaysia. Fourth, the dynamic dependence analysis infers that the dynamic conditional dependence between the conditional shocks of the three countries is not constant over time. All conditional dependence between the selected countries is positive over the time, which implies the destinations are positive dependent on one or the other. The empirical results of this study have important implications for policy makers in this three countries and tour operator who sell holiday to these three countries to make o make an accurate assessment about how the variations in Chinese tourist arrivals to one country affect Chinese tourist arrivals to the other countries.

In additional, the empirical result also show that China outbound tourism to the Singapore, Thailand and Malaysia are highly seasonal, with tourist arrivals being significantly concentrated in the peak tourist season. Specially, summer holiday and the spring festival are the Chinese tourism seasons; the competition is fierce. Therefore, policy makers and destination manager in these three countries should take some measure to attract more tourists during the tourist season. For example, providing a wide range of competitive tour packages; reducing transportation cost and regulating real exchange rates to attract Chinese tourists. The finding of this study have important implications for policy makers in this three countries and tour operator who sell holiday to these three countries to make o make an accurate assessment about how the variations in Chinese tourist arrivals to one country affect Chinese tourist arrivals to the other countries.

Table 6.1 Tests of hypotheses of unit-root

Variables	ADF		PP	
	Level	Difference	Level	Difference
Singapore	1.5396	-7.7844**	-1.8698	-24.4867**
Thailand	0.5787	-11.6388**	-1.6580	-26.9376**
Malaysia	0.0331	-19.4570**	-0.1231	-27.8142**

Note: Lag orders of ADF and PP tests are determined based on AIC. The critical values for the rejection of the null hypothesis of a unit-root are -2.5795 and -1.9428 for 1% and 5%, respectively. The symbol ** and * denote rejection of the null hypothesis at the 1% and 5% significance levels, respectively. The total number of observations for each series is 174.Levels refer to $Y_{s,t}$, while differences refer to $r_{s,t} = Log(Y_{s,t}/Y_{s,t-1})$.

Table 6.2 Summary statistics for the logarithm of the monthly arrival rate

	Mean	SD	Skewness	Kurtosis	Max	Min	JB	Obs
Singapore	0.0040	0.1387	-0.9043	7.8793	0.4011	-0.7604	195.1928***	173
Thailand	0.0027	0.1452	-0.6930	4.6871	0.3896	-0.5567	34.3663***	173
Malaysia	0.0045	0.2053	0.0878	15.3075	1.2373	-1.1490	1092.1040***	173

Note: The total number of observations for each series 4 is 174. ***, **, and * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.

Table 6.3 Results of the ARMA-GARCH model for the logarithm of the monthly arrival rate

	Singapore		Thailand		Malaysia	
	Par.	S.E.	Par.	S.E.	Par.	S.E.
Conditional mean						
$\phi_{s,1}$	-0.1572*	0.0855	-1.0309***	0.1037	-0.3785***	0.0613
$\phi_{s,2}$			-0.1133	0.0973		
$\theta_{s,1}$			0.9858***	0.0026		
Seasonal dummies						
$\varphi_{s,1}$	0.0513***	0.0147	0.0244	0.0243	0.0357	0.0225
$\varphi_{s,2}$	0.0746***	0.0152	0.0600**	0.0249	0.0053	0.0212
$\varphi_{s,3}$	-0.0996***	0.0147	-0.0737***	0.0226	-0.0362	0.0258
$\varphi_{s,4}$	0.0499***	0.0186	0.0414	0.0302	0.0020	0.0250
$\varphi_{s,5}$	-0.0577***	0.0148	-0.0600*	0.0371	-0.0411*	0.0218
$\varphi_{s,6}$	-0.0541***	0.0197	-0.0525*	0.0298	-0.0554*	0.0327
$\varphi_{s,7}$	0.1691***	0.0143	0.1423***	0.0303	0.1008***	0.0216
$\varphi_{s,8}$	0.0134	0.0160	0.0169	0.0254	0.0900***	0.0272
$\varphi_{s,9}$	-0.1787***	0.0154	-0.1023***	0.0229	-0.1195***	0.0218
$\varphi_{s,10}$	0.0688***	0.0177	0.0301	0.0285	0.0363	0.0286
$\varphi_{s,11}$	0.0562***	0.0116	0.0642**	0.0300	0.0360	0.0239
$\varphi_{s,12}$	-0.0034	0.0153	0.0132	0.0263	0.0163	0.0305
Conditional variance						
ω_s	0.0022**	0.0010	0.0064**	0.0025	0.0003	0.0003
α_s	0.6751*	0.3490	0.6599**	0.3161	0.0974	0.0611
β_s	0.2632*	0.1588	0.1274	0.1966	0.8855***	0.0457
n	3.4410***	0.9806	5.2700***	0.8630	3.2706***	0.7857
LL	204.8641		149.7725		117.6426	
AIC	-2.1972		-1.5503		-1.1771	
BIC	-1.8849		-1.2182		-0.8648	

Notes: The table shows the estimates and their standard errors for the parameters of the marginal distribution model defined in equations (8) The lags p and q were selected by using the AIC criterion for different combinations of values ranging from 0 to 2. ***, ** and * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively. The total number of observations for each series is 173.

Table 6.4 Test the student-t marginal distribution models

	First Moment	Second Moment	Third Moment	Fourth Moment	K-S test
Singapore	0.3142	0.1466	0.1674	0.1443	0.8967
Thailand	0.5035	0.3305	0.1518	0.5066	0.7563
Malaysia	0.1599	0.2204	0.1201	0.0984	0.9851

Note: This table reports the p-values from Ljung-Box (LB) tests for serial independence of the first four moments of the variables $U_{s,t}$. We regress $(u_{s,t} - \bar{u}_s)^k$ on the first 10 lags of the variables for k=1, 2, 3, 4. In addition, we present the p-values of the Kolmogorow-Smirnov (KS).

Table 6.5 Results of the static copula—GARCH model

	Gaussian Copula	Student-t Copula		Gumbel Copula	Clayton Copula		SJC copula
Singapore and Thailand							
ρ	0.7060***	0.7055***	τ	1.8440***	1.6751***	τ^L	0.3520***
	(0.0364)	(0.0443)		(0.1176)	(0.2439)		(0.1108)
n	-	5.4628*	-	-	-	τ^U	0.6336***
		(3.1594)					(0.0433)
AIC	55.7790	57.9289	AIC	47.5802	57.4019	AIC	126.6766
Singapore and Malaysia							
ρ	0.4314***	0.4369***	τ	1.3602***	0.6547***	τ^L	0.1625
	(0.0550)	(0.0656)		(0.0705)	(0.1212)		(0.1276)
n	-	7.1568	-	-	-	τ^U	0.3286***
		(5.3346)					(0.0866)
AIC	16.1453	17.0816	AIC	14.2114	15.4876	AIC	38.2790
Thailand and Malaysia							
ρ	0.2493***	0.2492***	τ	1.1702***	0.2983***	τ^L	0.0799
	(0.0692)	(0.0834)		(0.0629)	(0.1056)		(0.1103)
n	-	17.9622	-	-	-	τ^U	0.1000
		(27.6832)					(0.1076)
AIC	4.9469	4.5142	AIC	4.2669	3.9591	AIC	13.7842

Note: This table reports the estimates of static copula parameters defined in equations (9)-(14) and their corresponding standard errors (in brackets) for several copula specifications for each pair of growth rate of the tourist arrivals. ***, **, and * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively. The total number of observations for each series is 174.

Table 6.6 Result of the dynamic student-t copula—GARCH model

	Singapore and Thailand		**Singapore and Malaysia**		**Thailand and Malaysia**	
	Par.	S.E.	Par.	S.E.	Par.	S.E.
α_c	0.5215	0.4225	0.8783*	0.4312	0.2278	0.2275
β_c	0.6408***	0.2455	0.0001	0.0392	0.5077***	0.2171
γ_c	2.3539	1.5016	3.4692	2.2474	2.0116	1.7523
n	6.6602***	1.3960	6.6907***	2.5058	17.2807***	1.5313
AIC	-108.7766		-4.5090		-30.4837	

Note: This table reports the estimates of dynamic copula parameters defined in equations (15) for each pair of growth rates of the tourist arrivals. ***, **, and * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively. The total number of observations for each series is 173.

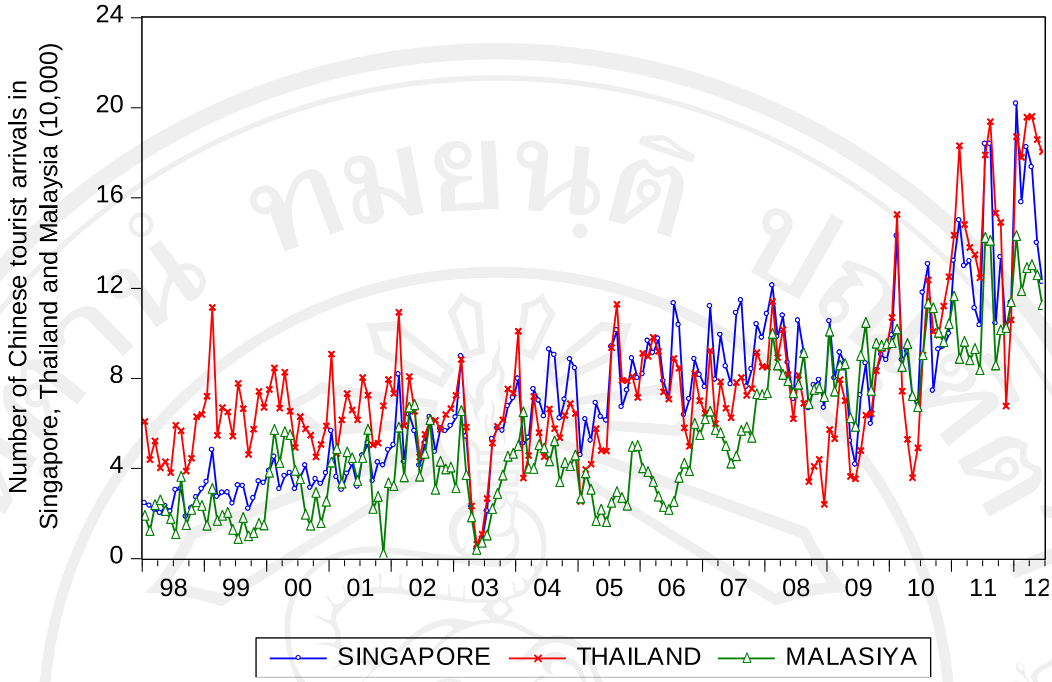

Figure 6.1 China outbound tourist arrivals in Singapore, Thailand, and Malaysia

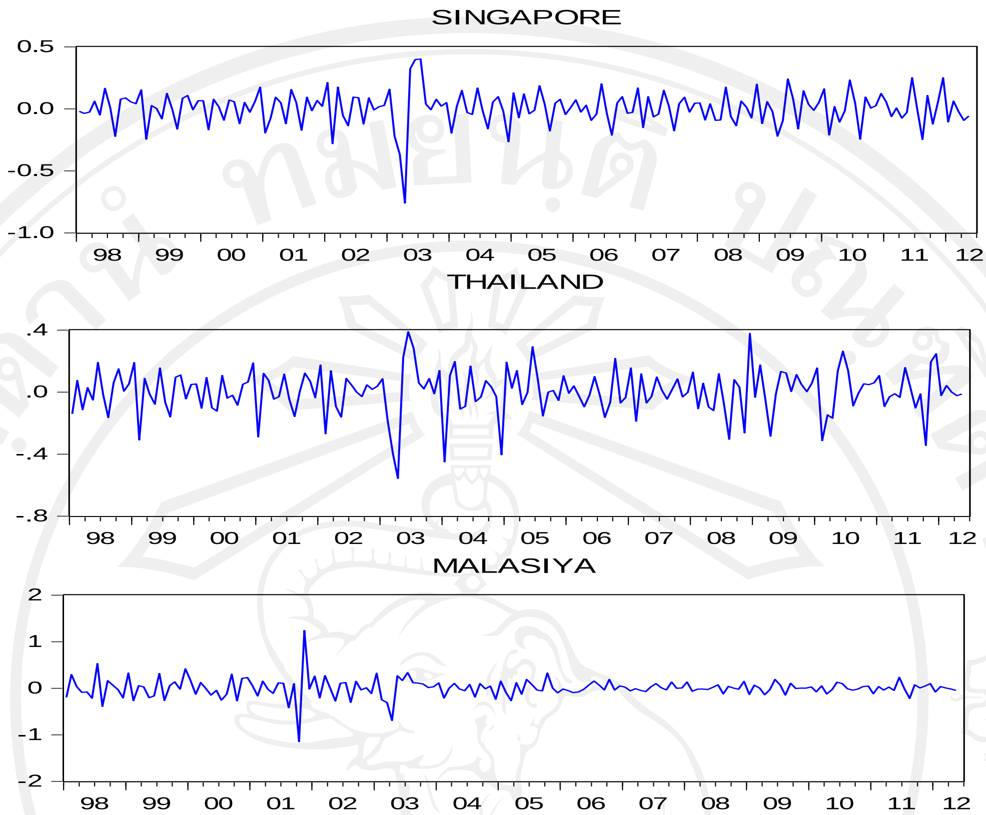

Figure 6.2 Logarithm of the monthly arrival rate for Singapore, Thailand, and Malaysia

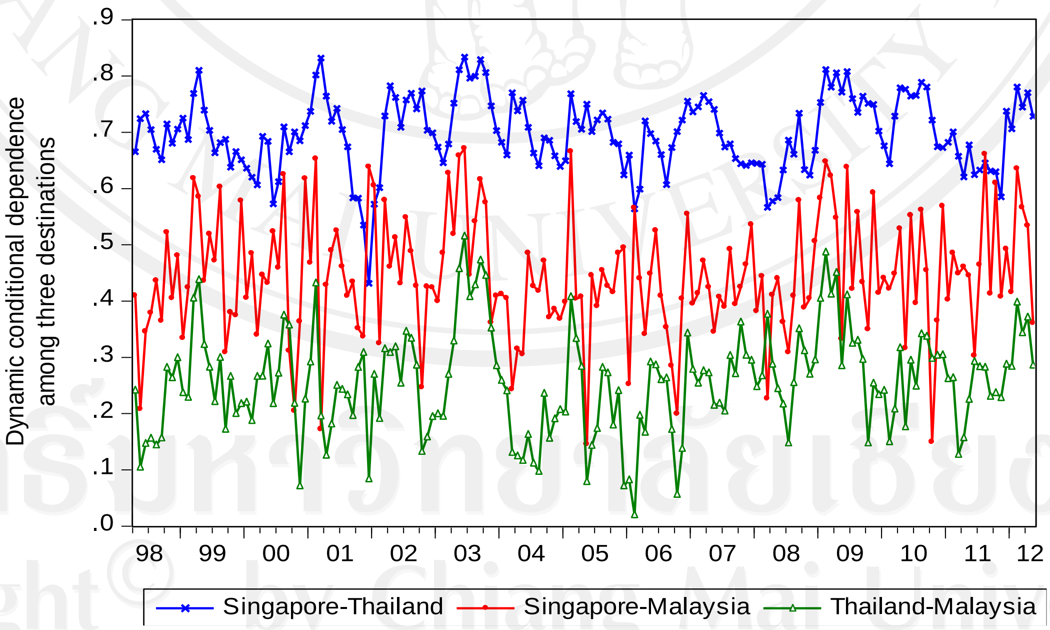

Figure 6.3 Dynamic conditional dependence among Singapore, Malaysia and Thailand