CHAPTER 4

Dynamic copula-based GARCH model analysis of China outbound tourism demand

This chapter is developed from the original paper "Dynamic copula-based GARCH model analysis China outbound tourism demand" by Tang et al. (2014) have presented in the International Symposium on Innovative Management, Information & Production, 2013, and published in the book by Springer Verlag. This paper is in the appendix A.

Abstract

This paper used dynamic copula-GARCH model to analysis volatility and dependency of China outbound tourism to four leading countries, namely, South Korea, Japan Thailand and Singapore. It was found that Japan, South Korea, and Thailand have high volatilities. Furthermore, the conditional dependence is time-varying and different copulas generate different the time path dependence structure. There is seasonal effect; the summer holiday and Chinese Spring Festival have positive effects on the all destinations. Finally, Thailand and Singapore have the strongest conditional dependence. The result indicates that Thailand and Singapore have a high complementary relationship.

4.1 Introduction

The purpose of this chapter is to investigate the dynamic dependence structure among the four China outbound tourism leading destinations based on monthly data, from a new perspective by Copula-GARCH model. The findings have important implications for destination manager and policy makers.

Over the last decade, there has been strong growth in China's outbound tourism. The main factors that generally affect outbound travel are the confidence of continued and rapid economic growth, constant increasing income, the government's favorable policy framework, increased leisure time and RBM appreciation. According the National Bureau of Statistics of China, the outbound tourism of China underwent a rapid growth from 2000 to 2010. Outbound travel have increased from around 10.5 million in 2000 to 57.4 million in 2010, the average annual growth rate is 18.5%. Affected by the SARS (2003) and economic crisis (2008), the number of outbound tourist sharply declined. Especially the economic crisis, it leaded a minimal gain of 4.0% registered in 2009. The unexpected is a huge increasing in 2010, the growth rate is more than 20% and it is back on track. Notably, compared to r Australia (32%) and Japan (13.1), the number of outbound tourists in 2010 only accounted for 4.1% in the total population of mainland China (China Outbound Tourism 2011). CTA reported that the number of outbound tourist did not only rapidly growth, but also spending a lot more money in destination countries. According to the WTO, China (US$ 55 billion) has overtaken the United Kingdom (US$ 49 billion) and placed third position in international tourism spending in 2010(World Tourism Organization). Undeniably, continued growth will be driven by the large mainland Chinese population and their increasing affluence. This information highlights that China has become one of most important tourism source country in the global tourism market and continuous growth of outbound tourism will bring tremendous business opportunities.

Table 4.1 shows the top 10 tourism destinations for mainland china tourist. Excluding the SARs of Hong Kong and Macau, the top tourism destinations are South Korea, Japan, Malaysia, Singapore, Thailand, USA, Vietnam and Australia, respectively. In order to attract Chinese tourist, many countries have adopted strategies. For instance, countries such as Thailand, Singapore, Malaysia and Australia are trying to attract Chinese tourists by setting up tourism offices in China and offering Chinese language tourism websites. In order to examine the time-varying volatility and time-varying dependence structure among the destinations in China outbound tourism demand, we selected South Korea, Japan, Singapore and Thailand as sample for this study(excluding Malaysia due to lack of data).

Based on the motivations discussed above, three research questions were formulated for this study :(1) what is the volatility; (2) the relationship between the four destination time-varying over the study time horizon; (3) what is conditional dependence (or co movement) between the two in the four destinations (4) Are between the two in the four destinations substitute or complement in regards to China's outbound tourism? The finding of these questions can be used to help destination manager and policy makers, and it also provide basic for scholars on reevaluating the international tourism demand models.

4.2 Data Descriptive

In order to estimate the dynamic dependent structure of tourism demand in the top destination, this research designated the proxy variable the number of China's tourist arrivals to the following four destinations: Thailand, Singapore, South Korea and Japan. China monthly tourist arrival data from January 1993 to October 2011 were used for this study, yielding a total of 178 observations obtained from the respective country tourist authorities. China's monthly tourist arrivals series are plotted in Figure 4.1, which exhibit a permanent deterministic pattern of the long-term upward trend with clear cyclical seasonal patterns. We can retain similar seasonal patterns, in spite of which tourist arrivals fell sharply around the time of SARS (2003) and the global financial crisis (2008 and 2009).

All tourism demands are expressed by the number of Chinese tourist arrival at the four destinations. In building a model, most of the economic time series data are processed with the use of the logarithmic transformation. Hence, the monthly growth rate tourist arrival $r_{i,t}$ are computed a continuous compounding basis as $y_{i,t} = \mathrm{Ln}(Y_t/Y_{t-1})$, where Y_t and Y_{t-1} are current and one-period lagged monthly tourist arrivals . $y_{i,t}$ is $y_{thai,t}, y_{sing,t}, y_{korea,t}$ and $y_{jap,t}$ as incremental rate of Chinese tourist arrivals in Thailand, Singapore, South Korea and Japan, respectively. The tourist arrival incremental rates are plotted in Figure 4.2, which show the large (small) incremental rate is followed by a large (small) incremental rate and there is a conditional variance processes in the data. It implies that the GARCH model is appropriate for modeling the growth rate of tourist arrival.

The descriptive statistics for the growth rate of Chinese tourist arrival for each destination are reported in Table 4.2, which show that the standard deviation of $y_{thai,t}$ is higher than the other and it has higher volatilities. The three of four Skewness statistics for Chinese tourist arrivals to each destination are negative. The null hypotheses of $y_{thai,t}$, $y_{sing,t}$ and $y_{jap,t}$ are rejected at the 1% significance level based on the results of the normality test by Jarque and Bera (1980). From the table 4.2, all growth rates of Kurtoses are greater than 3, and therefore, leptokurtosis. Since the skewness and Kurtosis of $y_{sing,t}$ are, respectively, lower and higher than the other in absolute values, and the Jarque and Bera statistics for Singapore is much higher.

Finally, the unconditional correlation matrix indicates a rather high correlation between the growth rates of the destination is expected. The correlation is the largest between Thailand and Singapore, and the smallest between Japan and South Korea. As the correlation coefficient shows the degree of relation between the variables, coefficients show a relation between each selected country.

The data should be stationary for modeling time series, thus testing unit roots is essential for time series analysis with GARCH models. Augmented Dickey-Fuller (ADF, Dickey&Fuller, 1979) and Phillips-Perron (PP, Phillips & Perron, 1988) can perform the test for unit-root; but there exist slightly different purpose. There exist the GARCH errors in the PP test. While the ADF tests unambiguously consider a serial conditional correlation, but not heteroskedasticity, by modeling the structure in the errors. PP tests use a non-parametric to analyze both serial conditional correlation and heteroskedasticity. Table 4.3 shows the results of unit-root tests. The tests strong support that all series are stationary.

4.3 Empirical Results

4.3.1 Empirical Results for GARCH model

The estimated result of the GARCH model is reported in the Table 4.4, using a maximum likelihood estimation method. All the negative values of c_1 imply that all tourism demand return (except the Japan) is negative related to the previous one. It can be seen that own-innovation or ARCH effect $\alpha_i$is significant in Thailand and Singapore, indicating that a shock to the logarithm monthly tourist arrivals rate series has short run persistence in this two. And all series have significant the lagged volatility or GARCH effect β_i at 10% level. This implies all cases have long-run persistence of shocks. The result of the conditional variance equations are $\alpha_i + \beta_i = 0.9626$, 0.9007 and 0.8027 for the Japan, South Korea and Thailand, respectively. The volatilities of these three destinations are highly persistent. However Singapore does not have such persistence. As can be seen in the variance equation, the asymmetry parameters, λ_i,are significant and negative for Thailand, Singapore and Japan ,but nonsignificant for the South Korea, exhibiting that Thailand , Singapore and Japan are skewed to the left. For the seasonal effect, the summer holiday and the Chinese Spring Festival turn out to be quite significant and have positive effects at the all destination in the GARCH model.

The model should distinguish from the true marginal distribution, when we model the conditional copula. If the marginal distribution models are mis-specified, then the probability integral transforms will not be Uniform (0, 1) and the copula model will maybe automatically be mis-specified. Hence, the crucially important step is to test marginal distribution. In this paper, our test divides two steps. The first step is Ljung-Box test, Ljung-Box test is to exam serial independence, we regress $(x_{i,t} - \bar{x}_i)^k$ on 5 lags of the variables for k=1, 2, 3, 4. Second, Kolmogorow-Smirnov (KS) tests is used to test whether marginal distribution is Uniform (0, 1). Table 4.5 present the Ljung-Box tests of serial independence of the probability integral transforms $U_{i,t}$, and the Kolmogorow-Smirnov (KS) tests of the density specification. The skewed-t marginal distribution of four destinations based on GARCH model pass the LB and KS tests at 0.05level, hence the copula model could correctly capture the dependency between tourist arrival and exchange rate.

4.3.2 Empirical Results for copula model

Table 4-6 reports the parameter estimates for different copula function based on the GARCH model, four parts are Panel A of estimation of the Guassian dependence structure, Panel B of estimation of the Student-t dependence structure, Panels C of estimation of the Gumbel dependence structure and Panels D of estimation of Clayton dependence structure, respectively. In the Panel A of Table 5, the autoregressive parameter β_c is close to 1, implying that a high degree of persistence pertaining to the dependence structure, and the latent parameter γ_c is significant and displaying that the latest return information is a meaningful measure between the four destinations returns, while excluding measures between Singapore and South Korea, and between Singapore and Japan. In the Panel B of Table 6, the autoregressive parameter β_c is significant between Thailand and Singapore and between Singapore and South Korea, indicating a degree of persistence pertaining to the dependence structure. The latent parameter γ_c is significant and implies that latest return information is a meaningful measure between Thailand South Korea. The Panel C of Table 5 show that β_c is significant between Thailand and Singapore, between Thailand and South Korea and between Japan and South Korea, γ_c is significant between Thailand and Singapore and between Thailand and South Korea; this information demonstrates that most of the latest return information is a meaningful measure. The γ_c of Thailand and South Korea is 117.089, showing that the latest return information is a large meaningful measure. From the Panel D of table 6, we know that the autoregressive parameter β_c is insignificant between the four destinations returns except between Thailand and South Korea and Singapore and South Korea, implying a degree of persistence pertaining to the dependence structure. The latent parameter γ_c is significant and displays that latest return information affect pre-return and is also a meaningful measure between Singapore and Japan and between Japan and South Korea.

The dependence parameter estimates between the four destinations returns, over the sample period generated from GARCH-copula model are plotted in Figure 4.3, Figure 4.4, Figure 4.5 and Figure 4.6. We can observe that different copula generates different dependence structure.

The Figure 4.3 show the conditional dependence estimates (Pearson's ρ_t) between four destinations based Guassian copula-GARCH. DT12 and DT23 have the same structure, increasing and stabling at 0.70 and 0.326, respectively. We can observe that the dependence structure in DT13, DT14, DT24 and DT34 sharply decreased in 2003 and 2008, respectively. This may be due to SARs (2003) and the World Financial Crisis (2008) respective. Regardless of these time, all the dependence structure for tourism demand among four destinations have shown increasing patterns .This implies that a positive relationship tends to increase as time progresses.

The Figure 4.4 plots the conditional dependence estimates (Pearson's ρ_t) between the four destinations based on Student-t copula-GARCH. DT12 is higher than other dependence structures and close to 1 at some times, dictating that Thailand and

Singapore have a higher correlation and could be recognized as the “complement effect”. The reason is their geographic position and the large number of groups of tourists traveling to Thailand and Singapore at the same time. DT13, DT14, DT24 and DT34 have the same structure and shock in 0.05, 0.2, 0.2 and 0.4, respective. DT23 have a higher relationship from 2000 to 2006,

The Figure 4.5 illustrates the implied time paths of the conditional dependence estimates (Kendall’s tau) between the four destinations, based on the Gumbel copula-GARCH. The Gumbel copula captures the right tail dependence. All of the conditional dependence changes over time. DT13 is very low and nearly 0.01, it dictates that Chinese tourist arrival to Thailand and South Korea are impossible the same at the time of increasing during extreme event. Conditional dependence in DT23 and DT24 obviously exhibited decrease trends, implying that negative relationship tend to decrease a time progresses.

The Figure 4.6 plots the conditional dependence estimates (Kendall’s tau) between the four destinations based on the Clayton copula-GARCH. The Clayton copula captures the left tail dependence. DT24 is very low and nearly 0.0001, it dictates that that Chinese tourist arrival to Singapore and Japan are impossible the same at the time of decreasing during extreme event. DT13 jumps from 0.01 to 0.24, and DT14 and DT34 shock around at 0.6 and 0.15, respectively. Chinese tourist arrival to Singapore and Thailand are possible the same at the time of decreasing during extreme event.

4.3.3 Goodness-of-Fit for copula and comparisons

The evaluations of the copula model have become a crucially important step. Therefore, Goodness-of-Fit (GOF) was applied to the copula, based on the empirical process comparing the empirical copula with a parametric estimate of the copula derived under the null hypothesis. This paper used Genest, Remillard and Beaudoin’s (2009) way to compute approximate P-values for statistics derived from this process consisting of using a parametric bootstrap procedure. An estimation method was to be used to estimate the dependence parameter of maximum pseudo-likelihood. Table 4.7 presents the results of the bivariate Goodness-of-Fit for the copula. These tests revealed that between Thailand and Singapore are not significant in the Gumbel-copula at the

5% level, and between Singapore and Japan are just significant in the Gumbel-copula at 5% the level. The others pass the test at 5% level.

In terms of the values AIC and the P-value in the table 4.6 and Table 4.7, respectively, the Gaussian dependence structure between Thailand and Singapore , Thailand and Japan and between Singapore and South Korea exhibit better explanatory ability than other dependence structure, the Gumbel dependence structure between Thailand and South Korea and Singapore and Japan exhibit better explanatory ability than other dependence structure, while the Clayton dependence structure between Japan and South Korea exhibits better explanatory ability than other dependence structures. These results imply that introducing the tail dependence between the four destinations adds much to the explanatory ability of the model.

4.4 Implications for policy planning and destination management

The empirical findings of this study imply that conditional dependence is different between each two destinations and all of the conditional dependence changes over time. Evidently, Thailand and Singapore have the strongest conditional dependence. The result indicates that Thailand and Singapore have a high complementary relationship. Therefore, the policy makers and destination managers in Thailand and Singapore need to consider forming strategic alliances to develop jointly products and Thailand and Singapore can complement one another to attract China's outbound tourists. They can also consider signing an agreement on visas, like the Schengen visa. It is recommended that they consider signing the Southeast Asian agreement about visa to improve competitiveness.

The results also found that the summer holiday and the Chinese Spring Festival turned out to be quite significant and have positive effects on the all destination. The summer vacation and the spring festival are the Chinese tourism seasons; the competition is fierce between destinations. Therefore, policy makers and destination manager should take some measure, for example, providing a wide range of competitive tour packages; reducing transportation cost and regulating real exchange rates to attract Chinese tourists.

Table 4.1 World top 10 tourism destinations for mainland china tourist

Rank	Destination	China Tourist arrivals (Million)		Rank	Destination	China Tourist arrivals (Million)	
		2008	2009			2008	2009
1	Macau	11.914	14.439	6	Singapore	1.015	0.8192
2	Hong Kong	9.380	9.411	7	Thailand	0.8257	0.5814
3	South Korea	0.939	1.031	8	USA	0.4931	0.4882
4	Japan	0.9807	0.8925	9	Vietnam	0.585	0.447
5	Malaysia	0.8493	0.8898	10	Australia	0.3564	0.3421

Source: Eouromonitor international, “Tourism Flows Outbound—China”, July 2010

Table 4.2 Summary statistics for the incremental rate of Chinese tourist arrival

	Thailand	Singapore	South Korea	Japan
Mean (%)	0.0050	0.0101	0.0149	0.0037
SD (%)	0.3359	0.3153	0.1695	0.1193
Skewness	-0.7088	-0.9598	0.0421	-0.2319
Excess Kurtosis	4.4870	8.0616	3.0072	5.6116
Max (%)	0.8970	0.9236	0.4367	0.3478
Min (%)	-1.2817	-1.7507	-0.4590	-0.5781
JB	31.132	216.1332	0.0527	51.8901
Correlation matrix				
Thailand	1.0000	0.84217	0.43139	0.4655
Singapore	0.8421	1.0000	0.5728	0.5166
South Korea	0.4313	0.5728	1.0000	0.3925
Japan	0.4655	0.5166	0.3925	1.0000

Table 4.3 Tests of unit-root

Variables	ADF		PP	
	Level	Log of first difference	Level	Log of first difference
Thailand	-5.1097^{**}	-12.04982^{**}	-4.9885^{**}	-28.3882^{**}
Singapore	-0.3090	-7.43598^{**}	-3.7792^{**}	-40.7605^{**}
South Korea	2.7158	-5.55876^{**}	-0.0980	-33.4513^{**}
Japan	-0.8423	-4.5195^{**}	-4.4855^{**}	-32.9507^{**}

Note: The ADF, the log of first difference ADF, PP and the log of first difference PP tests should be compared. The critical values for the rejection of the null hypothesis of a unit-root are -3.451, and -2.870 for 1% and 5%, respectively. The log of first difference series are at the 1% significance level. The symbol ** and * denote rejection of the null hypothesis at the 1% and 5% significance levels, respectively.

Table 4.4 Result for GARCH model

	GARCH			
	Thailand	Singapore	South Korea	Japan
C0	-0.0413^{***}	-0.0352^{***}	-0.0151^{**}	-0.0211^{***}
	(0.0134)	(0.0110)	(0.0061)	(0.0037)
C1	-0.5842^{****}	-0.5626^{***}	-0.3403^{***}	0.0626
	(0.0579)	(0.0583)	(0.1096)	(0.0868)
C2	0.7070^{***}	0.6214^{***}	0.2545^{*}	-0.8697^{***}
	(0.0759)	(0.0814)	(0.1449)	(0.0441)
D1	0.1648^{***}	0.1382^{***}	0.0955^{***}	0.1352^{***}
	(0.0260)	(0.0203)	(0.0165)	(0.0220)
D2	0.1406^{***}	0.1786^{***}	0.0996^{***}	0.0815^{***}
	(0.0223)	(0.0213)	(0.0140)	(0.0150)
ω_i	0.0028^{*}	0.0040^{***}	0.0004	0.0011
	(0.0017)	(0.0014)	(0.004)	(0.0008)
α_i	0.1916^{**}	0.2331^{**}	0.0456	0.3266
	(0.0941)	(0.1041)	(0.0452)	(0.3488)
β_i	0.6111^{***}	0.3390^{*}	0.8571^{***}	0.6360^{*}
	(0.1556)	(0.1975)	(0.1001)	(0.3332)
υ_i	5.4558^{***}	12.3850^{***}	6.0185^{***}	3.7896^{**}
	(1.6542)	(3.5203)	(2.2835)	(1.5674)
λ_i	-0.3668^{***}	-0.3223^{***}	-0.0233	-0.2963^{**}
	(0.1100)	(0.1140)	(0.1180)	(0.1236)

Note that ***, ** and * denote rejection of the null hypothesis at the 1%, 5% and 10% significance levels, respectively.

Table 4.5 Test the skewed-t marginal distribution models

	Thailand	Singapore	South Korea	Japan
First moment LB test	0.4885	0.0586	0.0642	0.1185
Second moment LB test	0.2879	0.2119	0.6221	0.7778
Third moment LB test	0.0923	0.1207	0.0811	0.1340
Fourth moment LB test	0.7540	0.3643	0.4616	0.9100
K-S test	0.9883	0.9852	0.9924	0.9706

Note that this table reports the p-values from Ljung-Box tests of serial independence of the first four moments of the variables $x_{i,t}$ (i stand for Thailand, Singapore, South Korea and Japan, respective). We regress $(x_{i,t} - \bar{x}_i)^k$ on 5 lags of the variables for k=1, 2, 3, 4. In addition we presents the p-values form the Kolmogorow-Smirnov (KS) tests for the adequacy of the distribution model.

Table 4.6 Results for dynamic Copula—GARCH

	Copula--GARCH					
	Thailand Singapore	Thailand South Korea	Thailand Japan	Singapore South Korea	Singapore Japan	Japan South Korea
Panel A: Estimation of Gaussian dependence structure						
α_c	0.1110^{**}	0.0030	0.0075^{**}	0.1538	0.1012	0.0264^{***}
	(0.0542)	(0.0022)	(0.0030)	(0.1659)	(0.0855)	(0.0064)
β_c	0.7688^{***}	0.9466^{**}	0.9950^{***}	0.4461	0.3704	0.9950^{***}
	(0.0857)	(0.2697)	(0.00564)	(0.5093)	(0.4642)	(0.0775)
γ_c	0.8807^{***}	-0.3037^{*}	-0.6991^{***}	0.9643	-0.9462	-1.3039^{***}
	(0.1543)	(0.1588)	(0.1913)	(0.7217)	(0.8911)	(0.1375)
Ln(L)	59.66281	1.384931	3.296107	10.89347	3.32421	9.797367
AIC	-113.3256	3.230139	-0.5922134	-15.78694	-0.6484196	-13.59473
Panel B: Estimation of Student-t dependence structure						
α_c	0.2533	0.1358	0.2470	0.0232	0.2150	0.4526
	(0.1802)	(0.1419)	(0.3027)	(0.0476)	(0.1817)	(0.3487)
β_c	0.7585^{***}	0.1804	0.0000	0.9413^{***}	0.3410	0.0000
	(0.1347)	(0.2994)	(1.0233)	(0.0813)	(0.4801)	(0.7145
γ_c	3.3614	3.3719^{*}	1.8875	0.6130	-2.0530	2.2645
	(2.7799)	(1.8966)	(2.2273)	(0.7228)	(1.8814)	(2.6400)
n	141.2247^{***}	21.1820^{***}	26.653^{***}	12.0641^{**}	76.5050^{***}	9.4572^{***}
	(0.2253)	(1.3286)	(0.9473)	(4.7672)	(0.4491)	(1.1817)
Ln(L)	58.5307	2.385122	2.002171	11.13946	3.345037	7.025383
AIC	-109.0614	3.229756	3.995658	-14.27892	1.309926	-6.050765
Panel C: Estimation of Gumbel dependence structure						
α_c	-0.3598^{***}	-18.4926^{***}	-2.0646	-0.02558	-0.0152	0.0976
	(0.1358)	(2.3076)	(3.7409)	(0.75430)	(0.8252)	(0.0830)
β_c	0.5236^{**}	0.2759^{***}	0.2455	0.9955	0.9950	0.9950^{***}
	(0.2201)	(0.0388)	(1.3960)	(0.2766)	(0.3588)	(0.1007)
γ_c	4.0572^{***}	117.0893^{***}	3.2423	0.3337	-0.2562	-6.0301
	(1.4765)	(13.8372)	(6.1443)	(0.3252)	(0.4728)	(6.2675)
Ln(L)	45.43125	10.45262	1.161393	9.427959	2.85591	7.447646
AIC	-84.86251	-14.90525	3.677214	-12.85592	0.2881799	-8.895292
Panel D: Estimation of Clayton dependence structure						
α_c	0.1823	-0.7780	-3.1137^{**}	-0.0874	-5.4474^{**}	-1.8565^{***}
	(0.176)	(0.873)	(1.326)	(0.464)	(2.420)	(0.581)
β_c	0.7778^{***}	0.0328	-0.4706^{*}	0.5596	0.8830^{***}	-0.6992^{**}
	(0.161)	(0.041)	(0.281)	(0.417)	(0.017)	(0.077)
γ_c	-0.6479	-8.3803	-1.3047	-1.7920	13.5870^{**}	-3.3375^{***}
	(0.739)	(7.185)	2.107	(1.812)	(2.2972)	(1.696)
Ln(L)	55.424	3.332	1.345	10.471	5.110	10.362
AIC	-104.8472	-0.6638	3.3106	-14.9429	-4.2206	-14.7233

Note that ***, ** and * denote rejection of the null hypothesis at the 1%, 5% and 10% significance levels, respectively

Table 4.7 Goodness-of-fit tests for the copula model

	Guassian Copula	Student-t Copula	Gumbel Copula	Clayton Copula
Thailand and Singapore	0.5779	0.7308	0.0034	0.0574
Thailand and South Korea	0.1024	0.1154	0.1414	0.0634
Thailand and Japan	0.6658	0.6778	0.8237	0.2972
Singapore and South Korea	0.5609	0.6449	0.5160	0.6439
Singapore and Japan	0.0365	0.0324	0.0724	0.0045
Japan and South Korea	0.4830	0.6039	0.1743	0.5270

Note: The test statistic is the Cramer-von Mises functional $S_n = \int_{[0,1]^d} C_n(u)^2 \, dC_n(u) = \sum_{i=1}^{n} \left\{ C_n(\hat{U}_i) - C_{\theta_n}(\hat{\hat{U}}_i) \right\}$ by Genest, Remillard and Beaudoin (2009). C_n is the empirical copula and C_{θ_n} is an estimator of C under the hypothesis that $H_0 : C \in \{C_\theta\}$ holds. We report the p-value from the Goodness of fit tests. A p-value less than 0.05 indicate a rejection of the null hypothesis that the model is well specified.

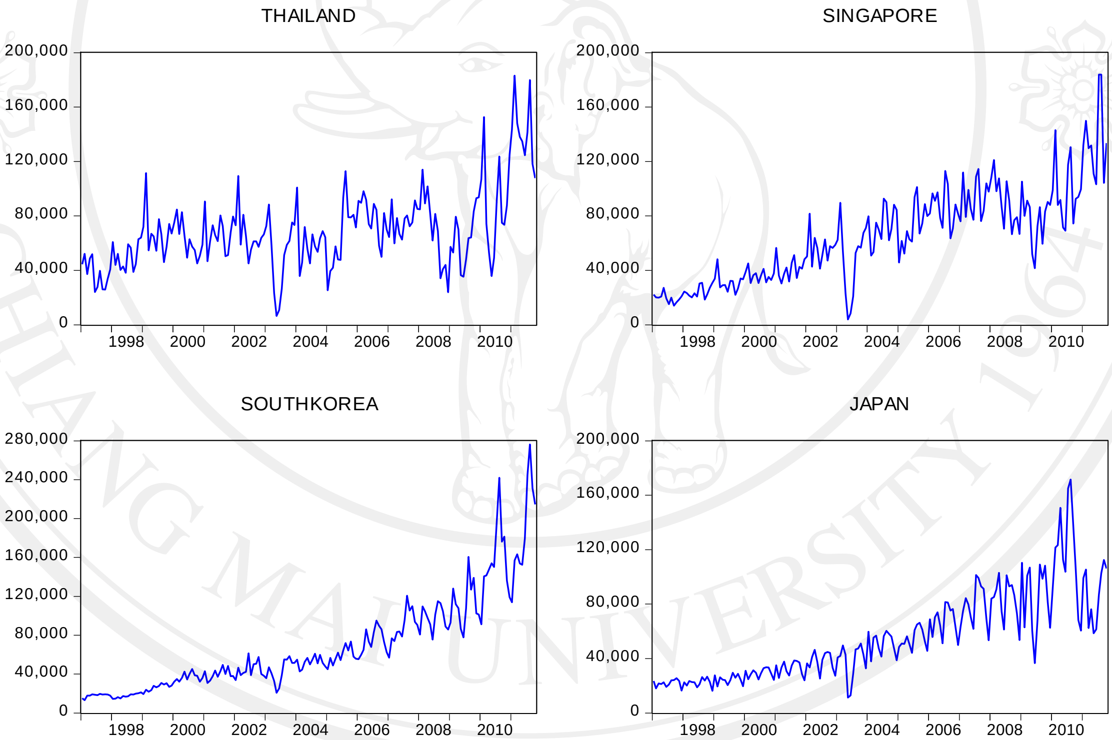

Figure 4.1 Chinese tourist arrivals to each destination

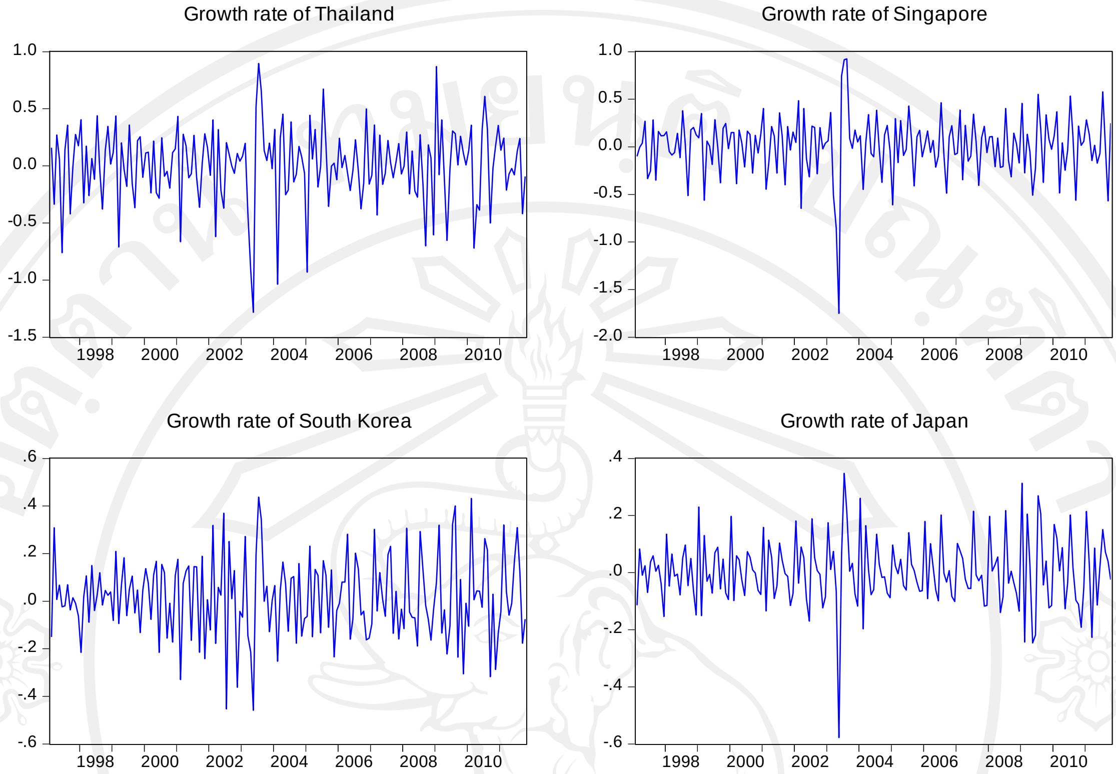

Figure 4.2 Log Chinese tourist arrivals rate to four destinations

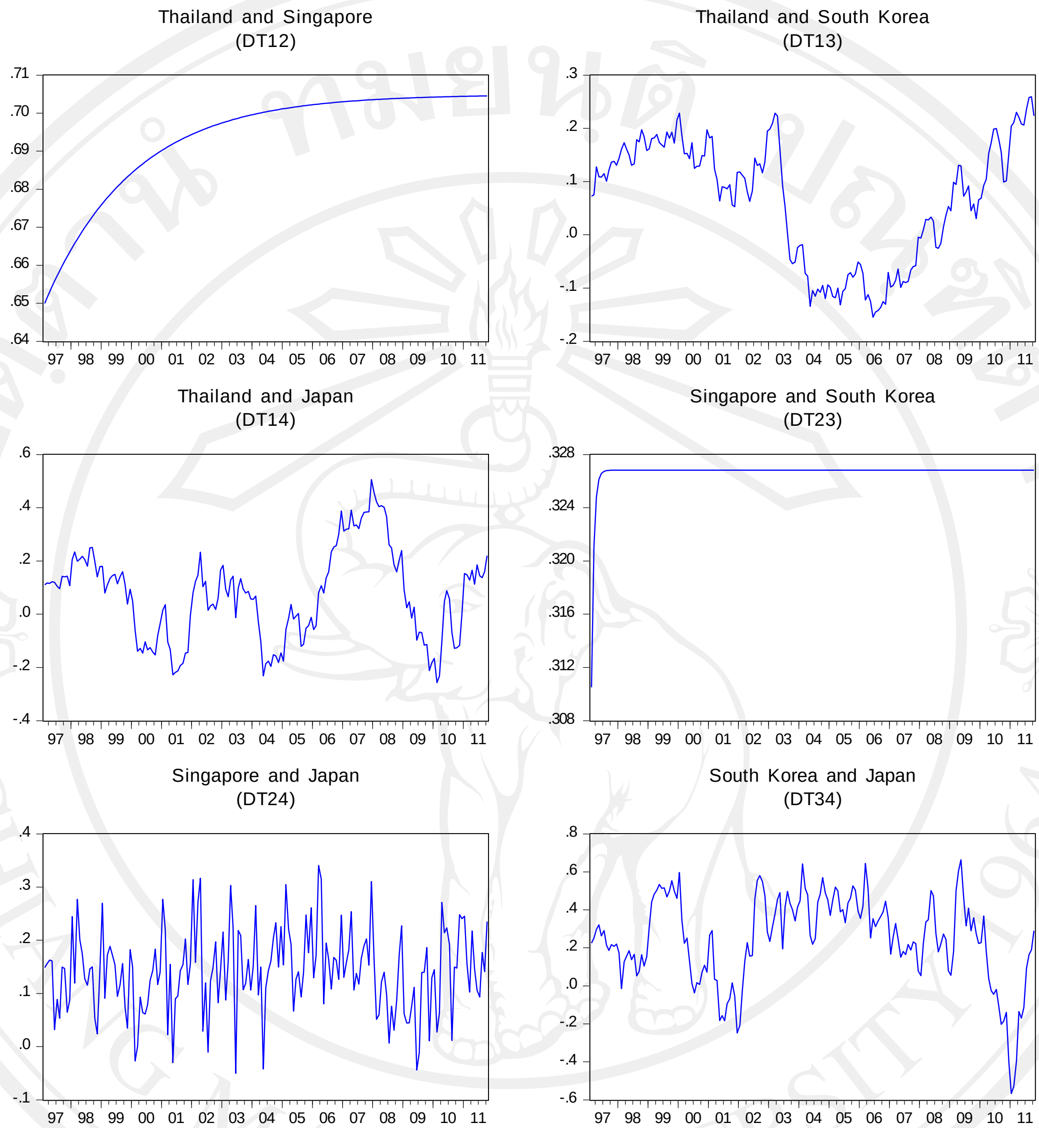

Figure 4.3 Conditional Dependence estimates (Pearson's ρ_t) between four destinations based Gaussian copula-GARCH

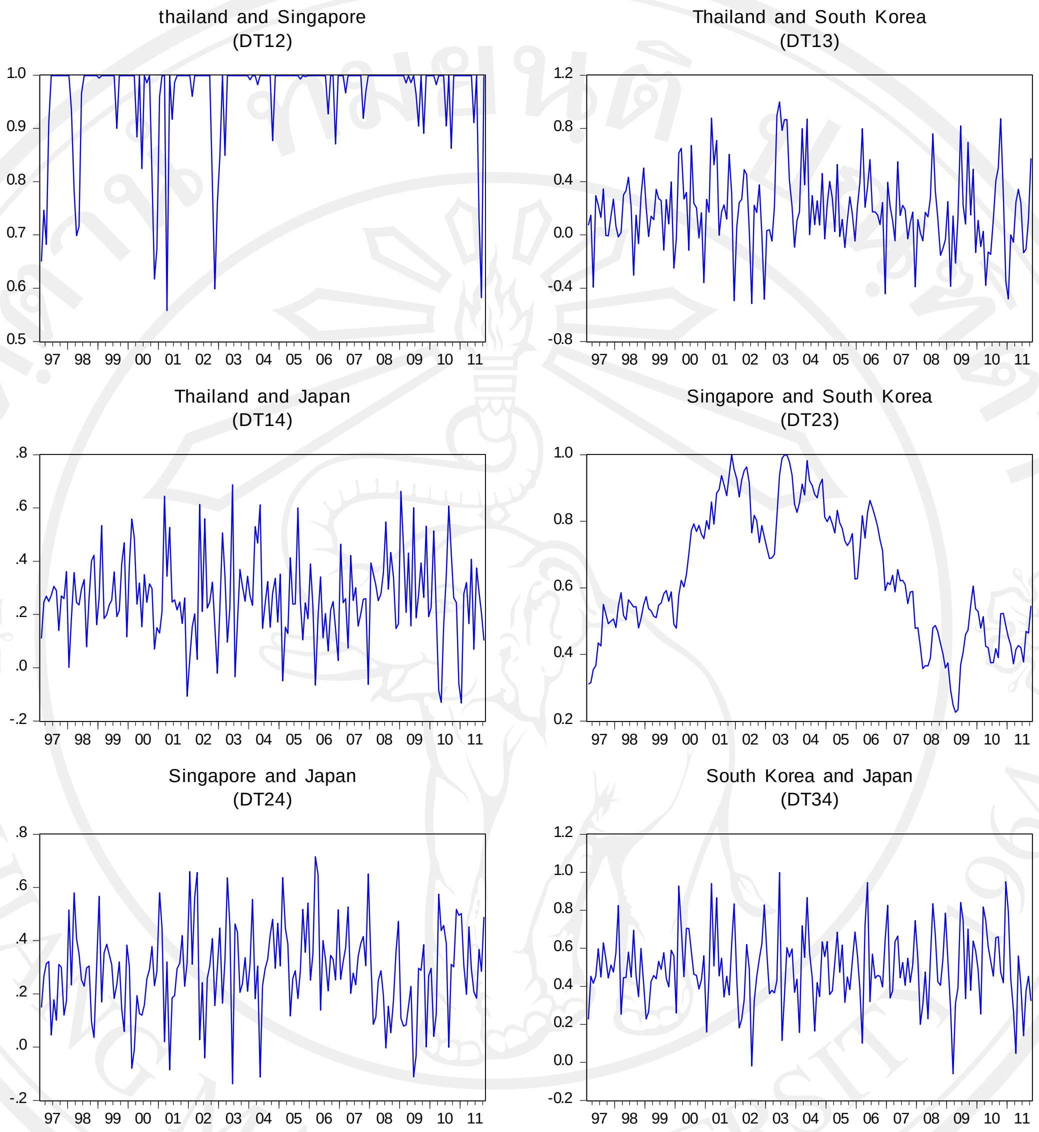

Figure 4.4 Conditional Dependence estimates (Pearson's ρ_t) between four destinations

based Student-t copula-GARCH

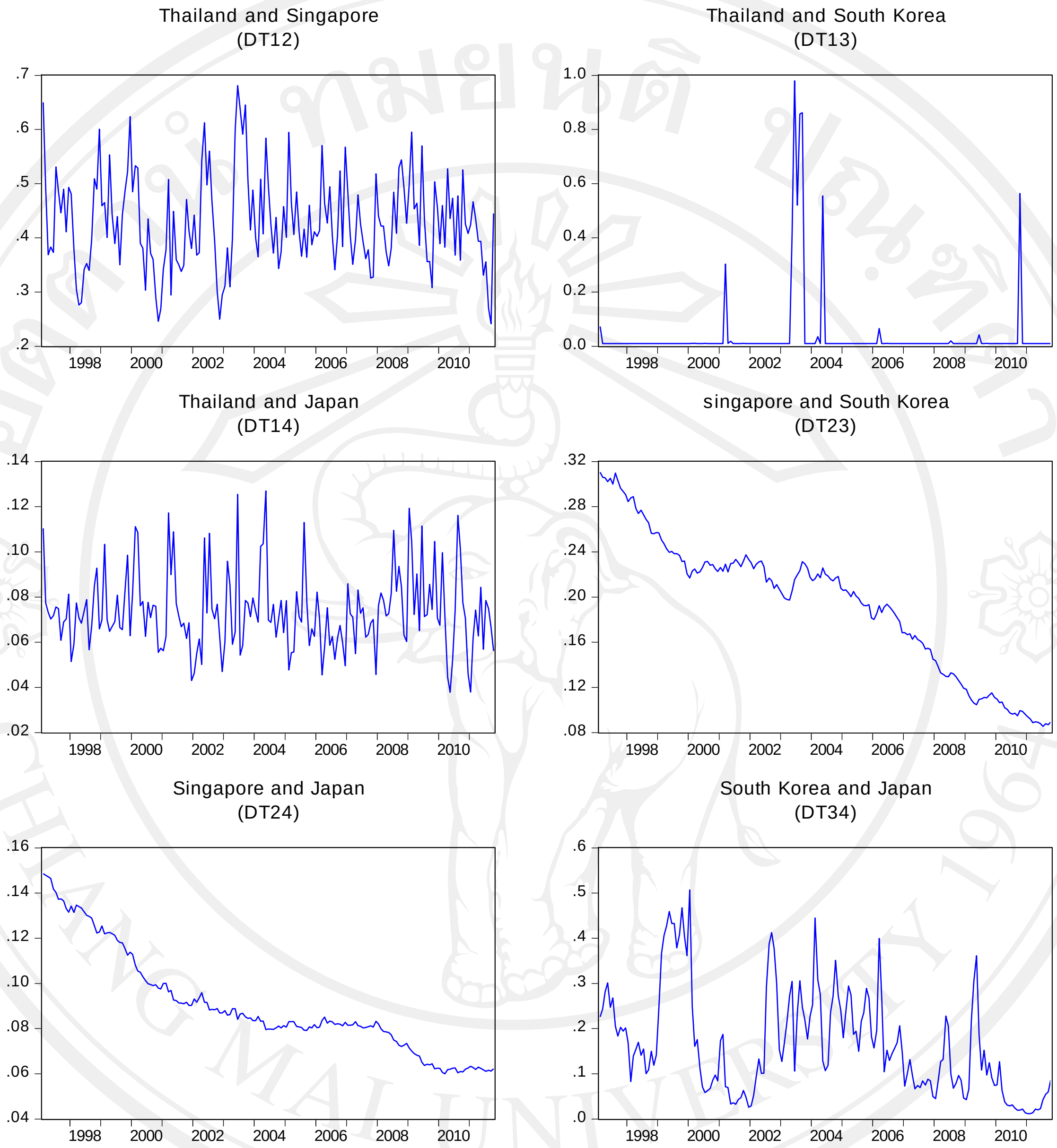

Figure 4.5 Conditional Dependence estimates (Kendall's tau) between four destinations based Gumbel copula-GARCH

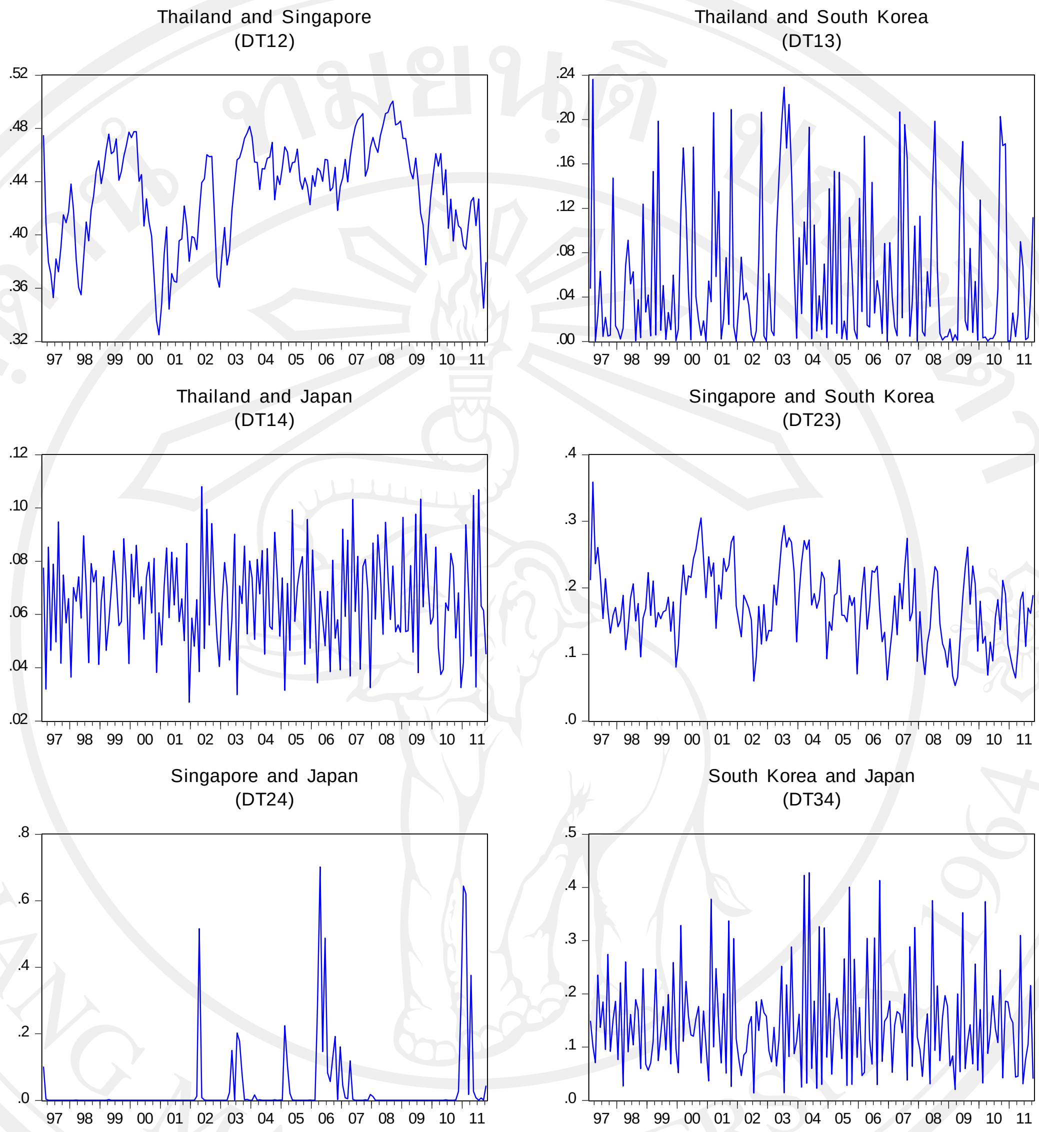

Figure 4.6 Conditional Dependence estimates (Kendall's tau) between four destinations based Clayton copula-GARCH