RISK ASSESSMENT OF TOURISM REVENUE IN THAILAND BY MARKOV-SWITCHING GARCH-X MODEL

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Abstract - This paper adopts the Markov-Switching GARCH-X model to find the volatility and the risk of tourism revenue from 5 countries consisting China, Japan, Korea, Malaysia, and the United Kingdom. We consider different distributions for our standardized residual. To select the best model, we consider the lowest values of AIC and BIC. The results show that the student-t innovation performs better for all countries except for Malaysia. We find that GED is the best fit distribution for Malaysia case. The result also confirms that the risk of Thai tourism revenue in high tourism arrival regime is lower than low tourism regimes.

Keywords - Value at Risk, Volatility

I. INTRODUCTION

Tourism is one of the most important roles impacting the domestic economy. It is categorized as a service industry. Along this decade, this sector generates a lot of income to the country and thereby leading economic growth and development. Nowadays, Thailand's tourism has achieved a great success by marketing and promoting the tourism sector. Nowadays, Thailand receive the title "Land of Smile". The tourism industry also generates income for the entrepreneurs as well as distributes income to the local area. This tourism revenue can measure the direction of the economy. It is calculated by the tourists that have the ability to travel and the other expenses during the trip. Moreover, the tourism revenue is taken into consideration in conjunction with the economic situation which is predicted to predict the trend of the tourism revenue level within the next year.

The tourism revenue of Thailand has been changed overtime and it has swing gradually along this decade. This is due to the politic uncertainty in Thailand. The volatility of this revenue may affect the financial planning of the policy maker. Arslanturk, Balcilar, and Ozdemir (2011) mentioned that the economic growth is affected by tourism revenue. Therefore, this volatility will contribute the risk to the economy. To measure the risk of the tourism sector we can assess it in term of the value at risk. It is a statistical technique used to measure and quantify the level of financial risk within a firm or investment portfolio over a specific time frame. Thus, we apply this risk measurement to quantify the risk of tourism revenue.

In this study, we also study the effect of gross domestic product and consumer price index from the top 5 countries on Thailand volatility by using the Markov-switching GARCH-X model. This model can include these variables as the exogenous variables in the model. We consider this model as the nonlinear structural change in the volatility of Thai's tourism revenue. Thus, we can predict the volatility of the tourism revenue for high tourism regime and low tourism revenue regime.

This study is organized as follows. Section 2 describes the metrology; economics theory and econometric theory. Section 3 is a data description about tourism revenue, gross domestic index and consumer price index from 5 countries. Section 4 shows the empirical results. Finally, Section 5 presents the conclusions.

II. THEORY

1) Microeconomic Theory for Tourism Demand

Microeconomics concept that describes the demand for tourism base on the basis of the theory of consumer behavior that consumer is rational. When the income and price of goods or services are provide, Consumers plan to spend their own money income to get the maximum utility. Under the concept of Ordinalist Bureau of Economics, the consumer utilities can be measured by the product's preference ranking. Therefore, consumers will be compared to the benefits of the utility obtained from the basket before making a decision to purchase the highest satisfaction under the limits of budget constraint(Mingsarnkhaosaard, 2014).

2)Tourism-led growth hypothesis

Tourism-led growth hypothesis (TLGH) has been steadily increasing in recent decades. The TLG hypothesis is based on the assumption of export-led growth (ELG). The long-term economic growth of the country can be explained by the expansion of tourism as well as exports. Therefore, TLGH assumptions are generally accepted when tourism growth encourages economic growth in spillover and external impacts in different styles or forms (Balaguer and Cantavella-Jordá, 2002)

3)A model of tourism and growth

The volatility of the tourist revenue model in this study can be costructed as follows:

$$TE = f(GDP, CPI) \quad (1)$$

The above model is developed based on the indirect demand theory. Most commonly used for forecasting factors that influence tourists' spending. Result from the model analysis is important for policy makers to encourage tourists to spend more.

TE = Tourism revenue

GDP,CPI = Factors determining the spending of tourists' revenue

4) Risk Theory

Value at risk (VaR) is a tool to measure the risk of the return or tourism revenue. Bali and Cakici (2004), Dar-Hsin Chen (2009) suggested that VaR can be described as an expected return on stock level. But in this study, we consider the tourism revenue. We note that the VaR measurement is based in the Local-Valuation Method and Full-Valuation Method.

5)Markov switching GARCH-X model

Denote the variable of interest at time tby y_t. We assume that y_t has zero mean and is not serially correlated. In other applications, the assumption that the Markov-switching GARCH process has conditional mean zero often implies applying the Markov-switching GARCH model to a demeaned time series. We allow for the regime–switching in the conditional variance process. Denote by I_{t-1} the information set observed up to time $t-1$, that is, $I_{t-1} \equiv \{y_{t-i}, i > 0\}$. The general Markov– switching GARCH specification can then be expressed as:

$$y_t|(s_t = k, I_{t-1}) \sim \mathcal{D}(0, h_{k,t}, \xi_k) \quad (2)$$

where$\mathcal{D}(0, h_{k,t}, \xi_k)$ is a continuous distribution with zero mean, time-varying variance $h_{k,t}$, and additional shape parameters gathered in the vector ξ_k. The integer-valued stochastic variable s_t, defined on the discrete space {1,2}, characterizes the Markov–switching GARCH model. In this study, we aim to investigate tourism demand risk and consider using Markov-switching GARCH:

$$y_t = \mu_{s_t} + \sigma_{s_t} u_t$$
$$\sigma^2_{s_t} = \omega_{s_t} + \alpha_{s_t} \varepsilon^2_{t-1} + \beta_{s_t} \sigma^2_{t-1} \quad (3)$$

In related papers, Yang (2000), Yao and Attali (2000), Yao (2001) and Francq and Zakoian (2002) derived conditions for the asymptotic stationarity of some AR and ARMA models with Markov-switching regimes. We also want to study the GDP and CPI variables. So we bring these exogenous variables into this equation; adopting Markov switching GARCH to add exogenous variables that called Markov switching GARCH-X model.

$$y_t = \mu_{s_t} + \sigma_{s_t} u_t + \theta_t GDP_t + \vartheta_t \frac{CPI_a}{CPI_b}$$
$$\sigma^2_{s_t} = \omega_{s_t} + \alpha_{s_t} \varepsilon^2_{t-1} + \beta_{s_t} \sigma^2_{t-1} \quad (4)$$

Where CPI_a is consumer price index of the destination country and CPI_b is consumer price index of the source country.

III. DATA DESCRIPTION

In this study, we collect top 5 countries providing tourism revenue to Thailand. We also collect the gross domestic product and consumer price index as the exogenous variables in our model. All data series are quarterly data, which covering the period from Q1, 2017 to Q2, 2018.

	Mean	Median	Max	Min	Std.	Skewness	Kurtosis
CHINA	0.15926	0.1574	1.60242	-0.69348	0.4556	0.8030	3.9080
JAPAN	0.04379	0.0032	0.75794	-0.48207	0.2680	0.4230	3.0852
KOREA	0.06659	0.0209	1.06780	-0.46797	0.3315	0.5602	3.0243
MALAY	0.05341	0.0170	0.65534	-0.35937	0.2185	0.6791	3.9598
UK	0.03612	0.0295	0.44095	-0.41719	0.2194	0.0069	2.3433
CPICHITH	-1.56396	0.1974	11.5036	-55.8811	10.341	-3.7963	18.9559
CPIJAPTH	17.4010	0.7645	731.878	-32.7389	101.49	6.7681	48.1473
CPIKORTH	-0.66874	-0.2330	41.1590	-25.2819	8.3197	1.4623	15.5856
CPIMALTH	-0.35771	-0.0077	0.36183	-17.98165	2.4713	-7.0375	50.6907
CPIUKTH	-9.20979	0.0209	7.94441	-401.9554	55.443	-6.9021	49.3567
GDPCHINA	0.34580	0.5520	1.13808	-0.76826	0.6908	-0.6315	2.08457
GDPJAPAN	0.00222	-0.0044	0.08711	-0.10673	0.0448	0.1860	2.52848
GDPKOREA	0.01511	0.0267	0.08392	-0.07864	0.0476	-0.7293	2.2784
GDPMALAY	-0.12987	-0.0185	1.80288	-3.45726	0.7976	-1.2212	7.8340
GDPUK	0.00945	0.02757	0.04566	-0.07506	0.0368	-1.1099	2.4979

Noted: From computation

Table 1 Descript return of tourism revenue from five countries

The descriptive statistics for tourism revenue, consumer price index and gross domestic product are reported in table 1. Tourism revenue from China is higher than Japan Korea Malaysia and United Kingdom which show that it has higher volatilities. For CPI, Japan has the highest standard deviation and for GDP, Malaysia has the highest standard deviation. The skewness statistic for CPI of China, Malaysia, United Kingdom and GDP of China, Korea, Malaysia, and the United Kingdom are negative, indicating the returns are significantly skewed to left. The skewness statistic for the others is positive, indicating the returns are skewed to right. For the excess kurtosis statistics, all of the variables in this study are positive. Thereby indicating that the distribution of returns has larger, thicker tails than the normal distribution.

IV. EMPIRICAL RESULT

Countries	Distribution	AIC	BIC
China	Norm	34.80734	66.33201
	Snorm	36.76181	72.22707
	Std	29.05737***	64.52262***
	Ged	45.25877	80.72403
	Sged	46.6939	86.09974
	Sstd	47.37569	86.78153
Japan	Norm	-15.98133	15.54334
	Snorm	-11.46557	23.99968
	Std	-20.07489***	15.39036***
	Ged	4.187023	39.65228
	Sged	5.690631	45.09647
	Sstd	15.98041	55.38625
Korea	Norm	-7.247151	24.27752
	Snorm	1.270695	36.73595
	Std	-23.42358***	12.04167***
	Ged	10.87985	46.3451
	Sged	16.69246	56.0983
	Sstd	12.16083	51.56667
Malaysia	Norm	-3.14089	28.38378
	Snorm	-13.87542	21.58983
	Std	-13.28185	22.1834
	Ged	-25.85986***	9.60539***
	Sged	5.518219	44.92406
	Sstd	8.957491	48.36333
UK	Norm	-13.31436	18.21031
	Snorm	12.98605	48.4513
	Std	-17.81511***	17.65015***
	Ged	16.88066	52.34592
	Sged	16.59493	56.00077
	Sstd	25.06041	64.46625

Table 2 Model selection

Noted: From computation
- norm is normal distribution
-snorm is skew normal distribution
-std is standardized student-t distribution
- ged is generalized error distribution
-sged is skew generalized error distribution
- sstd is skew standardized student-t distribution

To select the best fit to the distribution model, AIC and BIC are applied. We find that Markov-Switching GARCH (1,1) with student-t distribution provides the minimum AIC and BIC for all countries, except Malaysia. We find that Markov-Switching GARCH (1,1) with GED is the distribution for Malaysia case.

Country	Regime	parameter	μ	θ	ϑ	*lag*	ω	α	β	df		P(1,1)	P(2,2)
china	1	coef	0.2782722	-0.4376835	-0.4836823	0.05001845	1.00E-12	0.897697	0.004746357	5.819900	coef	0.5904	0.9036
		S.E	0.000319684	0.000839945	0.001450279	0.00010888	0.000002114	1.129174	0.006001179	14.77457			
	2	coef	0.2215796	-0.0593324	-0.2783299	-0.00618571	0.04542016	0.000001	0.1208753	3.965178	S.E.	0.1821	0.1213
		S.E	0.03937581	0.08030212	0.0446551	0.002140027	0.0391534	0.000183442	1.447392	2.778893			
japan	1	coef	0.08851312	-1.541409	2.767426	0.000411996	0.03216429	0.000001	0.8302707	4.578702	coef	0.7439	0.1186
		S.E	0.02546991	0.1558803	0.8921339	0.000189232	0.016861076	0.000165293	0.095927141	5.039272			
	2	coef	-0.1425277	0.05711327	1.027316	0.003434328	1.00E-12	0.002572715	0.08421914	3.381805	S.E.	0.0875	0.1164
		S.E	0.001571351	0.031726792	0.140412762	0.00013203	0.000007102	0.00285682	0.101540191	2.289992			
korea	1	coef	0.1772502	-0.9891202	-1.73871	-0.00688981	1.00E-12	0.8409037	0.000001	8.964911	coef	0.3792	0.3261
		S.E	0.00022496	0.001226332	0.003847666	0.000008566	0.000002229	0.288182	0.000073190	11.98886			
	2	coef	-0.00810329	-0.00810329	-4.23943	0.004260756	0.009376446	0.02796485	0.000001	3.117456	S.E.	0.1998	0.1849
		S.E	0.02688467	0.1129569	0.5605927	0.001438104	0.007134527	0.05705261	1.255235	1.861104			
malaysia	1	coef	0.134506977	-0.40174670	0.017393535	-0.00517333	0.065509577	0.000001	0.075024529	3.10000	coef	0.2010	0.0001
		S.E	0.04962348	0.4145852	0.05722975	0.02504363	0.01379342	0.000710934	0.7489623	1.335548			
	2	coef	-0.02689519	0.172015714	-0.00016885	-0.00482514	0.707442504	0.043414253	0.128576454	20.0000	S.E.	0.0953	0.1401
		S.E	0.01829491	0.01861867	0.00087589	0.004533475	0.06425437	0.01009161	0.08203099	16.03378			
uk	1	coef	0.1783959	0.1644922	4.502399	0.000823842	1.00E-12	0.1235842	0.0663417	17.81644	coef	0.4218	0.6183
		S.E	0.02928366	0.1963123	0.5451269	0.000377357	0.000287743	0.09339293	0.1217009	30.96243			
	2	coef	-0.00226700	-0.8281372	-4.43542	-0.00014991	1.00E-12	0.05348401	0.7105291	3.10000	S.E.	0.1317	0.0986
		S.E	0.08924219	0.3566231	2.097533	0.000345495	0.0193459	0.8271426	2.356043	16.60195			

Table 3 Estimated result from Markov Switching GARCH-X model

Noted: From computation

The estimated coefficients vary substantially across countries. For example, the tourism revenue of China,θ is the coefficient of gross domestic and ϑ is the coefficient of the consumer price index. In regime 1 and 2, they have a negative relationship to tourism revenue but in regime 2, θ = -0.0593 and ϑ = -0.278 which have less effect than regime 1, θ = -0.4376 and ϑ = -0.484. On the contrary, Japanese model coefficients in regime 1 θ is -1.54 less than θ in regime 2 that is 0.0571 which has a positive effect on tourism revenue. Moreover, ϑ in both regimes have a positive effect that is 2.77 and 1.03. So, the reduction of the tourism revenue could be explained by several factors, including gross domestic price and consumer price index as well as a stagnating economy.

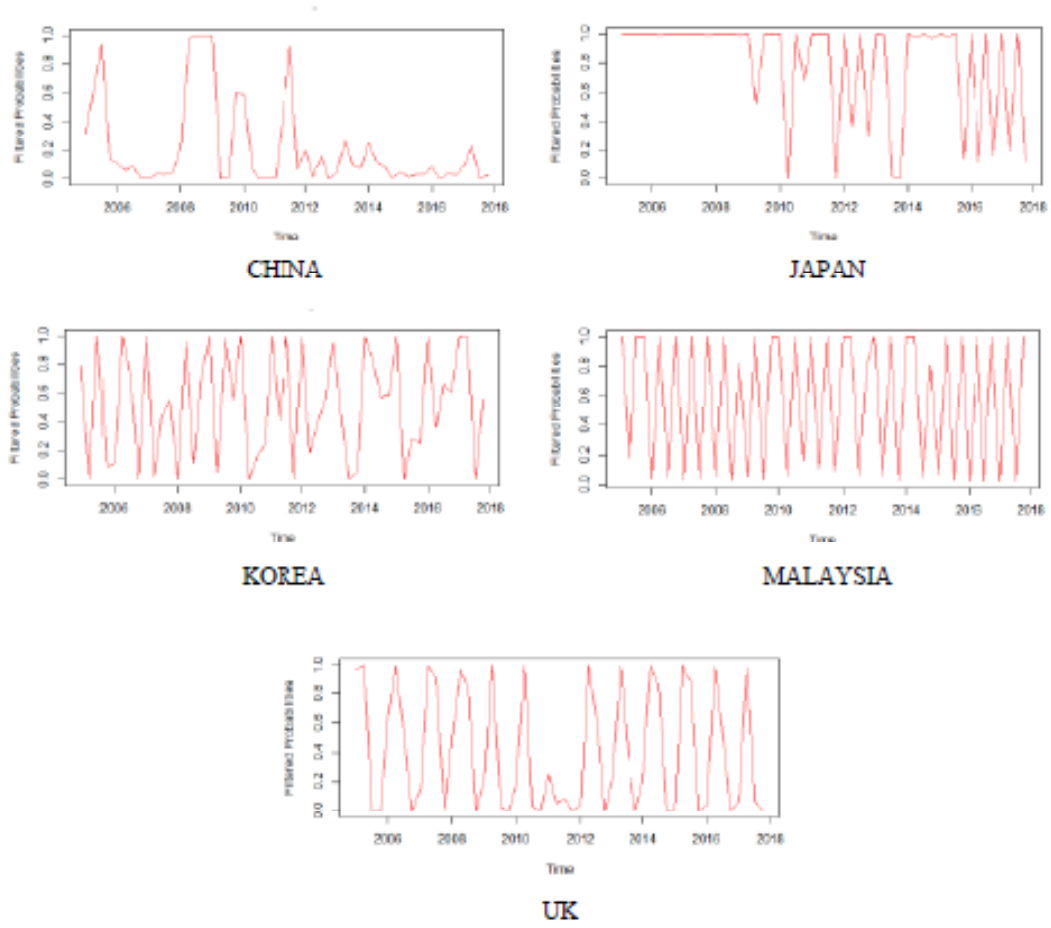


Figure 1: Regime probabilities of tourism revenue from five countries

Then, we produce the regime probabilities in order to illustrate the regime switching behavior of the Thai tourism revenue received form each country. In the China case, since 2005, the regime probabilities of Thai tourism revenuebegan to be low because China has the policy to tighten economic bubble and Thailand also had a tsunami in the previous year. Later, Chinese tourists continued to slow down due to uncertainty in Thai politics and the global economic recession. In 2009, a year of intense competition in the international travel market but Thailand has a plan to stimulate the Chinese tourism market until 2010, China is recovering the economic liquidity and the year 2012-2013 has the movie Lost in Thailand, causing Chinese tourists increase a lot but due to the incident of a tourist boat crashing in Phuket in mid-2018, tourists lose confidence.

For the Japan case, we can observe several drop of the regime probabilities after 2010. We expect that the Japanese tourists may face with the US financial crisis and severe economic recession during 2008-2009. In the following years, Japan experienced an aging society. In 2011, tsunami, severe earthquake as well as nuclear power plant explosion. Therefore, during those years, Japanese tourists have tended to postpone traveling overseas. However, after 2017, the Japanese economy grew faster than expected and contributed a positive way of tourism because the year 2018, Tourism Authorities of Thailand(TAT) has the policy to invite Japanese tourists to the local city. In the case of Korean tourists. We find that the regime probabilities are swing overtime. The reason of this phenomenon my cause from Korean won's appreciation affected by the slowdown of the US and Japan economies. These making Korean tourists sparse even in later years, In 2010, Korea was the 7th largest exporter in the world, but in 2015, Korea won had appreciated again. Moreover, there is Mers disease outbreak causing Korean tourists in Thailand to decrease in 2016. Tourism Authorities of Thailand(TAT) has a joint agreement with Korea Associaton of Travel Agent, planning to encourage tourists to visit in a variety of campaign activities in 2017. The number of tourists increased more than Japan in the first half of the year because it is not affected by the economic slowdown. Similar to Korean, the tourism revenue obtained from Malaysia also produce a large fluctuation of regime probabilities. The income from Malaysian tourists is quite volatile. In 2008, there was a political reversal for the first time. The economy is down. There is a slow growth in revenue during that year. Due to weak oil prices and weak Malaysian currency together with the Malaysian government campaigning for people traveling in the country to stimulate the economy. In the year 2018, Malaysian tourists come to relax in Thailand during the MerdekaDay, which is a holiday that matches Malaysia's national day and is likely to increase. Finally, there is quit a tourism revenue fluctuations for UK case. In 2011, there was a severe flood crisis in Thailand resulting in reduced traveling, that is a direct impact from the dissemination of Don Muang Airport news. Moreover rumors of a potential epidemic after a severe disaster in foreign media along with a warning statement of the foreign government that raises the level of violence. In the following year, there was an adjustment (APD: Air Passenger Duty) 8 percent in the UK. In addition, the enforcement of the European Union Emission Trading System (EU ETS) of the European Union Resulting in more remote travel costs revenue volatility continues and during the year 2016-2018, the UK has economic problems. The pound weakened. Inflation is higher, causing an economic slowdown from preparing to leave the European Union (Brexit). However, there is a tendency that the number of tourists will increase due to the Tourism Authorities of Thailand(TAT) marketing to restore purchasing power.

Probability	Period	CHINA	JAPAN	KOREA	MALAYSIA	UK
$\propto 0.1$	**Bull period**					
	VaR(X)	-0.0220523	-0.4725767	-0.5058673	-0.3456026	-0.1149707
	VaR	-2.655369e-06	-0.5355883	-2.383465e-06	-0.3409387	-0.01377105
	ES(X)	-0.02205341	-0.684979	-0.5058682	-0.4719058	-0.1149712
	ES	-3.628929e-06	-0.7344509	-3.258577e-06	-0.4694194	-0.01887785
	Bear period					
	VaR(X)	-0.6039945	-0.005322968	-0.01209274	-0.01192773	-0.04930734
	VaR	-0.2988743	-1.353348e-06	-0.1256579	-0.0125721	-0.02614108
	ES(X)	-0.713682	-0.005323467	-0.01255586	-0.01631601	-0.05900574
	ES	-0.4084208	-1.850614e-06	-0.1717887	-0.01715453	-0.03573863
$\propto 0.5$	**Bull period**					
	VaR(X)	-0.02205319	-0.63557	-0.505868	-0.4425252	-0.1149711
	VaR	-3.40246e-06	-0.6881915	-3.055009e-06	-0.4395322	-0.01768991
	ES(X)	-0.02205413	-0.8230399	-0.5058689	-0.5540026	-0.1149716
	ES	-4.261741e-06	-0.8637111	-3.827398e-06	-0.5529316	-0.02219725
	Bear period					
	VaR(X)	-0.6881665	-0.005323351	-0.01244813	-0.01529521	-0.0567497
	VaR	-0.3829381	-1.73494e-06	-0.1610577	-0.01608856	-0.03350605
	ES(X)	-0.7849786	-0.00532379	-0.0128569	-0.01916838	-0.06530968
	ES	-0.4796258	-2.173836e-06	-0.2017736	-0.02013309	-0.04197702
$\propto 0.01$	**Bull period**					
	VaR(X)	-0.0220547	-0.009413182	-0.5058694	-0.6243358	-0.1149719
	VaR	-4.803878e-06	-0.007920529	-4.314713e-06	-0.6244774	-0.02504102
	ES(X)	-0.02205546	-0.01093349	-0.5058701	-0.7147394	-0.1149723
	ES	-5.500719e-06	-0.009026839	-4.941089e-06	-0.7164396	-0.02869629
	Bear period					
	VaR(X)	-0.8460591	-0.005324068	-0.01311479	-0.02161203	-0.07071033
	VaR	-0.5406279	-2.450744e-06	-0.227462	-0.02268486	-0.04732151
	ES(X)	-0.9245697	-0.005324424	-0.01344628	-0.02475301	-0.07765212
	ES	-0.6190376	-2.80667e-06	-0.2604809	-0.02596481	-0.04732151

Table 4 Show value at risk and expected short fall for each probability

Noted: From computation

Table 4 shows the result of value at risk (VaR) and expected shortfalls (ES). Two models, namely MS-GARCH and MS-GARCH-X models are shown. The results show that if the exogenous variables are included, the VaR of the model is -0.02205235% and -0.6039945%, respectively, for high and low tourism regimes, while the model without exogenous variables is respectively, -2.655369e-06% and -0.2988743%, for high and low tourism regimes. Therefore, if the exogenous variables are included the risk of the tourism demand in China is larger in both regimes

For China, $\propto$=0.1 in high regime indicates that there are 10% chances to lose 0.02205235 when the exogenous variables are included and lose 2.655369e-06 when the exogenous variables are not included. In low regime, there are 10% chances to lose 0.6039945 with exogenous variables and lose 0.2988743 without exogenous variables. At $\propto$=0.5 in high regimeindicates that there are 5% chances to lose 0.02205319 when the exogenous variables are included and lose 3.40246e-06 when the exogenous variables are not included. In low regime, there are 5% chances to lose 0.6881665 when the exogenous variables are included and lose 0.3829381 without exogenous variables. Lastly, at $\propto$=0.01 in high regime means there are 1% chances to lose 0.0220547 when the exogenous variables are includedand lose 4.803878e-06 when the exogenous variables are not included. In low regime, there are 1% chances to lose 0.8460591 when the exogenous variables are included and lose 0.5406279 when the exogenous variables are not included.

All of 5 countries provide negative signs of risk. Moreover, value at risk and expected shortfall of tourism revenue of Thailand will higher when gross domestic price and consumer price index are included in the model. China will have a high risk in low tourism regime while Japan, Korea, Malaysia, and United Kingdom will have higher risk in high tourism regime.

V. CONCLUSION

From using models Markov-Switching GACH-X and quarterly observations on tourism revenue of Thailand, when there are economic factors involved, it will make more riskier on tourism revenue; that value at risk conditional on the gross domestic price and consumer price index. If we consider only tourism revenue, the risk is lower. It can be said that we calculate the risk, regardless of the economic variables will cause an exaggerated estimation.

The results show Thailand like inferior goods, which can be seen from the VaR and ES of all 5 countries. This means that China has a low risk in the low regime, consistent with the tourism revenue relationship with GDP and CPI. If the economic situation is in a recession period, tourists will come to Thailand and make more money for Thailand. In contrast, if the economy is in a prosperous period, Japan, Korea, and Malaysia will visit Thailand and pay a lot of money. Nevertheless, for the United Kingdom, CPI variables cannot be calculated. Since it is a variable that causes the redundant equation to occur, Thailand has not been affected much because the Thai currency has almost no effect on the United Kingdom at all.

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