The linkage between tourism development and quality of life: A Copula-based Seemingly Unrelated Regression (SUR) model

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Abstract. This paper investigates relationships between international tourist arrivals to China and local residents’ quality of life (QOL). We employed Seemingly Unrelated Regression (SUR) model based on the Gaussian Copula approach. Data on international tourist arrivals from Japan, South Korea, and Russia to China during 1994 and 2018 were employed in the model. Findings show direct impacts of inbound tourism on resident’s QOL. Moreover, result reveals an intrinsically reciprocal linkage between national economic growth and residents’ QOL across origins of tourists. Novel contributions of this paper include the robust and objective approach to estimate relationship between international tourism and QOL of local residents.

1. Introduction

In the past decades, tourism has been a key factor in economic development in both emerging and developed countries. Key benefits of tourism include creating job opportunities and increase income from national foreign exchange [1]. Hence such economic benefits can improve quality of life (QOL) of local residents, not only does in economic aspects but also social, cultural, and educational aspects across the value supply chain [2, 3]. Economic development according to the tourism industry was found asymmetric especially in southeast Asia [4-6]. Various types of tourism development in the niche market were found in the region such as incentive travels [2] and tourism for retirement segment [7].

Currently, not only does economic impact of tourism is considered but also those of social value issues such as sustainability, educational issues as well as social stability [8]. This value could be achieved by implementing supply chain collaboration between tourism enterprises [9]. Moreover, it should be noted that tourism impacts are not only positive but also negative impacts such as traffic in the urban area [10].

Literature related to QOL in tourism is emerging in the last decades. There are several findings related to distinct measurement methods and different case studies on tourism and QOL including sustainable development goals or SDG [11]. For example, Fu et al. [12] concentrated on objective QOL and employed the HDI (Human Development Index) as a measurement proxy for QOL and found that QOL positively affect number of tourist arrivals from Japan, but not for mainland China and the United
States. Moreover, it is not found that there is any evidence indicating a linkage between tourism development and residents' QOL. On the contrary, Aref [13] examined the unilateral linkage between tourism and QOL in Shiraz (a city in Iran). In their study, 20 indicators were selected to measure QOL, it showed that tourism could benefit local residents’ QOL. Therefore, the results from the previous studies are contradictory.

In this study, we consider that linkages between tourism demand (TD) and QOL are bilateral due to the QOL of residents is interrelated with tourism experiences and vice versa [12]. Based on this idea, our main objective is to investigate such linkage between the international tourism demand from the top 3 countries of origin to China and QOL of residents in China by applying the Copula-based SUR model. In addition, according to Fu et al. [12] and Ridderstaat et al. [14], we also employed Gross Domestic Product (GDP) as a mediating indicator to examine a potential relationship between TD and QOL.

2. Literature review
Considering literature related to relationship between QOL and TD, current studies were concentrated on investigating the unilateral relationship between them. According to Meng et al. [15], several provinces in China were selected at a different level of the tourism industry to investigate their local residents' QOL, measured by ten objective indicators (e.g., annual per capita income, sense of safe) to examine linkage between QOL and status of tourism development. Finding of Meng et al. [15] study was that the residents who lived in a tourism destination with a high level of tourism development gain higher QOL than those who lived in the province with a relatively low level of tourism development. Moreover, Woo et al. [16] studied the case in the United States to identify the different sensitivity for QOL between residents who are directly involved in the tourism industry and those who are not. Woo et al. [16] also found that those who have closer relationships with tourism development tend to have a higher sensitivity to the effects of tourism development, so that they will gain a better QOL which means they are better satisfied with their quality of life. Therefore, gaps in the literature include limited knowledge on relationships between QOL and TD as well as robustness of the estimation methods.

Contributions of this study are in twofold. First, this study employed a novel bilateral linkage analysis between tourism demand and residents’ QOL. Economic growth is included as a mediating. We found that attracting the international tourism demand can improve local residents’ QOL in China. Secondly, we improved the traditional SUR model, that can only obtain a linear relationship [12], by applying the Copula-based SUR model, which is more robust than the traditional one and able to capture non-linear linkage between the variables. Then, we can contribute to an empirical study for using the Copula-based SUR model in the tourism field.

3. Data and methodology

3.1. Data
We used annual data from a China Statistical Yearbook including tourist arrivals from the top three countries of (Japan, South Korea, and Russia) to China during 1994 to 2018. Then, from International Monetary Fund data source, we employed real gross domestic products at a constant price index of 2010 as an economic growth variable (EG). According to QOL, we used Human Development Index (HDI) as a proxy from the United Nations Development Programme. Besides, we also follow Fu et al. [12]’s structure to select four incidental variables to assess impacts on the dependent variables. Those incidental variables include the September 11 attacks (D_911), the Asian financial crisis in 1997 (D_ASIA_CRISIS), the avian flu crisis during 2004–2007 (D_AF_CRISIS) and the global financial crisis during 2008–2010 (D_GLOBALFIN). To deal with distribution, we transformed variables in logarithm forms, except for those of four incidental variables.

3.2. Methodology
At the initial stage of our model analysis, we applied three important methods to check stationary of the variables. Then, we employed Autoregressive Distributed Lag (ARDL) bounds test to test a long-run
relationship among the variables are on level or at first difference stationary. This is an approach based on the normally F and t statistic [17].

According to Zellner [18] proposed an approach to gain a higher effective estimator than the least square method. This idea was the Seemingly Unrelated Regression (SUR) Model. This method is a generalization off several linear equations. Each of those equations is independent system and can be estimated respectively because the model contains own dependent variables. According to the characteristics of this model, suppose it consisted of $K$ equations, then we can have an equation (1) as follows:

$$Y_i = X_i\beta_i + \varepsilon_i, \quad i = 1, \ldots, K, \quad (1)$$

Where $Y_i$ is a vector of explained variables. And $X_i$ is a matrix of explanatory variables. $\beta_i$ and $\varepsilon_i$ are coefficients and error terms, respectively. The SUR model postulates that error terms among equations are related. Then a variance-covariance matrix in the SUR model function (2) can be expressed as:

$$\Sigma = \begin{bmatrix}
\sigma_{11} & \sigma_{12} & \cdots & \sigma_{1K} \\
\sigma_{21} & \sigma_{22} & \cdots & \sigma_{2K} \\
\vdots & \vdots & \ddots & \vdots \\
\sigma_{K1} & \sigma_{K2} & \cdots & \sigma_{KK}
\end{bmatrix} \otimes I_K, \quad (2)$$

Where $I_K$ is a unit matrix and the $\otimes$ represents the tensor product of two matrixes. In that, the estimator of this model (3) can be shown as follows:

$$\beta_{\text{SUR}} = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}Y. \quad (3)$$

Regarding the copula approach, Sklar’s theorem is a fundamental basis. As we know, it is common to see that random variables have a different marginal probability distribution. Sklar proposed copula's idea, which was a convenient and effective tool to obtain the joint distribution of several random variables when the marginal distribution is known. Supposing we have a multidimensional joint distribution function $H$ with a response to random variables $x$. Moreover, $x$ has a known marginal distribution function, $F$ distribution. Then, we can get a copula $C$ for all $x$ and the copula function (4) can be written as follows:

$$H(x_1, \ldots, x_n) = C(F_1(x_1), \ldots, F_n(x_n)), \quad (4)$$

There is a unique copula $C$ when there are exists continuous marginal distributions $F$, where $F$ is multivariate distribution function. Therefore, copula can be written as:

$$C(u_1, \ldots, u_n) = C(F_1^{-1}(u_1), \ldots, F_n^{-1}(u_n)), \quad (5)$$

where $u_i = F_i(x_i)$ are probability integral transforms in uniforms $[0,1]$.

In this study, we employed one of the Elliptical Copula, Gaussian Copula. It is a fundamental copula's family. Moreover, it has been applied widely in the quantitative finance field. We employed the copula function form [19] as follows:

$$C(u_1, \ldots, u_n) = \Phi_n^{\Sigma}(\Phi_1^{-1}(u_1), \ldots, \Phi_n^{-1}(u_n)), \quad (6)$$

And the density of it will be

$$c(u_1, \ldots, u_n) = \frac{1}{\sqrt{\text{det}\Sigma}} \left( \frac{1}{2} \left( \Phi_1^{-1}(u_1), \ldots, \Phi_n^{-1}(u_n) \cdot (\Sigma^{-1} - I) \cdot \left( \begin{bmatrix}
\Phi_1^{-1}(u_1) \\
\vdots \\
\Phi_n^{-1}(u_n)
\end{bmatrix}
\right) \right) \right). \quad (7)$$

We applied the Bayes Factor to examine results instead of $p$-value. We adjust $p$-value to Bayes Factor by equation from Berger:

$$B_{01} = \frac{\text{likelihood of data given } H_1}{\text{likelihood of data given } H_0} = \frac{p(D|H_1)}{p(D|H_0)} = \frac{-\text{e}p\text{log}(p)}. \quad (8)$$

Where there is substantial evidence for $H_1$ if $B_{01}$ from 1/10 to 1/3, strong evidence for $H_1$ if $B_{01}$ from 1/30 to 1/10, very strong evidence for $H_1$ if $B_{01}$ from 1/100 to 1/30 and decisive evidence for $H_1$ if $B_{01}$ is less than 1/100.

We employ the structure of equations from Fu et al.[12] and set up the SUR model as follows:
\[ \Delta QOL_t = \alpha_0 + \alpha_1 \Delta EG_t + \alpha_2 \Delta TD_{it} + \alpha_3 QOL_{t-1} + \alpha_4 D_{911t} + \alpha_5 D_{ASIACRISIS_t} + \alpha_6 D_{AFCRISIS_t} + \alpha_7 D_{GLOBALFIN_t} + \varepsilon_{1t}, \]
\[ \Delta TD_{it} = \beta_0 + \beta_1 \Delta EG_t + \beta_2 \Delta QOL_t + \beta_3 TD_{it-1} + \beta_4 D_{911t} + \beta_5 D_{ASIACRISIS_t} + \beta_6 D_{AFCRISIS_t} + \beta_7 D_{GLOBALFIN_t} + \varepsilon_{2t}, \]
\[ \Delta EG_t = \gamma_0 + \gamma_1 \Delta TD_{it} + \gamma_2 \Delta QOL_t + \gamma_3 EG_{t-1} + \gamma_4 D_{911t} + \gamma_5 D_{ASIACRISIS_t} + \gamma_6 D_{AFCRISIS_t} + \gamma_7 D_{GLOBALFIN_t} + \varepsilon_{3t}. \]

In the above equations (9, 10, 11), we applied the Copula-based SUR model when the correlation among the \( \varepsilon_{1t}, \varepsilon_{2t}, \) and \( \varepsilon_{3t} \) is considered. We aimed to capture a structural relationship within variables by adjusting the dependent variables into lagged forms. From the results of Fu et al. [12], we can say that all three dependent variables (TD, QOL, EG) were affected by its previous values. It is necessary to check the structural relationship within them.

4. Results
First, it was found that international tourist arrivals from Japan, South Korea and Russia is non-stationary at level form except for EG and QOL (Table 1). Besides, it shows that all variables are in stationary status in the first order differential equation form. In this context, we applied the variables after taking the first differential equation in our study.

| Variables | ADF | PP | DF-GLS | Integration |
|-----------|-----|----|--------|-------------|
| TD\(_{KOR}\) | level | -1.5569 | -1.4045 | -1.4527 | I(1) |
| First difference | -5.3662*** | -7.5589*** | -5.5081*** | |
| TD\(_{JP}\) | level | -1.0462 | -1.2653 | -1.4033 | I(1) |
| First difference | -6.8377*** | -6.9614*** | -7.1595*** | |
| TD\(_{RUS}\) | level | -1.7409 | -1.5778 | -1.6717 | I(1) |
| First difference | -5.5477*** | -6.2637*** | -5.8029*** | |
| EG | level | -3.8661*** | -1.5051 | -3.3520*** | I(0) or I(1) |
| First difference | -2.2240 | -3.0521 | -2.8457** | |
| QOL | level | 0.6069 | 1.2045 | -1.9732* | I(0) or I(1) |
| First difference | 2.3068 | 2.3833 | -2.3674** | |

Note: Significance levels at the \( p \)-value < 0.01, 0.05, and 0.10 are indicated by ***, **, * respectively.

Secondly, we applied the bond test to analyze the cointegration among variables to test whether there is a long-term relationship within selected variables. From Table 2, there is a solid long-term linkage within the data except for international tourist arrivals from Japan.

Table 3, 4 and 5 present the results of the Copula-based SUR model and the traditional SUR model. Each table consists of three equations that treat TD, QOL, and EG as the dependent variable. The findings show that estimation under the Copula-based SUR model obtains higher level of effective results because the Copula-based SUR model can capture the nonlinear linkages within variables. In short, the outcomes, derived from the Copula-based SUR model, are more effective than the traditional SUR model. Therefore, we only utilize the outcome from the Copula-based SUR model.

Considering Japanese tourism arrivals, employing the QOL as a predicted variable, there is a nonsignificant relationship between QOL and tourist arrivals. In the bond test, there is no significant long-term relationship between variables, regarding to QOL as a dependent variable, in the Japanese data. Also considering TD\(_{JP}\) as a dependent variable, it obtains the same result of QOL, due to the same
reason. In equation (1), both EG and TD$_{JP}$ show a statistically significant outcome. In another word, with the development of the local economy, tourism can improve the QOL of the local host and community. Furthermore, the significant relationship between QOL and its lagged form presents that it is affected by its previous values. Findings of this equation (Table 3, equation (1)) also determine the significant relationships between QOL and the avian flu crisis during 2004 to 2007, but at a small scale. Moreover, It was found no significant relationship between other dummy variables. When TD$_{JP}$ is regarded as the dependent variable, there is no significant relationship among both EG and QOL, indicating that they do not influence QOL of Chinese local residents. Consider the lagged factor, findings show the same significant result as the previous one demonstrates that Japanese tourist arrivals also affected by its performance in the previous periods. Regarding EG as the dependent variable, tourist arrivals have a significant small negative impact on EG in China. Such results could be due to the situation that international tourism receipt of China decreasing from 51.664 billion to 40.368 billion in the period of 2013 to 2018. According to QOL, it was found significantly that increasing resident’s QOL can help to improve economic growth.

Table 2. Results of Bounds test

| F-statistic                  |           |
|------------------------------|-----------|
| $F_{QOL}(QOL|TD_{KOR} , EG)$ | 7.4629*** |
| $F_{QOL}(QOL|TD_{JP} , EG)$  | 3.1996    |
| $F_{QOL}(QOL|TD_{RUS} , EG)$  | 10.6624***|
| $F_{TD_{KOR}} (TD_{KOR}|QOL, EG)$ | 10.5809***|
| $F_{TD_{JP}} (TD_{JP}|QOL, EG)$ | 3.6024    |
| $F_{TD_{RUS}} (TD_{RUS}|QOL, EG)$ | 5.9678**  |
| FEGK (EG|QOL, TD$_{KOR}$)        | 7.3754*** |
| FEGK (EG|QOL, TD$_{JP}$)       | 16.4690***|
| FEGK (EG|QOL, TD$_{RUS}$)      | 10.7715***|
| Critical values              |           |
| I(0)                         | 1.000     |
| 10%                          | 3.17      |
| 5%                           | 3.79      |
| 1%                           | 5.15      |

Note: Significance levels at the $p$-value < 0.01, 0.05, and 0.10 are indicated by ***, **, * respectively.

Considering South Korean tourist arrivals, in the equation (1) of Table 5, we found that the results show that both EG and TD$_{KOR}$ cannot improve local QOL significantly, which is similar to the results of Japanese case. Moreover, it was found that the lagged QOL also has a significant structural impact on QOL. As for treat TD$_{KOR}$ as a dependent variable, it was also affected by its lagged value. Moreover, the improvement of China’s local residents has a substantial impact from tourist arrivals from South Korean. According to equation (3), there is a positive relationship between EG and QOL which indicates that the pursuit of QOL from China’s residents can enhance the progress of the national economy. Considering dummy variables, findings show that Asian financial crisis has a significant impact on China’s economic development.

According to the Russian data, in the equation (1), we also found that QOL has been affected by its previous value. This finding is similar to the Japan and South Korea data. Considering equation (2), there is a strong positive relationship between the TD from Russia and local resident QOL. The result shows that an appropriate living environment, good level of social development, can attract tourists to the destination. When we consider EG as a dependent variable, it was found that economic growth of the destination can be improved by not only does the QOL of local residents but also international visitors from Russia. While this is not the case for the Japan and South Korea case previously.
Table 3. Model outputs comparing the Copula-based SUR model and SUR model (Japanese tourists).

| Equation 1 | Coef. (Copula) | Coef. (SUR) | Equation 2 | Coef. (Copula) | Coef. (SUR) | Equation 3 | Coef. (Copula) | Coef. (SUR) |
|------------|----------------|-------------|------------|----------------|-------------|------------|----------------|-------------|
| (dep.=ΔQOL) | (dep.=ΔTD)     | (dep.=ΔEG)  |            |                |             |            |                |             |
| d_911      | -0.002         | 0.0432      | d_911      | 0.046          | d_911      | -0.031     | -0.002         |             |
| d_asia     | -0.002         | -0.096      | d_asia     | -0.091         | d_asia     | -0.063*    | -0.006         |             |
| d_AF_CRISIS | 0.004**       | 0.266***    | d_AF_CRISIS | 0.272**        | d_AF_CRISIS | 0.036      | 0.021          |             |
| d_globalfin | 0.002          | 0.131**     | d_globalfin | 0.129          | d_globalfin | 0.044      | 0.008***       |             |
| ΔEG_t      | 0.022**        | -0.134      | ΔEG_t      | -0.531         | ΔTD_{KOR,1} | -0.050**   | -0.007         |             |
| ΔTD_{KOR,1} | -0.011        | -4.754      | ΔQOL_{1}   | -4.345         | ΔQOL_{1}   | 6.104**    | 2.513**        |             |
| QOL_{1}    | -0.034***      | -0.382***   |            |                |             |            |                |             |

Note: Significance levels at the p-value < 0.01, 0.05, and 0.10 are indicated by ***, **, * respectively.

Table 4. Model outputs comparing the Copula-based SUR model and SUR model (South Korean tourists).

| Equation 1 | Coef. (Copula) | Coef. (SUR) | Equation 2 | Coef. (Copula) | Coef. (SUR) | Equation 3 | Coef. (Copula) | Coef. (SUR) |
|------------|----------------|-------------|------------|----------------|-------------|------------|----------------|-------------|
| (dep.=ΔQOL) | (dep.=ΔTD_{KOR}) | (dep.=ΔEG)  |            |                |             |            |                |             |
| d_911      | -0.002         | 0.018       | d_911      | 0.018          | d_911      | -0.001     | -0.001         |             |
| d_asia     | -0.001         | -0.229**    | d_asia     | -0.229*        | d_asia     | -0.006     | -0.006         |             |
| d_AF_CRISIS | -0.002        | 0.276***    | d_AF_CRISIS | 0.276          | d_AF_CRISIS | 0.020***   | 0.020***       |             |
| d_globalfin | 0.001          | -0.000      | d_globalfin | -0.000         | d_globalfin | 0.006      | 0.006          |             |
| ΔEG_t      | 0.188***       | -3.866***   | ΔEG_t      | -3.866***      | ΔTD_{KOR,1} | -0.006     | -0.006         |             |
| ΔTD_{KOR,1} | 0.001         | 7.346**     | ΔQOL_{1}   | 7.346          | ΔQOL_{1}   | 2.683***   | 2.683***       |             |
| QOL_{1}    | -0.016**       | -0.209**    |            |                |             |            |                |             |

Note: Significance levels at the p-value < 0.01, 0.05, and 0.10 are indicated by ***, **, * respectively.

Table 5. Model outputs comparing the Copula-based SUR model and SUR model (Russian tourists).

| Equation 1 | Coef. (Copula) | Coef. (SUR) | Equation 2 | Coef. (Copula) | Coef. (SUR) | Equation 3 | Coef. (Copula) | Coef. (SUR) |
|------------|----------------|-------------|------------|----------------|-------------|------------|----------------|-------------|
| (dep.=ΔQOL) | (dep.=ΔTD_{RUS}) | (dep.=ΔEG)  |            |                |             |            |                |             |
| d_911      | -0.002         | 0.062       | d_911      | -0.008         | d_911      | -0.027     | -0.001         |             |
| d_asia     | -0.001         | 0.119       | d_asia     | -0.056         | d_asia     | -0.061**   | -0.005         |             |
| d_AF_CRISIS | 0.003*        | 0.032       | d_AF_CRISIS | 0.148          | d_AF_CRISIS | 0.017      | 0.019*         |             |
| d_globalfin | 0.001          | -0.214      | d_globalfin | -0.016         | d_globalfin | 0.053*     | 0.008          |             |
| ΔEG_t      | 0.033***       | 0.881       | ΔEG_t      | 5.329          | ΔTD_{RUS,1} | 0.093*     | 0.006          |             |
| ΔTD_{RUS,1} | -0.001        | 5.033***    | ΔQOL_{1}   | -21.381        | ΔQOL_{1}   | 7.170***   | 2.672***       |             |
| QOL_{1}    | -0.025**       | -0.032      |            |                |             |            |                |             |

Note: Significance levels at the p-value < 0.01, 0.05, and 0.10 are indicated by ***, **, * respectively.

5. Conclusion
In this study, we examined relationships between the number of international tourist arrivals (from Japan, South Korea, and Russia to China) and local residents' quality of life using an inbound tourism arrival data of China. Comparing the Copula-based SUR model to the traditional one, we found that an estimation by Copula-based SUR model can improve the model comparing the traditional SUR model because the Copula method can obtain non-linear dependence among variables. Our empirical study provides a novel approach to improve the model in Fu et al. [12].

In the case of tourist arrival from Japan, the results reveal a unilateral linkage from TD to EG and a bilateral linkage between EG and QOL. This result demonstrates that the development of national
economics directly enhances residents' QOL. According to the negative relationship from TD to EG, based on Fu et al.[12], we interpret that even though the TD from Japan can contribute to the destination's economy. In general, this result cannot lead to comparable marketing fund increases allocated to attract tourists from Japan.

Our study also found that the results from the data of South Korean and Japan are consistent that EG can improve the local residents' QOL. Considering negative relationship from EG to TD, economic development of Chinese economy cannot positively impact attracting Japanese tourists. The increase in relative tourism costs, caused by the appreciation of the Chinese Yuan (RMB), is one of the reasons that lead to economic growth. This effect tends to have a negative impact on international tourist arrivals. Considering the results from Russian tourist arrivals data, it also has similar results of a bilateral linkage between EG and QOL, consistent to the previous cases except for there is a significant positive relationship between QOL to TD. It shows that the growth of QOL can attract more Russian tourist arrivals.

In conclusion, this study suggests that the development of a destination’s educational progress can improve tourist experiences and people's pursuit of income improvement. Such development can attract local residents' attention to tourism income, provide better services, and attract more tourist arrivals to the destination. However, according to the multi-dimensional definition of QOL, in the further study, we suggest that alternative indicators could be examined to analyze the effect of QOL on tourism development to gain a robust result.

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