Analysis on the influencing factors of China's tourism economy from the perspective of aging and tourism culture

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Abstract. The empirical analysis of this paper focuses on two issues, one is the impact of China's aging process on China's domestic tourism economy, and to what extent; the other is how to define and measure the impact of tourism culture on tourism economy. This research takes the domestic tourism revenue as the dependent variable and takes the elderly dependency ratio as the independent variable. In the modelling process, "external conditions" and "internal desires" are introduced as control variables and regarded as the software and hardware parts of tourism culture respectively. The time dummy variable is used to catch outliers and structural abrupt changes. Furthermore, quantile regression is carried out for the selected models. Based on ADL model and quantile regression, this paper analyzed the influence of aging and tourism culture on the development of China's tourism economy and its changing trend.

1. Introduction
The aging of the population will be the basic national condition of China and is an important trend of social development for a long time to come, which has a profound impact on economic operation, social construction and social culture. As a pillar industry of national economic development, tourism is becoming one of the biggest beneficiaries of the aging process [1], whose competition in the future is mainly about tourism culture. Therefore, many domestic and foreign scholars pay more and more attention to the impact of aging on tourism economy, meanwhile, the study and attention on tourism culture has become the fulcrum of China's tourism economy take-off and market development [2]. However, throughout the existing studies, most of the analysis for the impact of aging on the tourism economy focuses on the micro level and qualitative analysis, and the research on the impact of tourism culture on the tourism economy is mostly theoretical, Quantitative analysis of the macro impact of aging and tourism culture on tourism economy is rare.

In view of this, the empirical analysis of this paper focuses on two issues, one is the impact of China's aging process on China's domestic tourism economy, and to what extent; Second, how to define tourism culture and how to measure its impact on tourism economy.

For the purpose mentioned above, this research take the domestic tourism revenue as the dependent variable and take the elderly dependency ratio as the independent variable. In the modelling process, "external conditions" and "internal desires" are introduced as control variables and regarded as the software and hardware parts of tourism culture respectively [3]. The time dummy variable is used to catch outliers and structural abrupt changes. Furthermore, quantile regression is carried out for the selected models. Based on ADL model and quantile regression, this paper analyzed the influence of aging and tourism culture on the development of China's tourism economy and its changing trend.
2. Data and methods

2.1. Data
Based on previous studies, the aging in this paper is expressed by the elderly dependency ratio (X) \([4-6]\), the total domestic tourism expenditure (Y, Unit: 10 billion yuan) is adopted to represent the development level of domestic tourism economy \([4, 7]\). In order to eliminate the impact of price fluctuations \([8]\), the GDP deflator (1978=100) was used to process the data of the total domestic tourism expenditure, after which, the total domestic tourism expenditure was all converted into the actual value calculated at the constant price in 1978. Since the tourism indicators used were not counted until 1994, the sample data are the annual indicators from 1994 to 2016. The sample data and GDP deflator are from China statistical yearbook -2017.

2.2. Methods
The purpose of this study is to make an econometric analysis of the impact of aging and tourism culture on China's tourism economy. To this end, E-G two-step method was used to verify the co-integration relationship between China's aging population and tourism economy in the sample period; Using autoregressive distributed lag (ADL) model to fit the sample data, the ADL model was selected by the general to special method; The structural breakpoint of the ADL model was found by the Chow Breakpoint Test, and the different influence stages of aging on the development of China's tourism economy were confirmed; The influence of SARS on tourism economy in the sample period is described by time dummy variable; For the ADL model, "external condition" and "internal desire" are introduced as control variables to optimize the model, in which, a time gradient function is used to represent "internal desire", i.e. the "software" part of tourism culture, and the dependent variable with a delay of one unit of time is used as the "external condition", i.e. the "hardware" part of tourism culture; The quantile regression of the optimized model is carried out, in which, the information of aging and the influence of tourism culture on tourism economy is further mined through the quantile regression coefficient of three different quantiles.

3. Co-integration test
See Figure 1 and Figure 2, logarithmic transformation can reduce the influence of heteroscedasticity, and the coefficient of the dual logarithmic model can have a good Economic interpretation in this study. Therefore, the basic idea of this study is to find the long-term equilibrium relationship between \(\{\ln X_t\}\) and \(\{\ln Y_t\}\) so as to measure and analyze the influence of aging on the development of tourism economy. Since the existence of a long-term equilibrium relationship between non-stationary sequences is based on the premise that they are co-integrated, so, the first thing we're going to do is test the co-integration relationship between \(\{\ln X_t\}\) and \(\{\ln Y_t\}\).

![Figure 1. Trend chart of X and Y.](image1)

![Figure 2. Change trend chart of lnX and lnY.](image2)
As shown in Figure 2, \{\ln X_t\} and \{\ln Y_t\} are obviously non-stationary sequences and they share a certain degree of time variability, after unit root test, they are all \{1\} sequences. Therefore, there may be a co-integration relationship between them. Here, we apply E-G two-step method to carry out the co-integration test.

In the first step, OLS method was used to estimate the following sample regression equation (see Table 3 for details)

\[
\ln Y_t = -6.453537 + 3.355916 \ln X_t
\]

model 1.

The residual sequence is obtained by \( e_t = \ln Y_t - \ln Y_{t-1} \).

In the second step, the unit root ADF test is performed on the residual sequence to test its stationarity.

As can be seen from the line graph of Figure 3, it is necessary to conduct the unit root test of level without trend and intercept. The output results (Table 1) show that "null hypothesis" is rejected at the significance level of 0.01. It shows that the residual sequence is stationary, and thus proves that there is a co-integration relationship between \{\ln X_t\} and \{\ln Y_t\}.

![Figure 3. The line graph of the residual.](image)

**Table 1.** The unit root test results of the residual of the co-integration regression equation.

| Null Hypothesis: e has a unit root | t-Statistic | Prob.* |
|-----------------------------------|-------------|--------|
| Augmented Dickey-Fuller test statistic | -3.708928 | 0.0008 |
| Test critical values: 1% level | -2.674290 |
| 5% level | -1.957204 |
| 10% level | -1.608175 |

4. Model

4.1. ADL model

Consider using autoregressive distributed lag model (ADL):

\[
\ln Y_t = C + \sum_{i=1}^{p} \alpha_i \ln Y_{t-i} + \sum_{j=0}^{q} \beta_j \ln X_{t-j} + \mu_t
\]

After screening the values of \( p \) and \( q \) from large to small, it was confirmed that \( p=1, q=0 \), according to the goodness of fit and the judgment criteria of information criterion

\[
\ln Y_t = c + \alpha_1 \ln Y_{t-1} + \beta_0 \ln X_{t-1} + \mu_t
\]
Considering the outliers caused by SARS in 2003 (see Figure 2), dummy variables D0, were introduced into the model:

\[ D_{0t} = \begin{cases} 1, & t = 2013 \\ 0, & \text{otherwise} \end{cases} \]

\[ D_{1t} = \begin{cases} 1, & 2011 \leq t \leq 2016 \\ 0, & \text{otherwise} \end{cases} \]

\[ D_{2t} = \begin{cases} 1, & 2012 \leq t \leq 2016 \\ 0, & \text{otherwise} \end{cases} \]

Considering the abrupt steepening of the trend in 2011 (see Figure 2), the Chow Breakpoint Test at this point in 2011 was carried out. Results (see Table 2) verify that 2011 is indeed the structural mutation point. In order to capture this characteristic, dummy variable D1t is introduced:

**Table 2. The results of Chow Breakpoint Test.**

| Null Hypothesis: No breaks at specified breakpoints | F-statistic | Prob. F(3,16) | 0.0081 |
|--------------------------------------------------|-------------|---------------|--------|
| Log likelihood ratio                             | 15.78421    | Prob. Chi-Square(3) | 0.0013 |
| Wald Statistic                                   | 16.78767    | Prob. Chi-Square(3) | 0.0008 |

At the same time, after a sudden abrupt change in 2011, the trend of \( \ln Y_t \) slows down after 2012 (see Figure 2). For this reason, the dummy variable D2, is introduced, the regression model is as follows,

\[
\ln Y_t = c + \alpha_1 \ln Y_{t-1} + \beta_1 \ln X_t + \gamma_1 D_{0t} + \gamma_2 D_{1t} \times \ln X_t + \gamma_3 D_{2t} \times \ln X_t + \mu_t \quad (3)
\]

The sample regression equation is (see Table 3 for details):

\[
\ln Y_t = -1.695697 + 0.5513081 \ln Y_{t-1} + 1.016453 \ln X_t - 0.272422 D_{0t} + 0.115964 D_{1t} \times \ln X_t - 0.065323 D_{2t} \times \ln X_t - 0.039118 D_{3t} \quad \text{--- model 2.}
\]

**Table 3. Sample regression equation report.**

| Regression report content | Model 1 | Model 2 | Model 3 |
|---------------------------|---------|---------|---------|
| C                         | -6.45357 (p=0.0000) | -1.695697 (p=0.0039) | --- |
| LnX_t                     | 3.35591 (p=0.0000) | 1.016453 (p=0.0011) | 0.243747 (p=0.0000) |
| LnY_{t-1}                 | --- (p=0.0000) | 0.551308 (p=0.0000) | 0.538059 (p=0.0000) |
| D_{0t}                    | --- (p=0.0000) | -0.272422 (p=0.0000) | -0.273715 (p=0.0000) |
| D_{1t} \times \ln X_t    | --- (p=0.0000) | 0.115964 (p=0.0000) | 0.128982 (p=0.0000) |
| D_{2t} \times \ln X_t    | --- (p=0.0039) | -0.065323 (p=0.0114) | -0.051495 (p=0.0000) |
| D_{3t}                    | --- (p=0.0024) | --- (p=0.0000) | 0.039118 (p=0.0114) |
| R^2                       | 0.934071 | 0.995060 | 0.99533 |
| R^2                       | 0.930932 | 0.993516 | 0.993888 |
| AIC                       | -1.233683 | -3.5603 | -3.619342 |
| SC                        | -1.134944 | -3.26274 | -3.321785 |

Note: “---” Means not passing the significance test and is excluded; “***” Means not set.
4.2. The introduction of tourism culture variables

In order to further optimize the model, apart from the aging indicator as the main regressor, control variables are divided into external conditions and internal desires. External conditions include social progress and personal finances, time, and health and other objective factors, here, expressed in $\ln Y_{t-1}$, we see them as the Chinese tourism economy of endogenous driving factors, its coefficient represents the endogenous driving force on the driving effect of tourism economy, representing the material aspects of the tourism culture, the influence of the tourism culture hardware effect; Internal desire includes subjective spiritual factors such as happiness promotion, escape from routine, social interaction, knowledge seeking, pride, patriotism, personal reward and nostalgia. We call it the internal spiritual factor of tourism culture. It is the software of tourism culture and belongs to unmeasurable variables. It has the characteristics of short-term constancy and long-term equal progression. It's represented by the dummy variable $D_3_t$

In the new model, the stable period of $D_3_t$ is set as 2 years, 3 years, 4 years, 5 years, etc. After putting them into the model separately, the coefficient has the best significance if the stable period is 3 years.

Therefore, $D_3_t$ is set as:

$$D_3_t = \begin{cases} 
1,1994 \leq t \leq 1996 \\
2,1997 \leq t \leq 1999 \\
\quad \quad \quad \quad \quad \cdots \\
8,2015 \leq t \leq 2016 
\end{cases}$$

Therefore, the new regression model is:

$$\ln Y_t = \alpha_1 \ln Y_{t-1} + \beta_0 \ln X_t + \gamma_1 D_{0t} + \gamma_2 D_{1t} + \gamma_3 D_{3t} \ln X_t$$

The sample regression equation is (see Table 3 for details)

$$\ln \hat{Y}_t = 0.538059 \ln Y_{t-1} + 0.243747 \ln X_t - 0.272422 D_{0t} + 0.128982 D_{1t} + 0.051495 D_{3t} \ln X_t + 0.039118 D_{3t}$$

which in detail is

$$\ln \hat{Y}_t = \begin{cases} 
0.538059 \ln Y_{t-1} + 0.243747 \ln X_t + 0.039118 D_{3t}, 1994 \leq t \leq 2010, t \neq 2003. \\
0.538059 \ln Y_{2003-1} + 0.243747 \ln X_{2003} - 0.272422 + 0.039118 * 4, t = 2003. \\
0.538059 \ln Y_{t-1} + 0.372329 \ln X_t + 0.039118 * 6, t = 2011. \\
0.538059 \ln Y_{t-1} + 0.321234 \ln X_t + 0.039118 * D_{3t}, 2012 \leq t \leq 2016.
\end{cases}$$

Figure 4. Comparison of actual value and model fitting value.
5. Model selection and interpretation of empirical results

5.1. Model selection

The $p$ values in parentheses in Table 3 indicate that the sample estimates of each independent variable in the three models have very good statistical significance. Of the three models, the $R^2$ of model 3 is the largest and the value of AIC and SC of model 3 is the smallest. According to the goodness of fit standard of model evaluation and AIC and SC information criterion, model 3 is the relatively optimal model. This point can also be intuitively reflected in Figure 4: Most of the points of the actual value and the fitting value of model 3 almost coincide, which is obviously better than model 1 and model 2.

5.2. The empirical analysis results of the model

Based on the sample regression equation of model 3 and Table 4, the following conclusions are drawn,

1. In the whole sample period, $\ln Y_t$ has an elasticity coefficient of 0.538 to $\ln Y_{t-1}$, $\ln Y_{t-4}$ it can be seen that the development of tourism economy in the previous period contributes 53.8% to the growth of tourism economy in the current period. This reflects the driving effect of the hardware of tourism culture, indicating that the internal driving force of China's tourism economy is strong.

2. The coefficient of $D_3$ indicates that "internal desire", i.e. the software of tourism culture, makes the domestic tourism economy improve by 3.91% every three years.

3. The coefficient of $\ln X_t$ reflects the sensitivity of China's tourism economy to aging. In terms of elasticity coefficient, the value in 2011 was 52.75% higher than that between 1994 and 2010. Although the value between 2012 and 2016 decreased somewhat, it still increased by 31.79% annually on average over the period from 1994 to 2010. It can be seen that 2011 is a turning point in the development of tourism economy for the elderly in China. This conclusion can also be fully supported by the annual contribution rate of aging to tourism economic growth, between 1994 and 2010, the average annual contribution of aging population to tourism economic growth was 2.035%. That figure rose to 2.3434% in 2011 and 8.4843% between 2012 and 2016.

### Table 4. Annual growth rate. (geometric average)

| Year          | X     | Y     |
|---------------|-------|-------|
| 1994-2010     | 16.9766% | 1.4177% |
| 2011          | 53.4634% | 3.3613% |
| 2012-2016     | 15.3298% | 4.0488% |
| Whole sample period | 18.0481% | 2.0979% |

6. Quantile regression of the model and interpretation of empirical results

Quantile regression is a method to estimate the linear relationship between quantiles of the explained variables and regression elements. Quantile regression can describe the whole picture of the conditional distribution of the explained variables more comprehensively [9, 10]. Through the changes and comparative analysis of the estimated value of the regression coefficient under different quantiles, more valuable information can often be extracted. For model 3, we conducted quantile regression at 25%, 50% and 75% respectively (see Table 5) to expand the information of model 3.

From the data in Table 5, the main conclusions can be drawn as follows:

1. As can be seen from Table 5, with the increase of the quantile, the estimated coefficient of $\ln X_t$ also increases gradually and becomes more significant, indicating that the more developed the domestic tourism economy is in the sample interval, the more sensitive it is to aging.

2. The coefficient of $D_1*\ln X_t$ represents the improvement of the sensitivity of the domestic tourism economy to aging in 2011 compared with the previous degree. The estimated value has little change in each quantile and is highly statistically significant, indicating that 2011 is indeed an important turning point for China's elderly tourism economy.
3. The coefficient of $D_2t^*\ln X_t$ represents the change of the sensitivity of domestic tourism economy to aging relative to 2011 in the average annual period from 2012 to 2016. The estimated value is all negative. With the increase of the quantile, the absolute value is decreasing, and the estimated value at the 75% is not statistically significant. This indicates that the promotion of the aging population on tourism economy is weakened from 2012 to 2016, but the weakening effect is limited. As long as the domestic tourism economy continues to grow at a high speed, the rapid development momentum of the elderly tourism economy that broke out in 2011 will continue to be maintained.

4. The coefficient of $D_3t$ increases as the quantile increases, and the estimates on the first two quantiles are not significant, while the estimates at the 75% be highly significant. The larger the quantile, the more significant, which means that "internal desire", that is, the software effect of tourism culture has limited effect when the tourism economy is underdeveloped. When the tourism economy is at a high level, the stronger its promoting effect on the tourism economy, the higher its status.

5. The coefficient of $\ln y_{t-1}$ represents the "external conditions", that is, the endogenous driving force of the tourism economic system, represents the objective factors of the material, and is the hardware effect of the tourism economy. In contrast to the case of $D_3t$, the coefficient decreases with the increase of the quantile, and the significance of the test decreases with the increase of the quantile. This shows that, with the tourism economy continuously rising, its objective, material driving force is weakening.

Table 5. The estimate of the coefficients of the least squares and quantile regression.

| Independent variable | OLS       | Quant25   | Quant50   | Quant75   |
|----------------------|-----------|-----------|-----------|-----------|
| $\ln X_t$            | 0.243747  | 0.160747  | 0.221454  | 0.321141  |
| (p=0.0000)           | (p=0.1219)| (p=0.0024)| (p=0.0010)|           |
| $\ln Y_{t-1}$        | 0.538059  | 0.695171  | 0.596002  | 0.370301  |
| (p=0.0000)           | (p=0.0047)| (p=0.0007)| (p=0.0392)|           |
| $D_0_t$              | -0.273715 | -0.250827 | -0.267824 | -0.296960 |
| (p=0.0000)           | (p=0.0002)| (p=0.0000)| (p=0.0392)|           |
| $D_1^*\ln X_t$       | 0.128982  | 0.132500  | 0.132222  | 0.121261  |
| (p=0.0000)           | (p=0.0001)| (p=0.0000)| (p=0.0000)|           |
| $D_2^*\ln X_t$       | -0.051495 | -0.071736 | -0.056998 | -0.028731 |
| (p=0.0114)           | (p=0.0428)| (p=0.0331)| (p=0.3457)|           |
| $D_3_t$              | 0.039118  | 0.025149  | 0.029674  | 0.060388  |
| (p=0.0024)           | (p=0.3070)| (p=0.1647)| (p=0.0077)|           |

7. Conclusions
From the empirical results of the ADL model, it can be seen that after 2011, with the rapid increase of China's aging, it has released a different role in promoting domestic tourism economy. The hardware effect of tourism culture is very significant, while the software effect is gradually showing strong vitality. In the quantile regression results, it can be seen that the promoting effect of "hardware" of tourism culture on tourism economy is decreasing, but for "software", it is increasing, by which, a philosophical conclusion can be drawn that with the rapid development of domestic tourism economy, the promoting role of objective and material factors is decreasing, while the role of spiritual factors is increasing. This fully supports the conclusion that "the modern tourism phenomenon is actually a comprehensive mass activity based on spiritual and cultural needs and enjoyment, involving economic, political, social and international exchanges"; Cultural factors permeate all aspects of modern tourism activities. Culture is the soul of tourism, the source of tourist attraction, and the starting point and destination of tourists.
Studies have shown that cultural leisure tourism accounts for the largest proportion (38.5%) of elderly tourism, while cultural leisure tourism is the largest market segment of elderly tourism, and spiritual pursuit tourism accounts for 11.5% [11]. Therefore, cultural tourism is becoming a popular and vigorous form of tourism for the elderly. Cultural factors will have a more profound influence on the modern tourism activities of the elderly.

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