

Analysis of Chongqing's Tourism and Economic Growth under the Impact of the Pandemic

Haodong Tang*

Department of Economy and Management, Chongqing University, Chongqing, 400044, China

*Corresponding author: tanghaodong@chd.edu.cn

Abstract. Tourism is the backbone of any country's economic development. Domestic and offshore tourism was the most affected by the COVID-19 crisis, and more than any other sector globally in China. China's once flourishing tourism industry has endured a significant impact due to travel restrictions, regional isolation, and quarantine measures. This study focusses on historical tourist economic data from the micro to the macro level in order to assess the impact of tourism on Chongqing's and China's economy both before and after the pandemic crisis. The study used the vector error correction model (VECM) to quantitatively analyze data on Chongqing Gross Domestic Product (GDP), China tourism revenue (CTR) and Chongqing tourism revenue (CQTR) for the period from 2004 to 2023. The results show that COVID-19 leads to a significant decline in tourism-related income. In terms of the relationship between the two, after quantitative analysis of variance the effect of CQTR on Chongqing GDP is unidirectional rather than the main cause of Chongqing GDP, and the relationship between CQTR and CTR is bidirectional and interacts with it. This also explains why the CQTR dramatically drops in 2021–2023 while Chongqing GDP grows continuously and shows the reason why CQTR and CTR go up or down in the same trend.

Keywords: Tourism revenue; pandemic; VECM.

1. Introduction

Sustainable economic growth is made possible by the tourism industry. Changes in the tourism industry take a broader view of countries' economic expansion, job creation, tourism economic growth and tourism economic efficiency [1]. Environmental climate change and epidemics, such as natural disasters and highly infectious diseases, make tourism highly vulnerable to sharp declines [2]. The tourism industry is highly reliant on travellers' behavior patterns, destination selection, etc. as a result of the high security risk and environmental factors in this context [3]. One of the main causes of the short-term downturn in the travel industry was the COVID-19 epidemic. Tourism is affected by COVID-19 Very serious economic benefits, in part because of the considerable decline in domestic traveller movement relative to international traveller populations [4]. As of March 25, 2021, there have been over 126.7 million registered COVID-19 cases widely, with 2.7 million deaths, according to the Worldometer Data Tracker (WDT) latest statistics. Despite this, there are 102. 2 million recovered cases worldwide. Statistics show that more than 90,159 Chinese citizens have been widely infected, resulting in 4,636 deaths [5].

From 2020 onwards due to the threat of the virus, tourists across the globe are hesitant to interact with the Chinese. As a result, they have cancelled many upcoming events and projects. As a result of the Government's regulation of international and domestic travel and transport, the tourism industry is in immediate and serious danger of collapse. The main contributors to the growth of China's tourism economy are foreign inbound tourists, and the industries that contribute to the tourism process include urban transport, air and high-speed rail, ships, resorts, hotels, daily food and beverages, and a large number of traditional festivals. By collating and summarizing a sample of tourism data from China and Chongqing Municipality, this paper provides the most realistic quantitative assessment of the economic impact of tourism in Chongqing, which can be achieved by examining the VECM data and comparing the data two-by-two to arrive at a relatively accurate picture of the economic interdependencies and impacts.

2. Literature Review

Numerous studies have examined the economic determinants and indicators impacting the global growth of tourism in the corpus of current literature. Studies indicate that because of location and people migrations, China was more affected by the COVID-19 epidemic than other foreign nations. Fear of the outbreak caused almost all social and cultural activities to be halted, and the aviation and tourism industries experienced significant effects. unprecedented impact on China's tourism industry will not be mitigated until the COVID-19 outbreak has intensified significantly. In addition, studied the transmission pattern of coronavirus in Macau and the decline of tourism. A supply and demand curve analysis were used in the study to measure the ecological decline of tourism. Travel and tourism demand decreased due to the embargo and movement restrictions caused by the COVID-19 scare, as revealed by the results. The decrease in demand resulted in a decline in tourism revenues [6]. Tourist attractions share the same vulnerability to disasters and crises as other tourism subsectors. In 2002-2003, the tourism attractions sub-sector of China lost around \$1 billion in direct economic loss as a result of panic-stricken of severe acute respiratory syndrome (SARS) [7]. The total economic losses in China's domestic tourism industry were about 5% because of this. Significant economic losses to tourist attractions along the Pacific Coast were caused by the 2011 earthquake in Japan and the subsequent tsunami, but it is not possible to accurately quantify them [8]. In China, COVID-19 was initially popular but was later suppressed due to extensive travel restrictions and an embargo regime, as was the case [9]. But after applying panel structural vector autoregressions to evaluate the probable effect of COVID-19 on travel to 185 nations, it was found that the pandemic has significantly harmed international travel, and it will take years for things to get back to normal [10].

3. Empirical Analysis

3.1. Data and Model Description

In this paper, by selecting the Chongqing GDP, China tourism revenue (CTR), and Chongqing tourism revenue (CQTR) from 2004 to 2023, the VECM model is applied to study the relationship between CQTR and Chongqing GDP and CTR. Data on the following variables from different sources were sought for the study needs, such as the Chongqing Municipal Bureau of Statistics, the National Bureau of Statistics of China and the Ministry of Culture and Tourism of the People's Republic of China. The constructed VECM model is as follows:

$$\Delta LNY_t = \alpha + \sum_{i=1}^k \beta_1 \Delta LNY_{t-k} + \sum_{i=1}^k \beta_2 \Delta LNX_{t-k} + \mu_t \quad (1)$$

Therefore, the term for random error in equation 1 is described as μ , the coefficient mentioned as β . The variable used in equation 1 are Y and X, and α is the constant term, whereas t means time from 2004 to 2023, and k is the decreasing number of t. The data descriptive statistics for each variable are shown in Table 1.

Table 1. Variable descriptive statistics (million yuan)

	GDP	CTR	CQTR
Mean	14846.0337293.451067.000		
Median	13825.6933443.501020.000		
Maximum	30145.7966300.002000.000		
Minimum	3059.50011510.00320.0000		
Std. Dev.	9168.78117574.48528.5442		
Skewness	0.2698890.2379540.198128		
Kurtosis	1.7335451.6244241.754546		
Jarque-Bera	1.5793901.7655811.423479		
Probability	0.4539830.4136270.490790		
Observations	20	20	20

Based on the statistical findings, the average GDP of Chongqing stands at 14846.03, with a standard deviation of 9168.781, signifying a relatively high level of volatility in the city's GDP in recent years. Similarly, the average CTR is 37293.45, with a standard deviation of 17574.48, indicating substantial fluctuations in China's tourism revenue in recent years. Meanwhile, the average CQTR is 1067, with a standard deviation of 528.544, highlighting the pronounced fluctuations in Chongqing's tourism revenue over time. In addition, the p-value of the Jarque-Bera statistic for Chongqing GDP, CTR and CQTR is greater than 0.1, indicating that each variable obeys a normal distribution.

3.2. Unit Root Detection

The ADF test was used to measure the smoothness of the data and Table 2 analyses the data to show the results.

Table 2. Result of unit root test

	ADF Statistics	Level			Prob	Finding
		1%	5%	10%		
LNGDP	0.5661	-4.5326	-3.6736	-3.2774	0.9986	Nonstationary
D(LNGDP)	-3.9225	-4.5716	-3.6908	-3.2869	0.0330	Stationary
LNCTR	-2.3407	-3.8315	-3.0300	-2.6552	0.1704	Nonstationary
D(LNCTR)	-5.0677	-3.8574	-3.0404	-2.6606	0.0009	Stationary
LNCQTR	-1.6576	-3.8315	-3.0300	-2.6552	0.4354	Nonstationary
D(LNCQTR)	-5.0098	-3.8574	-3.0404	-2.6606	0.0010	Stationary

Table 2 demonstrates that the Chongqing GDP, CTR, and CQTR original series are non-stationary, with P-values corresponding to the ADF statistics of the original series being 0.9986, 0.1704, and 0.4354, respectively, when tested for smoothness. All of these values are greater than 0.1.

The ADF statistics of the Chongqing GDP, CTR, and CQTR first-order difference series have corresponding P-values of 0.0330, 0.0009, and 0.0010, all of which are less than 0.1 and have passed the smoothness test. This means that the Chongqing GDP, CTR, and CQTR first-order difference series are all smooth series. That is, each variable is single-integrated of the same order, and further cointegration test is carried out.

3.3. Cointegration Experiment

The Johansen cointegration test was used for experiment because the unit root test showed that all the variables were single integer variables of the same order. After performing the optimal lag test; the results are shown in Table 3, the optimal lag is when the demand for LR, FPE, AIC, SC and HQ is lagged by one period, which presents the desired state.

Table 3. Optimal latency experiment

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-14.93573	NA	0.001326	1.887972	2.037094	1.913209
1	53.75881	108.4651*	2.52e-06*	-4.395665*	-3.799177*	-4.294715*

This prompted the conduct of additional cointegration tests, the results of which are displayed in Table 4 and Table 5.

Table 4. Trace outcome

Conjectured	Eigenvalue	Trace	0.05	Prob. **
No. of CE(s)		Statistic	Crucial Value	
No*	0.770903	42.78499	29.79707	0.0010
At most 1 *	0.585034	16.26005	15.49471	0.0383
At most 2	0.023497	0.427994	3.841466	0.5130

Table 5. Max-Eigen experiment

Conjectured	Eigenvalue	Max-Eigen	0.05	Prob. **
No. of CE(s)		Statistic	Crucial Value	
No *	0.770903	26.52494	21.13162	0.0079
At most 1 *	0.585034	15.83205	14.26460	0.0280
At most 2	0.023497	0.427994	3.841466	0.5130

The cointegration test results indicate that Chongqing GDP, CTR, and CQTR have a long-term cointegration connection since their significance level in "None" is less than 0.05, which passes the cointegration test. The co-integration equation for Chongqing GDP and CQTR is as follows:

$$LNGDP = 0.8047LNCQTR \tag{2}$$

According to the cointegration equation, CQTR has a long-term positive impact on Chongqing GDP; specifically, Chongqing GDP will increase by 0.8047% for every 1% increase in CQTR. The relationship between Chongqing's GDP and tourism revenue is 0.8047.

The CTR and CQTR covariance equations are as follows:

$$LNCTR = 1.4187LNCQTR \quad (3)$$

According to the cointegration equation, CQTR and CTR have a coefficient of 1.4187, meaning that a 1% rise in CQTR will result in a 1.4187% increase in CTR. This suggests that CQTR has a long-term beneficial effect on China's tourist earnings.

3.4. Error Correction Analysis

3.4.1 Estimated error correction

The findings of the error correction are displayed in Table 6 as this work continues to investigate the link between the variables. to keep things rigorous and make sure the error term doesn't significantly affect the variable.

Table 6. Error correction result

Cointegrating Eq: CointEq1			
LNGDP (-1)	1.000000		
LNCTR (-1)	0.374500		
	(0.24853)		
	1.50683		
LNCQTR (-1)	-1.336071		
	(0.27321)		
	-4.89035		
C	-4.149459		
Error Correction: D(LNGDP)D(LNCTR)D(LNCQTR)			
CointEq1	-0.108738	-0.576703	0.208653
	(0.05422)	(0.42569)	(0.35774)
	-2.00546	-1.35474	0.58325
D (LNGDP (-1))	0.494161	2.318467	1.665107
	(0.24309)	(1.90850)	(1.60387)
	2.03285	1.21481	1.03818
D (LNCTR (-1))	0.054884	-1.459294	-0.436698
	(0.08976)	(0.70470)	(0.59222)
	0.61147	-2.07080	-0.73740
D (LNCQTR (-1))	-0.168982	0.832613	0.265911
	(0.08806)	(0.69138)	(0.58102)
	-1.91891	1.20428	0.45766
C	0.071345	-0.264249	-0.129507
	(0.03381)	(0.26546)	(0.22309)
	2.11003	-0.99542	-0.58051
R-squared	0.594099	0.285822	0.164070
Adj. R-squared	0.469206	0.066075	-0.093139
Sum sq. resids	0.022345	1.377343	0.972730
S.E. equation	0.041459	0.325499	0.273542
F-statistic	4.756877	1.300687	0.637886
Log likelihood	34.68280	-2.408957	0.721290
Akaike AIC	-3.298089	0.823217	0.475412
Schwarz SC	-3.050763	1.070543	0.722738
Mean dependent	0.120453	0.051071	0.087891
S.D. dependent	0.056906	0.336817	0.261630

According to the equation, the correction coefficients are close to 0 rather than 1 and -1, the error term has a small effect on the independent variable, and the model is weakly corrected. To obtain the outcomes of the impulse and variance decompositions, more observations are required in order to

delve deeper into the effects of the aforementioned components on Chongqing's GDP. The conclusions can be used to create the error correction equation:

$$D(\text{LNGDP}) = -0.108 + 0.494 \cdot D(\text{LNGDP}(-1)) + 0.054 \cdot D(\text{LNCTR}(-1)) - 0.168 \cdot D(\text{LNCQTR}(-1)) + 0.071 \quad (4)$$

$$D(\text{LNCTR}) = -0.576 + 0.2318 \cdot D(\text{LNGDP}(-1)) - 1.459 \cdot D(\text{LNCTR}(-1)) + 0.832 \cdot D(\text{LNCQTR}(-1)) - 0.264 \cdot D(\text{LNCQTR}) = 0.208 + 1.665 \cdot D(\text{LNGDP}(-1)) - 0.436 \cdot D(\text{LNCTR}(-1)) + 0.265 \cdot D(\text{LNCQTR}(-1)) - 0.129 \quad (5)$$

3.4.2 Impulse response

Further impulse analysis is carried out in this paper to study the impulse results between the factors, which are shown in Figure 1.

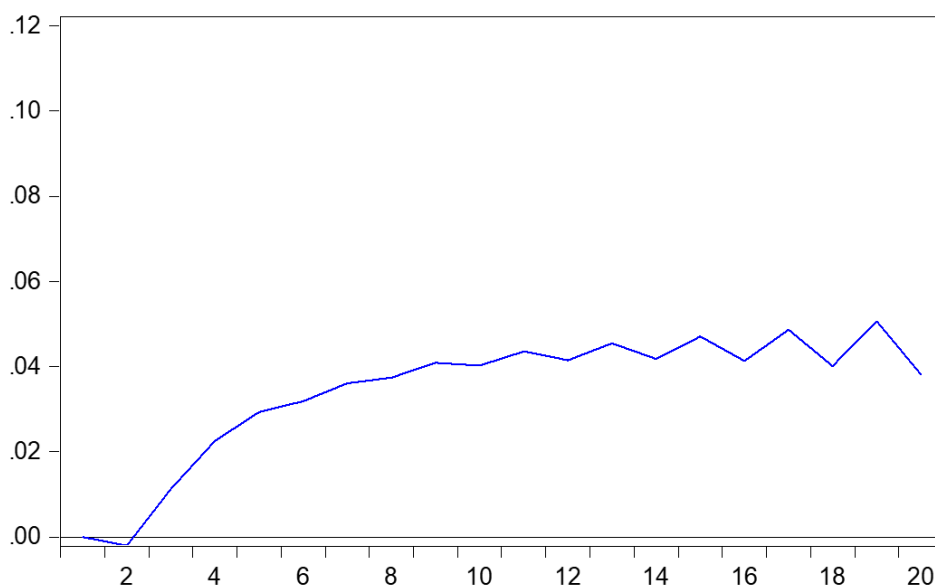


Fig. 1 Impulse response result of Chongqing GDP on the tourism revenue (Picture credit: Original)

The impulse findings show that Chongqing GDP responds to a maximum information shock with a response degree of 0 in the first period, a mild negative reaction in the second, and a positive response in the third. The strength of the positive response increases, and beyond the twelfth period, it exhibits a propensity toward wave-like fluctuations, especially during the eighteenth and twentieth periods (2020–2022). The degree of responsiveness has diminished, and there is a significant variability. That is to say, CQTR has a favorable short-term influence on Chongqing GDP overall, but because of the epidemic, this impact is diminished and exhibits significant fluctuations.

Figure 2 illustrates that, for a maximum information shock of Chongqing tourism revenue, the degree of response of CQTR to Chongqing GDP is approximately 0.1 in the first period, after which the degree of response increases. However, after the tenth period, it exhibits a wave-type trend, with the largest fluctuation and decline in the degree of response occurring during the period from the eighteenth to the twentieth period (2020-2022). It demonstrates that Chongqing GDP has a beneficial short-term impact on CQTR. However, throughout the epidemic, the degree of reaction declines and fluctuations are greater.

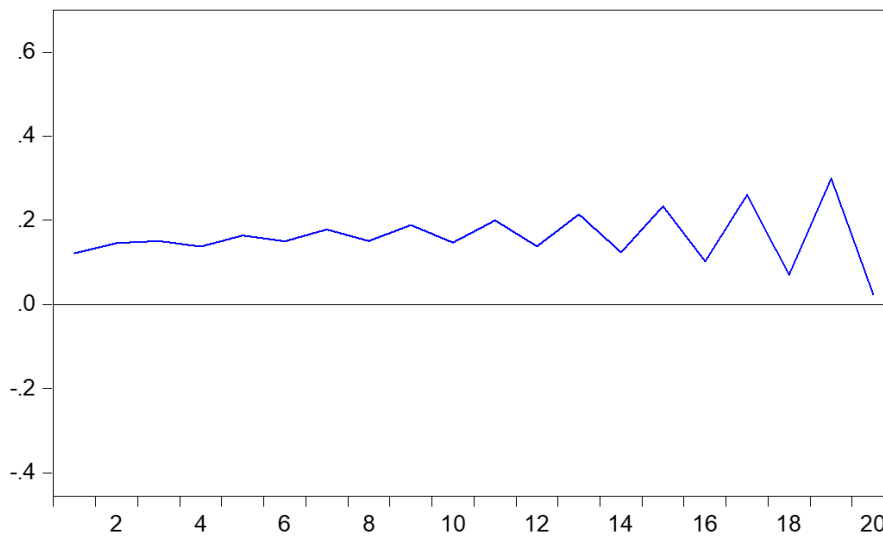


Fig. 2 Impulse response results of CQTR to Chongqing GDP (Picture credit: Original)

A maximal information shock to CTR causes its reaction to CQTR to be zero in the first period and positive in the second, and then gradually strengthens. However, during the epidemic period, there is a greater fluctuation, indicating that while CQTR initially benefits CTR, CTR is more impacted by the epidemic, and even a greater degree of negative response happens during the epidemic period (the 18th to the 20th period) (Shown in Figure 3).

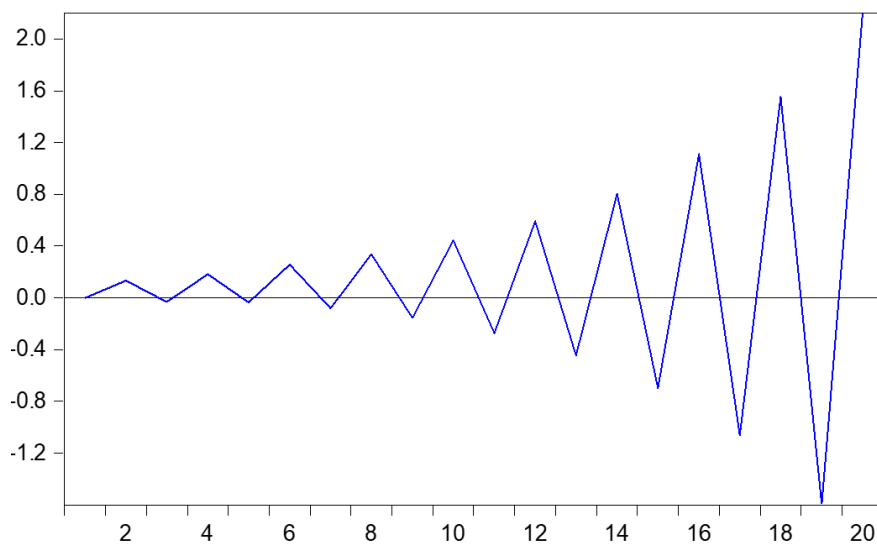


Fig. 3 Impulse response results of CTR to CQTR

As seen in Figure 4, for a maximum information shock of CQTR, the response degree of Chongqing tourism revenue to CTR is about 0.2 in the first period, and the response degree increases after that, but it shows a wavy trend after the sixth period, especially during the period from the eighteenth to the twentieth (2020-2022), there is a greater variation and perhaps a negative reaction. It demonstrates that while CQTR has a generally good short-term effect on CTR, it is impacted by the pandemic and even exhibits a negative reaction (suppressed influence) while the epidemic is going on.

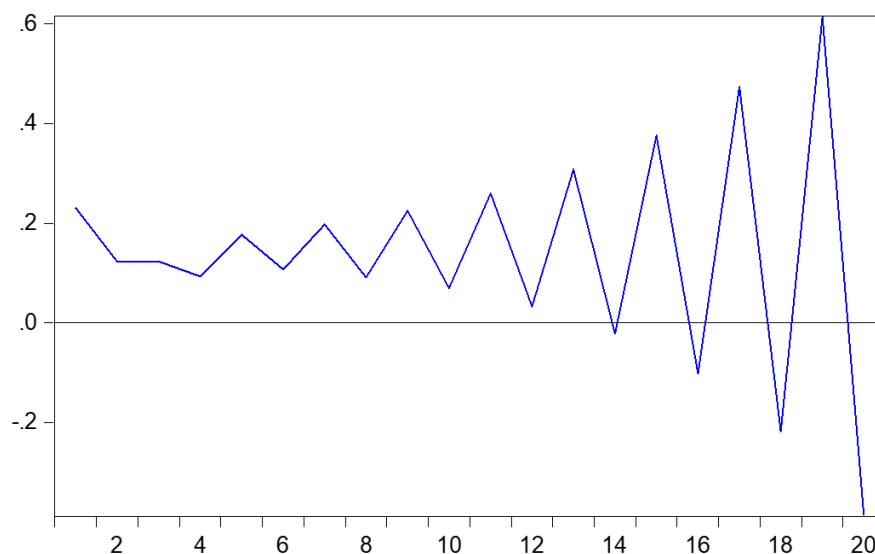


Fig. 4 Impulse response results of CQTR to CTR

3.4.3 Variance decomposition

Table 7 displays the variance decomposition results. The results of Chongqing GDP's variance decomposition reveal that CQTR's contribution rate to Chongqing GDP grew from 0% in the first period to 8.08% in the twentieth; the findings of the variance decomposition of CTR show that the contribution rate of CQTR to CTR was 0 in the first period and increased to 50.6% in the twentieth; the findings of the variance decomposition of CQTR show that the contribution rates of Chongqing GDP and CTR to CQTR in the twentieth period are 40.35% and 42.08%, respectively.

Table 7. Decomposition of variance

Period	Variance Decomposition of LNGDP:			Variance Decomposition of LNCTR:			Variance Decomposition of LNCQTR:		
	LNGDP	LNCTR	LNCQTR	LNGDP	LNCTR	LNCQTR	LNGDP	LNCTR	LNCQTR
1	100.0000	0.000000	0.000000	19.53974	80.46026	0.000000	19.79924	70.90327	9.297485
2	99.88509	0.035591	0.079314	27.22664	62.97144	9.801918	30.66882	57.69480	11.63638
3	94.59568	4.128760	1.275557	30.77395	63.58480	5.641244	37.78348	53.37674	8.839781
4	85.52405	11.19307	3.282883	32.73938	55.27915	11.98147	41.01936	48.39117	10.58946
5	79.95880	15.31713	4.724069	32.29367	59.85620	7.850127	42.18265	49.56496	8.252386
6	76.61384	17.95720	5.428966	32.64451	52.96417	14.39132	43.28950	45.68447	11.02602
7	74.25803	19.65369	6.088283	31.74072	57.50818	10.75109	43.61621	47.48834	8.895450
8	72.40345	21.14809	6.448467	31.24480	51.11456	17.64064	43.99591	43.93856	12.06553
9	71.00594	22.11600	6.878053	29.86965	55.73682	14.39353	43.50534	46.45925	10.03541
10	69.89482	23.04731	7.057871	28.50531	49.32500	22.16969	43.18270	42.82399	13.99331
11	69.04269	23.59650	7.360807	26.77558	53.93736	19.28706	42.04613	45.88053	12.07335
12	68.32382	24.23888	7.437294	24.53318	47.43111	28.03571	40.94457	41.96695	17.08848
13	67.76235	24.55601	7.681642	22.62447	51.90922	25.46632	39.11760	45.50305	15.37935
14	67.26475	25.04541	7.689838	19.68733	45.52864	34.78403	37.00971	41.26295	21.72735
15	66.87801	25.21147	7.910519	17.90805	49.70174	32.39021	34.51469	45.17248	20.31283
16	66.51393	25.62111	7.864962	14.73962	43.86627	41.39411	31.30365	40.72563	27.97073
17	66.23720	25.67666	8.086132	13.38977	47.55880	39.05143	28.41479	44.78418	26.80103
18	65.95515	26.05357	7.991285	10.52348	42.65360	46.82292	24.40234	40.41428	35.18338
19	65.75039	26.01634	8.233266	9.715283	45.74355	44.54117	21.66294	44.30123	34.03583
20	65.51729	26.39549	8.087222	7.468644	41.92630	50.60506	17.56090	40.35681	42.08229

In other words, while the contribution rate of Chongqing GDP and China tourism revenue CTR to CQTR are both roughly 40%, which indicates proportionally larger interactions, the contribution rate of CQTR to CTR is higher while the contribution rate to Chongqing GDP is comparatively lower.

3.4.4 Test of causality

By processing and grouping the data, the Granger causality test is presented in Table 8.

Table 8. Granger causality test

Hypothesis-nought	Lags	Prob.	Conclude
LNCTR does not Granger Cause * LNGDP	1	0.3183	accept
LNGDP → LNCTR		0.9078	accept
LNCQTR → LNGDP	1	0.9754	accept
LNGDP → LNCQTR		0.0494	reject
LNCQTR → LNCTR	1	0.9410	accept
LNCTR → LNCQTR		0.4254	accept
LNCTR → LNGDP	3	0.3914	accept
LNGDP → LNCTR		0.7682	accept
LNCQTR → LNGDP	3	0.4013	accept
LNGDP → LNCQTR		0.4820	accept
LNCQTR → LNCTR	3	0.1494	accept
LNCTR → LNCQTR		0.0733	reject
LNCTR → LNGDP	5	0.0630	reject
LNGDP → LNCTR		0.6409	accept
LNCQTR → LNGDP	5	0.6022	accept
LNGDP → LNCQTR		0.8547	accept
LNCQTR → LNCTR	5	0.0053	reject
LNCTR → LNCQTR		0.0030	reject

The results of the Granger causality test for each lag period show that, in accordance with the original hypothesis, neither Chongqing GDP nor CQTR is the Granger cause of the other. Since the P-value is more than 0.1, the initial hypothesis is accepted. Put otherwise, CQTR represents the Granger causation of Chongqing GDP, indicating the rejection of the first premise. The fact that the P value for the original hypothesis is more than 0.1 indicates that Chongqing GDP is not the Granger cause of CQTR.

The correlation between Chongqing GDP and tourism revenue is unidirectional Granger causality. As for the first hypothesis, given that the P-value is less than 0.1 and CQTR is the Granger cause of CTR, it is possible to conclude that the first hypothesis is rejected.

4. Conclusion

With COVID-19, the global economy has suffered tremendously. Travel restrictions worldwide that have never been seen before have seriously hampered corporate operations. The tourism sector, which contributes significantly to China's GDP, has stalled as a result of travel restrictions, border closures, and embargoes. Since 2003, Chongqing's travel and tourism sector has been expanding quickly; however, the current crisis has drastically curtailed this development. Measuring the tourism sector's response to the pandemic in Chongqing is therefore essential.

Investigating the relationships between the COVID-19 pandemic and CQTR, CTR, and Chongqing GDP is the aim of this empirical study. The vector in this study is covaried with error correction using the VECM model, the significance of the variables is evaluated using impulse and variance tests, and the kind of causality between the variables at various magnitudes is ascertained using the Granger causality test. Furthermore, concerning short-term dynamics, the impulse test findings show that in the near term, Chongqing GDP has an overall positive impact on CTR, but is

affected by the epidemic, and even shows a negative response (suppression of the impact) during the epidemic period, and Chongqing GDP has a reciprocal positive impact on CQTR, but also is affected by the epidemic, and has greater fluctuations during the epidemic period, and the degree of response has decreased.

Furthermore, the Granger causality test demonstrates a unidirectional Granger link at all magnitudes between CQTR and Chongqing GDP and a bidirectional causal relationship between CQTR and CTR. Therefore, while CQTR is not the primary driver of GDP development in Chongqing, the empirical findings of this study suggest that there is a cointegration connection between CTR and CQTR. This helps to explain why, throughout the outbreak, Chongqing GDP grew favorably yet CQTR did not reach pre-epidemic levels.

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