

The Relationship between Total Retail Sales of Consumer Goods and Economic Growth: Based on the Time Series Analysis of 1992-2019

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Abstract. This paper uses cointegration analysis and multiple dynamic regression model to study the relationship between the total retail sales of consumer goods and economic growth in China. The empirical results show that there is a long-term equilibrium relationship between GDP and residents' consumption level. This evidence shows that China's social consumption demand and economic growth are endogenous, and the two variables are interrelated. The results of this study can provide a reliable basis for further understanding of economic development and consumer demand, and finally provide a reference for formulating relevant policies.

Keywords: social consumption; economic growth; time series.

1. Introduction

“Total Retail Sales of Social Consumer Goods”(Hereinafter referred to as TRC) refers to the amount of physical goods sold to individuals and social groups by enterprises or through transactions, which are not used for production or operation, and the amount of income obtained by providing catering services. The retail industry counted by this index is the link between production and consumption, which can reflect people's consumption in time. It could not only provide services for production and consumption, but also promote consumption and production in turn, which has an important impact on the development of the consumer market and is the pillar industry of China's economic growth.

Since the "12th Five-Year plan" China has emphasized the coordinated development of consumption, investment and export to jointly promote economic growth. At present, we are in the decisive stage of building a moderately prosperous society in an all-round way. At the same time, we are also in the important stage of increasing consumption demand, shifting consumption growth and accelerating the upgrading of consumption structure. Therefore, it is necessary to promote the adjustment of economic structure so as to coordinate and adapt the structure to China's national conditions. In this context, with the introduction of a series of policies to stimulate consumption, TRC has attracted more and more attention in China. Because at the moment of deepening the reform and transformation of China's economic and political system, consumption has become a key factor in promoting economic growth because of its wide influence on related industries. In fact, it can not only reflect the consumption demand of Chinese residents in different periods, but also is the main factor to promote the development of local economy. Consequently, it is of great practical significance to study the relationship between TRC and economic growth.

2. Literature Reviews on TRC and Economic Growth

The qualitative analysis of TCR and economy has always been the mainstream research method of domestic scholars, but in recent years, the trend has changed to analyze and predict the total retail sales of social consumer goods by fitting the model. For example, Huang Yan(2011) used the season model of ARIMA model to accurately analyze the fluctuation of total retail sales of social consumer goods in 2001-2010, then use historical data to demonstrate the accuracy of model prediction [1]. Jia Xin, Xu Yongli(2016) used the main difference method to fit the data of TRC in China from 1984 to 2010, trying to describe the long-term trend and seasonal fluctuation of total retail sales of consumer goods[2]. There are also tests on the reliability of total retail sales data of social consumer goods. For example, according to Bai Dongjie and Zhang Yuan(2019), the

deviation between the actual frequency of the first number of total retail sales of social consumer goods and Benford's expected frequency tends to decrease in general, and the difference value is small, so we can think that the data quality of total retail sales of social consumer goods is relatively reliable[3].

Domestic research has analyzed the relationship between TRC and different economic variables. For example, through empirical analysis, Fang Huli(2009) found that the TRC in China showed a trend of “middle downturn, active at both ends” and “stable and sustainable development”. There is a one-way positive relationship among the monthly fluctuation of exchange rate, fiscal expenditure and consumption[4]. After analyzing and studying the influencing factors of the TRC, farina (2010) concluded that only income and consumption can maintain a good linear correlation in the estimation of parameters and various test methods. In the current economic situation, it is necessary to stimulate consumption and the key is to increase the per capita disposable income of residents. [5]. However, there are few studies on the relationship between total retail sales of consumer goods and economic growth in the long-term state and good model explanation. Therefore, this paper attempts to fit the dynamic regression model by studying the long-term fluctuation of total retail sales of consumer goods and economic growth in China and whether there is long-term interaction between the two time series. This study can provide a reliable basis for a deeper understanding of the state of economic and social development and living standards, and then provide a reference for decision-makers to make decisions and relevant policies and measures.

3. Methods and Models

3.1 Indicators and Data Description

Gross Domestic Product (GDP) refers to the final result of production activities of all resident units in a certain period of time calculated according to the national market price. It is recognized as the best indicator to measure the national economic situation, and also the most important macro indicator in the national accounting system of China. It can reflect a country's economic strength and market size. Whether a country or region's economy is in the stage of growth or recession can be intuitively felt from the change of figures. The TRC is an important factor to reflect the level of people's consumption in a country, and also a very important indicator in the national economic system. How about the consumption level of residents, whether the material and cultural living standards have been improved, whether the purchasing power of social goods in China has been realized to a greater extent, and whether the development scale of China's retail and market has been expanded and so on. These questions can be more accurately judged by studying the TRC.

Since the index of TRC before 1992 is different from the current statistical caliber, to ensure consistency and accuracy of the study, we use the GDP annual data from 1992 to 2019 to measure the level of China's long-term economic development, and use the annual data of total retail sales of consumer goods to measure the total social consumption level, The data sources are all from China Statistical Yearbook. In order to eliminate the differences caused by time series regression, this paper takes LnGDP as dependent variable and LnTRC as input variable, optimizes the natural logarithm of the sequence of gross domestic product and total retail sales, and constructs a dynamic regression model.

3.2 Augmented Dickey-Fuller Test

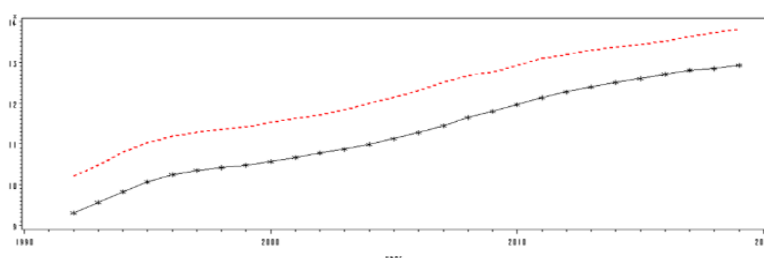


Fig. 1 Sequence Chart of LnGDP and LnTRC from 1992 to 2019

In Figure 1, the solid line is the LnTRC sequence, and the dotted line is the lnGDP sequence. From the sequence diagram, it can be seen that there is a relationship of synchronous change between the two sequences. That is, when consumption increases, the economy is also in the growth stage, and their change speed is almost the same. First, let's look at the characteristics of the two time series separately. Since the first requirement of modeling a time series is that the series should be stable. So the first step, we do ADF test for NtrC and lnGDP series respectively:

The ARIMA Procedure
Augmented Dickey-Fuller Unit Root Tests

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	0.3131	0.7506	10.55	0.9999		
	1	0.2300	0.7296	1.50	0.8632		
Single Mean	0	-0.7021	0.8016	-2.71	0.0844	94.53	0.0010
	1	-0.2572	0.9340	-0.37	0.9398	1.32	0.7932
Trend	0	-5.0748	0.7900	-1.96	0.5864	5.40	0.1938
	1	-29.1491	0.0004	-4.09	0.0180	8.37	0.0161

Fig. 2 Augmented Dickey-Fuller Unit Root Tests of LnTRC

Augmented Dickey-Fuller Unit Root Tests

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	0.2872	0.7440	9.63	0.9999		
	1	0.2251	0.7283	1.70	0.9751		
Single Mean	0	-0.8909	0.8853	-3.19	0.0312	85.54	0.0010
	1	-0.5111	0.9164	-0.76	0.8129	1.98	0.5779
Trend	0	-6.6416	0.6485	-2.70	0.2434	8.79	0.0093
	1	-19.0919	0.0300	-3.27	0.0928	5.52	0.1174

Fig. 3 Augmented Dickey-Fuller Unit Root Tests of LnGDP

In Figure 2, the output of the first column is the type of test model, and the second column is the number of autocorrelation delays. The two columns jointly determine the specific form of the test model. The fifth and sixth columns output the value of Tau Statistics (τ) and the test p value. According to the output results, we can judge that when the significance level is 0.05, the sequence LnTRC is non-stationary, but the sequence is stable after eliminating the linear trend. In Figure 3, according to the value of fifth column and sixth column output Tau Statistics (τ) and check the P value, we can judge that when the significant level is 0.05, the sequence LnGDP is nonstationary for all kinds of test models.

The classical regression model needs to be based on stable data variables. For non-stationary sequence variables, even if there is no economic relationship between them, they may still show a high determinable coefficient when regression is carried out. This is called pseudo regression, which is also called false regression phenomenon. Therefore, if the non-stable variables are used to build the classical regression model, there will be many problems such as false regression. In this case, the regression model is meaningless unless there is a cointegration relationship between them. However, if there is a long-term stable relationship between two unstable variables, it indicates that they are cointegrated and in this case, we can use the classical regression model. Similarly, From Figure 1, we find that the two sequences have a stable and constant relationship, which indicates that there may be an internal stable mechanism between them. It leads to a long-term equilibrium relationship between them although their own sequences are non-stationary. Based on these characteristics, we try to consider the establishment of a two sequence ARIMAX model.

3.3 Cointegration Test

The key to the establishment of dynamic regression model between multiple nonstationary series is whether they have cointegration relationship. So the next step is to carry out Engle-Granger test on the two series by assuming the following conditions:

- H_0 : There is no cointegration relationship between multivariate nonstationary sequences.
 H_1 : There is cointegration relationship between multivariate nonstationary sequences.

Because the cointegration relationship is determined by examining the stationarity of regression residuals, the above assumptions can be transformed into:

H_0 : The regression residual sequence $\{\varepsilon_t\}$ is nonstationary.
 H_1 : The regression residual sequence $\{\varepsilon_t\}$ is stationary.

Augmented Dickey-Fuller Unit Root Tests							
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-4.5294	0.1340	-1.75	0.0750		
	1	-8.2848	0.0370	-2.08	0.0379		
Single Mean	0	-3.9796	0.1601	-1.23	0.1938		
	1	-4.5422	0.4535	-1.73	0.4054	1.59	0.6738
	2	-8.3006	0.1609	-2.05	0.2638	2.13	0.5410
Trend	0	-3.9549	0.5193	-1.19	0.8833	0.72	0.8832
	1	-4.4547	0.8391	-1.71	0.7211	2.14	0.7548
	2	-7.9491	0.5252	-2.06	0.5452	2.40	0.7063
							0.9700

Fig. 4 Augmented Dickey-Fuller Unit Root Tests of Residual Sequence

Autocorrelation Check for White Noise							
To Lag	Chi-Square	DF	Pr > ChiSq	-----Autocorrelations-----			
6	84.46	6	<.0001	0.882	0.770	0.668	0.575
				0.485	0.394		

Fig. 5 Autocorrelation Check for White Noise of Residual Sequence

Output the residual sequence, and carry out unit ADF test on the residual sequence. The results show that in the class of models with one step delay and no mean value, the residual sequence is significantly stable, while according to the Figure 5, all the statistics are less than the significance level 0.05, which is not white noise sequence. This shows that we have 96.21% assurance that the residual sequence is stable and has first-order autocorrelation, that is to say, we have 96.21% assurance that there is a cointegration relationship between sequence LnGDP and sequence LnTRC, so we can establish a regression model between the two sequences without worrying about false regression.

3.4 Model Establishment

Crosscorrelations																								
Lag	Covariance	Correlation	-1	9	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	1	
-7	0.954890	0.31903	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
-6	0.457024	0.41091	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
-5	0.596955	0.50923	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
-4	0.654237	0.58823	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
-3	0.756410	0.69009	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
-2	0.867647	0.78010	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
-1	0.969224	0.89726	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0	1.110700	0.99863	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	0.878437	0.87971	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	0.651665	0.76573	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	0.739326	0.85933	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	0.622943	0.56009	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	0.516959	0.46471	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	0.412141	0.37056	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	0.305917	0.27605	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

, marks two standard errors

Fig. 6 Cross correlations Chart of Residual Sequence

Figure 8 shows the correlation between LnGDP and LnTRC of different lag steps. From the graph, when the lag steps of the dependent variable sequence in the first column are zero, the correlation with the sequence LnTRC is the strongest. Therefore, sequence LnGDP and sequence LnTRC can be modeled simultaneously. Therefore, sequence LnGDP and sequence LnTRC can be modeled simultaneously. The autocorrelation graph and partial autocorrelation graph of the residual sequence output from the dynamic regression model are as follows:

Autocorrelation Plot of Residuals																								
Lag	Covariance	Correlation	-1	9	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	1	Std Error
0	0.0032050	1.00000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
1	0.0028586	0.82953	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.188982
2	0.0019153	0.59759	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.291317
3	0.0014249	0.44458	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.332226
4	0.00077141	0.24069	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.352935
5	0.00004616	0.01440	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.358651
6	-0.0003961	-0.12358	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.358671
7	-0.0008280	-0.25836	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.360189

, marks two standard errors

Fig. 7 Autocorrelation Chart of Residual Sequence

increase in total retail sales of social consumer goods will cause economic growth of 2.02 percentage points. Therefore, in view of the need to speed up the restructuring of economic development, we ought to play the leading role of consumption in economic growth. That is to say, the development of a country cannot be separated from its economic development, and expanding consumption demand is the most important part of that.

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