Research on the relationship between disposable income and real consumption expenditure

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Abstract. Based on data from 1979 to 2013 in China, we calculate disposable income (Dinc) and actual consumption spending (ACS). Then, we build Dinc and ACS counteraction theory and error correction model by time series analysis. After further testing, we conclude disposable income is the Granger cause of actual consumption spending, but actual consumption spending is not the Granger cause of disposable income.

1. Introduction

Since the reform and opening up, China's economy has grown rapidly, and residents' disposable income has increased significantly. In addition, the consumption spending and consumption level of residents have greatly improved. In recent years, based on different theories, domestic scholars discussed the relationship between disposable income and real consumption spending. Tian Qing's paper proved that there is co-integration relationship between consumption and income [1]. Liu Liying used co-integration theory, ECM model and Granger causality test and so on to conclude that there is a long-term stable co-integration relationship between rural residents' income and consumption [2]. And Wang Mingxing's research showed that there is a long-term equilibrium relationship between real consumption and real income of urban residents in Shanxi Province [3]. The research above indicate that there is a high correlation between real consumption spending and real disposable income. Based on the co-integration theory of Econometrics, this paper studies the relationship between urban residents' disposable income and consumption spending in China, and it explores the dynamics and laws of change of them.

2. Co-integration Analysis Between Dinc and ACS

In order to study the relationship between consumption spending and disposable income, we select some indicators and collected relevant data from 1979 to 2013 in china. First, we need to get actual consumption spending (ACS). We select total consumption spending of residents (CS, 100 million yuan) and the consumer price index (CPI, 1978 as the base year, CPI of 1978 = 100). We use CPI to adjust CS, then we got ACS.

$$ACS = CS / CPI \tag{1}$$

As for disposable income (Dinc), we select nominal gross domestic product (GDP, 100 million yuan) and total government revenue (Tax, 100 million yuan). Then we calculated by the following formula.

$$Dinc = (GDP - Tax) / CPI \tag{2}$$

3. Co-integration Analysis Between Dinc and ACS

To reduce the data fluctuation, we take natural logarithm of ACS and Dinc and got sequences diagram[4]. Then check the stability, and establish the following equation.

$$\ln ACS_t = c_0 + c_1 \ln Dinc_t + \varepsilon_t \tag{3}$$

Last, we do equence analysis, and make timing chart. We get the two sequences are both rising, obviously not smooth. But they grow and change roughly same, which means there may be co-integration relationship between them. So we must check their single integral order[5]. If they are both integrated of order one, there may be co-integration. If the whole order is not the same, we will use the difference to make it first order singular sequence.

Among general economic analysis, most time series data are not stationary and have a certain growth trend[6]. So we shall do stationary test before co-integration analysis. According to the basic steps of unit root test, we do stationary test toward the sum. Test results are shown in table 1:

Table 1. Unit root test results

Variable	Inspection form(c,t,k)	ADF	1% critical value	5% critical value	10% critical value	P	Conclusion
lnACS	(c,0,0)	1.937	-3.639407	-2.951125	-2.614300	0.9997	no stationary
D(lnACS)	(c,0,0)	-3.355	-3.646342	-2.954021	-2.615817	0.0202	stable
lnDinc	(c,0,0)	1.172	-3.639407	-2.951125	-2.614300	0.9973	no stationary
D(lnDinc)	(c,0,0)	-3.666	-3.646342	-2.954021	-2.615817	0.0095	stable

From table 1, for a significant level of 0.01, 0.05 and 0.1, the Mackinnon of unit root test are -3.639407, -2.951125 and -2.614300 respectively. The value of t test statistic is 1.937, greater than the critical value. Thus we cannot refuse H. It is shown that the lnACS sequence has a unit root and is a non-stationary sequence. Similarly, we can see that lnDinc is also a non-stationary sequence.

Then,we choose the first order difference sequence in the unit root test dialog, select intercept and difference between the 1, and got the order of lnACS and lnDinc sequences. From the test results in table 1, D(lnACS) is a stationary sequence at 1% significance level. Same as the D(lnDinc). That is , D(lnACS)～I(1), D(lnDinc)～I(1).

In this paper, the equation (3) is estimated and the results are shown in table 2:

Table 2. OLS estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.871775	0.059084	14.75495	0.0000
lnDinc	0.846128	0.006160	137.3639	0.0000
R-squared	0.998254	Mean dependent var		8.940154
Adjusted R-squared	0.998201	S.D. dependent var		0.890985
Log likelihood	66.01826	F-statistic		18868.84
Durbin-Watson stat	0.362621	Prob(F-statistic)		0.000000

As seen from the table, despite D.W statistics is small, other statistics show that the model is ideal. Coefficient of determination after equation adjustment $\bar{R}^2 = 0.998201$. It indicates the model fitting effect is good. Coefficient estimate of lnDinc can express income elasticity of consumption spending.

In order to show that the sequence $\ln ACS_t$ and $\ln Dinc_t$ is Co integration, we do unit root test for residual sequence, got the following formula:

$$\hat{u}_t = \ln ACS_t - c_0 - c_1 \ln Dinc_t \tag{4}$$

Unit root test for $\hat{u}_t$. If the residual $\hat{u}_t$ is stationary, the sequence $\ln ACS_t$ and $\ln Dinc_t$ are Co integration. Therefore, using the data, the results are as follows:

Table 3. Residual unit root test results

ADF Test Statistic	-4.916598	1% Critical Value*	-2.6369
		5% Critical Value	-1.9517
		10% Critical Value	-1.6213

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ET)
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ET(-1)	-0.984869	0.200315	-4.916598	0.0000

In Table 3, at the 1% significant level, the t test statistic is -4.917, which is less than the critical value. It indicates there is no unit root in the residual sequence. That means there is a co-integration relationship between disposable income and actual consumption spending.

4. Co-integration test and error correction model estimation

Co-integration means a single time series data is non-stationary, but its' some line combination may be smooth. There is a long-term stable equilibrium relationship between these variables (co-integration) [7]. In this paper, we use EG two-step method to test whether variables' data are co-integration.

The equation (3) characterizes the long-run equilibrium relation of $\ln ACS_t$ and $\ln Dinc_t$. We need error correction model to analyse the dynamic relationship between real consumption spending and disposable income. The following is error correction model.

$$\Delta \ln ACS_t = c + c_t \Delta \ln Dinc_t + c_t ecm_t + \varepsilon_t \tag{5}$$

In the model, ecm_t is error correction term?

$$ecm_t = \ln ACS_{t-1} - c_0 - c_1 \ln Dinc_{t-1} \tag{6}$$

Then, the error correction model is estimated, and the results are shown in Table 4.

Table 4. Error correction model estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015438	0.009921	1.556178	0.1313
D(LNDINC)	0.719185	0.083605	8.602220	0.0000
ECM(-1)	-0.141483	0.216813	-0.652559	0.5196
R-squared	0.734283	Mean dependent var		0.093089
Adjusted R-squared	0.714601	S.D. dependent var		0.042166
Log likelihood	72.80463	F-statistic		37.30598
Durbin-Watson stat	1.145691	Prob(F-statistic)		0.000000

From the Table 4, the P value of the model estimation F statistics is very small, $\hat{R}^2$ =0.734. It shows that the overall model estimates are significant. In addition, the coefficient estimates of $\Delta \ln Dinc_t$ are significant, implying the short-run elasticity of consumption spending to income. At the 10% test level, the coefficient estimates of the error correction terms $ecm(-1)$ are significantly. The coefficient can react the adjustment of consumption away from the long term equilibrium. The greater the absolute value of the coefficient is, the faster the non-equilibrium state is restored to equilibrium state [8]. If $ecm(-1)$ is estimated to be 0, $\ln ACS_t$ and $\ln Dinc_t$ adjust in the same period immediately.

Therefore, the estimation results of the error correction model are bellow.

$$\Delta \ln ACS_t = 0.0154 + 0.7192 \Delta \ln Dinc_t - 0.1414 ecm_t \tag{7}$$

Using the estimated model, we can analyze the short-term change of consumption spending. There are two reasons for consumption spending change. One is that the short-term income changes. The

other is consumer spending of previous period deviates from the long-term equilibrium[9]. If $ecm_{t-1} = 0$, the previous period consumption does not deviate from the long-term equilibrium. So, the current consumption spending change is caused by real disposable income. If $ecm_{t-1} \neq 0$, the previous period of consumption deviates from the long-run equilibrium.In order to maintain the long-run equilibrium relationship between real consumption spending and disposable income, the current consumption spending will be at the rate of -0.14148 (i.e., the coefficient estimates of the error correction) to adjust the imbalance between consumption and income in the previous period.

5. Granger causality test

We use Granger causality test to test the causal relationship between variables. After multiple experiments, we choose 2 as the lag period. And make lnACS and lnDinc Granger causality test, the results are shown in table 5.

Table 5. Granger causality test result

Null Hypothesis:	Obs	F-Statistic	Probability
lnDinc does not Granger Cause lnACS	33	0.80168	0.45860
lnACS does not Granger Cause lnDinc		0.73631	0.48792

As seen from Table5, at the 10% significant level, disposable income is the Granger cause of actual consumption spending. Conversely, actual consumption spending is not the Granger cause of disposable income. In other words, actual disposable income has a positive effect on consumption spending, but actual consumption spending has little effect on disposable income.

6. Summary

Through the empirical research above, there is a long-term equilibrium relationship between real disposable income and real consumption spending. Granger causality tests indicates disposable income stimulates actual consumption spending significantly, but actual consumption spending has little effect on disposable income. The disposable income of residents has increased in recent years, and it has a significant effect on the actual consumption spending. But it still not reaches the ideal state, and the effect of consumption on demand is blocked.

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