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Research Article

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Disposable income and actual sports consumption expenditures correlation research based on co-integration theory and error correction model

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ABSTRACT

According to China consumption expenditures, nominal GDP, government total revenue, consumer price index time series data in 1978 to 2012, then make use of these four variables calculating disposable income (Dinc) and actual sports consumption expenditures (ACS) two variables, after that utilize co-integration theory and error correction model as well as other econometrics methods to analyze relationships between Dinc and ACS. Research results show that China disposable income and actual sports consumption expenditures exists co-integration relationships; and during 10% significance levels, actual disposable income is the Granger cause of actual sports consumption expenditures, on the contrary actual sports consumption expenditures is not the Granger cause of disposable income.

Key words: Disposable income, sports consumption level, consumption consciousness, co-integration theory, error correction model, Granger causality test

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INTRODUCTION

With the improvement of living standards of the people of China and implementation of national fitness program, people health and sports' consciousness strengthen as well as sports life-oriented, mercerization and industrialization deepen, people's consumption demand in sports cultural industry are constant increasing, sports industry has already become new and significant growth point of national economy. Especially in these years, people invested money and time on sports have been obviously improved [1-3].

National economic status, households disposable income are uppermost factors that affect sports consumption. No matter economics theory analysis or recent 20 years China and foreign countries' research documents, resident income status is main factor that affects consumption and sports consumption. There is an investigation that displays the higher households per capita income are, the more participating in sports consumption would be, the higher proportion of consumption in fitness entertainment center and purchasing tickets to watch sports competitions would be. Income levels directly restrict resident sports consumption level, income level and households per capita sports consumption behavior have higher positive correlations [4-6].

Recently years, more and more scholars research disposable income and actual consumption expenditures relationships. Tian Qing (2008) verified in "Our country urban resident income and consumption relationships co-integration test-based on different income classes empirical analysis" that consumption and income have co-integration relationship. Liu Li-Ying (2010) in "Rural resident income and consumption short term dynamic state and long term equilibrium relationship empirical analysis, utilized co-integration, ECM model and Granger causality test as well as other analysis tools, according to Hebei province statistics data, it proved that rural resident income and consumption expenditures exist long term stable co-integration relationships. But there is still lack of experts about resident actual income and sports consumption expenditures correlation research. This paper on this basis, researches actual income and consumption expenditures co-integration relationships that provides reference

for further reasonable planning resident income distribution.

INDICATOR SELECTION AND DATA HANDLING

Research objects are sports consumption expenditures and disposable income co-integration relationships as well as their error correction model. Table 1 listed our country resident total consumption expenditures(CS, unit is a hundred million RMB), nominal gross domestic product(GDP, unit is a hundred million RMB), government total revenue(Tax, unit is a hundred million RMB) in 1978 to 2012 and resident sports consumer price index with 1978 as base year(CPI, year 1978 CPI=100) data that derives from China national bureau of statistics annual data and statistic yearbook (http://www.stats.gov.cn/tjsj/ndsj/).

Table 1: Sports consumption expenditures, nominal GDP, government total revenue and resident consumer price index in 1978 to 2012

Obs	CS	GDP	Tax	CPI
1978	1759.1	3645.20	1132.26	1.0000
1979	2011.5	4062.60	1146.4	1.0200
1980	2331.2	4545.60	1159.93	1.0810
1981	2627.9	4891.60	1175.8	1.1070
1982	2902.9	5323.40	1212.3	1.1280
1983	3231.1	5962.70	1367	1.1450
1984	3742	7208.10	1642.9	1.1770
1985	4687.4	9016.00	2004.82	1.2810
1986	5302.1	10275.20	2122	1.3630
1987	6126.1	12058.60	2199.4	1.4640
1988	7868.1	15042.80	2357.2	1.7396
1989	8812.6	16992.30	2664.9	2.0505
1990	9450.9	18667.80	2937.1	2.1150
1991	10730.6	21781.50	3149.48	2.1880
1992	13000.1	26923.50	3483.37	2.3276
1993	16412.1	35333.90	4348.95	2.6696
1994	21844.2	48197.90	5218.1	3.3130
1995	28369.7	60793.70	6242.2	3.8789
1996	33955.9	71176.60	7407.99	4.2000
1997	36921.5	78973.00	8651.14	4.3180
1998	39229.3	84402.30	9875.95	4.2836
1999	41920.4	89677.10	11444.08	4.2235
2000	45854.6	99214.60	13395.23	4.2401
2001	49213.2	109655.20	16386.04	4.2696
2002	52571.3	120332.70	18903.64	4.2350
2003	56834.4	135822.76	21715.25	4.2862
2004	63833.5	159878.34	26396.47	4.4006
2005	71217.5	183867.88	31649.29	4.3116
2006	80120.5	210870.99	38760.2	4.2989
2007	95609.8	265810.31	45621.97	4.3139
2008	111670.4	314045.43	54223.79	4.3619
2009	123584.6	340902.81	59521.59	4.4209
2010	140758.6	401512.80	73210.79	4.4139
2011	164945.2	473104.05	89738.39	4.4469
2012	189087.7068	518942.11	100614.28	4.5009

Use resident consumer price index CPI to adjust resident consumption expenditures CS, it gets actual consumption expenditures; according to Deng Feng investigation result, resident sports consumption expenditures is nearly 3.03% of actual consumption expenditures that ACS=3.03%CS/CPI; actual disposable income Dinc is got by following calculation :Dinc= (GDP-Tax)/CPI.

ACTUAL SPORTS CONSUMPTION EXPENDITURES (ACS) AND ACTUAL DISPOSABLE INCOME (DINC) CO-INTEGRATION ANALYSIS

Model establishment

In order to reduce data fluctuation, value natural logarithm for actual sports consumption expenditures ACS and actual disposable income Dinc, it gets series lnACS and lnDinc, carry out stationary test on the two and establish following equation (1):

$$\ln ACS_t = c_0 + c_1 \ln Dinc_t + \varepsilon_t \quad (1)$$

Model test

Two variables sequence chart: Make two sequences through Eview 6.0 to sequence chart drawing refers to Figure

1, both two sequences are in rising trends, obvious they are not stable, but the two has roughly same growing and changing tendencies, which indicates the two may exist co-integration relationships. However, to verify that the two have co-integration relationships, it should first check the two single integration orders, if all are one order single integration, then they may exist co-integration relationships, if single integration orders are not the same, then it should adopt differential way to convert them into one order single integration sequence [7].

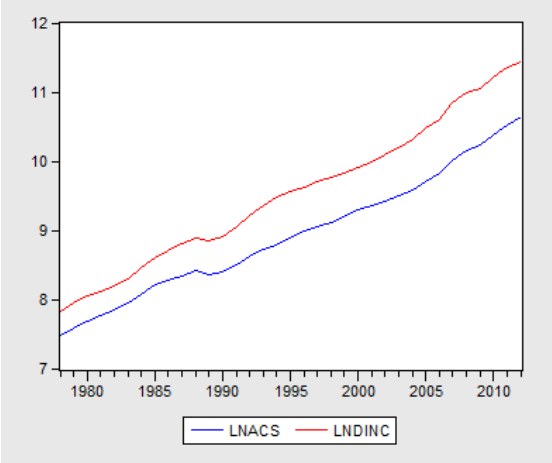

Figure 1: LNACS and LNDINC sequence chart

Sequence unit root test: Classical time sequence analysis and regression analysis have lots of hypothesis premises, such as sequence stability, normality and so on, on the condition that these hypothesis are met, carried out t test, F test and others will have higher reliability. But time sequence data in general economic analysis are mostly non stable, all have certain growing tendency, therefore when carrying out co-integration analysis of these data, it first carries out stationary test, judge data stability method normally is with the help of unit root test. According to unit root test basic steps, utilize Eview6.0 software, carries out stationary test on lnACS and lnDinc, test result refers to Table 2.

Table 2: Unit root test result

Variable	Checking form(c, t, k)	ADF value	1% critical value	5% critical value	10% critical value	P	Result
LNACS	(c, 0, 0)	1.937	-3.639407	-2.951125	-2.614300	0.9997	non stable
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	non stable
D(LNDINC)	(c, 0, 0)	-3.666	-3.646342	-2.954021	-2.615817	0.0095	stable

Table 2 result shows for LNACS, under significance level 0.01、0.05and 0.1, unit root tested Mackinnon are respectively -3.639407, -2.951125and -2.614300, t test statistics value 1.937 is larger than critical value, so that it cannot refuse H; It indicates that LNACS sequence exists unit root, is non stationary sequence. Similarly, it is clear that LNDINC is also non stationary sequence.

In order to get LNACS and LNDINC sequence single integration orders, carry out unit root test on one order difference sequence that appointed by unit root test dialog box, select intercept item, lagging difference item selects 1 order. For D(LNACS), from table 2 test result, under significance level 0.01、0.05 and 0.1, unit root tested Mackinnon are respectively -3.646342、-2.954021and -2.615817, t test statistics value is -3.355, less than 1% significance level critical value, indicates D(LNXM) is stationary sequence under 1% significance level, use the same method, it can be got that D(LNDINC)is also stationary sequence under 1% significance level, that is D(LNACS)～I(1)、D(LNDINC)～I(1).

Model estimation: Make estimation on equation (1) through Eviews6.0, estimation result as following Figure 2 shows:

Dependent Variable: LNACS
Method: Least Squares
Date: 01/09/14 Time: 09:54
Sample: 1978 2012
Included observations: 35

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.871778	0.059084	14.75499	0.0000
LNDINC	0.846128	0.006160	137.3636	0.0000

R-squared	0.998254	Mean dependent var	8.940153
Adjusted R-squared	0.998201	S.D. dependent var	0.890983
S.E. of regression	0.037788	Akaike info criterion	-3.658188
Sum squared resid	0.047123	Schwarz criterion	-3.569311
Log likelihood	66.01829	Hannan-Quinn criter.	-3.627508
F-statistic	18868.77	Durbin-Watson stat	0.362621
Prob(F-statistic)	0.000000		

Figure 2: OLS estimation result

From Figure 2, it is clear equation estimated results are all remarkable, after equation adjustment coefficient of determination $\bar{R}^2 = 0.998201$, very close to 1, indicates model fitting effect is better. LNDIC coefficient estimation value expressed sports consumption expenditures income elasticity, the coefficient estimation value is 0.846128, indicates disposable income increases 1%, actual sports consumption expenditures will increase 0.846128%. Except for D.W statistics value is smaller, other statistics show model estimation effects are relative ideal.

Residual sequence unit root test:
First establish model formula (1):

$$\hat{u}_t = \ln ACS_t - c_0 - c_1 \ln Dinc_t \tag{2}$$

Carry out unit root test on $\hat{u}_t$. If residual $\hat{u}_t$ is stable, then it indicates sequence $\ln ACS_t$ and $\ln Dinc_t$ are co-integrated.

The next, residual test
Through Figure 3, it is clear that under 1% significance level, t test statistics is -2.778, less than corresponding critical value, so that residual sequence doesn't exist unit root and is stationary sequence, which shows that actual disposable income (LNDIC) and actual consumption expenditures (LNDINC) have co-integration relationships.

Augmented Dickey-Fuller Unit Root Test on RESID01

Null Hypothesis: RESID01 has a unit root
Exogenous: None
Lag Length: 3 (Automatic based on SIC, MAXLAG=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.778284	0.0071
Test critical values:	1% level	-2.641672	
	5% level	-1.952066	
	10% level	-1.610400	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID01)
Method: Least Squares
Date: 01/09/14 Time: 10:06
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

Figure 3: Residual unit root test result

Co-integration test and error correction model estimation
Co-integration test: Co-integration refers to single time sequence data is not stable, but their some linear combinations may be stable, that is to say, these variables have long-term stable equilibrium relationships (co-integration relationship). There are two methods for testing whether variables data are co-integrated or not, one is testing on regression results residual which is also called single equation co-integration test; the other is two-phase co-integration test based on EG, this paper adopts the second method.

Error correction model establishment

Equation 1 describes sequence $\ln ACS_t$ and $\ln Dinc_t$ long-term equilibrium relationships, to check actual consumption expenditures and actual disposable income dynamic relations, it needs to carry out analysis with the help of error correction model. Error correction model:

$$\Delta \ln ACS_t = c + c_t \Delta \ln Dinc_t + c_t ecm_t + \varepsilon_t \quad (3)$$

Among them, ecm_t is error correction item, and $ecm_t = \ln ACS_{t-1} - c_0 - c_1 \ln Dinc_{t-1}$.

Error correction model estimation

From Figure 4, it is clear model estimation result F statistics corresponding probability value P is quite small, $\hat{R}^2$ =0.725 so that indicates model estimation overall is remarkable. $\Delta \ln Dinc_t$ Coefficient estimation value is also very remarkable, which can be explained as sports consumption expenditures short-term elasticity on income changes that is income increases 1%, then in short term, sports consumption expenditures will increase around 0.688938%, less than 0.846128%. Error correction item ecm (-1) coefficient estimation value under 10% test level is remarkable, the coefficient reflects adjustment of resident sports consumption expenditures' deviating long-term equilibrium relations, the bigger its absolute value is, then the faster recovering non-equilibrium state to equilibrium state speed would be. Especially, if error correction item ecm (-1) coefficient estimation value is 0, then it indicates $\ln ACS_t$ and $\ln Dinc_t$ changes should be immediately adjusted in the same period.

Dependent Variable: D(LNACS)
Method: Least Squares
Date: 01/09/14 Time: 10:42
Sample (adjusted): 1979 2012
Included observations: 34 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.019834	0.009002	2.203346	0.0351
D(LNDINC)	0.688938	0.077447	8.895655	0.0000
ECM(-1)	-0.120155	0.110623	-1.086162	0.2858

R-squared	0.725167	Mean dependent var	0.093327
Adjusted R-squared	0.707436	S.D. dependent var	0.039765
S.E. of regression	0.021509	Akaike info criterion	-4.756629
Sum squared resid	0.014341	Schwarz criterion	-4.621950
Log likelihood	83.86270	Hannan-Quinn criter.	-4.710700
F-statistic	40.89788	Durbin-Watson stat	1.107969
Prob(F-statistic)	0.000000		

Figure 4: Error correction model estimation result

Error correction model estimation result:

$$\Delta \ln ACS_t = 0.0198 + 0.68894 \Delta \ln Dinc_t - 0.120155 ecm_t$$

t=(2.2033) (8.89566) (-1.086162)

R^2 =0.7252 DW=1.10797 F=40.89788

$\Delta \ln Dinc_t$ Coefficient estimation value is very remarkable, which can be explained as sports consumption expenditures short-term elasticity on income changes that income increases 1%, then in short term, sports consumption expenditures will increase around 0.688938%, less than 0.846128%. Error correction item ecm (-1) coefficient estimation value under 10% test level is remarkable, the coefficient reflects adjustment of resident sports consumption expenditures' deviating long-term equilibrium relations, the bigger its absolute value is, then the faster recovering non-equilibrium state to equilibrium state speed would be. Especially, if error correction item ecm (-1) coefficient estimation value is 0, then it indicates $\ln ACS_t$ and $\ln Dinc_t$ changes should be immediately adjusted in the same period.

Use estimated model, we can analyze sports consumption expenditures short-term fluctuation. Sports consumption expenditures fluctuation can be divided into two parts, one is due to short-term income changes influences; the other

one is due to previous term sports consumption expenditures deviated from long-term equilibrium relationships influences. Assume that previous term sports consumption didn't deviate from long term equilibrium relationships that $ecm_{t-1} = 0$, then the term consumption expenditures fluctuations are all derive from the term actual disposable income fluctuation influences. If the previous term sports consumption deviated from long term equilibrium relationships that $ecm_{t-1} \neq 0$, then in order to maintain actual sports consumption expenditures and actual disposable income long-term equilibrium relationships, the term will make adjustment of the previous term consumption expenditures and income non equilibrium state at the speed of -0.1202(that is error correction item coefficient estimation value), pull it back to long-term equilibrium state. For example, if previous term excessive consumes,

Then this term sports consumption expenditures should have some reduction.

GRANGER CAUSALITY TEST

The most effective method to test variables causality is Granger causality test, the research after multiple experiments, finally selects lag phase as 2, Granger causality test result on LNACS and LNDINC with measurement software Eviews6.0 can refer to Figure 5.

Pairwise Granger Causality Tests
Date: 01/09/14 Time: 13:51
Sample: 1978 2012
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LNDINCP does not Granger Cause LNACS2	32	2.73592	0.0828
LNACS2 does not Granger Cause LNDINCP		1.08964	0.3507

Figure 5: Granger causality test result

From Figure 5, it is clear that under 10% significance level, actual disposable income is the Granger cause of actual sports consumption expenditures, on the contrary actual sports consumption expenditures is not the Granger cause of disposable income. That is to say, actual disposable income promotes actual consumption expenditures, but actual sports consumption expenditures have no great promotion on actual disposable income.

CONCLUSION

Through above empirical research, results show actual disposable income and actual sports consumption expenditures have long-term equilibrium relationships, Granger causality test indicates actual disposable income has significant promotion on actual sports consumption expenditures, however, actual sports consumption expenditures influences on actual disposable income is not significant. Though resident actual disposable income is increasing year by year, and it plays significant roles in sports consumption expenditures, but it still hasn't arrived at ideal state that causes consumption pulling functions on demands blocked. These causes may be lead by residents focus on deposits, ignore consumption as well as social insurance system not perfect.

Resident consumption expectation is low. Suggest that government depart focuses on consumption when focuses on accumulation, meanwhile perfect social insurance system, improve resident sports consumption positivity, improve consumption structure, increase national physique.

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