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Research on the Relationship between Income and Consumption of the Urban Residents in Hunan Province on the Basis of Error Correction Model

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Abstract By using error correction model, I conduct co-integration analysis on the research of the relationship between the per capita practical consumption and per capita practical disposable income of urban residents in Hunan Province from 1978 to 2009. The results show that there is a co-integration relationship between the per capita practical consumption and the practical per capita disposable income of urban residents, and based on these, the corresponding error correction model is established. Finally, corresponding countermeasures and suggestions are put forward as follows: broaden the income channel of urban residents; create goods consuming environment; perfect socialist security system.

Key words Residential income, Co-integration, Error correction model, China

Consumption as an important variable in macro economy, which determines and influences the products and service need, impacts production and employment and even the whole economic activity. The scholars at home and abroad have conducted many researches on the problem of consumption^[1-10], and most of them hold that income is the most important factor influencing consumption. Since the reform and openness, the economy of Hunan Province develops rapidly and continuously; the consumption level of urban residents is continuously elevated; the consumption structure is gradually optimized. In 2009, the urban residents' discretionary income per capita in Hunan Province was 15 084.31 yuan, increasing by 9.1% (1 258.8 yuan) over the year 2008; apart from the factor of goods price, it increases by 9.5% actually. The wage per capita is 8 979.96 yuan, increasing by 6.7% over the previous year; the net profit of operation is 1 744.37 yuan, increasing by 10.7% over the previous year; the transference income is 3 940.8 yuan, increasing by 12.2%; the possession income is 419.17 yuan, increasing by 32.4% over the previous year. The urban residents' consumptive expenditure in whole province is 10 828.23 yuan, increasing by 8.9%. The family appliance and service increase by 18.3%, the clothing increases by 5.1% and food expenditure increases by 5.1%. Further stimulating the consumption of urban residents is an important decision-making of the economic development of Hunan Province and even China, and the key factor of guaranteeing the continuous, healthy and stable development of economy. So, researching the relationship between urban residents' income and consumption in Hunan Province is significant in reality. I select the relevant data about the

income and consumption of residents from 1978 to 2009, and use ECM model to research the relationship between the consumption per capita and discretionary income of urban residents of Hunan Province, in order to provide reference for the relevant decision-making.

1 Variables selection, data source and research methods

1.1 Variables selection According to the need of research, I select the discretionary income per capita of urban residents in Hunan Province ($ADPI$) and consumptive expenditure per capita ($APCE$) as nominal variables, and the practical variables are substituted by R_ADPI and R_APCE .

1.2 Data source and data processing The data comes from *Hunan Statistical Yearbook* from 1982 to 2009 and *The Statistical Communique of National Economy and Social Development of Hunan Province in 2009*.

Because the data source is nominal value, here we take the year 1978 as base period, put aside the factor of inflation, and conduct the analysis by using the practical value. On the basis of the urban consumption price index (P) of Hunan Province taking the year 1978 as base period, I use the formula (1) to calculate the practical value R_ADPI_t and R_APCE_t , and calculate to two decimal places. The results of data processing can be seen in Table 1.

$$R_ADPI_t = \frac{ADPI_t}{P_t} \times 100, R_APCE_t = \frac{APCE_t}{P_t} \times 100 \quad (1)$$

2 Research methods

According to the data from 1982 to 2009, by using the statistical software EVIEWS 6.0, we conduct the relevant analysis, unit root test, Granger test, and establish the error correction model in order to research the relationship between the consumption and income in Hunan Province.

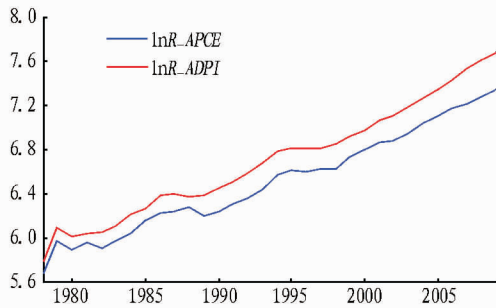
Table 1 The practical income and consumptive expenditure of urban residents in Hunan Province from 1978 to 2009

Year	The practical discretionary income per capita (R_ADPI)	The practical consumptive expenditure per capita (R_APCE)	Year	The practical discretionary income per capita (R_ADPI)	The practical consumptive expenditure per capita (R_APCE)
1978	289.56	323.88	1994	709.85	880.63
1979	393.03	441.43	1995	744.33	901.20
1980	362.61	405.56	1996	732.21	902.67
1981	386.91	419.50	1997	748.91	903.74
1982	367.38	424.28	1998	754.47	938.01
1983	392.20	448.94	1999	831.85	1 007.82
1984	416.35	496.53	2000	892.82	1 063.88
1985	471.47	523.40	2001	959.39	1 172.91
1986	506.06	590.33	2002	968.19	1 208.54
1987	511.12	596.88	2003	1 041.82	1 314.42
1988	533.11	585.49	2004	1 132.74	1 417.85
1989	490.80	593.66	2005	1 209.41	1 534.77
1990	511.60	629.19	2006	1 293.19	1 662.87
1991	543.95	670.81	2007	1 359.33	1 858.69
1992	574.04	719.87	2008	1 443.08	2 005.42
1993	619.39	796.68	2009	1 544.86	2 152.08

3 Results and analysis

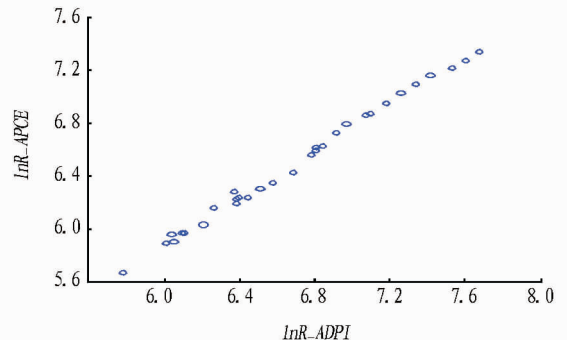
3.1 Correlation analysis We take the logarithm of R_ADPI and R_APCE , and eliminate the heteroscedasticity of data in order to make data smooth. After taking the logarithm of practical income and practical consumption, they are notated as $\ln R_ADPI_t$ and $\ln R_APCE_t$. By using EVIEWS 6.0, we draw the timing chart of the practical income per capita and practical consumption per capita after taking the logarithm (Fig. 1) and correlation scatter diagram (Fig. 2).

From Fig. 1, there is a prominent time tendency of the

**Fig.1** The time sequence of $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$

practical income per capita and practical consumption per capita after taking the logarithm; from Fig. 2, there is strong linear relationship between the practical discretionary income per capita and practical consumption per capita, which offers powerful support for the subsequent research.

3.2 Unit root test By using EVIEWS 6.0, we conduct the ADF test on $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$ as well as the sequences after differencing (they are notated as $\Delta \ln(R_ADPI_t)$ and $\Delta \ln(R_APCE_t)$ respectively, the results of test can be seen in Table 2.

**Fig.2** The correlation relationship between $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$ **Table 2** $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$ the unit root test results of sequence after differencing

Variable	Test type (c, t, k)	ADF value	DW test value	Threshold value 1%	Threshold value 5%	Threshold value 10%	Conclusion
$\ln(R_ADPI_t)$	($c, t, 2$)	-2.1652	1.804 866	-4.309 8	-3.574 24	-3.221 73	Instable
$\ln(R_APCE_t)$	($c, t, 2$)	-2.409 5	1.575 944	-4.296 7	-3.568 38	-3.218 38	Instable
$\Delta \ln(R_ADPI_t)$	($c, 0, 2$)	-9.073 2	0.890 552	-3.670 2	-2.963 97	-2.621 01	Stable
$\Delta \ln(R_APCE_t)$	($c, 0, 2$)	-4.580 5	1.311 824	-3.689 2	-2.971 85	-2.625 12	Stable

Note: c represents constant item; t represents tendency item; k is the lagged phases.

From Table 2, the ADF value of the practical discretionary income per capita and practical consumption per capita after taking the logarithm are both bigger the threshold value of the significance level of 1%, 5% and 10%; the sequences of the practical income per capita and practical consumption per capi-

ta after taking the logarithm are not stable; after first order difference, the ADF value is smaller than the threshold value of 1%, 5% and 10%, there is no unit root in the sequences of the practical income per capita and practical consumption per capita after taking the logarithm and first order difference, and they

are stable sequence, namely $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$ are both first-order integratedness sequence $I(1)$.

3.3 Co-integration test Firstly, we establish the metric model of the function of the practical discretionary income per capita and practical consumption per capita in Hunan Province as follows:

$$\ln(R_APCE_t) = a_0 + a_1 \ln(R_ADPI_t) + u_t \quad (2)$$

In the formula, $\ln(R_APCE_t)$ refers to the urban residents' consumptive expenditure per capita in Hunan Province; $\ln(R_ADPI_t)$ refers to the urban discretionary income per capita in Hunan Province.

We conduct the regressive analysis on the model (2) and use OLS to get the following results:

$$\ln(R_APCE_t) = 0.529\ 65 + 0.892\ 013 \ln(R_ADPI_t) + u_t \quad (3)$$

$$(0.073\ 756) \quad (0.010\ 978)$$

$$t \quad (7.181\ 165) \quad (81.251\ 50)$$

$R^2 = 0.995\ 476$; the adjusted $R^2 = 0.995\ 326$; $D.W = 1.231\ 146$.

We conduct the unit root test on the residual sequence of model (3) and still adopt the ADF test; the test type of (c, t, k) is $(0, 0, 0)$; the results show that the statistical value of t under ADF test is $-3.638\ 566$, smaller than the threshold value of significance level of 1%, 5% and 10%, which indicates that under confidence level of 99%, we can disprove the null hypothesis of unit root. The residual sequence of model (3) is stable sequence, so we can think there is co-integration relationship between $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$, namely there is stable balanced relationship between the discretionary income per capita and consumption per capita of urban residents in Hunan Province from 1978 to 2009.

3.4 The Granger causality test We conduct Granger causality test on $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$, and the results can be seen in Table 3.

Table 3 The Granger causality test results of $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$

0 hypothesis	F statistical amount	Probability
$\ln(R_APCE)$ is not the Granger cause of $\ln(R_ADPI)$	1.171 72	0.326 3
$\ln(R_ADPI)$ is not the Granger cause of $\ln(R_APCE)$	5.610 62	0.009 7

From Table 4, the probability of null hypothesis $\ln(R_ADPI_t)$ being not the Granger cause of $\ln(R_APCE_t)$ is 0.009 7, and the null hypothesis should be disproved, namely the urban discretionary income per capita in Hunan Province exerts prominent impact on consumption per capita, and the discretionary income per capita is the Granger cause of consumption; while the probability of null hypothesis $\ln(R_APCE_t)$ being not the Granger cause of $\ln(R_ADPI_t)$ is 0.326 3, and the null hypothesis should be accepted, namely is the consumption per capita is not the Granger cause of the discretionary income per capita.

3.5 The establishment of error correction model Error Correction Model (ECM), is always called DHSY model, and econometric model with particular form. Its main form was put

forward by Davidson, Hendry, Srba and Yeo in 1978. The specific form is as follows:

$$\Delta Y_t = \beta_1 \Delta X_t - \lambda (Y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}) + \varepsilon_t \text{ or } \Delta Y_t = \beta_\Delta X_t - \lambda \text{ecm} + \varepsilon_t \quad (4)$$

This research is based on ECM model. According to the need of research, we take the stable time sequence \hat{u}_t as error correction item, and establish the error correction model as follows:

$$\Delta(\ln R_APCE) = C(1) + C(2) \times \Delta(\ln R_ADPI) + C(3) \times \Delta(\ln R_APCE(-1)) + C(4) \times \Delta(\ln R_ADPI(-1)) + C(5) \times \text{ECM}(-1) + u_t \quad (5)$$

We use EVIEWS 6.0 and OLS to get the following estimated model:

$$\Delta(\ln R_APCE) = 0.008\ 764 + 0.737\ 176 \times \Delta(\ln R_ADPI) - 0.099\ 206 \times \Delta(\ln R_APCE(-1)) + 0.069\ 671 \times \Delta(\ln R_ADPI(-1)) - 0.593\ 245 \times \text{ECM}(-1) \quad (6)$$

$$(0.011\ 732) \quad (0.134\ 448) \quad (0.201\ 334) \quad (0.216\ 622)$$

$$(0.235\ 296)$$

$$t \text{ statistical amount } (0.746\ 966) \quad (5.482\ 986) \quad (-0.492\ 742) \quad (0.321\ 627) \quad (-2.521\ 273)$$

$$R^2 = 0.687\ 097; \text{ the adjusted } R^2 = 0.637\ 033; D.W = 1.888\ 872.$$

In the light of model analysis, $\Delta(\ln R_APCE(-1))$ and $\Delta(\ln R_ADPI(-1))$ do not pass the significance test. Putting aside the two variables, the new model is established as follows:

$$\Delta(\ln R_APCE) = C(1) + C(2) \Delta(\ln R_ADPI) + C(3) \text{ECM}(-1) + u_t \quad (7)$$

$$\text{We use EVIEWS 6.0 and OLS to get following estimated model: } \Delta(\ln R_APCE) = 0.002\ 103 + 0.860\ 623 \Delta(\ln R_ADPI) - 0.638\ 722 \times \text{ECM}(-1) \quad (8)$$

$$(0.007\ 661) \quad (0.088\ 170) \quad (0.181\ 493)$$

$$t \text{ statistical amount } (0.274\ 473) \quad (9.760\ 972) \quad (-3.519\ 276)$$

$$R^2 = 0.819\ 877; \text{ the adjusted } R^2 = 0.807\ 011; D.W = 2.001\ 003; F = 63.724\ 57. \text{ Error correction model describes the balanced error exerting short-term dynamic impact on consumption per capita.}$$

From (7), the error correction model reflects the short-term dynamic relationship between $\ln(R_ADPI_t)$ and $\ln(R_APCE_t)$. In the light of short-term dynamic changes, the variation of discretionary income per capita of residents in this period shows prominent impact on the variation of consumption per capita, namely when the discretionary income per capita of residents in this period is increased by 1%, the consumption in this period will be increased by 0.860 623%. The error correction coefficient is $-0.638\ 722$, indicating that long-term balanced tendency error correction item plays the role of strong reverse regulation in adjusting consumptive expenditure. The t statistical value of explanatory variables of error correction model can pass significance test, and the goodness of fitting is good, reaching 0.819 877. So the conclusion is unquestionable. Fig. 3 shows these characteristics.

4 Conclusion and suggestions

4.1 Conclusion

(1) From the estimated empirical model (3), we know that there is co-integration relationship between urban residents' discretionary income per capita of Hunan Province and con-

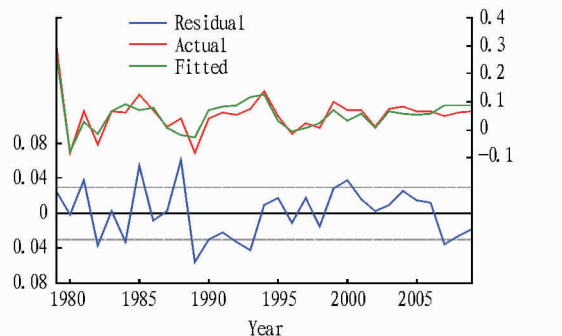


Fig.3 The residual sequence of ECM model and the sequence of the actual value and the fitted value of $\ln(RAPCE)$

sumptive expenditure per capita after taking logarithm from 1978 to 2009. The model shows that the consumption per capita of urban residents in Hunan Province hinges on discretionary income per capita greatly. The long-term elasticity of consumption per capita on discretionary income per capita is 0.892 013.

(2) From error correction model (8), if the discretionary income per capita of urban residents in Hunan Province changes 1%, the consumption per capita changes 0.860 623%, which indicates that consumption per capita of urban residents in Hunan Province has high sensitivity over the discretionary income per capita. Error correction model demonstrates that the deviation of the long-term balanced relationship between consumption per capita of urban residents in Hunan Province and the discretionary income per capita can be corrected in the next period.

4.2 Suggestions The economic connotation, reflected by using error correction model, meets the strategic need of expanding domestic need in China. Increasing discretionary income per capita is the primary prerequisite, but we must also give attention to two or more things. The specific suggestions are as follows.

4.2.1 Open widely the income channel of urban residents. We should reinforce the financial market regulation in Hunan Province, promote financial innovation continuously, and expand financial investment implement; we should guide the residents of Hunan Province to transform from inflation-proof deposits to investing and financing step by step, we can obtain dividend and capital earnings by investing securities and investing insurance; we should actively create good environment of entrepreneurship, and encourage the urban residents to get more income by using multi-channels; we should strengthen the degree of wage reform, and elevate the percentage of labor income in the total income of whole province; we should stren-

gthen the degree of governmental transfer defrayal.

4.2.2 Create good environment of consumption. Firstly, we should reinforce the degree of executing law of administrative departments of business and technological supervision in whole province, and regulate and normalize the circulation order of commodity; secondly, we should reinforce the role of consumer association in order to protect the licit right of consumers vigorously; thirdly, we should broaden consumption credit business with might and main, and expand the scale of consumption credit in order to change the potential demand into realistic consumption; fourthly, we should ameliorate the service quality of monopoly industry and crush the commercial behavior of profiteering; finally, we should guide the transformation of urban residents' consumption structure step by step.

4.2.3 Perfect social security system. As for the social security system, endowment insurance, basic medical insurance, unemployment insurance, injury insurance and comprehensive social insurance and other system involving the interests of urban residents in Hunan Province, we should conduct comprehensive and up-to-date reform and solve the worries of urban residents.

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