Determination on the Demand Level of Rural Resident's Basic Pension Based on the Extended Linear Expenditure System Model

Cao Wenxian

Department of Economic and Management
Xiangnan University
Chenzhou, China
e-mail: caowenxian103@163.com

Abstract ——By using extended linear expenditure model，this paper calculates per capita basic living demand expenditure of China's rural residents from 2004 to 2011 and forecasts the moderate demand level of rural basic pension from 2012 to 2020 on this basis. The conclusion thinks that the addition of both the minimum food and clothing should be treated as the upper limit of the basic pension after the minimum food demand expenditure has been provided at this stage. It suggests to improve properly rural basic pension standard before the end of the "Twelfth Five-Year Plan " and establish the linkage mechanism of basic pension linked to rural residents' income and the lowest living standard of rural residents.

Keywords- the new rural social pension insurance;extended linear expenditure model;basic pension

I. INTRODUCTION

With the pilot and full open of the new rural social pension insurance in China's rural areas, the provisions for the farmers'old-age security level from the basic pension standard of the system has become the focus of attention of many scholars.The research of scholars laid a solid theoretical foundation for further study of the rural pension insurance system and broadened the perspective of financial support for rural social pension insurance. But the current research are limited to static angle in the majority and can analyze from the perspective of dynamic less.The integarated research of specific calculation and analysis based on practical pension demand level of the rural elderly and the future development trend of the demand level are more a lack of. Therefor, this paper analyzes the demand level of rural resident's basic pension from the dynamic perspective on the basis of existing research results and provides empirical support for the study of the moderate level of the basic pension. In view of China put forward to build comparatively well-off society until 2020, the specific objectives of urban and rural residents covered by the social security system should also be fully implemented when the time comes. At the same time the prediction results is relatively convincing from now until 2020. Thus, this study's time is to 2020 in the analysis．

II. DETERMINATION ON THE DEMAND LEVEL OF THE RURAL ELDERLY'S BASIC PENSION

The basic pension of the new rural social pension insurance belongs to nature of the GSP. Thus, it should be able to meet the basic living demand of the rural elderly and reach the minimum security standards of the rural elderly living at least. China mainly put the residents'living consumption goods into food, clothing, housing, household equipment, transportation and communication, education and entertainment, health care, other commodities. Therefor, the minimum living security standard consists of the lowest food demand expenditure and the lowest non-food demand.The latter includes clothing, housing, household equipment, transportation and communication, education and entertainment, health care, other commodities. The lower limit for moderate level of the basic pension from the new rural social pension insurance should be the minimum food demand expenditure and meet the most basic needs for survival. The upper limit should add the minimum food and non-food expenditure demand together and the expenditure determines the basic daily life consumption level and meet the most basic living needs of the highest level. In order to analyze the demand level of future annual basic pension, The following contents forecast future annual net income of rural residents．

A. Forcasting future annual per capita net income of rural residents

This paper forcasts per capita net income of rural residents relying on the polynomial curve trend extrapolation. We can use trend extrapolation to do a forcast when the forecasted object presents some upward or downward trend with time change, no obvious seasonal fluctuation, and a suitable function curves reflecting this trend can be found.

we can see that per capita net income of China's rural residents is showing a rising trend with time change and no obvious seasonal fluctuation from Fig. 1. We can establish a trend model $\hat{Y_t} = f(t)$ by using the time t as independent variables and time series value Y as the dependent variable．
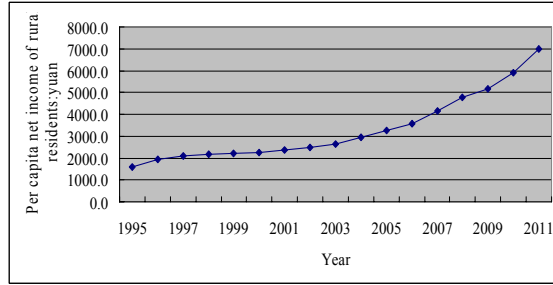
Figure 1. The original data curve figure about per capita net income of China's rural residents from 1995 to 2011.

This paper decides to adopt the 4 polynomial prediction model after the fitting and recognition of the growth curve for the sample data. This trend equation as follows：

$$\hat{Y}_t = a_0 + a_1 t + a_2 t^2 + a_3 t^3 + a_4 t^4 \qquad (1)$$

a_0 , a_1 , a_2 , a_3 and a_4 is undetermined in the formula.

We can find out the model parameters by least square method if we do a linear transformation to the trend equation:

a_0 =1268.7, a_1 =432, a_2 =-75, a_3 =5.9, a_4 =-0.11.

The trend equation as follows：

$$\hat{Y}_t = 1268.7 + 432t - 75t^2 + 5.9t^3 - 0.11t^4$$

the coefficient of determination is 97.79%, it shows that the model has higher fitting. Significance F is equal to 6.36×10^{-16} ,if we assume that the significance level α is equal to 0.05. This indicates that the model is very significant. T test of parameters estimation value can pass and have a good significance. We can forcast per capita net income of China's rural residents from 2012 to 2020 through computering(they can be seen from table Ⅰ).

TABLE1 THE RESULTS OF 4 POLYNOMIAL TREND EXTRAPOLATION ABOUT PER CAPITA NET INCOME OF CHINA'S RURAL RESIDENTS FROM 1995 TO 2020 UNIT:YUAN

year	t	actual value	predicted value	year	t	actual value	predicted value
1995	1	1577.7	1631.5	2008	14	4760.6	4580.5
1996	2	1926.1	1878.1	2009	15	5153.2	5217.5
1997	3	2090.1	2040.1	2010	16	5919.0	5938.1
1998	4	2162.0	2146.1	2011	17	6977.3	6737.1
1999	5	2210.3	2222.5	2012	18		7606.1
2000	6	2253.4	2292.5	2013	19		8534.5
2001	7	2366.4	2377.3	2014	20		9508.7
2002	8	2475.6	2494.9	2015	21		10512.7
2003	9	2622.2	2661.1	2016	22		11527.7
2004	10	2936.4	2888.7	2017	23		12532.5
2005	11	3254.9	3188.1	2018	24		13502.9
2006	12	3587.0	3566.9	2019	25		14412.5
2007	13	4140.4	4030.3	2020	26		15231.7

B. Determination on the demand level of the rural elderly basic pension

This study do an econometric analysis to the demand level of the rural elderly basic pension using extended linear expenditure model.The model is put forward by the economist Luch in 1973. It as follows:

$$C_i = \alpha_i + \beta_i Y \qquad (2)$$

$$\alpha_i = P_i Q_i - \beta_i \sum_{i=1}^{n} P_i Q_i \qquad (3)$$

C_i indicates real consumption expenditure of i kinds of commodities for a consumer. P_i indicates the price of i kinds of commodities. Q_i indicates the basic demand of i kinds of commodities. Y indicates disposable personal income. β_i indicates marginal propensity to consume and $0 < \beta_i < 1$. For cross-section data, $P_i Q_i$ and $\sum_{i=1}^{n} P_i Q_i$ in the model are constants．

For the i sum from (3) on both sides,this can be obtained：

$$\sum_{i=1}^{n} P_i Q_i = \frac{\sum_{i=1}^{n} \alpha_i}{\left(1 - \sum_{i=1}^{n} \beta_i\right)} \qquad (4)$$

Further,this can be obtained by (3) and (4)：

$$P_i Q_i = \alpha_i + \beta_i \frac{\sum_{i=1}^{n} \alpha_i}{\left(1 - \sum_{i=1}^{n} \beta_i\right)} \qquad (5)$$

By using the least square method, α_i and β_i can be obtained by (2),Then, $P_i Q_i$ that indicates the basic demand expenditure of i kinds of commodities for a consumer can be obtained by (5).Finally， $\sum_{i=1}^{n} P_i Q_i$ that indicates the addition of the basic demand expenditure from all goods for a consumer can be obtained.

This study do a regression analysis to the cross section data for consumption expenditure of rural residents in all provinces (city,area) by using the expenditure respectively food,clothing,housing,household equipment，transportation and communication, education and entertainment, health care, other commodities expenditure as the dependent variable and the per capita net income as the independent variable In 2012 the "China Statistical Yearbook".

TABLE2 THE PARAMETER ESTIMATE ABOUT THE PER CAPITA BASIC LIVING DEMAND EXPENDITURE INDEX OF CHINA'S RURAL RESIDENTS IN 2011.

article	α_i	Pr ob	β_i	Pr ob	R^2	P_iQ_i
food	566.6	0.0016	0.218	0.0000	0.80	1007.59
clothing	29.2	0.5066	0.046	0.0000	0.71	122.25
housing	201.2	0.0586	0.108	0.0000	0.72	419.67
household equipment	35.6	0.2754	0.037	0.0000	0.75	110.45
transportation and communication	-54.5	0.3071	0.086	0.0000	0.86	119.47
education and entertainment	-81	0.1772	0.068	0.0000	0.75	56.56
health care	41.5	0.4550	0.056	0.0000	0.70	154.78
other commodities	-4.3	0.7405	0.018	0.0000	0.81	32.11
$\sum$	734.3		0.637			2022.88

R^2 Value in table Ⅱ show that per capita net income is a significant factor affecting the consumption expenditure of all kinds of goods. But for α_i, that of other expenditures were not significant in addition to $_{\mathrm{Pr}\,ob}$ of food if we assume that the significance level is equal to 0.05．Thus，it will reduce the credibility of the basic demand expenditure of the corresponding commodity calculated. In order to solve this problem, this study revised extended linear expenditure model to make the results more in line with the actual situation. assuming the constant term of m kinds of commodities is not significant when doing a regression analysis using (2)We assume that α_i of the estimating equations are not significant and β_i of the estimating equations significant for former m kinds of commodities while both α_i and β_i of the estimating equation for other commodities significant($i=1,2,\ldots,m$) [1] .

Firstly，we can get the value of β_i if we do a new estimation to the equations for former m kinds of commodities while α_i =0.We can get following m equations according to (3) while α_i=0 and i =1,2,…, m :

$$0 = P_iQ_i - \beta_i \sum_{k=1}^{m} P_kQ_k - \beta_i \sum_{j=m+1}^{n} P_jQ_j, \quad \text{while } i=1,2,\ldots,m$$

For the i sum from the above formula on both sides, this can be obtained:

$$0 = \sum_{k=1}^{m} P_kQ_k - (\sum_{k=1}^{m} \beta_k) \sum_{k=1}^{m} P_kQ_k - (\sum_{k=1}^{m} \beta_k) \sum_{j=m+1}^{n} P_jQ_j$$

Solution to:

$$\sum_{k=1}^{m} P_kQ_k = (\sum_{k=1}^{m} \beta_k) \frac{\sum_{j=m+1}^{n} P_jQ_j}{(1 - \sum_{k=1}^{m} \beta_k)}$$

If it is substituted into (3), the basic demand expenditure of former m kinds of commodities are calculated as:

$$P_iQ_i = \beta_i \frac{\sum_{j=m+1}^{n} P_jQ_j}{(1 - \sum_{k=1}^{m} \beta_k)} \tag{6}$$

The basic demand expenditure of later $n-m$ kinds of commodities can be calculated by (5). Thus, If we do origin regression to the estimating equations that their α_i are not significant, we can calculated the basic demand expenditure for these commodities according to the formula (6). While the basic demand expenditure for those commodities that α_i of their estimating equations are significant can be get through doing the regression analysis with (2) and using (5) computing. The results are shown in Table Ⅲ.It can be seen that significant degree of β_i is greatly improved and goodness of fit for each equation is also greatly enhanced after a new analysis is done．

TABLE3 THE MODIFIED PARAMETER ESTIMATE ABOUT THE PER CAPITA BASIC LIVING DEMAND EXPENDITURE INDEX OF CHINA'S RURAL RESIDENTS IN 2011.

article	α_i	Pr ob	β_i	Pr ob	R^2	P_iQ_i
food	566.6	0.0016	0.218	0.0000	0.80	927.77
clothing			0.049	0.0000	0.95	81.18
housing			0.132	0.0000	0.96	218.69
household equipment			0.042	0.0000	0.96	69.58
transportation and communication			0.08	0.0000	0.97	132.54
education and entertainment			0.058	0.0000	0.94	96.09
health care			0.061	0.0000	0.95	101.06
other commodities			0.018	0.0000	0.97	29.82
$\sum$	566.6		0.659			1656.73

We can also get the results in Table Ⅳ. T test of parameters estimation value for the corresponding α_i and β_i can pass and have a good significance for each equation. Hence, we can get the per capita basic living demand expenditure of China's rural residents from 2004 to 2011(They can be seen from Table Ⅴ). We can see that at present the basic pension standard of 660 yuan per person per year is difficult to meet the basic demand of farmers old-

age and need to make appropriate adjustments.Through calculation, the minimum food demand expenditure accounting for the proportion of per capita net income of rural residents for the same year from 2004 to 2011 is respectively 19.67%, 19.32%，16.28%, 16.01%, 15.2%, 14.56%，14.75% and 13.29% and the annual average value is 16.14%.Clothing expenditure accounting for the proportion of per capita net income of rural residents for the same year from 2004 to 2011 is respectively 1.39%, 1.38%, 1.34%, 1.22%, 1.07%, 1.22%, 1.14% and 1.16% and the annual average value is 1.24%.All the basic living demand expenditure accounting for the proportion of per capita net income of rural residents for the same year from 2004 to 2011 is respectively 33.9%, 30.15%, 28.42%, 26.04%, 23.95%, 26.68%, 25.93% and 23.74% and the annual average value is 27.35%. If we measure the moderate level of rural basic pension with the minimum food demand expenditure or the addition of both the minimum food demand expenditure and the minimum non-food demand expenditure accounting for the proportion of per capita net income of rural residents for the same year, this index shows a decreasing trend. One of the important reasons is that the Engel coefficient is declining as per capita net income of rural residents increase. Accordingly，if finance pay the basic pension according to the actual value of the proportion, which means that the pension income of rural elderly could be completely excluded in economic growth, especially the decreasing lower limit is not conducive to social harmony and stability. Thus, the minimum standard for the moderate level of rural basic pension should be set. Looking from the existing research，the moderate level of the substitution rate for China's pension should be maintained at 40% and 60%[2]. The reasonable urban basic pension substitution rate is between 20% and 30%[3].Therefore, reasonable GSP pension substitution rate is between 20% and 30%.After comprehensive consideration, this study set a standard for the moderate level of China's pension from 2012 to 2020:the lower limit accounting for 15% of per capita net income of rural residents for the same year and the upper limit 25% of per capita net income of rural residents for the same year.

According to per capita net income of rural residents in table Ⅰ ,we can calculate the moderate level of rural residents pension demand from 2012 to 2020.The results are shown in Table Ⅵ. Among them, the minimum food expenditure of the rural elderly or say the lower limit of per capita rural basic pension demand level increase from 1140.91 yuan in 2012 to 2284.76 yuan in 2020 and the will decline to 28.8% and that of the basic living demand

expenditure addition of both the minimum food and non-food demand or say the upper limit of per capita rural basic pension demand level increase from 1901.52 yuan in 2012 to 3807.93 yuan in 2020.

III.   CONCLUSION

According to the results in Table Ⅴ，We can calculate that the standard of 660 yuan per person per year accounting for the proportion of the minimum food expenditure of the rural elderly for the same year from 2009 to 2011 is respectively 87.9%, 75.6% and 71.1% and the proportion of the basic living demand expenditure of the rural elderly for the same year 47.9%, 42.9% and 39.8%.This propration played a great role for alleviating rural old-age poverty in the initial implementation of the system.However，if the payment level unchanged, Through the results in Table Ⅵ，we can calculate that it accounting for the proportion of the minimum food expenditure of the rural elderly in 2020 expenditure of the rural elderly 17.3% in 2020．By then, it will be difficult to effectively play an important role in supporting the basic living of the rural elderly. Therefore，the basic pension should be increased from a long-term perspective. While in the moderate level, the minimum food expenditure of the rural elderly will be satisfied at least. Considering the financial payment beneficial to many people's livelihood, it can properly reduce the upper benefit amount at this stage. As if the addition of both the minimum food and clothing should be treated as the upper limit of the basic pension after the minimum food demand expenditure has been provided. It suggests to improve properly rural basic pension standard before the end of the "Twelfth Five-Year Plan" and establish the linkage mechanism of basic pension linked to rural residents' income and the lowest standard of rural residents living.

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TANLE4 THE MODIFIED PARAMETER ESTIMATE ABOUT THE PER CAPITA BASIC LIVING DEMAND EXPENDITURE INDEX OF CHINA'S RURAL RESIDENTS FROM 2004 TO 2010.

year	parameter	food	clothing	housing	household equipment	transportation and communication	education and entertainment	health care	other commodities
2004	α_i	359.54							
	β_i	0.219	0.041	0.121	0.033	0.071	0.089	0.049	0.016
	R^2	0.73	0.95	0.91	0.93	0.94	0.95	0.91	0.91
2005	α_i	408.19			-46.16	-61.73			
	β_i	0.225	0.046	0.118	0.048	0.093	0.093	0.054	0.017
	R^2	0.75	0.96	0.95	0.83	0.92	0.95	0.93	0.92
2006	α_i	344.39				-35.42			
	β_i	0.235	0.047	0.132	0.036	0.089	0.086	0.055	0.017
	R^2	0.77	0.96	0.95	0.94	0.94	0.95	0.95	0.95
2007	α_i	419.1					-83.7		
	β_i	0.226	0.047	0.139	0.035	0.080	0.092	0.052	0.018
	R^2	0.75	0.95	0.93	0.96	0.98	0.81	0.94	0.93
2008	α_i	460.58							
	β_i	0.231	0.045	0.135	0.036	0.077	0.084	0.054	0.015
	R^2	0.76	0.95	0.95	0.96	0.98	0.80	0.94	0.96
2009	α_i	440.03							
	β_i	0.226	0.046	0.146	0.038	0.082	0.069	0.057	0.016
	R^2	0.83	0.95	0.95	0.96	0.97	0.93	0.91	0.96
2010	α_i	558.8							
	β_i	0.205	0.044	0.138	0.036	0.081	0.064	0.053	0.015
	R^2	0.82	0.95	0.96	0.96	0.95	0.94	0.93	0.97

TABLE5 THE CALCULATION TABLE ABOUT THE PER CAPITA BASIC LIVING DEMAND EXPENDITURE OF CHINA'S RURAL RESIDENTS FROM 2004 TO 2011 UNIT:YUAN

year	food	clothing	housing	household equipment	transportation and communication	education and entertainment	health care	other commodities	Σ
2004	577.65	40.83	120.50	32.87	70.71	88.64	48.80	15.94	995.94
2005	629.00	45.14	115.8	0.95	29.54	91.27	53.00	16.68	981.37
2006	584.02	47.93	134.6	36.71	55.33	87.69	56.08	17.33	1019.7
2007	662.83	50.69	149.90	37.75	86.28	15.52	56.08	19.41	1078.46
2008	724.06	51.33	153.98	41.06	87.82	3.64	61.59	17.11	1140.59
2009	750.8	63.25	200.76	52.25	112.76	94.88	78.38	22.00	1375.08
2010	873.51	67.55	211.85	55.27	124.35	98.25	81.36	23.03	1535.17
2011	927.77	81.18	218.68	69.58	132.54	96.09	101.06	29.82	1656.73

TABLE6 THE MODERATE LEVEL OF RURAL BASIC PENSION FROM 2012 TO 2020 UNIT:YUAN

standard	2012	2013	2014	2015	2016	2017	2018	2019	2020
The lower limit	1140.91	1280.18	1426.31	1576.91	1729.16	1879.88	2025.44	2161.88	2284.76
The upper limit	1901.52	2133.63	2377.18	2628.18	2881.93	3133.13	3375.73	3603.13	3807.93