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Research on Rural Consumer Demand in Hebei Province Based on Principal Component Analysis

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Abstract By selecting the time sequence data concerning influencing factors of rural consumer demand in Hebei Province from 2000 to 2010, this paper uses the principal component analysis method in multiplex econometric statistical analysis, constructs the principal component of consumer demand in Hebei Province, conducts regression on the dependent variable of consumer spending per capita in Hebei Province and the principal component of consumer demand so as to get principal component regression, and then conducts quantitative and qualitative analysis on the principal component. The results show that total output value per capita (yuan), employment rate, and income gap, are correlative with rural residents' consumer demand in Hebei Province positively; consumer price index, upbringing ratio of children, and one-year interest rate are correlative with rural residents' consumer demand in Hebei Province negatively; the ratio of supporting the elderly and medical care spending per capita are correlative with rural residents' consumer demand in Hebei Province positively. The corresponding countermeasures and suggestions are put forward to promote residents' consumer demand in Hebei Province as follows: develop county economy in Hebei Province and increase rural residents' consumer demand; use industry to support agriculture and coordinate urban-rural development; improve rural medical care and health system and resolve actual difficulties of the masses.

Key words Consumer demand, Principal component analysis, Regression analysis, Hebei Province, China

Due to the profound influence of international financial crisis, consolidating the achievements and confronting the brunt of international financial crisis is an important task in the Twelfth Five-year Plan period. Sticking to the strategy of expanding domestic demand, especially the residents' consumer demand, is a longstanding strategic guideline of China. Fully exploiting the enormous potential of China's domestic demand is the key to promoting long-term, steady and healthy development of China's economy. Therefore, for China, such developing country, the most principal force of promoting economic growth is still the domestic demand, while an important measure of expanding domestic demand is to stimulate domestic consumption. As rural resident is a gargantuan consumption group, the improvement of rural residents' consumption level and expansion of rural consumption market are the necessary choices of expanding domestic demand in China.

On the basis of the researches of predecessors, by using quantitative analysis method and qualitative method, we conduct research on influencing factors of rural consumer demand in Hebei Province, in order to explore the constraint factors of expansion of rural residents' consumer demand in Hebei Province. We further propose corresponding countermeasures and suggestions, in order to expand consumer demand and promote economic development.

1 Variable selection, data source and model selection

1.1 Variable selection Amid considerable factors that affect

consumer demand, there are qualitative factors and quantitative factors. According to existing theories and literatures^[1-2], this paper summarizes the factors as seven aspects, and introduces the function mechanism of factors that affect consumer demand.

1.1.1 Residents' income. In general, residents' income level is correlative with consumer demand positively. As incomes rise, consumption level will also increase. According to identical equation of national economy, the income is mainly used for consumption and saving, therefore, the income level is an important factor affecting the consumption. This paper selects total output value per capita of the rural residents in Hebei Province to quantify the influencing factor of residents' income.

1.1.2 Distribution status. The low-income residents have relatively high average propensity to consume, while the high-income residents have relatively low average propensity to consume. Thus, the equilibrium of propensity to consume can be conducive to promoting consumption level. This income gap in this paper is denoted by the ratio of the disposable income of urban residents in Hebei Province and the net income per capita of rural residents, and the greater the ratio, the greater the income gap.

1.1.3 Price level and price expectation. In general, consumer spending has a negative correlation with the price level. Significant change of prices will cause significant change of consumers' purchase amount (the demand elasticity of this commodity is normal). Moreover, people will have their own expectations on changes of the price, and change consumer spending decisions, according to their own expectations on changes of the price. If the expected price level rises, the consumers will increase the consumer spending at the time in order to avoid future losses of consumer spending; if the expected

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price level declines, the consumers will decrease the consumer spending at the time in order to increase savings. In this paper, the consumer price index is to represent the general price level.

1.1.4 Employment rate. In general, if the employment rate declines, the income of residents will decrease, and it will reduce consumer spending of residents; if the employment rate increases, the income of residents will increase, and it will increase consumer spending of residents.

1.1.5 Upbringing coefficient. Upbringing coefficient equals upbringing coefficient of children and supporting coefficient of the elderly. In theory, the size of upbringing coefficient is correlative with consumer spending negatively. Because children need to consume the wealth created by other family members so that it is used for survival, education and training of labor skills. The elderly lose the ability to work and they also need to consume the wealth created by other family members.

1.1.6 Social security system status. Sound social pension insurance, unemployment insurance, and other social security system, are the stabilizer of society, which can enhance the living security of residents, and decrease the monetary demand arising from the precautionary motive, so that the consumption of residents is increased. Due to the imperfect social security system in rural areas, we select medical care spending per capita to reflect the impact of it on consumer demand.

1.1.7 Interest rate level. In general, if the level of interest rates rises, people will reduce consumption; if the level of interest rates declines, people will increase consumption. In this paper, we use one-year interest rate of savings to represent the interest rate factor.

The dependent variable we select in the process of establishing model is the level of consumer spending per capita in Hebei Province (Y), and the interdependent variables are as follows: total output value per capita (X_1), urban-rural income gap (X_2), consumer price index of residents (X_3), employment rate (X_4), upbringing ratio of children (X_5), the ratio of supporting the elderly (X_6), medical care spending per capita (X_7), and one-year interest rate of savings (X_8).

1.2 Data source This data comes from *Hebei Province Rural Economic Yearbook* from 2000 to 2010^[3], *China Statistical Yearbook* of the relevant years compiled by the National Bureau of Statistics of China^[4], one-year RMB benchmark interest rates of financial institutions in the relevant years released by People's Bank of China, and online data.

1.3 Model selection-principal component analysis By means of coordinate transformation, principal component analysis is to conduct linear transformation on original p relevant variables (x_i), and transform it into another group of irrelevant variables (y_j), and they can be expressed as follows:

$$\begin{cases} y_1 = u_{11}x_1 + u_{21}x_2 + \cdots + u_{p1}x_p \\ y_2 = u_{12}x_1 + u_{22}x_2 + \cdots + u_{p2}x_p \\ \cdots \\ y_p = u_{1p}x_1 + u_{2p}x_2 + \cdots + u_{pp}x_p \end{cases}$$

$y_1, y_2, y_3 \cdots y_p$ is the first, second, third... p th principal component of original variable. Wherein, the proportion of y_1 in total variance is biggest, and y_1 has the strongest ability to integrate

original variables. The proportion of the other principal components in total variance decreases progressively, that is, the ability to integrate original variables weakens successively. The principal component analysis is to choose the front principal components with biggest variance, thus it achieves the goal that there are few variables in factor analysis, and meanwhile it can reflect most of the information of original variables by few variables.

In actual analysis, we should have a clear understanding of the connotation of factor variable. We can rotate the factor matrix to have a clear understanding of the connotation of factor variable. The final step is to calculate the score of factors. After determining factor variable, as for each sample data, we wish to get the specific numerical value in different factors. These numerical values are the scores of factors, which corresponds to the scores of original variables. If we have scores of factors, we can carry out the future research by using the scores of factors with few dimensions^[2].

2 Results and analysis

Now we use the sample data from 2000 to 2010, and SPSS statistical software to conduct principal component analysis. The execution results can be seen in Table 1.

In the light of the correlation matrix in Table 1, most of the correlation coefficients of all variables are greater than 0.3, and they are suitable for factor analysis.

As can be seen in Table 2, the front two factors contain 87.649% information. According to the principle of cumulative contribution rate $\geq 85\%$ and the extraction principle of the default system in this software, when extracting the factors with eigenvalue greater than 1, we should extract the front two factors as principal components to take the place of 8 original variables.

According to Table 3, we know that the expressions of two principal components are as follows:

Component 1 = $0.986X_1 + 0.937X_2 + 0.920X_3 + 0.254X_4 - 0.964X_5 + 0.797X_6 + 0.981X_7 + 0.124X_8$

Component 2 = $0.090X_1 - 0.238X_2 - 0.002X_3 - 0.841X_4 + 0.113X_5 + 0.464X_6 - 0.016X_7 + 0.842X_8$, where, total output value per capita- X_1 , urban-rural income gap- X_2 , consumer price index of residents- X_3 , employment rate- X_4 , upbringing ratio of children- X_5 , the ratio of supporting the elderly- X_6 , medical care spending per capita- X_7 , one-year interest rate of savings- X_8 .

As the denomination and explanation of load matrix of initial factor towards factors are not prominent, it is difficult to name the front two factors we have extract, so we conduct maximized rotation of variance, and the load matrix after rotation can be seen in Table 3.

From Table 3, we know that in Component 1, the load of total output value per capita, urban-rural income gap, consumer price index of residents, upbringing ratio of children, the ratio of supporting the elderly, and medical care spending per capita is greater than the load of one-year interest rate of savings and employment rate, so Component 1 is mainly reflected by

the six variables of total output value per capita, urban-rural income gap, consumer price index of residents, upbringing ratio of children, the ratio of supporting the elderly, and medical care spending per capita, denoted by Z_1 ; in Component 2, the load of one-year interest rate of savings and employment rate is greater than the load of total output value per capita, urban-ru-

ral income gap, consumer price index of residents, upbringing ratio of children, the ratio of supporting the elderly, and medical care spending per capita, so Component 2 is mainly reflected by two variables of one-year interest rate of savings and employment rate, denoted by Z_2 . Then we get: $C = 0.663 \times Z_1 + 0.214 \times Z_2$.

Table 1 The correlation matrix of sample variables from 2000 to 2010

Variable	Total output value per capita	Income gap	Consumer price index	Employment rate	Upbringing ratio of children	The ratio of supporting the elderly	Medical care spending per capita	One-year interest rate
Total output value per capita	1.000	0.921	0.889	0.161	-0.924	0.855	0.945	0.170
Income gap	0.921	1.000	0.838	0.406	-0.898	0.655	0.896	-0.114
Consumer price index	0.889	0.838	1.000	0.132	-0.872	0.623	0.938	0.064
Employment rate	0.161	0.406	0.132	1.000	-0.408	-0.182	0.243	-0.451
Upbringing ratio of children	-0.924	-0.898	-0.872	-0.408	1.000	-0.684	-0.947	-0.110
The ratio of supporting the elderly	0.855	0.655	0.623	-0.182	-0.684	1.000	0.749	0.410
Medical care spending per capita	0.945	0.896	0.938	0.243	-0.947	0.749	1.000	0.097
One-year interest rate	0.170	-0.114	0.064	-0.451	-0.110	0.410	0.097	1.000

Table 2 Explained total variance

Component	Initial eigenvalue			Extract quadratic sum load			Rotate quadratic sum load		
	Total	Variance percentage//%	Accumulation percentage//%	Total	Variance percentage//%	Accumulation percentage//%	Total	Variance percentage//%	Accumulation percentage//%
1	5.302	66.280	66.280	5.302	66.280	66.280	5.302	66.272	66.272
2	1.710	21.369	87.649	1.710	21.369	87.649	1.710	21.377	87.649
3	0.544	6.805	94.454						
4	0.300	3.749	98.203						
5	0.083	1.035	99.238						
6	0.031	0.393	99.631						
7	0.024	0.303	99.933						
8	0.005	0.067	100.000						

Table 3 The matrix of component after rotation

Variable	Component	
	1	2
Total output value per capita	0.987	0.077
Income gap	0.934	-0.250
Consumer price index	0.920	-0.014
Employment rate	0.243	-0.844
Upbringing ratio of children	-0.962	0.126
The ratio of supporting the elderly	0.803	0.453
Medical care spending per capita	0.980	-0.029
One-year interest rate	0.135	0.841

From the above formula, we know that the primary principal factor affecting rural residents' consumer demand in Hebei Province is Z_1 , and secondary principal factor affecting rural residents' consumer demand in Hebei Province is Z_2 .

We name Z_1 as income influencing factors, and name Z_2 as social influencing factors.

We calculate the coefficients in the auto-regression of standardized independent variables, so as to get the regression equation denoted by standardized independent variables. According to matrix which is composed of the coefficient vectors of the two front principal components, and the estimation value of regression coefficient vector of principal component, we get:

$$\begin{pmatrix} 0.986 & 0.090 \\ 0.937 & -0.238 \\ 0.920 & -0.022 \\ 0.254 & -0.841 \\ -0.964 & 0.113 \\ 0.797 & 0.464 \\ 0.981 & -0.016 \\ 0.124 & 0.842 \end{pmatrix} \begin{pmatrix} 0.663 \\ 0.214 \end{pmatrix} = \begin{pmatrix} 0.673 \\ 0.570 \\ -0.610 \\ 0.012 \\ -0.615 \\ 0.628 \\ 0.647 \\ -0.262 \end{pmatrix}$$

The regression equation denoted by standardized independent variables is as follows: $C = 0.673x_1 + 0.570x_2 - 0.610x_3 + 0.012x_4 - 0.615x_5 + 0.628x_6 + 0.647x_7 - 0.262x_8$.

3 Conclusion and suggestions

3.1 Conclusion As can be seen from the regression equation, amid the factors that affect rural residents' consumption in Hebei Province, total output value per capita (yuan), employment rate, income gap, the ratio of supporting the elderly and medical care spending per capita are correlative with rural residents' consumer demand in Hebei Province positively; consumer price index, upbringing ratio of children, and one-year interest rate are correlative with rural residents' consumer demand in Hebei Province negatively.

First, total output value per capita (yuan), employment

rate, income gap are correlative with rural residents' consumer demand in Hebei Province positively. Moreover, when the variable value increases by 1%, the consumer demand will increase by 67.3%, 1.2% and 57% respectively. It shows that with the increase of income and increase of employment rate, the rural residents' consumption will increase. In the mean time, as the income level in rural areas is lower than the income level in urban areas, so the rural residents have relatively high propensity to consume.

Second, consumer price index, upbringing ratio of children, and one-year interest rate are correlative with rural residents' consumer demand in Hebei Province negatively. Moreover, when the consumer price index, upbringing ratio of children and one-year interest rate increase by 1%, the consumer demand will decrease by 67.3%, 1.2% and 57% respectively, that is, the increase of the consumer price index will reduce the consumption level of rural residents, and the increase of upbringing ratio of children will also reduce the consumption level of rural residents. The income level of rural residents is relatively low, while upbringing spending of children is relatively high, especially the educational expenditure, so the households with high ratio of upbringing of children have relatively low consumer demand. Relatively high interest rates will also make rural residents increase savings and reduce consumer demand.

Third, the ratio of supporting the elderly and medical care spending per capita, are correlative with rural residents' consumer demand in Hebei Province positively. If the ratio of supporting the elderly and medical care spending per capita increase by 1%, the consumer demand will increase by 62.8% and 64.7% respectively.

3.2 Countermeasures and suggestions Based on the analysis of influencing factors of rural residents' consumer spending in Hebei Province, in order to expand the consumer demand in rural areas of Hebei Province, we should give priority to considering the expansion of employment opportunities, and elevate holistic income level of residents; establish and improve the social security system as quickly as possible, and actively guide income expectation and rational consumption of residents; spare no efforts to develop the rural market, improve the consumption environment in rural areas, and exploit the potential of consumption of rural residents. Taking into account the generally low income of farmers in Hebei Province, and large proportion of rural population on total population, increasing rural residents' income has great significance to increasing consumer demand of residents.

3.2.1 Develop county economy in Hebei Province and increase rural residents' consumer demand. The income level of farmers directly determines farmers' ability to pay in consumption market. Currently, the relatively low level of income of rural residents in Hebei Province determines the shortage of consumption ability of rural residents in Hebei Province. Increasing the income of farmers is conducive to the increase of each item of consumer spending. Therefore, developing economy, increasing the income of rural residents and expanding the consumer demand of rural residents are the basic measures to promote the consumption level of rural residents to continue to rise, and to improve consumption structure increasingly^[5].

3.2.2 Use industry to support agriculture and coordinate urban-rural development. We should vigorously expand rural commodity markets, and strengthen using the industry to nurture agriculture; at the same time, we should clearly know that currently the demand of rural areas for industrial products and technology products is showing strong growth trend, and the rural demand is changing towards the demand structure of urban areas. According to the consumer demand of rural market, we should adjust consumption structure, endeavor to expand service-orientated institutions and service markets, strengthen the consumption of health care and transportation and communication in the rural consumer market, speed up the process of constructing small towns in rural areas.

3.2.3 Improve rural medical care and health system and resolve actual difficulties of the masses. Health care spending accounts for small proportion in spending of rural residents, but the increase of per capita health spending rate will increase consumer demand. Sound health care system is the prerequisite to guarantee the gratifying living conditions of farmers, and the necessary requirement of promoting constitution of rural residents. In the mean time, sound health care system can lay foundation for establishing consumption confidence of residents, and resolve actual difficulties of the masses, so that it is conducive to the promotion of consumption. In order to establish and perfect the social security system, we should gradually establish minimum living security system in rural areas, rural old-age security system and rural health care insurance and co-ordination system in rural areas, so that the social security system, with multiplex capital sources, standardized security system and socialization of management service, takes shape^[6]; uncertain expected expenditure of rural residents in the future is reduced; the current consumption of farmers is increased.

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