The Analysis of Limitation of Engel's Coefficient

——A Case Study of Rural Areas in Hebei Province

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Abstract On the basis of introducing relevant theories of Engel's coefficient, this paper analyzes the limitation of these theories in practical application currently in China, for example, continuing to use original theory, not in line with reality of China; comparison invalidity in length and breadth, is not conducive to relevant analysis; culling out the special factors easily causes distortion of conclusion. Taking rural areas in Hebei Province as an example, this paper analyzes the limitation of Engel's coefficient in analyzing the gap of rural economy: in terms of region horizontally, Engel's coefficient neglects the difference of consumption structure among regions, and difference of economic stages among regions; in terms of time vertically, Engel's coefficient neglects the periodic change of consumption structure and the ratio change of different families in different periods. According to the reality of China's rural areas, the correction model of Engel's coefficient is established as follows. Firstly, Engel's coefficient = Percentage of expenditure variation (food + education + medical service)/Percentage of total expenditure variation; Engel's coefficient = Percentage of expenditure variation (food + education + medical service)/Percentage of income variation. Secondly, Engel's coefficient = Percentage of expenditure variation of food/Percentage of variation of (total expenditure educational expenditure-medical expenditure. Thirdly, Engel's coefficient = Percentage of expenditure variation of food/Percentage of total expenditure variation.

Key words Engel's coefficient, Difference of consumption structure, Economic cycle, Comparability, Rural areas in Hebei Province, China

Engel's coefficient is one of the important indicators of measuring people's living standards, which plays an indicative role in China's economic development and formulation of policies. Although Engel's coefficient is of great significance both theoretically and practically in particular region in some period, it has its own certain limitation, thus it is not suitable for measuring urban-rural residents' life standard in some regions. Using simple Engel's coefficient to evaluate statistically the living standard of the rural residents will get distorted results, and the results are distorted even in whole China, because rural areas in China have their own conditions, for example, there is a large proportion of education costs and medical costs in contemporary rural household spending, and even most of rural households slash their food consumption expenditure for education and medical care use. Taking rural areas in Hebei Province as an example, we lay stress on the discussion of limitation and the reason of malfunction of Engel's coefficient in measuring rural residents' life standard in Hebei Province, so that we can find the very indicator that can reflect rural residents' life standard genuinely. Finally we put forward suggestions of correcting Engel's coefficient.

1 Relevant theory of Engel's coefficient and the limitation

1.1 Engel's coefficient and Engel's law Engel's coefficient is a common indicator which is universally used to analyze the living standards of people and poverty degree in a given country or region currently in research field. Engel's coefficient was put forward by a German statistician Engel in the 19th century, according to statistical data. Its formula is as follows: Engel's coefficient (R) = Food consumption expenditure/Total consumption expenditure. The meaning of economic statistic is by calculating the proportion of food consumption expenditure in the total expenditure to approximately measure the actual living standards of people, in order to indirectly reflect the regional economic development. If the Engel's coefficient is high, it indicates that the proportion of the food consumption expenditure in the total expenditure in the region is high, and the corresponding proportion of the expenditure used by people in the higher consumption, education and investment fields is low, so to a certain extent, the living standard of the people is lower, and *vice versa*. It is clear from the formula that the size of the Engel's coefficient is positively correlated with food consumption, but is negatively correlated with the total consumption expenditure.

Engel's law is that the less a family's income, the greater the proportion of expenditure used in food purchasing in household income (or total expenditure); with the increase of household income, the proportion of expenditure used to purchase food in household income (or total expenditure) will be smaller. By extension, the poorer one country or region, the bigger the proportion of expenditure used in food purchasing in average income (or average expenditure) of each people, and as the countries or regions become rich, this proportion will tend to decline. Engel's law mainly describes the trend of the proportion of food expenditure in total consumption expenditure which changes along with income. It reveals the relationship between people's income and food expenditure, and uses the proportion of food expenditure in total consumption expenditure to expound the impact of economic development and income increase on consumption.

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1.2 Application and limitation of Engel's coefficient and Engel's law After Engel's law and Engel's coefficient were put forth, they are widely accepted and recognized by western economic circles and thought to have general applicability. Engel's coefficient is often used internationally to measure living standards of people in a country or region. According to FAO's standard, if the Engel's coefficient is more than 59%, it means poorness; 50% to 59% means that people dress warmly and eat one's fill; 40% to 50% means affluence; 30% to 40% means richness; less than 30% means that the living standard is richest. China also applied Engel's coefficient to the statistical work early, and now in measurement system of the goal of building a comprehensive well-off society put forth by China at present, the Engel's coefficient is as one of 16 indicators of measuring material living standard, whose weight accounts for 7% of the total proportion. Meanwhile, the Engel's coefficient is also one of 10 basic indicators of building a comprehensive well-off society.

Although the Engel's coefficient and the application of Engel's law have certain theoretical significance and practical effect, there are limitations in the process of using the Engel's coefficient and Engel's law to evaluate and measure people's life in China. Simply adopting Engel's coefficient and Engel's law to statistically evaluate the living standard of the rural residents will get distorted results, and the results are distorted even in whole China, because rural areas in China have their own conditions, for example, there is a large proportion of education costs and medical costs in contemporary rural household spending, and even most of rural households slash their food consumption expenditure for education and medical care use. The limitations are analyzed elaborately as follows.

1.2.1 Continuing to use original theory, not in line with reality of China. The Engel's coefficient used in China now is still the most primitive "Engel's coefficient" of western academic circles. The appearance of any kind of theory is closely related with socio-economic status at the time, and the Engel's coefficient is no exception, but today's socio-economic situation has great changes, no matter in residents' income level, people's consumption concept, and the government's economic and market orientation, or abundance degree of commodity in market, compared with that of Europe 150 years ago. Merely by calculating food expenditure to judge social progress or residents' standard of living is inappropriate, and especially in the current socialist China with its own distinctive feature, the theory deviates from reality.

1.2.2 Comparison invalidity in length and breadth is not conducive to relevant analysis. The Engel's coefficient, as a pointer of measuring residents' consumption structure, just reveals the relationship between income and consumption structure at a particular stage, and it is not applicable to the comparison among various regions and among all stages. Economic development has different stages, for example, the stage of development of human society can be divided from the perspective of the marketization as follows: the natural economy devoid of market exchange, early simple commodity economy, initial market-oriented commodity economy, and highly marketized modern market economy. Therefore, in different stages of economic development, people's economic activities have different characteristics, and the degree of dependence of non-survival necessities or survival necessities on market is different in consumption structure. The advancing of Engel's coefficient, in fact, hides one premise of theoretical hypothesis, namely that there is a highly market-oriented society, so the consumption expenditure of all people is from the market, which can be measured by price. Perhaps it is suitable for areas with rapid development, but not suitable for other areas. Obviously, the Engel's coefficient is difficult to explain consumers' characteristics and living conditions in regions with largely different marketization degrees in different stages of development[1]. In reality, there are certain limitations when it is applied, easily leading to invalidity of vertical and horizontal comparison, which is not conducive to relevant analysis.

1.2.3 Culling out the special factors easily causes distortion of conclusion. Engel's coefficient is always used in western countries, and the application of its findings is correct, which lies in that the urbanization, food processing and catering industry in western countries have reached very high level, and the social security system, medical insurance, and education system of the rural residents have become very perfect, while China is still at primary stage of socialism and a transitional stage of planned economy. Although the dietary level of farmers becomes relatively high, whether the income will be increased or not is still a problem niggling in farmers' mind, let alone making their dietary level climb to extremely high level. In addition, the social security system in China is not perfect and the expenditure on education and medical service tends to increase considerably. In this context, we do not lay stress on considering consumption price disparity, differences of residents' living habit, and a series of special factors due to different socio-economic system, but accordingly cull out the incomparable factors in cross-sectional comparison when we conduct analysis and comparison. The value of Engel's coefficient we have calculated is of error, this Engel's coefficient which represents the living standard of farmers, is bound to have distortion.

2 Analysis of Engel's coefficient in rural areas of Hebei Province

2.1 Horizontal analysis of rural residents in regions of China In reality, many people often use the size of Engel's coefficient to judge optimization degree of consumption structure or economic development degree in regions, but they often neglect the problem of comparability in the process of comparison.

Engel's coefficient of rural residents in regions of China and the ordering of Engel's coefficient in 2008 can be seen in Table 1[2].

Table 1 shows that in 2008, the Engel's coefficient of rural residents in Hebei Province ranked NO. 6 in the Engel's coefficient of rural residents and the ranking of the Engel's coefficient of all regions in China, namely 38.2%, followed by Shanghai,

Tianjin, Jiangsu, Fujian and Guangdong and other provinces, trailed behind Heilongjiang, Beijing, Zhejiang, Shaanxi, and Shandong. In addition, the gap between Fujian, Guangdong and Hebei is large.

Table 1 Engel's coefficient of rural residents in regions of China and the ordering of Engel's coefficient in 2008

Region	Engel's coefficient//%	Ordering	Region	Engel's coefficient//%	Ordering	Region	Engel's coefficient//%	Ordering
Heilongjiang	33.0	1	Tianjin	41.0	12	Jiangxi	49.4	23
Beijing	33.9	2	Inner Mongolia	41.0	12	Yunnan	49.6	24
Zhejiang	36.9	3	Jiangsu	41.3	14	Hunan	51.2	25
Shaanxi	37.4	4	Ningxia	41.6	15	Guizhou	51.7	26
Shandong	38.1	5	Xinjiang	42.6	16	Sichuan	52.0	27
Hebei	38.2	6	Qinghai	43.6	17	Tibet	52.4	28
Human	38.3	7	Anhui	44.3	18	Hainan	53.3	29
Shanxi	39.0	8	Fujian	46.4	19	Chongqing	53.3	29
Jilin	39.6	9	Hubei	46.9	20	Guangxi	53.4	31
Liaoning	40.6	10	Gansu	47.2	21			
Shanghai	40.9	11	Guangdong	49.0	22			

According to economic significance of Engel's law and Engel's coefficient, and based on the data in Table 2, across China, in Hebei Province, the rural economy develops rapidly, in the leading level, and the living standard of farmers is high, at the rich stage. In addition, the Engel's coefficient of Hebei Province is higher than that of traditionally developed coastal provinces, showing that the living standard of rural residents in Hebei Province is far higher that of the coastal rural areas. However, according to the reality and actual situation, we clearly know that the level of economic development in Shanghai, Tianjin, Jiangsu, Fujian and Guangdong and other coastal provinces is much higher than that of Hebei Province, and their living standard of rural residents is also higher than that of the rural residents in Hebei Province. It can be seen that the Engel's coefficient of rural areas in Hebei Province is ineffective during the horizontal comparison among regions in China, and the reasons is as follows.

2.1.1 Engel's coefficient neglects the difference of consumption structure among regions. The data in Table 1 is calculated simply by using formula of the Engel's coefficient without taking into account the difference between rural areas of Hebei Province and those of other provinces, especially distant provinces in terms of regional distribution. Different rural areas have different lifestyles, while different life habits will have different effects on consumption structure, and the different consumption structures are bound to generate difference on demand for consumer goods. It is likely to cause such a phenomenon that the particular living habits of some regions make them have a great demand for food with high price level, so the proportion of the food with high price level is big in consumption structure, and then the Engel's coefficient in the region must be high. For example, the coastal areas in Fujian and Guangdong have a great demand for seafood, and this demand will not change radically due to the relatively high price of seafood products, thus this characteristic makes the region's Engel's coefficient become accordingly high[3]. The price of most food in rural consumer goods of Hebei Province is at low level, which makes the proportion of food consumption in total consumption small, therefore, it can cause the phenomenon that the Engel's coefficient of its rural areas is very low.

2.1.2 Engel's coefficient neglects the difference of economic stages among regions. Since the reform and opening up, the provinces in China are all in the period of rapid economic growth, and the rural economic development of all provinces is stunning, but due to different geographical locations and strategic importance of different provinces, there is inevitable difference in economic development speed and stages. If the national economy is divided into three stages according to development conditions in different areas, the Yangtze River Delta, Pearl River Delta and other coastal areas as well as the northeast old industrial base are at the second stage, in the period of rapid economic development, with high level economic development and high-degree marketization, while as against the Yangtze River Delta, Pearl River Delta and other coastal areas as well as the northeast old industrial base, the central region is at the second stage, where the market tends to be mature, with relatively rapid economic development, and high level of economy. The western region is at the first stage. Hebei Province is in the central region, thus at the second stage of economic development. So in different provinces, the economic development stages in rural areas are different. Different stages of economic development in different provinces, with varying degrees of marketization, are accompanied by different levels of exchange of goods. Due to high-degree marketization in Guangdong, Shanghai, Fujian and other places, the rural residents need to purchase basic necessities in market, which to some extent, increases the amount of food consumption. The rural marketization degree of Hebei Province is low, and people's need for basic living necessities is still in self-sufficient state, without buying them from market, thus reducing food consumption. Obviously the calculated Engel's coefficient of the former is higher than that of the latter.

2.2 Vertical analysis of Engel's coefficient in rural areas of Hebei Province The invalidity of comparative reference of Engel's coefficient, not only exists in different spatial dimensions, but also in different temporal dimensions, namely that in the longitudinal analysis, the size of the Engel's coefficient shows the stages of swing and whirl, and there is no constant

trend of decline along with improvement of living standards as described in the theory. According to data from *Hebei Economic Yearbook* 2009[4] and *Statistical Bulletin of Economic and Social Development of Hebei Province in* 2009[5], we draw the trend figure of the Engel's coefficient of rural households and per capita net income annually of rural households in Hebei Province from 1980 to 2009, which can be seen in Fig. 1 and 2.

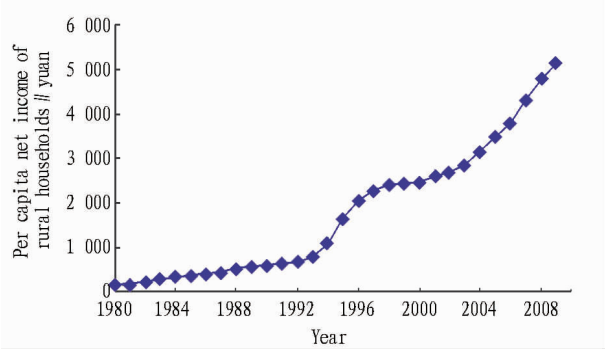

Fig. 1 Trend of Per capita net income annually of rural households in Hebei Province from 1980 to 2009

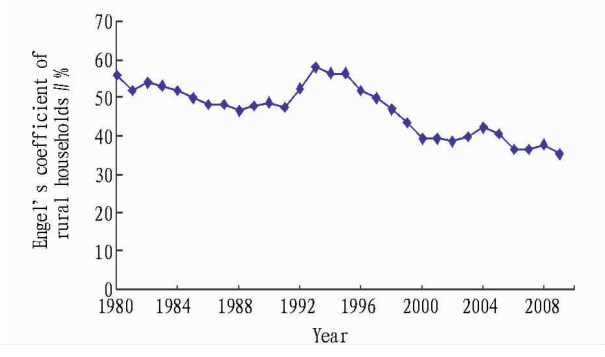

Fig. 2 Trend of Engel's coefficient of rural households in Hebei Province from 1980 to 2009

Fig. 1 and 2 show that from 1980 to 2009, the per capita net annual income of rural households in Hebei Province tends to rise, that is, the per capita net income of farmers increases year by year, even if the growth degree is different. However, the corresponding Engel's coefficient of rural households in Hebei Province from 1980 to 2009 has no trend of increasing decline, such as the sharp rise stage from 1992 to 1997, and slightly swing stage from 2003 to 2005 and from 2006 to 2008. During the period, many data indicate that although the overall trend of Engel's coefficient of rural residents in Hebei Province from 1980 to 2009 is decline, the fluctuation is prominent. On the whole, the size of the Engel's coefficient of rural households in Hebei Province has no constant trend of decline along with improvement of living standards in the process of longitudinal development, as described in the traditional theory. This obviously shows that the Engel's coefficient of rural areas in Hebei Province is ineffective in the longitudinal comparison, and the reasons are as follows.

2.2.1 Engel's coefficient neglects the periodic change of consumption structure. The change law of the Engel's coefficient of rural areas in Hebei Province correlates with cyclical changes of consumption structure to some extent. People's consumption not only has the characteristic of tendency, but also has the characteristic of time period. In the light of the impact of the consumption of consumer durables on the Engel's coefficient of rural areas, the expenditure of consumer durables is always one-time expenditure, while the utilization of consumer durables will take a long time, especially in rural areas, where the farmers' consumption of consumer durables is slow, and thus the consumer durables are updated slowly. Therefore, lumping expenditures of consumer durables together into the consumption expenditures at the year is not rational. If we share equally the spending of durable goods to each year, according to useful life, it can offset the impact on the Engel's coefficient to some extent; or if the consumption of rural residents on consumer durables in the province is flat, and the consumption spending fluctuates slightly every year, then it is not likely to cause great fluctuation of the Engel's coefficient. But on the contrary, the expenditure on consumer durables in the rural areas of Hebei Province takes on periodic characteristic, and the spending of consumer durables is only included in the statistical total spending of consumption in the year, which thus makes the Engel's coefficient rise at the cyclical boom stage. After this cyclical boom stage, the Engel's coefficient will drop accordingly, reverting to the general trend of the Engel's coefficient declining along with income increase.

2.2.2 Engel's coefficient neglects the ratio change of different families in different periods. The Engel's coefficient of rural areas in Hebei Province is not the Engel's coefficient of one rural household, but the Engel's coefficient reflected from myriad rural families comprehensively. Therefore, examining the longitudinal change of the Engel's coefficient of rural areas in Hebei Province is inseparable from the proportion of different types of rural households in rural households in whole province. Based on this, we divide families into three categories: young stage, middle age stage and old age stage. At the early stage when a family is established, it is at young stage, with fewer burdens on the family, and there is no such case that the food expenditure is suppressed. When a family steps into the middle age stage, especially for one in rural areas, under the circumstance that the family income has not yet been promoted conspicuously, on one hand, it has to pay the college fees of offspring; on the other hand, it has to pay the cost of medical care for the elderly. Moreover, one rural family has more than one school children and family member who need the medical care. In this case, people will be passive in restricting expenditure on food, in order to save money to pay the expenses of education, medical service, and so on. In light of comparability of time, the Engel's coefficient of one family is smaller than ever. If in this period, the proportion of rural families at middle age stage in whole province is large, then the corresponding Engel's coefficient of rural areas across the province will be lower than that in other periods. However, although the Engel's coefficient is reduced, it cannot indicate that in this period, the living standard of the rural residents is promoted. On the contrary, it indicates that the living standards in rural areas decline, thus it will cause

the ineffectiveness of longitudinal comparison of application of the Engel's coefficient in rural areas of Hebei Province.

2.3 Overall analysis of Engel's coefficient in rural areas of Hebei Province Food consumption is the most basic one for human survival, so taking food standards as a basis to evaluate rural living standards is feasible to a certain extent. However, it requires the Engel's coefficient for estimation, and the accuracy degree of estimation will have great impact on definition of poverty and richness, because of the fact that although the Engel's coefficient can reflect the general difference of rural residents' living standards in the macroscopic perspective, there is more or less deviation when measuring degree of poverty and richness due to differences in consumption habits, consumption structures, income levels and growth speed. The derived Engel's coefficients of rural residents in Hebei Province from the above analysis are apparently not in line with the actual levels of wealth and poorness. In horizontal comparison, the Engel's coefficient of rural residents in Hebei Province is prominently higher than the Engel's coefficient of rural residents in traditionally developed coastal provinces, such as Fujian and Guangdong, which does not match with the actual situation, and causes malfunction of comparison of the Engel's coefficient among regions; in longitudinal comparison, the Engel's coefficient of rural residents in Hebei Province in certain period (Fig. 2) is higher than that in the past. However, it is not the theoretical constant decline along with income increase or improvement of living standards, and there is ineffectiveness phenomenon of longitudinal comparison. On the whole, by analyzing the Engel's coefficient of rural areas in Hebei Province, we can find that although the overall trend is downward, the Engel's coefficient cannot truly reflect the level of the rural living standards in the case of the horizontal or vertical comparison.

From the above analysis and comparison and historical data, the Engel's coefficient cannot truly reflect the level of the rural living standards. If we calculate the Engel's coefficient simply by food expenditure/total expenditure, then the Engel's coefficient of rural residents in Hebei Province in 2004 has reached 42.51%, which means that the life has reached a comfortable level, and it is moving towards the level of affluence. The Engel's coefficient of rural areas in Hebei Province in 2009 is down to 35.70%, indicating that it has reached the level of affluence. However, according to reality, the real living standard of the rural areas in Hebei Province is at subsistence level, close to the stage of a comfortable level of living.

Not only in Hebei Province, the Engel's coefficient forms many "upside down" situations nationwide: in 2007, the Engel's coefficient of urban residents in Guangzhou was 35.3%, while the Engel's coefficient of urban households in Shanxi in 2005 was 32.4%, so it seems that Shanxi residents step into wealthy stage earlier than Guangzhou residents, and the residents in Shanxi are richer than residents in Guangzhou. In addition, in 2007, among the statistical Engel's coefficients of all provinces, unexpectedly the Engel's coefficient of rural areas was higher than that of urban areas. The Engel's coefficient of urban residents and rural residents was 32.2% and 32.1% respectively; the Engel's coefficient of urban areas in Heilongjiang was 35.0%, while the Engel's coefficient of rural areas in Heilongjiang was 34.6%. It seems that the rural residents in Beijing and Heilongjiang are richer than the urban residents in the two provinces, so the ineffectiveness of the Engel's coefficient is evident. Such examples are countless, for instance, according to the public information, cities whose Engel's coefficients are at comfortable or subsistence living levels are rare, and most of the Engel's coefficients are at level of richness, or close to the richest level. The Engel's coefficient of backward areas is seemingly lower than the Engel's coefficient of the developed areas, so it forms "richness illusion"[6]. Therefore, the decline of the Engel's coefficient of rural areas in Hebei Province does not mean that rural living standards are improved, but rather indicates that the true living standard of the rural areas in Hebei Province is lower than the conclusion we draw on the basis of data.

3 Correction of Engel's coefficient

3.1 Strengthen the objective statistical degree on Engel's coefficient Although the strengthening of objective statistical degree of Engle's coefficient is merely the strengthening in form, it is conducive to highlighting the authenticity of data, and curbing the "false" phenomenon in the statistical process of the Engel's coefficient. The government should increase financial and human resources input, go down to the grass-roots units, survey the true living standards of farmers, and get first-hand data through the forms of seminars and visits; the statisticians should strengthen the sense of responsibility, resolutely put an end to sloppy statistical work, eradicate the phenomenon of false reports and deal blow to the bad behavior of directly using the data in the past for estimation without investigation, establish the mechanism of supervision and incentive on statisticians and relevant investigators, and increase the pressure and at same time stir their enthusiasm.

If the chain of investigation and statistical work is strengthened, there will be no phenomenon of exaggerating actual situation and minimizing actual situation. Otherwise, the real life situation of farmers can not be reflected, and the national and the provincial government's policy will deviate from reality. No matter how good the policies and the measures are, if they are inconsistent with the actual situation, the final result will not be implemented, and it cannot play any positive role.

3.2 Form Engel's coefficient with its own characteristics Using simple Engel's coefficient to statistically evaluate the living standard of the rural residents in Hebei Province will get distorted results, and the results are distorted even in whole China, because rural areas in China have their own conditions, for example, there is a large proportion of education costs and medical costs in contemporary rural household spending, and even most of rural households slash their food consumption expenditure for education and medical care use. We should establish the Engel's coefficient with our own characteristics in accordance with our own characteristics in order to reflect the living standards of farmers comprehensively, accurately and tru-

ly. We believe that this will be of great significance for promoting Hebei Province and even China to formulate rural policies better and address the issue of farmers. So, the Engel's coefficient should be perfected under the circumstance of objective situation of rural areas at present.

The Engel's coefficient of rural areas is as follows:

Firstly, Engel's coefficient = Percentage of expenditure variation (food + education + medical service)/Percentage of total expenditure variation; Engel's coefficient = Percentage of expenditure variation (food + education + medical service)/Percentage of income variation.

Secondly, Engel's coefficient = Percentage of expenditure variation of food/Percentage of variation of (total expenditure-educational expenditure-medical expenditure.

Thirdly, Engel's coefficient = Percentage of expenditure variation of food/Percentage of total expenditure variation.

Among them, education, health care and other objective factors cannot be simply lumped together into the total expenditure. We should elaborately analyze the farmers' variation situation of these aspects, so that the real living standards of farmers are revealed.

We should pay special attention to that the education expenses and medical expenses in the above formula of the Engel's coefficient are not total expenditure on education and health care regardless of the actual situation and regional difference, but a certain education and medical care expenditure under particular circumstance in given regions, or reasonable education, and health care expenditure. We should not copy mechanically and apply indiscriminately the Engel's coefficient and should not dogmatize the Engel's coefficient, otherwise, the Engel's coefficient with its own characteristics is more superficial than real, and it cannot reflect the real living standards of farmers.

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(From page 23)

of main body of insurance is important content of supervision and management. Therefore, the targets of the insurance of agricultural catastrophe are government's behavior, the insurance organization's behavior and the behavior of rural households. Supervision and management on government's behavior, in fact, are the supervision and management on its policy support behavior of the insurance of agricultural catastrophe. Whether the insurance of agricultural catastrophe gets the government's policy support, depends on the action of government, therefore, China's insurance law of agricultural catastrophe clearly stipulates the supervision and monitoring on the government's behavior.

Supervision and management on agricultural insurance organizations are mainly to monitor it that whether the insurance organizations carry out insurance business and daily operation and management illicitly, and whether the insurance organizations do harm to the interests of the state and the farmers. Supervision and management on farmers are to supervise and manage moral hazard of farmers.

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