CHAPTER 4

RESULT AND DISCUSSION

4.1 Descriptive Analysis of the Growth of Preschool Children

The analysis result for the growth of preschool children are shown in Table 4.1 and Table 4.2.

Table 4.1 Basic Description of Sample

	Male		Female		
	Number	Percentage	Number	Percentage	Total
Urban	3007	52	2772	48	5779
Rural	5773	54	4909	46	10682
Total	8780	53	7681	47	16461

The total sample size is 16,461, which consisted of 400 children per county at least for 40 counties. There were 5,779 preschool children from urban areas and 10,682 preschool children from rural areas. In detail, for urban areas, including male 3,007 and female 2,772, for rural areas, including male 5,773 and female 4,909. The proportion of gender is nearly equal, in accurate the proportion of male is just a little more than that of female. Its distribution by gender was quite similar with that for whole Chinese preschool children.

From the result of analysis (Table 4.2), it obviously showed that, the problems people faced are totally difference between urban area and rural area. In the urban area, all the figures (column 2,4,6) in positive side are more than that (column 1,3,5) in negative side. Obesity caused by over-nutrition is becoming the first problem for the growth performance of children in urban area. On the contrary, in the rural area, all the figures (column 1,3,5) in negative side are more than that (column 2,4,6) in positive side. Particularly in poor rural area, the gap is quite significant in HAZ (Z-score of height for age, percentage of stunted was close to one-third) and WAZ (Z-score of weight for age, percentage of underweight was close to one-fifth). It means underweight and stunted are still serious problems of preschool children in rural area even their living condition has gotten a great improvement than that in before. The prevalence of malnutrition is still very high in rural area.

Table 4.2 Prevalence of Malnutrition of Preschool Children

	HAZ		WAZ		WHZ	
	< -2 Z (%)	>= 2 Z (%)	< -2 Z (%) (%)	>= 2 Z (%)	< -2 Z (%)	>= 2 Z (%)
Total	17.50	2.21	10.12	2.69	2.49	3.90
Urban	4.07	5.33	2.70	6.06	2.08	5.22
Rural	21.98	1.17	12.59	1.57	2.62	3.46
Rich rural	18.13	1.23	9.64	1.91	2.30	3.83
Poor rural	30.98	1.03	19.46	0.79	3.36	2.58

At the same time, the result from Table 4.2 pointed out that, absolute poverty was the primary reason resulting in high prevalence of malnutrition in underweight and stunted to preschool children. In other words, with the increasing of people's income, nutritional status of people will be improved remarkably. Nevertheless, another malnutrition in obesity was emerging gradually with the increasing of people's income. It means that, guiding reasonable food consumption should be taken into account while the people's income was improving.

4.2 Food Consumption and Dietary Pattern - Descriptive Analysis of Nutritional Status

As mentioned in previous chapter, in order to reduce bias, the whole sample was separated into six income groups by household income in nutritional analysis. The sample size is 953 households in urban area and 2010 households in rural area.

4.2.1 Result of Analysis in Urban

The result of food consumption and dietary pattern in urban area were presented in Table 4.3 to Table 4.7.

Table 4.3 Food Consumption of Urban Households by Income Groups (kg/capita/year)

Category	Income Groups*					Average
	1	2	3	4	5	
Cereals	130	133	124	131	121	126
Vegetables	135	143	146	154	149	147
Fruits	49.5	61.5	72.8	80.7	86.7	73.3
Veg. Oil	11.5	12.1	9.9	9.2	8.8	9.9
Legumes	1.3	1.4	1.2	1.4	1.1	1.3
Legume Pro.	3.7	4.1	4.6	4.9	4.5	4.4
Pork	18.4	21.8	23.9	26.9	26.3	24.1
Beef & Mutton	4.1	5.2	4.2	4.7	3.3	4.4
Poultry	4.8	6.1	8.7	11.6	13.4	9.4
Fish	9.1	11.2	16.4	20.5	21.2	16.7
Eggs	14.9	15.8	17.1	16.1	15.4	15.9

* Group 1 to 5 ranks the households from lowest to highest income groups

By analysis, it represented that, along with the increment of household income, the consumption of cereals, vegetables and eggs took a stable increasing. It had a decline trend for the consumption of vegetable oils with the income increasing. At the same time, it had notable increasing about the consumption of fruits, poultry and fish with the household income boost up. For pork consumption, it took a raise from the lowest income group to medium income group. Compare with the quantity of pork consumption, the quantity of consumption for beef & mutton was very few. The consumption of legume and its product stayed in very low level. The result showed that, with the increasing of household income, people had more money in food consumption to satisfy their preference. Once the previous constraint was broken about household budget promotion in food consumption to urban household, they will prefer much more high quality food than before to satisfy their new need, such as fruits poultry, fish and other seafood. It will form new demand in food market in urban. Likewise, the pork consumption will increase also, but in high-income level of household, it will be substituted by poultry, fish and other seafood. As the basic food for people's nutrition security, cereals, vegetables, and eggs will take a stable increasing to people's food consumption in urban area.

Table 4.4 Main Nutrient Intake of Urban Households by Income Groups (per capita per day)

Category	Income Groups*					Average	Standard
	1	2	3	4	5		
Energy (kcal)	2179	2236	2188	2290	2274	2253	2400
Protein (g)	61.5	67.5	67.1	73.1	71.6	69.2	70
Fat (g)	66.7	71.1	70.8	74.4	72.9	71.2	65
Energy from Fat %	28.2	28.8	29.1	28.2	28.9	28.6	< 25

* Group 1 to 5 ranks the households from lowest to highest income groups

Table 4.5 Source of Energy of Household Diet in Urban by Income Groups

Category	Income Groups*					Average
	1	2	3	4	5	
Cereals %	55.4	53.9	52.5	51.6	51.2	52.9
Legumes %	1.3	1.4	1.3	1.4	1.3	1.3
Food from Animal Product %	16.8	18.1	19.2	19.9	20.1	18.8
Others %	26.5	26.2	27.0	27.1	27.4	27.0

* Group 1 to 5 ranks the households from lowest to highest income groups

Table 4.6 Source of Protein of Household Diet in Urban by Income Groups

Category	Income Groups*					Average
	1	2	3	4	5	
Cereals %	47.2	45.3	41.2	40.1	39.7	42.8
Legumes %	4.4	4.6	4.2	4.2	4.4	4.4
Food from Animal Product %	33.9	35.3	37.6	38.9	40.5	37.6
Others %	14.5	14.8	17.0	16.8	15.4	15.2

* Group 1 to 5 ranks the households from lowest to highest income groups

All income household groups were adequate in energy and protein intake, the dietary energy intake of urban households remained around 2,200 kcal. They have been above 90 percentage of RDA (Recommended Dietary Allowance). Thus, energy intake of the urban population was adequate.

However, for fat consumption level has risen to unhealthy levels. Chronic diseases such as diabetes and heart disease increase as the energy from fat rises above 20% of total energy intake, so it would be wise to keep the proportion less than 25% of the total energy intake. The percentage of energy from fat in urban areas was close to 30%, it was quite high and came to the dangerous level.

Herein, we will mention the standard intake of protein and fat again, for protein was 70 g per capita per day, for fat was 65 g per capita per day. To compare with the standard intake and the result of analysis, even in the lowest income group, the intake of fat was more than the standard intake. The people in urban area should control and reduce their fat intake in the future, particularly in pork consumption. Certainly, with the decreasing of food from animal product consumption, the protein intake will take a drop too. It was better to increase the consumption of legume and its product and cereals to reinforce people's protein intake.

Table 4.7 Food Dietary Pattern of Urban Households by Income Groups

Category	Income Groups*					Average	Standard score
	1	2	3	4	5		
Cereals	28.9	27.2	26.7	26.6	25.9	27.0	30.0
Meat & seafood	32.6	35.4	37.8	37.7	37.2	36.2	35.0
Added Fats & Oils	8.4	8.1	7.3	7.2	7.3	7.6	9.0
Legumes	3.3	3.4	3.3	3.4	3.4	3.4	12.5
Sugar	1.2	1.2	1.1	1.1	1.1	1.1	2.5
Nuts & Oilseeds	0.9	1.0	1.0	1.1	1.0	1.0	1.0
Fruit & Vegetables	12.9	13.4	13.7	13.9	14.2	13.7	10.0
DDP	**88.2**	**89.7**	**90.9**	**91.0**	**90.1**	**90.0**	**100**

* Group 1 to 5 ranks the households from lowest to highest income groups

We figured out the DDP score by eight food categories and showed them in Table 4.7. In fact, the DDP score was very high even in the lowest income group. At the same time, the score of meat & seafood was close to 40 (the maximal allowance score) and the score of legume was very low if we compared with the recommended score in Table 3.2, that was 12.5. In the future, they could improve their dietary pattern for meat & seafood consumption to legume consumption.

4.2.2 Result of Analysis in Rural

From table 4.8 to table 4.12, we listed the result of data analysis in rural area. It would show us the characteristic of food consumption and dietary pattern in rural area.

Table 4.8 Food Consumption of Rural Households by Income Groups (kg/capita/year)

Category	Income Groups*					Average
	1	2	3	4	5	
Cereals	237	253	268	279	285	267
Vegetables	98	109	129	148	161	130
Fruits	7.7	12.3	19.8	29.7	39.8	20.8
Veg. Oil	4.3	5.8	6.1	7.2	8.2	6.3
Legumes	2.1	3.4	4.8	5.6	4.1	4.2
Legume Pro.	1.9	2.1	2.3	2.4	2.6	2.3
Pork	9.9	11.6	12.1	13.4	13.5	12.0
Beef & Mutton	0.3	0.6	0.8	1.1	1.3	0.8
Poultry	2.3	2.1	2.4	3.1	4.4	2.8
Fish	1.3	1.9	2.6	4.7	6.4	3.4
Eggs	1.9	3.7	5.4	6.7	8.8	5.3

* Group 1 to 5 ranks the households from lowest to highest income groups

The result pointed out, cereals was main food to whole population in rural area. Its consumption remained a remarkable level whatever for low-income group and high-income groups. With the increment of household income, it had a significant increasing tendency in the consumption of many categories food, including vegetables, fruits, vegetable oil, pork, fish and eggs. If we compared with the absolute value in urban areas, the increasing magnitude was still very small. By analysis, we could imagine, in rural areas of China, the change of food consumption pattern was just on the way. Along with the increasing of household income, people were transferring their food consumption habit from basic foods to more high quality foods to satisfy their need. In the meantime, traditional food consumption conception will continue to influence on their food consumption behavior in a long time, such as cereals consumption. On the other hand, as not only consumer but also producer was played by the farmer in rural areas. Under the traditional economic mode, they have to choose some basic foods to themselves in order to earn more money by selling other high quality foods. With the improvement of multiple economic modes, it will stimulate the change of food consumption for the people in rural areas to form new demand in food market. If we relate to the huge population in rural of China, the new demand of food would take a tremendous effect in food market, not only in China but also in world.

Table 4.9 Main Nutrient Intake of Rural Households by Income Groups (per capita per day)

Category	Income Groups*					Average	Standard
	1	2	3	4	5		
Energy (kcal)	2119	2326	2453	2562	2689	2449	2400
Protein (g)	62.3	67.9	73.9	76.1	75.8	71.1	70
Fat (g)	36.8	42.5	47.9	51.1	55.9	46.7	65
Energy from Fat %	15.9	17.5	17.7	18.1	18.8	17.6	< 25

* Group 1 to 5 ranks the households from lowest to highest income groups

Table 4.10 Source of Energy of Household Diet in Rural by Income Groups

Category	Income Groups*					Average
	1	2	3	4	5	
Cereals %	73.9	72.7	71.7	70.9	70.6	72.0
Legumes %	1.5	1.9	2.1	2.2	2.1	1.9
Food from Animal Product %	9.1	8.5	8.6	8.8	9.5	8.8
Others %	15.5	16.9	18.2	18.1	17.8	17.3

* Group 1 to 5 ranks the households from lowest to highest income groups

Table 4.11 Source of Protein of Household Diet in Rural by Income Groups

Category	Income Groups*					Average
	1	2	3	4	5	
Cereals %	65.6	64.9	65.6	65.1	65.2	65.3
Legumes %	4.3	5.8	6.3	6.1	5.7	5.7
Food from Animal Product %	9.9	10.7	11.5	12.9	15.4	12.1
Others %	20.2	18.6	16.6	15.9	13.7	16.9

* Group 1 to 5 ranks the households from lowest to highest income groups

In rural areas, all income groups people were adequate in energy intake. Besides low-income group, other income groups people also got enough protein intake. At the same time, it had a great gap in fat intake compare with the standard intake, which was 65 g per capita per day. In the same way, cereals food consumption played a regnant role in food source of energy and protein. Certainly, the figure of energy intake was not low, that means food consumption could satisfy the basic need of their body. But we had to point out that the key factor of this result was based upon large quantity of cereals food consumption. Percentage of energy from fat remained around 17%, it still had space to increase their food from animal product consumption.

From table 4.10, it was very obviously, even with the increment of household income, there was a decline tendency, but the percentage of energy from cereals was still greater than 70%.

To combine with the analysis mentioned above, in rural, based on the constraints of people's income level and food consumption habit, they chose too much cereals food and few food from animal products in their food consumption. It should be improved with their income increasing and the change of living habit.

Table 4.12 Food Dietary Pattern of Rural Households by Income Groups

Category	Income Groups*					Average	Standard
	1	2	3	4	5		Score
Cereals	36.1	35.7	35.5	35.6	34.8	35.5	30.0
Meat & seafood	16.5	16.8	17.6	18.4	19.8	17.8	35.0
Added Fats & Oils	5.2	5.9	6.0	5.9	6.7	5.9	9.0
Legumes	2.9	3.8	4.4	4.1	3.5	3.8	12.5
Sugar	0.3	0.3	0.4	0.4	0.4	0.4	2.5
Nuts & Oilseeds	0.1	0.2	0.2	0.3	0.3	0.2	1.0
Fruit & Vegetables	5.4	6.1	6.6	6.9	7.8	6.6	10.0
DDP	**66.5**	**68.8**	**70.7**	**71.6**	**73.3**	**70.2**	**100**

* Group 1 to 5 ranks the households from lowest to highest income groups

It was not optimistic result if we took a judgement in nutritional evaluation from DDP score that just remained around 70. For the highest income group, the DDP score was only 73.3, and that for two low income groups were less than 70. It means that the dietary pattern for rural households were not adequate and the malnutrition was still a primary problem for the people in rural area, especially for the lowest income level. In addition, comparing with the standard score of each food category, except cereals, all of them were lower than the standard score of its food category, particularly in meat & seafood and legumes consumption. People in rural areas should reduce the food consumption on cereals and increase the intake on food from animal product, vegetables, fruits to mend their integrated dietary level. To Concern about the absolute value of their household income, it was possible to choose some relative cheap substitute foods to improve their dietary pattern. For instance, increasing the consumption of oil, especially on animal fats consumption to promote fat intake level in their food pattern. In the mean time, they could put more legume and its products into their dietary in order to improve their protein intake level. It a good way to promote the integrated dietary level to low-income people.

4.2.3 Integrated Result Combining with Urban and Rural

In order to identify the specific nutritional status between urban area and rural area, we gathered round the average value for each item about nutritional calculation to form Table 4.13 and Table 4.14. It would show the nutritional information to us in focus on the difference between urban and rural.

Table 4.13 Comparison of Food Consumption between Urban and Rural (kg/capita/year)

Category	Urban (Average)	Rural (Average)
Cereals	126	267
Vegetables	147	130
Fruits	73.1	20.8
Veg. Oil	9.9	6.3
Legumes	1.3	4.2
Legume Pro.	4.4	2.3
Pork	24.1	12.0
Beef & Mutton	4.4	0.8
Poultry	9.4	2.8
Fish	16.7	3.4
Eggs	15.9	5.3

In Table 4.13, besides the consumption of cereals and legumes, the quantity for each rest item in urban area was greater than that in rural area. Some of them were several folds than that in rural, particularly in the consumption of food from animal product such as the consumption of pork, poultry, fish, eggs and so on. On the other hand, cereals consumption in rural had already gotten a remarkable level, that was two times than the cereals consumption in urban area. Herein, a pair very interesting figures should be discussed, legumes and its products. We saw that the summation of legumes and its product was about 5.7 kg per capita per year for urban and 5.5 kg per capita per year for rural. It had significant gap to recommended standard which was 8 kg per capita per year (MOH, 1995) in legumes and its products consumption. We considered that, this scenario result from the scarcity in nutrition knowledge for people. Most of people did not know the importance of legumes and its products consumption in integrated dietary pattern.

Table 4.14 Comparison of Nutritional Status between Urban and Rural

Category	Urban (Average)	Rural (Average)	Standard recommended
Nutrient Intake (per capita per day)			
Energy (kcal)	2253	2449	2400
Protein (g)	69.2	71.1	70
Fat (g)	71.7	46.7	65
Energy from Fat %	28.6	17.6	< 25
Source of Energy			
Cereals %	52.9	72.0	-
Legumes %	1.3	1.9	-
Food from Animal Product %	18.7	8.8	-
Source of Protein			
Cereals %	42.8	65.3	-
Legumes %	4.4	5.7	-
Food from Animal Product %	37.6	12.1	-
DDP	90.0	70.2	-

The coincident scenario took place in Table 4.14. By comparing with the two columns between urban and rural, even if the energy of rural was more than that in urban and the RDA standard which was determined 2,400 kcal per capita per day also, most of them were contributed by cereal food whatever in source of energy or source of protein. In depth, the intake of protein had already satisfied the need of people both urban and rural. The intake of fat in urban area, 71.7 g per capita per day, was more than the recommended standard, which equals 65 g per capita per day. There was obvious gap between the intake of fat in rural, which equaled 46.7 g per capita per day and lower than the recommended standard. For the percentage of energy from fat, it is a very useful indicator in dietary equilibrium. The percentage of energy from fat in urban was already close to a dangerous level, i.e. 30 percent. In rural, people should increase the food consumption of food from animal product and oil in order to step up the percentage of energy from fat. From DDP score side, the average value of rural area was 70.2 only, had a significant gap to average DDP score in urban, which was 90.0. Hence, both in urban and rural, dietary energy intake of people have been above 90 percent of the RDA standard, and protein intake of people was quite close to the recommended standard. On the negative side, there were different problems about dietary equilibrium in urban area and rural area, that in urban was represented by over-intake about food from animal product, at the same time, the problem in rural was shown by over-intake about cereal food and under-intake about food from animal product and oil.

In order to compare with the consumer behavior on food consumption between urban areas and rural areas, we figured out the value of household income for each group. The result was shown in Table 4.15

Table 4.15 Comparison of Household Income between Urban and Rural (Unit: Yuan*)

	Group 1 <20%	Group 2 20% - 40%	Group 3 40% - 60%	Group 4 60% - 80%	Group 5 > 80%
Urban					
Min.	2559	10692	14235	18008	23553
Max.	10587	14232	17985	23469	118185
Mean	8133	12538	15944	20480	32213
Rural					
Min.	1864	7275	9952	12988	17452
Max.	7268	9948	12960	17448	101975
Mean	5333	8652	11421	14978	25061

* Yuan: the unit of Chinese currency. Exchange rate in 1998: 1 US$ = 8.3 Yuan.

To combine with household income and food consumption information between urban and rural, we could find the answer about the difference in food consumption among urban and rural. In rural areas, since the constraint for low household income, people had to choose some low-priced foods as their basic food in dietary consumption, such as cereals food. Herein, we had to mention about the demand conception in economic theory. As demand, it should content two crucial prerequisites, consumer has willingness to pay and has ability to pay. Therefore, it means that people in rural areas had not enough ability to buy more high quality food to satisfy their need. In urban areas, people had enough money to choose much more much high quality foods to satisfy their need. Then, just like the description by Engle Curves ('Microeconomics', 4th Edition. Pindyck R.S. and Rubinfeld D. L.), with the increasing of household income, some normal food, such as cereals food, transformed into inferior food and the quantity of food consumption would decline. At the same time, some high quality food, such as fruits and seafood, would transform into normal food. Also, the consumption of them went up with the increasing of household income.

Another point we should pay attention. Even in the same income level, for example, the mean (14,978) of group4 in rural was quite close to the mean (15,944) of group3 in urban, the food consumption pattern was totally different among the two specific groups. We considered, traditional conception of food consumption was still influencing on people's food consumption behavior. In rural areas, people continued to choose a mass of cereals food as their major food. In urban, high-energy and high-fat food were eaten more and more when people got much more money. Likewise, we knew there was a notable hypothesis in economics that is about the complete information of goods. If people could get more knowledge and information about nutrition and the relationship between nutrition and health, under purchasing power, they will pick out a more reasonable pattern about their food consumption. Maybe, people have to undergo a long period to establish their new food consumption conception.

4.3 Multiple Factors Analysis

4.3.1 Cross-sectional Correlation over 40 Counties

From the analysis of the growth of preschool children, we could get the Z-score for HAZ, WAZ, WHZ to each household. At the same time, we figured out the DDP score for each household from the descriptive analysis of nutritional status also. Since the two kinds of figures were from different households but same counties, so we just worked out the mean for each item and merged them together by county code. Then, it formed a new 4 X 40 data matrix, that would be shown in Table A.1 in detailed. The result of correlation analysis be presented in Table 4.16.

Table 4.16 Correlation between DDP score and Z-score

	DDP	HAZ	WAZ	WHZ
DDP	1.000000	0.807368	0.716101	0.382910
HAZ		1.000000	0.932541	0.561715
WAZ			1.000000	0.820607
WHZ				1.000000

The result showed us that the correlation coefficient r_1 which between DDP and HAZ was 0.81, r_2 which between DDP and WAZ was 0.72, and r_3 which between DDP and WHZ was 0.38. Since r is a sample estimate we must test its statistical reliability by conducting some test of significance. The Student's t test would be applied for establishing the significance or non-significance of the sample estimate r. The value of the t statistic was estimated from the sample correlation coefficient r, by the expression,

$$t = \frac{r}{\sigma_r} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

and was compared with the theoretical value of $t_{0.025}$ (for a two-tailed test at the α =0.05 level of significance) with df = n-2 degrees of freedom.

Herein, the df = 40 – 2 = 38, then the theoretical $t_{(0.025,38)}$= *2.024*. Following the *Formula (4.1)*, we figured out t value for each r, then, t_1 = *8.51*, t_2 = *6.40*, t_3 = *2.53*. Since all t-values estimated were more than the theoretical t value with 38 degrees of freedom at α =0.025 level of significance (single tailed), in statistics, we considered the sample linear correlation coefficients were different from zero in 95% confidence interval.

They pointed out the strength of linear association in each pair of variables. All of them presented positive correlation, but the degree of linear correlation was different. The third one was more close to 0, that means the correlation was very weaken. Other two figures were close to 1, that means DDP have more compact relationship with HAZ and WAZ to measure the nutritional status of cohort.

4.3.2 Multivariate Regression Analysis

In order to fit the request of constant elasticity model, as the dependent variable, we would put the deviation score of DDP into model estimated by ratio mode. In normal way, the deviation score of DDP is the difference between DDP score computed and the maximum limited score. Sometime, since the figure of deviation score was negative or zero, it was not able to put into constant elasticity model by logarithmic mode. Hence, we use ratio mode between DDP score and maximum limited score to express the deviation of DDP score for specific food category. For instance, in case of the DDP score for meat & seafood was 30, 40,and 50, we had already known the maximum limited score of meat & seafood was 40. Then, the deviation ratio between DDP score and maximum limited score for meat & seafood was 3/4, 1,and 5/4. For the ratio lower than 1, just like 3/4, it means under-intake to standard recommended. If the ratio was greater than 1, that means over-intake to standard recommended. Referring to Table 3.3, we showed the classification of DDP Deviation for each major food by ratio mode in Table 4.17.

Table 4.17 Classification of Deviation Ratio by Major Foods

Item	Deviation Ratio	Classification
Cereals	≥ 1	Normal
	< 1	Risky
Meat & Seafood	≤ 1	Normal
	> 1	Risky
Fruit & Vegetable	≥ 1	Normal
	< 1	Risky

As dependent variables, we chose the deviation of DDP score for cereals, meat & seafood, and fruit & vegetable by urban and rural. Each of them would be separated into normal deviation and risky deviation to estimate model individually. Whereafter, using Chow test to test whether they was different or not between the model estimated by normal deviation and that by risky deviation.

4.3.2.1 Multivariate Regression Analysis with Urban Data

1) Cereals

The estimated model were shown in equation 4.1 and equation 4.2, For all statistical tests using the α =0.05 level of significance.

$$Log(NORMAL) = 0.063 - 0.022Log(INC) + 0.004H\_SIZE - 0.001H\_EDU + 0.002S\_EDU$$

$$\textbf{t-stat.} \quad (0.50) \quad (-1.59) \quad (0.59) \quad (-0.53) \quad (1.03)$$

$$+ 0.037Log(P\_RICE) + 0.052Log(P\_PORK) - 0.038Log(P\_VEG)$$

$$(1.23) \quad (1.38) \quad (-1.80)$$

$$- 0.011Log(P\_EGG) + 0.034Log(P\_OIL)$$

$$(-0.41) \quad (1.68)$$

$$R^2 = 0.12 \qquad \bar{R}^2 = 0.08$$

$$F\text{-}stat. = 2.33 \qquad N = 231 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.1)$$

This regression model included 231 available observations. The R-square of this model is about 0.12, that means all variables considered by this model was able to explain about 12 percent of independent variable. The other 88 percent needed to be modified by error term.

Unfortunately, none of coefficients estimated were significant at α =0.05 level of significance. There was no obvious relationship between normal deviation for cereals and all explanatory variables we put in this model.

$$Log(RISKY) = -0.129 - 0.050Log(INC) - 0.001H\_SIZE + 0.00007H\_EDU - 0.002S\_EDU$$

t-stat. **(-0.81)** **(-2.94)** **(-0.11)** **(0.03)** **(-1.01)**

$$- 0.039Log(P\_RICE) + 0.074Log(P\_PORK) - 0.092Log(P\_VEG)$$

(-1.23) **(1.56)** **(-3.54)**

$$+ 0.092Log(P\_EGG) + 0.057Log(P\_OIL)$$

(3.16) **(1.90)**

$R^2 = 0.77$ $\bar{R}^2 = 0.61$

$F\text{-stat.} = 4.81$ $N = 527$ ....(4.2)

There were 527 available observations to be involved in this model. The R-square of this model is about 0.77, that means some determination as explanatory variable in this model may not completely explain the depend variable and /or some other independent variable were out of the model. In other words, the variable considered by this model was able to explain about 77 percent of independent variable. The other 23 percent needed to be modified by error term.

In this group, people's cereal intake was lower than the standard recommended. Estimated coefficients for household income, price of vegetable and price of egg were significant at α =0.05 level of significance. However, the magnitude of coefficient determining the amount of dependent variable was smaller. The household income elasticity negative number of –0.05. It showed us, if household income increase 10 percent, the risky deviation for cereal would decrease 0.5 percent. In other words, with the increasing of household income to this group people in urban areas, the quantity of cereal consumption would decrease. In constant elasticity model, we knew that when the cross-price elasticity is positive, the two goods are substitutes, and when the cross-price elasticity is negative the two goods are complements. In this case, if the price of vegetable went up 10 percent, the risky deviation for cereal would decline 0.92 percent. It means the quantity of cereal consumption would increase. On the contrary, with increasing price of egg, this group people would cut down their cereal consumption.

- Chow test for cereals models

Using all the observations about deviation of DDP for cereals food, we estimated a model and obtained its residual sum of squares (RSS) which was 24.9 with df =(758 – 10) = 748. Where, 758 was the sample size N and the parameters *K* was estimated was 10. At the same time, we got the RSS_{normal}, sample size N_{normal} from model 4.1 which was estimated by observations with normal deviation, and the RSS_{risky}, sample size N_{risky} from model 4.2 which was estimated by the observations had risky deviation.

$RSS = 24.9$, $N = 758$

$RSS_{normal} = 1.5$, $N_{normal} = 231$

$RSS_{risky} = 11.8$, $N_{risky} = 527$

So, following the figure 3.5, we figured out the *F* value was 58.0

Since the total sample size N was more than 200, then the degree of freedom was $+\infty$ in the table of *F* distribution, the number of parameters estimated *K* was 10. From the table of *F* distribution, if α is fixed at the 5% level, the critical $F_{10,\ \infty}= 1.83$. Then, the observed *F* value exceed the critical $F_{10,\ \infty}= 1.83$ at $\alpha=0.05$ level of significance, we rejected the hypothesis that model 4.1 and model 4.2 was same. It means there was obvious structural difference between normal deviation group and risky deviation group on cereals consumption in urban areas.

2) Meat & Seafood

The estimated model were shown in equation 4.3 and equation 4.4, For all statistical tests using the α =0.05 level of significance.

$$Log(NORMAL) = -0.814 + 0.131Log(INC) + 0.001H\_SIZE + 0.005H\_EDU - 0.002S\_EDU$$
$$\textbf{t-stat.} \quad (-2.23) \quad (3.27) \quad (0.04) \quad (0.87) \quad (-0.43)$$
$$- 0.187Log(P\_RICE) - 0.305Log(P\_PORK) + 0.182Log(P\_VEG)$$
$$(-2.13) \quad (-2.63) \quad (2.82)$$
$$+ 0.113Log(P\_EGG) + 0.022Log(P\_OIL)$$
$$(1.43) \quad (0.29)$$
$$R^2 = 0.74 \qquad \bar{R}^2 = 0.67$$
$$F\text{-stat.} = 4.05 \qquad N = 286 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.3)$$

In this regression model, including about 286 available observations. The R-square was about 0.74, that means the variable considered by this model was able to explain about 74 percent of independent variable. The other 26 percent needed to be modified by disturbance term.

The observations whose meat & seafood intake was lower than standard recommended were involved in this group. According to the result, coefficients estimated for household income, price for rice, price for pork and price for vegetable were significant at α=0.05 level of significance. The household income elasticity took on positive of 0.13. If household income increase 10 percent, the normal deviation of meat & seafood would go up 1.3 percent. It means that people in this group will consume much more meat and seafood with the increasing of their income. For the elasticity of rice, with the rising of its price, meat and seafood consumption would go down since they are usually consumed jointly. Just like the own-elasticity for any normal goods, if the price of pork increased 10 percent, its consumption will decline 3.05 percent in this group people. As the major substitute for non-staple food, the deviation of meat & seafood will increase 1.1 percent with the 10 percent increasing of the price for vegetable.

$$Log(RISKY) = 0.213 + 0.043Log(INC) + 0.0153H\_SIZE + 0.00008H\_EDU + 0.003S\_EDU$$

$$\textbf{t-stat.} \quad (1.02) \quad (1.97) \quad (1.49) \quad (0.02) \quad (1.04)$$

$$+ 0.036Log(P\_RICE) - 0.122Log(P\_PORK) + 0.141Log(P\_VEG)$$

$$(0.92) \quad (-2.09) \quad (4.33)$$

$$- 0.191Log(P\_EGG) + 0.067Log(P\_OIL)$$

$$(-4.96) \quad (1.99)$$

$$R^2 = 0.84 \qquad \bar{R}^2 = 0.72$$

$$F\text{-stat.} = 5.83 \qquad N = 472 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.4)$$

This regression model included about 472 available observations. The R-square of this model is about 0.84, that means the variable considered by this model was able to explain about 84 percent of independent variable. The other 16 percent needed to be modified by error term.

The members in this group, the intake on meat & seafood was greater than maximum limited standard recommended. Based on the result from analysis, coefficients estimated for household income, price for pork, price for vegetable, price for egg, and price for oil were significant at α=0.05 level of significance. The household income elasticity took on positive of 0.043. If household income increase 10 percent, the normal deviation of meat & seafood would go up 0.43 percent. It means that people in this group will add their intake on meat and seafood with the increasing of their income even it was already more than the maximum limited standard. As the same food category, elasticity for pork and elasticity for egg were negative number of –0.122 and –0.181. It told us people would cut down their consumption on meat & seafood when they face the increasing price for pork and egg. Likewise, if the price of vegetable and oil move up, it will stimulate people to consume added food from animal product, such as pork, poultry, and seafood.

- Chow test for meat & seafood models

Using all the observations about deviation of DDP for meat & seafood, we estimated a model and obtained its residual sum of squares (RSS) which was 89.4 with df =(758 – 10) = 748. Where, 758 was the sample size N and the parameters K was estimated was 10. At the same time, we got the RSS_{normal}, sample size N_{normal} from model 4.3 which was estimated by observations with normal deviation, and the RSS_{risky}, sample size N_{risky} from model 4.4 which was estimated by the observations had risky deviation.

$RSS = 89.4$, $N = 758$

$RSS_{normal} = 20.1$, $N_{normal} = 286$

$RSS_{risky} = 15.4$, $N_{risky} = 472$,

So, following the figure 3.5, we figured out the F value was 107.8

Since the total sample size N was more than 200, then the degree of freedom was $+\infty$ in the table of F distribution, the number of parameters estimated K was 10. From the table of F distribution, if α is fixed at the 5% level, the critical $F_{10,\ \infty}$= 1.83. Then, the observed F value exceed the critical $F_{10,\ \infty}$= 1.83 at α=0.05 level of significance, we rejected the hypothesis that model 4.3 and model 4.4 was same. It means that there was obvious structural difference between normal deviation group and risky deviation group on meat & seafood consumption in urban areas.

3) Fruit & Vegetable

The estimated model were shown in equation 4.5 and equation 4.6, For all statistical tests using the α =0.05 level of significance.

$$Log(NORMAL)=-0.723+0.154Log(INC)+0.007H\_SIZE+0.004H\_EDU+0.009S\_EDU$$
$$\textbf{t-stat.}\quad (-2.39)\quad (4.84)\quad (0.45)\quad (0.80)\quad (2.20)$$
$$+0.018Log(P\_RICE)-0.054Log(P\_PORK)+0.069Log(P\_VEG)$$
$$(0.31)\quad (-0.61)\quad (1.39)$$
$$-0.156Log(P\_EGG)+0.098Log(P\_OIL)$$
$$(-2.81)\quad (1.96)$$
$$R^2=0.61 \qquad \bar{R}^2=0.53$$
$$F\text{-stat.}=7.11 \qquad N=681 \qquad \ldots\ldots\ldots\ldots\ldots\ldots(4.5)$$

This regression model included about 681 available observations. The R-square of this model is about 0.61, that means the variable considered by this model was able to explain about 61 percent of independent variable. The other 39 percent needed to be modified by error term.

The observations whose Fruit & Vegetable intake was higher than standard recommended were involved in this group. According to the result, coefficients estimated for household income, education level of the spouse, price for egg, and price for oil were significant at α=0.05 level of significance. The household income elasticity was positive number of 0.154. People's fruit and vegetable consumption would go up 1.5 percent while their household income increase 10 percent. Even the magnitude was very weaken, to improve the education level of the spouse, normally means women, will get the promotion of fruit and vegetable intake. At the same time, with 10 percent increasing of price for egg, people would decline their fruit and vegetable consumption 1.56 percent. If the price for oil go up 10 percent, people would increase their fruit and vegetable consumption 0.98 percent.

$$Log(RISKY) = -0.756 + 0.146Log(INC) + 0.003H\_SIZE - 0.005H\_EDU + 0.007S\_EDU$$

$$\textbf{t-stat.} \quad (-1.05) \quad (1.98) \quad (0.08) \quad (-0.43) \quad (0.57)$$

$$+ 0.0009Log(P\_RICE) - 0.127Log(P\_PORK) + 0.031Log(P\_VEG)$$

$$(0.004) \quad (-0.56) \quad (0.29)$$

$$+ 0.007Log(P\_EGG) - 0.197Log(P\_OIL)$$

$$(0.04) \quad (-1.01)$$

$$R^2 = 0.21 \qquad \bar{R}^2 = 0.12$$

$$F\text{-stat.} = 1.12 \qquad N = 77 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.6)$$

This regression model included about 77 available observations only. Actually, the sample size was not big enough. The R-square of this model is about 0.21, that means the variable considered by this model was able to explain about 21 percent of independent variable. The other 79 percent needed to be modified by disturbance term.

Only the coefficient for household income of 0.146 was significant at α=0.05 level of significance in model 4.6. In this observation group, people's fruit and vegetable consumption was lower than the standard recommended. It means that people in this group will boost up their fruit and vegetable consumption 1.46 percent when their household income increase 10 percent.

- Chow test for Fruit & Vegetable models

Using all the observations about deviation of DDP for fruit & vegetable, we estimated a model and obtained its residual sum of squares (RSS) which was 121.4 with df =(758 – 10) = 748. Where, 758 was the sample size N and the parameters K was estimated was 10. At the same time, we got the RSS_{normal}, sample size N_{normal} from model 4.5 which was estimated by observations with normal deviation, and the RSS_{nsky}, sample size N_{nsky} from model 4.6 which was estimated by the observations had risky deviation.

$RSS = 121.4$, $N = 758$

$RSS_{nromal} = 69.7$, $N_{normal} = 681$

$RSS_{risky} = 5.7$, $N_{risky} = 77$,

So, following the figure 3.5, we figured out the F value was 46.

Since the total sample size N was more than 200, then the degree of freedom was $+\infty$ in the table of F distribution, the number of parameters estimated K was 10. From the table of F distribution, if α is fixed at the 5% level, the critical $F_{10,\ \infty}= 1.83$. Then, the observed F value exceed the critical $F_{10,\ \infty}= 1.83$ at $\alpha=0.05$ level of significance, we rejected the hypothesis that model 4.5 and model 4.6 was same. It means there was obvious structural difference among normal deviation group and risky deviation group on fruit & vegetable consumption in urban areas.

4) Discussion

In order to find the different effect between normal deviation and risky deviation for each food category in urban areas, Table 4.18 summarized the coefficients and the value of *t-statistic* from equation 4.1 to 4.6.

This study produced consistent and important result. It showed that there were important ways in which indicator changes could affect the food consumption of various groups with different effect.

Table 4.18 Result of Regression Analysis with Urban Data by Major Foods

	Dependent Var.	Inc	H_size	H_edu	S_edu	P_rice	P_pork	P_veg	P_egg	P_oil	N	R^2
Cereals	Normal	-0.22	0.004	-0.001	0.002	0.037	0.052	-0.038	-0.011	0.034	231	0.12
	(t-stat).	-1.59	0.59	-0.53	1.03	1.23	1.38	-1.80	-0.41	1.68		
	Risky	**-0.05***	-0.001	0.0007	-0.002	-0.039	0.074	**-0.092***	**0.092***	0.057	527	0.77
	(t-stat).	**-2.94**	-0.11	0.03	-1.01	-1.23	1.56	**-3.54**	**3.16**	1.90		
Meat & Seafood	Normal	**0.131***	0.001	0.005	-0.002	**-0.187****	**-0.305***	**0.182***	0.113	0.022	286	0.74
	(t-stat.)	**3.27**	0.04	0.82	-0.43	**-2.13**	**-2.63**	**2.82**	1.43	0.29		
	Risky	**0.043****	0.015	0.0008	0.003	0.036	**-0.122****	**0.141***	**-0.191***	**0.067****	472	0.84
	(t-stat.)	**1.97**	1.49	0.02	1.04	0.92	**-2.09**	**4.33**	**-4.96**	**1.99**		
Fruit & Vegetable	Normal	**0.154***	0.007	0.004	**0.009****	0.018	-0.054	0.069	**-0.156***	**0.098****	681	0.61
	(t-stat.)	**4.84**	0.45	0.80	**2.20**	0.31	-0.61	1.39	**-2.81**	**1.96**		
	Risky	**0.146****	0.003	-0.005	0.007	0.0009	-0.127	0.03	0.007	-0.197	77	0.21
	(t-stat.)	**1.98**	0.08	-0.43	0.57	0.004	-0.56	0.29	0.04	-1.01		

* Significantly different from zero at the 1% level; ** Significantly different from zero at 5% level.

On cereals consumption, most of observations belong to the groups which had risky deviation. It means cereals consumption in most households were lower than the standard recommended (60% of total energy). With the increment of household income, people would cut down their food consumption on cereals both normal deviation group and risky deviation group. Although the magnitude of income elasticity to normal deviation group was higher than that to risky deviation group, it had no statistical significance at 5% level. Changes of household size, educational level of household head and the spouse, and rice price elasticity had contrary effect on cereals consumption between normal deviation group and risky deviation group. However, the magnitudes of them were very weak and without statistical significance. Both normal deviation group and risky deviation group, the pork price elasticity and oil price elasticity presented positive sign and insignificant at 5% level. The figures to risky deviation group were higher than that to normal deviation group. If the prices of pork and oil increase, people would consume more cereals food. Vegetable price elasticity in both groups was negative number. It was complement between vegetable and cereals. The absolute value of vegetable price elasticity to risky deviation groups was bigger than that to normal deviation group. It indicated that the degressive effect on cereals consumption to risky deviation group would be higher than which to normal deviation group when the vegetable price increased. At the same time, among two groups, the egg price elasticity showed different effect. With the increment of egg price, cereals consumption would decrease in normal deviation group and would move up in risky deviation group with more stronger effect. Clearly, it was a useful way to decrease vegetable price and increase the prices for egg and oil in order to encourage cereals consumption to risky deviation group.

On meat & seafood consumption, a majority of observations had risky deviation. Meat & seafood consumption in most of households was higher than standard recommended. With the growing of household income, both groups would increase their meat & seafood consumption. That effect to normal deviation group was more powerful than that to risky deviation group. The magnitudes of coefficients estimated for household size, educational level of household head and the spouse were very weak to both groups and without statistical significance. The effect of rise price was different between normal deviation group and risky deviation group. To increase the price of rise would reduce meat consumption to normal group. At the same time, it would stimulate meat consumption to risky group with quite limited effect. As own-price elasticity, pork price elasticity was significant factor to both groups. Both groups people would reduce their meat consumption when pork price moved up. For primary substitute in non-staple foods, vegetable price elasticity was a sensitive factor with quite high statistical significance to both groups. If vegetable price decreased, both groups people would cut down their meat consumption. Comparing with normal deviation group, the changes for egg price and oil price had more powerful effects to risky group with higher statistical significance. Hence, for the sake of reducing over meat consumption, it was a impactful way to increase the prices of pork and egg and decrease vegetable price.

On fruit and vegetable consumption, the normal deviation group comprised the most part observations. Only few households need promote their fruit & vegetable consumption. In terms of the result, household income was the most important factors to increase people's fruit & vegetable consumption to both two groups. Both income elasticities were positive number and had statistical significance at 5% level. To increase educational level of the spouse and oil price, and decrease vegetable price would promote fruit & vegetable consumption to normal deviation group people. Although other factors had different effect to normal deviation group and risky deviation group, most of them were very weak and insignificant. To improve fruit & vegetable consumption, the best way was to increase household income.

Based on the analysis mentioned above, there was evidence of substantial responses to household income on food consumption. These elasticities from equation 4.1 to equation 4.6 indicated that increase of household income led to a rise probability of consumption for some high quality food, such as meat and seafood, fruit and vegetable. On the other hand, the cereal consumption for majority of household was lower than its standard recommended. People's cereals consumption still remained a lower level. Hence, in terms of the result, we thought people in urban areas have already gotten enough money on their food consumption and there were adequate kinds of food in market to satisfy their need. Some traditional conceptions on food consumption were already changed from low energy food to high energy, high fat food.

As was shown in this analysis, price change for meat & seafood, like pork, had a large effect on reducing fat intake. It will also stimulate the increasing of vegetable consumption. At the same time, we could image, with the increase of pork price, people would like to choose another important substitute – poultry to reinforce the reducing for energy and protein intake. It also would satisfy their preference of meat consumption for people in urban areas. In nutrition side, poultry was more health-giving food to compare with pork since poultry contained higher energy and protein, but lower fat. In addition, some relative research indicated that the feedingstuff translation ratio for poultry was much higher than that for pork. The meat of poultry 1kg need 2.5 to 2.8 kg of feedingstuff to translate and that for pork was 4.0 to 4.5 kg (FAO,1998). It will also reduce the pressure of demand for grain of feedingstuff. As suggestion, in urban areas, it would be very useful to use price policy to guide people's pork consumption into a reasonable level.

Some factors in this study, such as household size, educational level for household head and the spouse, were insignificant. Since processing rigid birth control policy in urban of China, it was inevitable about the household size becoming smaller and smaller. With the improvement of socioeconomic, people's educational level went up obviously, particularly for young couple. It was very difficult to find any evidence to distinguish the effect on food consumption among these factors. Maybe, it was better to select some new factors to fit this kind of change.

4.3.2.2 Multivariate Regression Analysis with Rural Data

1) Cereals

The estimated model were shown in equation 4.7 and equation 4.8, For all statistical tests using the α =0.05 level of significance.

$$Log(NORMAL)=0.432 - 0.045Log(INC) + 0.007H\_SIZE - 0.0008H\_EDU + 0.001S\_EDU$$

$$\textbf{t-stat.} \quad (6.70) \quad (-8.07) \quad (3.21) \quad (0.69) \quad (1.30)$$

$$+ 0.007Log(P\_RICE) + 0.039Log(P\_PORK) - 0.025Log(P\_VEG)$$

$$(0.53) \quad (2.11) \quad (-2.44)$$

$$+ 0.031Log(P\_EGG) - 0.0006Log(P\_OIL)$$

$$(2.45) \quad (-0.06)$$

$$R^2 = 0.67 \qquad \bar{R}^2 = 0.59$$

$$F\text{-stat.} = 11.47 \qquad N = 1452 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.7)$$

In this regression model, including about 1,452 available observations. The R-square of this model is about 0.67, it means the variable considered by this model was able to explain about 67 percent of independent variable. The other 33 percent needed to be modified by error term.

In this group, people's cereal intake was higher than the standard recommended. Coefficients estimated for household income, household size, price for pork, price for vegetable and price for egg were significant at α =0.05 level of significance. Herein, the household income elasticity was negative number of –0.045. It indicated that cereals consumption would decline 0.45 percent with the increasing of household income by 10 percent. Growing the household size, people had to choose cereals food more regarding their basic food. Pork and egg were belong to food from animal source. If the prices of them moved up 10 percent respectively, cereals consumption would take a increment by 0.39 percent from the change of the price for pork, 0.31 percent from the change of the price of egg. To most of rural households, vegetable was a major kind of non-staple food. When the price for vegetable rose 10 percent, cereal consumption of people in rural would take a drop by 0.31 percent.

$$Log(RISKY) = -1.728 + 0.556Log(INC) - 0.038H\_SIZE - 0.008H\_EDU + 0.046S\_EDU$$
$$\textit{t-stat.} \quad (-0.70) \quad (3.23) \quad (-0.69) \quad (-0.27) \quad (1.68)$$
$$- 0.085Log(P\_RICE) + 0.431Log(P\_PORK) + 0.506Log(P\_VEG)$$
$$(-0.15) \quad (0.80) \quad (1.77)$$
$$- 2.736Log(P\_EGG) + 0.028Log(P\_OIL)$$
$$(-5.27) \quad (0.10)$$
$$R^2 = 0.32 \qquad \bar{R}^2 = 0.26$$
$$F\text{-}stat. = 5.51 \qquad N = 117 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.8)$$

There were about 117 available observations to be involved in this regression model included. The R-square of this model is about 0.32, that means the variable considered by this model was able to explain about 32 percent of independent variable. The other 68 percent needed to be modified by error term.

To compare with the sample size in equation 4.7, which was 1,452, the household whose cereal consumption under standard recommended was the minority within whole household in rural areas. The coefficients estimated of household income and the price for egg were significant at α =0.05 level of significance. When household income increase 10 percent, cereal consumption would increase 5.56 percent. With the raise of the price for egg, cereal consumption would take a significant drop. Clearly, cereals food was still the primary choice on food consumption to people in rural areas.

- Chow test for cereals models

Using all the observations about deviation of DDP for cereals food, we estimated a model and obtained its residual sum of squares (RSS) which was 173.2 with df =(1569 – 10) = 1559. Where, 1569 was the sample size N and the parameters K was estimated was 10. At the same time, we got the RSS_{normal}, sample size N_{normal} from model 4.7 which was estimated by observations with normal deviation, and the RSS_{risky}, sample size N_{risky} from model 4.8 which was estimated by the observations had risky deviation

RSS = 173.2, N = 1,569

RSS_{normal} = 14.9, N_{normal} = 1,452

RSS_{risky} = 61.2, N_{risky} = 117

So, following the figure 3.5, we figured out the F value was 194.2

Since the total sample size N was more than 200, then the degree of freedom was $+\infty$ in the table of F distribution, the number of parameters estimated K was 10. From the table of F distribution, if α is fixed at the 5% level, the critical $F_{10, \infty}$= 1.83. Then, the observed F value exceed the critical $F_{10, \infty}$= 1.83 at α=0.05 level of significance, we rejected the hypothesis that model 4.7 and model 4.8 was same. It indicated there was obvious structural difference among normal deviation group and risky deviation group on cereals consumption in rural areas.

2) Meat & Seafood

The estimated model were shown in equation 4.9 and equation 4.10, For all statistical tests using the α =0.05 level of significance.

$$Log(NORMAL)=-1.525 + 0.161Log(INC) - 0.010H\_SIZE - 0.004H\_EDU - 0.009S\_EDU$$
$$\textbf{t-stat.} \quad (-3.18) \quad (3.89) \quad (-0.65) \quad (-0.42) \quad (-1.28)$$
$$- 0.015Log(P\_RICE) - 0.279Log(P\_PORK) + 0.201Log(P\_VEG)$$
$$(-0.15) \quad (-2.07) \quad (2.68)$$
$$+ 0.049Log(P\_EGG) - 0.092Log(P\_OIL)$$
$$(0.53) \quad (-1.10)$$
$$R^2 = 0.62 \qquad \bar{R}^2 = 0.53$$
$$F\text{-stat.} = 3.28 \qquad N = 1405 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.9)$$

We put about 231 available observations in this regression model. The R-square of this model was about 0.62, that means the variable considered by this model was able to explain about 62 percent of independent variable. The other 38 percent needed to be modified by disturbance term.

In this observation group, people's meat and seafood consumption was lower than the standard recommended. The coefficients estimated of household income, price for pork, and price for vegetable were significant at α =0.05 level of significance. The household income elasticity was positive number of 0.161. It means meat and seafood consumption would increase 1.61 percent if household income moved up 10 percent. The elasticity of price for pork and vegetable were –0.279 and 0.201. It showed use if the price of pork and vegetable moved up 10 percent respectively, the consumption of meat and seafood would decrease 2.79 percent and 2.01 percent individually. Thus, in order to ensure the normal consumption of meat and seafood, it was necessary to keep pork price in a lower level in rural areas.

$$Log(RISKY) = 0.866 - 0.074Log(INC) - 0.007H\_SIZE - 0.035H\_EDU + 0.003S\_EDU$$
$$\textbf{t-stat.} \quad (1.31) \quad (-1.52) \quad (-0.41) \quad (-3.55) \quad (0.38)$$
$$- 0.364Log(P\_RICE) - 0.176Log(P\_PORK) + 0.297Log(P\_VEG)$$
$$(-2.36) \quad (-1.04) \quad (3.33)$$
$$- 0.821Log(P\_EGG) - 0.032Log(P\_OIL)$$
$$(-4.92) \quad (-0.34)$$
$$R^2 = 0.46 \qquad \bar{R}^2 = 0.42$$
$$F\text{-stat.} = 6.03 \qquad N = 165 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4.10)$$

This regression model included about 165 available observations. The R-square of this model is about 0.46, it told us the variable considered by this model was able to explain about 46 percent of independent variable. The other 54 percent needed to be modified by error term.

The observations whose had higher meat and seafood consumption were included this group. The coefficients estimated of educational level for household head, price for rice, price for vegetable, and price for egg were significant at α =0.05 level of significance. To increase the educational level of household head will decrease the meat and seafood consumption to household. As the major substitute of non-staple food, when the price of vegetable took a increment by 10 percent, the consumption of meat and seafood would increase 2.97 percent. At the same time, if the price for egg moved up by 10 percent, the meat and seafood consumption would cut down by 8.21 percent.

- Chow test for meat & seafood models

Using all the observations about deviation of DDP for cereals food, we estimated a model and obtained its residual sum of squares (RSS) which was 1096.6 with df =(1570 – 10) = 1560. Where, 1570 was the sample size N and the parameters *K* was estimated was 10. At the same time, we got the RSS_{normal}, sample size N_{normal} from model 4.9 which was estimated by observations with normal deviation, and the RSS_{risky}, sample size N_{risky} from model 4.10 which was estimated by the observations had risky deviation

$RSS = 1096.6$, $N = 1570$

$RSS_{normal} = 778$, $N_{normal} = 1405$

$RSS_{risky} = 10.8$, $N_{risky} = 165$

So, following the figure 3.5, we figured out the F value was 60.4

Likewise, since the observed F value exceed the critical $F_{10,\infty} = 1.83$ at $\alpha=0.05$ level of significance, we rejected the hypothesis that model 4.9 and model 4.10 was same. It means there was obvious structural difference between normal deviation group and risky deviation group on meat & v seafood consumption in rural areas.

3) Fruit & Vegetable

The estimated model were shown in equation 4.11 and equation 4.12, For all statistical tests using the α =0.05 level of significance.

$$Log(NORMAL) = -0.080 + 0.154Log(INC) - 0.013H\_SIZE + 0.008H\_EDU - 0.004S\_EDU$$

t-stat. (-0.16) (3.48) (-0.74) (0.80) (-0.47)

$$+ 0.157Log(P\_RICE) - 0.103Log(P\_PORK) - 0.152Log(P\_VEG)$$

(1.32) (-0.77) (-1.92)

$$+ 0.212Log(P\_EGG) - 0.132Log(P\_OIL)$$

(2.17) (-1.56)

$R^2 = 0.42$ $\bar{R}^2 = 0.35$

$F\text{-stat.} = 2.99$ $N = 380$ ……………… (4.11)

In this regression model, including about 380 available observations. The R-square of this model is about 0.42, that means the variable considered by this model was able to explain about 42 percent of independent variable. The other 58 percent needed to be modified by error term.

The members in this group, its intake on fruit and vegetable was greater than standard recommended. The coefficients estimated of household income and price for egg were significant at α =0.05 level of significance. The *p* value of *t-statistic* of the price for vegetable was 0.0552. It got a little bit more than α =0.05 significant level. As own-price elasticity, it should be mentioned too. The household income elasticity was 0.154. It means when household income increase 10 percent, people would add their consumption on fruit and vegetable by 1.54 percent. For own-price elasticity, same as other normal goods, if the price for vegetable moved up 10 percent, its consumption would take a decline by 1.52 percent. In the meantime, increasing the price for egg by 10 percent would advance people's consumption on fruit and vegetable by 2.12 percent.

$$Log(RISKY) = -1.627 + 0.067Log(INC) - 0.026H\_SIZE - 0.001H\_EDU + 0.004S\_EDU$$

$$t\text{-stat.} \quad (-3.26) \quad (1.57) \quad (-1.63) \quad (-0.14) \quad (0.55)$$

$$- 0.005Log(P\_RICE) - 0.112Log(P\_PORK) + 0.100Log(P\_VEG)$$

$$(-0.05) \quad (-0.79) \quad (1.30)$$

$$+ 0.257Log(P\_EGG) + 0.032Log(P\_OIL)$$

$$(2.60) \quad (0.37)$$

$$R^2 = 0.11 \qquad \bar{R}^2 = 0.04$$

$$F\text{-stat.} = 2.88 \qquad N = 1190 \qquad \ldots\ldots\ldots\ldots (4.12)$$

This regression model included about 1,190 available observations. The R-square of this model is about 0.11, that means the variable considered by this model was able to explain about 11 percent of independent variable. The other

89 percent needed to be modified by error term.

In this observations group, the consumption of fruit and vegetable was lower than the standard recommended. Based on the result of regression analysis, only the coefficient estimated of the price for egg was significant at α =0.05 level of significance. The cross-price elasticity of the price for egg was positive number of 0.257. It represented the consumption on fruit and vegetable would moved up 2.57 percent if the price for egg increased by 10 percent to the household in this group.

- Chow test for meat & seafood models

Using all the observations about deviation of DDP for cereals food, we estimated a model and obtained its residual sum of squares (RSS) which was 1103.4 with df =(1570 – 10) = 1560. Where, 1570 was the sample size N and the parameters K was estimated was 10. At the same time, we got the RSS_{normal}, sample size N_{normal} from model 4.11 which was estimated by observations with normal deviation, and the RSS_{risky}, sample size N_{risky} from model 4.12 which was estimated by the observations had risky deviation

RSS = 1103.4, N = 1570

RSS_{normal} = 61.5, N_{normal} = 380

RSS_{risky} = 570.2, N_{risky} = 1190

So, following the figure 3.5, we figured out the F value was 115.05

Likewise, since the observed F value exceed the critical $F_{10,\ \infty}$= 1.83 at α=0.05 level of significance, we rejected the hypothesis that model 4.11 and model 4.12 was same. It showed that there was obvious structural difference among normal deviation group and risky deviation group on fruit & vegetable consumption in rural areas.

Table 4.19 Result of Regression Analysis with Rural Data by Major Foods

	Dependent Var.	Inc	H_size	H_edu	S_edu	P_rice	P_pork	P_veg	P_egg	P_oil	N	R^2
Cereals	Normal	**-0.045***	**0.007***	-0.0008	0.001	0.007	**0.039****	**-0.025****	**0.03****	-0.0006	1452	0.67
	(t-stat).	**-8.07**	**3.21**	0.69	1.30	0.53	**2.11**	**-2.44**	**2.45**	-0.06		
	Risky	**0.556***	-0.038	-0.008	0.046	-0.085	0.43	0.506	**-2.73***	0.028	117	0.32
	(t-stat).	**3.23**	-0.69	-0.27	1.68	-0.15	0.80	1.77	**-5.27**	0.10		
Meat & Seafood	Normal	**0.16***	-0.010	-0.004	-0.009	-0.015	**-0.279****	**0.201***	0.049	-0.092	1405	0.62
	(t-stat.)	**3.89**	-0.65	-0.42	-1.28	-0.15	**-2.07**	**2.68**	0.53	-1.10		
	Risky	-0.074	-0.007	**-0.035***	0.003	**-0.364****	-0.176	**0.297***	**-0.821***	-0.032	165	0.46
	(t-stat.)	-1.52	-0.41	**-3.55**	0.38	**-2.36**	-1.04	**3.33**	**-4.92**	-0.34		
Fruit & Vegetable	Normal	**0.154***	-0.013	0.008	-0.004	0.157	-0.103	-0.152	**0.212****	-0.132	380	0.42
	(t-stat.)	**3.48**	-0.74	0.80	-0.47	1.32	-0.77	-1.92	**2.17**	-1.56		
	Risky	0.067	-0.026	-0.001	0.004	-0.005	-0.112	0.100	**0.257***	0.032	1190	0.11
	(t-stat.)	1.57	-1.63	-0.14	0.55	-0.05	-0.79	1.30	**2.60**	0.37		

* Significantly different from zero at the 1% level; ** Significantly different from zero at 5% level.

4) Discussion

Table 4.19 summarized the coefficients and the value of *t-statistic* from equation 4.7 to 4.12 in order to find the different effect between normal deviation and risky deviation for each food category in rural areas,

On cereals consumption, most of observations had normal deviation. It means cereals consumption in most households was higher than the standard recommended (60% of total energy). Household income elasticity showed contrary effect between normal deviation group and risky deviation group. With the increment of household income, normal deviation group household would cut down their cereals consumption. On the other hand, the household in risky deviation group would increase their cereals consumption by a large magnitude. Household size was positive number with statistical significance to normal deviation group even the effect was very limited. Educational level for household head and the spouse, price for rice, and price for oil were insignificant factors to both two groups. If the price for pork would move up, both two groups would increase their cereals consumption. Although that effect to risky group was more powerful, it had no statistical significance. With the increment of vegetable price, normal deviation group household would reduce their amount of cereals consumption even that effect was not too strong. On the contrary, for risky group, they would increase their cereals consumption whereas its t-statistic got a little bit lower at 5% level. Egg price elasticity was a significant factor to both two groups with reverse effect. If egg price reduced, the cereal consumption to normal deviation group household would decline and that to risky group household would be moved up. Hence, in order to control the cereals consumption to normal deviation group and to promote that to risky deviation group, it would be useful to increase household income and to reduce the price for egg a little bit since the magnitude of egg price elasticity to risky deviation group was very huge.

On meat & seafood consumption, majority of observations belongs to normal deviation group. Meat consumption in most of households was lower than standard recommended. Household income elasticity to normal deviation group was positive number with statistical significance at 5% level. Most of household would eat more meat & seafood when their income increased. On the contrary, household income elasticity to risky deviation group present negative sign without statistical significance at 5% level. That effect was very weak also. The effects of household size, educational level of the spouse and price for oil to both group were quite limited and to be insignificant factors. With the increment of pork price, meat consumption to both two groups would decline. The decreasing degree to normal deviation group was higher than that to risky deviation group. As substitute, when vegetable price increased, both two groups household would increase their meat consumption. The magnitude of income elasticity to risky deviation group was higher than that to normal deviation group. This situation should be paid more attention. In the meantime, for risky deviation group, to increase rice price and egg price had negative effect to influence on meat consumption to risky deviation group.

On fruit & vegetable consumption, most part of observations was comprised in risky deviation group. Their fruit and vegetable consumption was lower than standard recommended. Increasing household income was useful to promote fruit and vegetable consumption to both normal deviation group and risky deviation group. The magnitude of income elasticity to risky deviation group was lower than that to normal deviation group and without statistical significance at 5% level. If people faced the increment of egg price, both two groups household would promote their fruit and vegetable consumption by contiguous degree. The coefficients of other factors had no significance at 5% level. At the same time, their effects were quite limited. Herein, it indicated, at present, the egg price and household income were the most important factors to affect fruit and vegetable consumption to both two groups in rural areas.

In terms of the result, we could find that, household income was a sensitive factor on people's food consumption. In rural, with the increment of household income, it had a tendency in increasing the consumption for high quality foods and reducing cereals food consumption. Nevertheless, since the constraint of the absolute value for household income that was shown in Table 4.15, up to now, cereal food was still primary choice for people in rural areas. It also could explain why the own-price elasticity of rice was insignificant factor in most of situations. By the same reason, the increment of household size will restrict people to consume some high quality food. People had to continue to increase their cereals food consumption. It showed us population control was still a very important policy in rural area of China, the increasing population will become a heavy burden in nutritional improvement and will reduce the quality of dietary to family.

In traditional Chinese diet, vegetable is regarded a very important non-staple food. It was also useful to improve the quality of diet. The own-price elasticity for vegetable was a sensitive factor in most of circumstances. From Table 4.13 we knew, even in rural area, the quantity of vegetable consumption was not too low. They were at the same level between urban and rural on vegetable consumption. It was very important to preserve the price for vegetable at stable level. Because of the limitation on source data, we did not put the price for legume and its product into our model. Actually, in terms of the result was shown in Table 4.13, the quantity of legume consumption in rural was much more than that in urban. We could imagine, while to remain the basic quantity of vegetable food intake, people in rural area could increase the quantity of legume food consumption. It has great advantage in promotion their integrate nutritional level, particularly for low income group.

A very interesting result was shown in this study about the price of egg in rural areas. The price elasticity of egg was a significant factor in most of situations. It indicated that egg consumption was a very important way in providing protein from animal source to people in rural areas. The change of price for egg would affect the quality of people's nutritional status directly. Considering the consumption of meat and seafood still stay a lower level, it was necessary to take price protection, such as government subsidy, in order to improve the diet quality for rural areas people.

As few amount of food from animal product was consumed in rural area when compare with that in urban area, majority household in rural area was not sensitive in the change of prices for pork. Nevertheless, with the increment of household income and the change of people's consumption conception, in long views, they will increase their consumption on food from animal product to improve their nutritional status.

Since the constraints of household income and some traditional conception on food consumption, some fixed food consumption patterns were formed by people in rural areas. In this study, educational level of household head and the spouse were insignificant factors in majority of models. It also indicated that nutritional education was a laborious and long-term work in rural areas. In fact, Chinese people always pay more attention to their health and nutritional status even for low income people. People would like to receive more nutritional knowledge and information. Hence, it was a feasible to help people improve their nutritional status by nutritional education under existing conditions. Certainly, it was necessary to carry out systemic and uninterrupted nutritional education to rural inhabitant in multiple modes. In the meantime, it needs some essential support in policy side and monetary, especially by government.