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The Impacts of Income from Non-agricultural Industries Operated by Rural households on Farmers' Income

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Abstract Income from non-agricultural industries operated by rural households is an important income source of farmers' income. According to the *Regional Rural Residents' Net Income Per Capita* in 2004 issued by the State Statistics Bureau and the relevant statistics of national comprehensive investigation (CGSS2005) in 2005, the impacts of farmers' income gap and farmers' individual features on their income and the impacts of income from non-agricultural industries operated by rural households on farmers' individual income differences are analyzed by applying Hierarchical Linear Models (HLM) as an analysis tool to establish the null model of HLM, excluding the second level model of the second level prediction variables and including the second level model of the second layer prediction variables. The analysis assumes that farmers' individual income varies hugely in different provinces; farmers' individual income has close relation with farmers' individual features; the improvement of income from non-agricultural industries operated by rural households has different impacts on farmers' income.

Key words Non-agricultural income, Household operation, hierarchical linear model, China

Non-agricultural income of farmers means income by rural labors from the other fields instead of agriculture, including industry and service industry. It equals to wage income plus non-agricultural household income. Among them, wage income means the income obtained by rural labors, who are employed by unit or individual to sell their labors. Non-agricultural household income means income obtained from non-agricultural operation in fields of industry, architecture and service industry. In 2009, affected by financial crisis nationwide, parts of enterprise industry are hard to operate, in particular, the production operation in coastal areas. So the number of migrant labors decreased sharply, which led to the slump of wage income. For another thing, non-agricultural household income has become an important source for farmers' income. According to statistics, the proportion of non-agricultural household operation income of Chinese farmers to the rural households' total non-agricultural income has surpassed 20%. The non-agricultural household operation income has become a major component. At the present, the researches on non-agricultural problems of rural household operation are mainly from the perspective of transferring rural labor resources to get non-agricultural income. The impacts of the income level of non-agricultural operation on farmers' income are analyzed to provide new thought pattern for researching farmers' income.

1 Index selection, data source and research method

1.1 Index selection Establishing HLM model: $Y_{ij} = B_{0j} + B_{1j}X_{ij} +$

R_{ij} , $B_{0j} = G_{00} + U_{0j}$, $B_{1j} = G_{10} + U_{1j}$, among which, X_{ij} is independent variable, Y_{ij} is dependent variable. J is the provincial administrative district of farmers, R_{ij} , B_{1j} and B_{0j} are residual coefficient, regression coefficient and intercept respectively; G_{00} and G_{10} are the average number of B_{0j} and B_{1j} respectively; U_{0j} and U_{1j} are the random elements of B_{0j} and B_{1j} , used to indicate the variables among provincial administrative districts. The model can be further evolved to $Y_{ij} = G_{00} + G_{10}X_{ij} + U_{0j} + U_{1j}X_{ij} + R_{ij}$, if U_{0j} and U_{1j} are zero, than the formation is the standard and common least square regression equation.

1.2 Data source Two groups of statistics are fostered to a statistic structure with two layers. The statistics in the first group is extracted from *Net Income Per capita of Rural Households in Part of Rural Areas* in 2004 issued by State Statistical Bureau. The statistics include detailed and specific information of net income per capita of rural households at provincial levels in various fields. Statistics in the second group came from the rural part of national social comprehensive survey in 2005 (CGSS2005). (Data analyzed in this paper were collected by the research project "China General Social Survey (CGSS)" sponsored by the China Social Science Foundation. This research project was carried out by Department of Sociology, Renmin University of China & Social Science Division, Hong Kong Science and Technology University, and directed by Dr. Li Lulu & Dr. Bian Yanjie. The authors appreciate the assistance in providing data by the institutes and individuals aforementioned. The views expressed herein are the authors' own.). (CGSS2005 is a sampling survey nationwide, the survey adopts the random sampling method. The interviewers survey interviewees through questionnaires. The survey is conducted in the time period from September, 2005 to October, 2005. The interviewers select 10 000 rural households from more than

100 districts and counties of 28 provinces and cities nationwide. Among each rural household selected, one family member is selected. The survey subjects are adult more than 18 years old without upper bound. People with listening defects and communication barriers are excluded from the survey. The specific information of interviewees are surveyed including, the provinces of the interviewees, personal income, gender, age, education accepted, identity *et al.*

1.3 Research method The hierarchical linear model (HLM) is selected as analysis tool, the overall income differences are decomposed to different layers. A quantitative index is given to measure the share taken by income difference to total difference caused by variables in different layers.

2 Results and analysis

2.1 Relevant assumption

2.1.1 At individual level, Becker, G S put forward that human capital is the knowledge, skills and physical of exist in human body and it can enhance future monetary and material gain^[1]. He thinks that through adding human resources, the future monetary and mental income can be affected. That is any activity on increasing farmers' production and income capability is human capital investment^[2]. Jacob, Mincer thinks that: the human capital investment way include accepting education, participating career training, healthcare and migration *et al.*^[3]. Besides, physical features of labors have direct impacts on income and production efficiency^[4]. Among these factors, educational level and health are the two key elements that determine the ownership of human capital. Rural labors can acquire knowledge through accepting education and skills after participating training, so the farmers' income has relation with individual educational degree. At macro level, due to the insufficient input on rural education and irrational investment structure, rural fundamental education is extremely weak (the average educational year of is less than nine year); The vocational education and adult education are still very weak^[5]. Agricultural production is still the labor with intensive labor forces, when participating in non-agricultural activities; most farmers take the simple labor-intensive labors as the major features^[6]. Therefore, farmers' income is related to the biological features, which determines weather they can bear long term and hard work. According to the above analysis, the assumptions on farmers' individual layers are put forward.

A1: the income of male farmers is higher than that of female farmers

A2: income of young farmers is higher than that of older farmers

A3: farmers with high educational degree has higher income.

2.1.2 Impacts of non-agricultural household operation income in different industries to farmers and their income. The non-agricultural household operation income level in industry is the average income obtained by non-agricultural operation in a certain industry. There are two prerequisites for obtaining non-agricultural income^[7]: the first one is the human capital demands, which including cultural education quality of labors, comprehen-

sive cultural quality of family members; the second one is the household material capital demands, which including productive fixed capital accumulation and reserved productive capital owned by rural households *et al.* Besides, the operation activities of different industries have different demands on human capital and material capital of operators. Therefore, the following assumption can be obtained:

B1: the non-agricultural household operation income from different industries has different impacts on farmers' income.

2.1.3 Income of farmers from different administrative areas. Due to the differences existed in different administrative areas; the following assumption can be made.

C1: Differences in farmers' income from different provincial administrative areas

2.2 Data processing In order to analyze the data, the data should be processed. Firstly, in CGSS2005M statistics, all the individual cases of urban registration, dependent variable (annual income) and individual cases with defects in independent variables (including zero annual income) should be eliminated. After that, 4 141 cases are left. The cases are arranged according to 28 provincial districts and each provincial district has 4 to 388 cases, which is in accordance with the demand of model analysis. Secondly, the two layers form the variables used in analysis. In the first layer, the variables used including annual income (dependent variables), gender (male = 2, female = 1), birth year, formal education accepted by interviewees (no formal education = 1, self schooled = 2, one year's education = 3, that is the number of year plus 2); in the layer of provincial districts (two layers), the variables used include the income of farmers in the fields of industry, construction industry, transportation, wholesale and retail, social services, culture, education, hygienic industries. In the end, input the processed statistics into the HTM data processing industries to analyze (Table 1).

2.3 Dissolution of farmers' income differences By using the HLM zero models, the income differences can be dissolved. The level-1 is $QB12B = B_0 + R$; The level-2 is $B_0 = G_{00} + U_0$. The model can be obtained:

$$QB12B = G_{00} + U_0 + R$$

In the model, B_0 is the intercept of level-1 equation, R is random effects, G_{00} is the fixed effects of the level-1 intercept in the second level; U_0 is random effects of level-2. In the model, there is no any variable, so the distribution of total can be tested. The test results indicates that the average number of income is 7 345.63 yuan. The interclass variable of individual income is 55 272 334.525 79, the between class variable is 61 344 995.111 00, X^2 value is 1 006.542 00, under the 27 degree of freedom, the P value is close to 0, which indicates that farmers' income differences among provincial administrative districts are vary significance (proving assumption C1). According to the distribution of variable components of HLM is level-2, the trans-grade relevant coefficient is 52.6%, which indicates that the difference provincial administrative districts lead to the differences of farmers' individual income. And the differences account for 52.6% of overall income differences, with the deviation degree of 85 688.671 67, which indicates the log-

arithm of model fit is similar to function value used to weight the improved degree of model.

Table 1 Descriptive Statistics of each variable

	Code	Variable Name	N	Mean	Standard deviation	Minimum	Maximum
LEVEL-1	QA201	Gender	4 141	1.50	0.50	1.00	2.00
	QA301	Birth Year	4 141	1 961.15	13.55	1 912.00	1 987.00
	QB03B	Education(year)	4 141	8.07	4.38	1.00	23.00
	QB12B	Income(yuan)	4 141	5 379.50	8 029.22	20.00	200 000.00
LEVEL-2 Yuan	V1	Industry	28	56.12	77.00	3.70	394.60
	V2	Construction	28	50.24	54.80	2.70	253.30
	V3	Transport, Post and Telecommunication Services	28	85.35	97.21	13.30	468.30
	V4	Wholesale and Retail Trade and Catering Services	28	91.55	69.69	14.10	327.20
	V5	Social Services	28	33.55	29.23	4.60	116.90
	V6	Education, Culture, and Health Care	28	8.65	5.83	0.50	22.80
	V7	Others	28	34.85	24.64	4.90	90.50

2.4 Impacts of farmers' individual features on their income

Through establishing hierarchical linear models without the variables in macro-level the impacts of farmers' individual features on their income are analyzed. The level-2 model without the prediction variables of the second level can be constructed as follows:

$$\text{level-1: } QB12B = B_0 + B_1 * (QA201) + B_2 * (QA301) + B_3 * (QB03B) + R$$

$$\text{level-2: } B_0 = G_{00} + U_0$$

$$B_1 = G_{10} + U_1$$

$$B_2 = G_{20} + U_2$$

$$B_3 = G_{30} + U_3$$

B_1 , B_2 and B_3 is the coefficients of the level-1 function; G_0 is the intercept of level-2 function; U_i is the residual variance, which has not been explained by the current mode in level-2 equation; the connotation of other variables is as mentioned. According to the above model, the analysis results can be obtained(Table 2).

Table 2 Regression results of model without level-2 Explanatory Variables (with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	P-value
For INTRCPT1, B0				
INTRCPT2, G00	7 232.221 717	1 555.535 529	4.649	0.000
For QA201 slope, B1				
INTRCPT2, G10	3 500.774 396	1 588.356 470	2.204	0.036
For QA301 slope, B2				
INTRCPT2, G20	82.211 224	28.968 053	2.838	0.009
For QB03B slope, B3				
INTRCPT2, G30	660.834 999	170.570 986	3.874	0.001
Random Effect	Standard Deviation	Variance Component	Chi-square	P-value
INTRCPT1, U0	8 327.653 67	69 349 815.678 32	1 245.176 28	0.000
QA201 slope, U1	8 416.831 09	70 843 045.533 21	263.481 16	0.000
QA301 slope, U2	148.129 23	21 942.269 79	81.674 96	0.000
QB03B slope, U3	903.912 56	817 057.918 84	225.705 18	0.000
level-1, R	6 575.657 10	43 239 266.355 87		
Deviance	84 693.604 89			

Table 2 shows the analysis results which take farmers' individual annual income as dependent variable and farmers' individual features as independent variables. Compared with deviation degree of zero model's analysis results, the model has increased three variables, but the deviation degree has decreased by 995. According to Chi-square tests in 2.3, the improvement of model fit has the significance of statistics. The results show that farmers' individual features are the prediction factor of individual income. Among these features, the regression coefficients of degree of gender, birth year, educational degree are 3 500.7743 96 ($P = 0.036$), 82.211 224 ($P = 0.009$) and 660.834 999 ($P = 0.001$) respectively, which indicate that they are all the positive prediction factor of farmers' individual income. That is to say, the higher the education accepted, the higher the income; the bigger the birth year of farmers, the

higher income of farmers; the income of male workers is higher than that of female farmers. The model tested that the assumption A1, A2 and A3 are established.

2.5 The impacts of non-agricultural household operation income in different industries on farmers' individual income

The level-2 model including the second level prediction variables is established to analyze the impacts of non-agricultural household operation environment on farmers' income

The first level:

$$QB12B = B_0 + B_1 * (QA2.01) + B_2 * (QA3.01) + B_3 * (QB03B) + R$$

The second level: $B_0 = G_{00} + U_0$

$$B_1 = G_{10} + G_{11} * (V1) + G_{12} * (V2) + G_{13} * (V3) + G_{14} * (V4) + G_{15} * (V5) + G_{16} * (V6) + G_{17} * (V7) + U_1$$

$$B_2 = G_{20} + G_{21} * (V1) + G_{22} * (V2) + G_{23} * (V3) + G_{24} * (V4) + G_{25} * (V5) + G_{26} * (V6) + G_{27} * (V7) + U_2$$

$(V_4) + G_{25} * (V_5) + G_{26} * (V_6) + G_{27} * (V_7) + U_2$
 $B_3 = G_{30} + G_{31} * (V_1) + G_{32} * (V_2) + G_{33} * (V_3) + G_{34} * (V_4) + G_{35} * (V_5) + G_{36} * (V_6) + G_{37} * (V_7) + U_3$
 G_{ij} is the regression coefficient of the level-2 equation, which re-

presents the impacts of each variable in the second level to the intercept B_i of the first level; the connotation of other variables is similar to the variables above.

Table 3 Regression results of model with level-2 Explanatory Variables (with robust standard errors)

Fixed Effect	Coefficient	Standard Error	T-ratio	P-value
Fixed Effect	Coefficient	Standard Error	T-ratio	P-value
For INTRCPT1, B0				
INTRCPT2, G00	7 243.664 801	1 533.319 195	4.724	0.000
For QA201 slope, B1				
INTRCPT2, G10	6 456.347 799	1 962.597 973	3.290	0.004
Industry G11	32.657 617	13.025 685	2.507	0.021
Construction G12	-13.372 066	7.289 625	-1.834	0.081
Transport, Post and Telecommunication Services G13	-42.059 015	6.234 439	-6.746	0.000
Wholesale and Retail Trade and Catering Services G14	-32.013 568	18.437 904	-1.736	0.097
Social ServicesG15	19.687 681	27.131 139	0.726	0.476
Education, Culture, and Health Care G16	87.032 411	89.278 227	0.975	0.342
Others G17	26.522 554	14.066 996	1.885	0.074
For QA301 slope, B2				
INTRCPT2, G20	37.564 957	32.641 492	1.151	0.264
Industry G21	-0.261 244	0.228 440	-1.144	0.267
Construction G22	-0.258 047	0.207803	-1.242	0.229
Transport, Post and Telecommunication ServicesG23	-0.125 026	0.302 777	-0.413	0.684
Wholesale and Retail Trade and Catering ServicesG24	-0.043 708	0.279 783	-0.156	0.878
Social ServicesG25	0.448 427	0.793 538	0.565	0.578
Education, Culture, and Health Care G26	4.176 940	3.080 618	1.356	0.190
Others G27	1.033 900	0.260 157	3.974	0.001
For QB03B slope, B3				
INTRCPT2, G30	709.721 773	172.216 705	4.121	0.001
Industry G31	0.050 426	0.535 988	0.094	0.926
Construction G32	0.847 069	0.633 402	1.337	0.196
Transport, Post and Telecommunication ServicesG33	-1.323 384	0.559 203	-2.367	0.028
Wholesale and Retail Trade and Catering Services G34	-0.693 426	0.633 623	-1.094	0.287
Social ServicesG35	2.832 117	2.326 745	1.217	0.238
Education, Culture, and Health Care G36	5.448 173	5.975 621	0.912	0.373
Others G37	-2.374 141	0.960 205	-2.473	0.023
Random Effect	Standard	Variance	Chi-square	P-value
INTRCPT1, U0	8 207.785 81	67 367 747.978 86	1 253.548 47	0.000
QA201 slope, U1	9 796.782 99	95 976 957.031 19	371.705 14	0.000
QA301 slope, U2	136.623 70	18 666.035 95	65.550 13	0.000
QB03B slope, U3	890.311 75	792 655.015 45	225.843 72	0.000
level-1, R	6 564.372 27	43 090 983.282 65		
Deviance	84 577.730 059			

The model increased 7 variables compared with the model above in 2.4, but the deviance decreased 126. According to Chi-square test, it can be regarded that the model fit has further improvement. The results show that household operation income obtained from industry and other fields has intensified the relevant relations between farmers' gender and income; the household operation income obtained from construction industry, transportation and wholesale and retail sharpened the relevant relations between farmers' gender and income; household operation income obtained from other industries increased the relevant relations between farmers' birth year and income; the household operation income obtained from transportation and other industries sharpened the relevant relations between farmers' educational degree and income.

3 Conclusion

Non-agricultural operation income is an important way for increasing farmers' income, but in view of the different demands on farmers' individual features and labors in various industries, the improvement of non-agricultural operation income obtained from different industries has different impacts on farmers' income. The improvement of household operation income obtained from industry and other industries has enlarged the income gap among farmers caused by gender difference. The household operation income obtained from other industries enlarged the income gap bought by birth year; the increase of household operation income obtained from transportation and other industries weakens the income gap bought by different educational degrees.

preservation, and refrigerated transportation is backward, focusing on simple storage; the vegetables that are exported to ASEAN have low quality and low grade, and neglect packaging, so most of the vegetables that enter the bazaar and supermarket are the low-grade products, and the price of these vegetables is also universally lower than that of the products of the same type in other countries; in terms of quality, the nutrition, taste, appearance, hygiene, and safety of vegetables have a large gap with that of the developed countries. There are few opportunities for agricultural products of Guangxi to enter Malaysia, Indonesia, Singapore and other medium-and-high income countries. Therefore, it should vigorously introduce modern production factors, greatly improve the quality of laborers, play the significant role of modern science and technology, management, information, resources and other factors in modern large-scale production, ceaselessly improve the grade of agricultural products, and improve the competitiveness of agricultural products.

2.6 The governmental function should change from traditional one-way-direction-oriented function to modern integrated-service-and-supervision-oriented function that meets the requirements of export To improve the competitiveness of international trade of agricultural products, the role of government is extremely critical, and the function of government must change from traditional one-way-direction-oriented function to modern integrated-service-and-supervision-oriented function that meets the requirements of export.

2.6.1 Strengthen the management of quality safety of agricultural products. Strengthening the quality and safety management of agricultural products is the fundamental way to eliminate "green barrier" of international trade. It should gradually carry out test of agricultural products and food, further promote the standardization of production, establish quality monitoring system, further perfect the test and safety monitoring system of export agricultural products, focus on strengthening and improving the test work concerning advantageous export agricultural products and related agricultural inputs, and improve the competitiveness of China's agricultural products in international market.

2.6.2 Establish the warning mechanism of technological trade barrier. The government should strengthen the construction of web sites of communication and consulting, establish overseas technical trade barriers information center and database, timely release warning information, provide services of information consulting for enterprises, strengthen the research on technical standards, technical policies, relevant regulations, standard structure and standard content of developed countries and

China's major trading partner countries, and pay close attention to the new trend of changes of global technical trade measures, so that the agricultural products are up to the international standards and avoid falling into the trap of technical barrier.

2.6.3 Implement the strategy of green brand. Nowadays, the competition of international market has entered the era of brand competition, so if we want to break through the green barriers in the trade of agricultural products, we must take the brand road of "recognition by market". Therefore, the government should guide enterprises to take the road of standardized production, strictly in accordance with international standards and market access standards of the countries of ASEAN, and help the agricultural production and processing enterprises to obtain domestic and foreign market access qualification. In the process of development, the enterprise should seize this opportunity, and vigorously develop agricultural and animal husbandry products of green brand. The specialized households, bases and enterprises should establish and enhance brand awareness, and learn to build brand, especially the green brand.

3 Conclusion

Guangxi must grasp opportunities brought by the establishment of China-ASEAN Free Trade Area, strengthen the adjustment of international trade industry, realize rapid development of international trade in Guangxi, and improve the international competitiveness of agricultural products in Guangxi.

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