



## Empirical Analysis of Liaoning Provincial Rural Economic Growth Influential Factors Based on Ridge Regression

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### Abstract

Taking Liaoning Province as an example, this article analyzes quantitatively rural economic growth influential factors by the ridge regression technology and the standard SPSS statistical software, and the result indicates the key factors of Liaoning rural economic development rest with investment, consumption and foreign trade, and we advise Liaoning Province should extend educational investments, enhance the quality of human resource and expedite steps of industrial structure updating and independent innovation to ensure sustainable quick development of Liaoning Provincial rural economy and complete vitalization of the old industrial base.

**Keywords:** Ridge regression, Rural economic growth, Influential factors, Empirical analysis

The CPC Central Committee has confirmed the strategic deployment of present, agriculture and rural development by the form of “document No.1” since 2004. Because Liaoning Province is the national old industrial base, so whether the rural development can follow urban development becomes the key to actualize science-based development and urban-rural harmonious development. Therefore, it is very important to confirm main factors influencing Liaoning rural economic growth and adopt appropriate methods to comprehensively evaluate Liaoning rural economy, which can not only implement short-term control and introduction of rural economy for the government, but also improve the long-term development of whole rural economy. Taking Liaoning rural economy as the objective, this article tries to open out the decisive factors of stagnation and vitalization of rural economy, and offer intelligent supports to improve quick developments of Liaoning Provincial rural economy and complete vitalization of the old industrial base.

### 1. Rural economic change analysis of Liaoning Province

#### 1.1 Interim changes

As viewed from the absolute quantity of Liaoning rural economy (taking the total production values of agriculture, forest, herd and fishing as the observation index), the gross is ascending in 26 years from 1980 to 2005, but it presents obvious interim character. The stage from 1980 to 1985 is the term of slow growth, the stage from 1986 to 1997 is the term of quick growth, the stage from 1998 to 2000 is the term of balanced development, the stage from 2001 to 2005 is another term of quick growth. But as viewed from rural economy growth rate, the stage from 1980 to 1985 is reduced year after year, the stage from 1986 to 1997 maintains high level growth, the stage from 1998 to 2000 almost has no growth, the rural economy growth rate after 2001 is enhanced year after year, and it doesn't achieve 22.71% of the average growth level during 1986 to 1997.

#### 1.2 Appearance of difference

Comparing with national rural economic growth at the same term, the yearly average growth rate exceeds 10% than the national level, which indicates that as the important commodity grain bases and equipment manufacturing bases, Liaoning possesses driving developmental tendency (Zhai, 2005, p.4-8). But after 2000, that predominance has been reduced to 5%, and with Chinese new round economic development wave, the late-development predominance occurs and Liaoning urgently needs new developmental impetus.

### 2. Empirical analysis of Liaoning provincial rural economic growth factors

#### 2.1 Selection of variables and data

This article utilizes the ridge regression method to analyze the influential factors of Liaoning rural economic growth. When we select research variables, except for taking economics theory as the base and absorbing acquired research results (Xu, 2003, p.105-107 & Li, 2006, p.38-40), we also consider the economic developmental situation of Liaoning and the objectivity and acquisition of variable data, and we take the gross of agriculture, forest, herd and fishing (ZCZ) as the attributive variable, select 11 variables as independent variables including labor force investment (LDL), human capital investment (RL), material capital investment (GZ), technical level (JS), import (JK), export (CK), overseas

investment (WZ), denizen consumption payout level (XF), population increase (RK), urban-rural structure (CXJ), and industrial structure (CYJ), in addition, we take “ZCZ” (unit: hundred million Yuan) to represent the whole rural economic developmental level of Liaoning.

In above 11 variable indexes, the labor force investment is denoted by rural employee amount of Liaoning (unit: ten thousand) in past years, the human capital is denoted by the student amount (unit: ten thousand) in middle vocational schools of Liaoning in past years, the material capital is denoted by the collective economy fixed assets investment gross (unit: hundred million Yuan) of Liaoning, the technical level is denoted by the three patents application authorized amount of Liaoning in past years, the import and export of farm products are respectively denoted by the farm product import gross (unit: ten thousand dollars) and the farm product export gross (unit: ten thousand dollars) of Liaoning in past years, the overseas investment is denoted by the actual utilized foreign capital (unit: ten thousand dollars) of Liaoning in past years, the denizen consumption payout level is denoted by the rural denizen consumption payout level (Yuan per person) of Liaoning in recent years, the urban-rural structure is denoted by the urban population proportion accounting for total population of Liaoning, the industrial structure is denoted by the second and third industrial growths accounting for domestic production gross, and the population increase is denoted by the natural population increase rate of Liaoning. The data of all variables are selected from the annual data from 1980 to 2005 (the original data come from “Liaoning Province Statistical Yearbook”). Before the ridge regression analysis, we make logarithmic processing to all variable data, which would not influence relations among variables. Various variables after logarithmic processing are respectively noted as  $Y=\ln ZCZ$ ,  $X1=\ln RL$ ,  $X2=\ln XF$ ,  $X3=\ln LDL$ ,  $X4=\ln CK$ ,  $X5=\ln JK$ ,  $X6=\ln WZ$ ,  $X7=\ln GZ$ ,  $X8=\ln RK$ ,  $X9=\ln JS$ ,  $X10=\ln CYJ$ ,  $X11=\ln CXJ$ .

## 2.2 Quantitative analysis of influential factors of Liaoning provincial rural economic growth

### 2.2.1 Ordinary least square (OLS) regression

We utilize the ordinary least square method to make multivariate linear regression, and the test results of the model are  $R^2=0.9953$ ,  $F=274.2374$ ,  $p=0.0000$ , the value of most regression coefficients  $P$  is bigger than 0.05 and has no markedness. Make relativity analysis to various variables, from the relative coefficients among various variables, we found that strong relativity existed in variables (every relative coefficient is bigger than 0.5, and for the coefficient relative to  $Y$ , six variables are bigger than 0.9 and five variables are in 0.8-0.9.), and the regression coefficient and test results are seen in Table 1. Next, we make multivariate linear regression diagnosis to the above model.

### 2.2.2 Multivariate linear diagnosis

We adopt the following two methods to judge whether the above multivariate regression equation has the multivariate linear problem.

(1) If the regression  $R^2$  of  $Y$  to all  $X$  is always bigger than the  $R_k^2$  of attributive variable to every independent variable, so serious multivariate linear exists.

(2) If the value of VIF, difference expansion coefficient is bigger than 10, so the multivariate linear exists, where  $VIF = 1/(1 - R_k^2)$ .

From Table 2, we can see that for the first method,  $R^2$  is always bigger than  $R_k^2$ , so serious multivariate linear exists. In the difference expansion coefficient, the expansion coefficients of  $\ln RL$ ,  $\ln XF$ ,  $\ln LDL$ ,  $\ln JK$ ,  $\ln WZ$  and  $\ln CXJ$  are bigger than 10, which indicates that various variables have close relations. Under this situation, if we use the OLS regression analysis method, the model conclusion may have a big difference with reality, which would induce the explanation of the model is of no effect. Therefore, in this article we utilize the ridge regression method to analyze influential factors.

### 2.2.3 Ridge analysis of influential factors of Liaoning provincial rural economic growth

#### (1) Principle of ridge regression

The method of ridge regression is a sort of biased estimation method specially used to multivariate data analysis, and it is a sort of improved least square method actually which looks for regression process more according with practice but with little effect and costs unbiased estimation of least square method and part precisions (Zhang, 2002). Its idea is to add a matrix  $D$  in the regression coefficient and cost unbiased estimation to reduce difference and correct multivariate linear. Though the residual sum of square deserved from ridge regression is bigger than from least square regression, but its endurance to bad data is far stronger than least square regression. In equation (1),  $k$  is the step size which usually begins from a small positive number such as 0.01, and gradually experiment until the coefficient estimation is stable.

$$b = [X'X + kD]^{-1} X'y \quad (1)$$

#### (2) Analysis result of ridge regression

Though SPSS doesn't offer the interface of dialog box for ridge regression, but it has a set of complete macro-program which is called “ridge regression. sps” and put in the install approach of SPSS, and its transfer method is as follows.

“INCLUDE”SPSS approach\ Ridge Regression.sps’.

Ridgereg enter= list of independent variable

/dep= name of attributive variable

/start= the starting vale of k, the default is 0

/stop= the ending vale of k, the default is 1

/inc= the searching step of k, the default is 0.05

/k= number of k allowing searching, the default is 999.”

In the program, we first should use the order of “include” to reading macro-program, then transfer it by name of “ridgereg”, and notice that every variable with default value need not be set. The last “.” represents the end of whole sentence, which can not be missed.

After running the ridge regression macro program of SPSS12.0, we can get ridge regression coefficients of various independent variables under different ridge parameters, which are seen in Table 3. From Table 3, we can see that when the ridge parameter is bigger than 0.45, the regression coefficients of various independent variables go to stable, and from the ridge trace in Figure 1, we can also see that when  $k=0.5$ , changes of various variables take horizontal beeline as the asymptotic line, so we select standardization regression equation when the ridge parameter is 0.45.

$\ln ZCZ=0.1052\ln RL+0.1782\ln XF+0.0504\ln LDL+0.1026\ln CK+0.0717\ln JK+0.0895\ln WZ+0.1354\ln GZ-0.0582\ln RK+0.0789\ln JS-0.0129\ln CYJ+0.121\ln CXJ$

### (3) Result analysis of ridge regression

From the ridge regression result, we can see that in 11 independent variables, only  $\ln RK$  presents negative correlativity, and others present positive correlativity, and in 11 positive correlative variables, the sequence of regression coefficient is  $\ln XF$ ,  $\ln GZ$ ,  $\ln CXJ$ ,  $\ln RL$ ,  $\ln CK$ ,  $\ln WZ$ ,  $\ln JS$ ,  $\ln JK$  and  $\ln LDL$ . From the symbols of regression coefficient, we can see that except population increase and over large proportion of the first industry block the economic growth of Liaoning, the enhancements of other variables can improve the rural economic growth. From the regression coefficient, we can see that the variables which influence  $Y$  (rural economic growth) most are the denizen consumption level (0.1782) and the material capital (0.1354), and the variables which influence  $Y$  least are the industrial structure (0.0128) and the labor force quantity (0.0504). Through classifying selected variables, we found that investments (including overseas investment and material capital) have large influences to economic growth, then consumption, then foreign trade (import and export), urban-rural structure and human capital, and above indexes fully influence the economic growth of Liaoning, but labor force, technology and industrial structure have little influence to the rural economic growth of Liaoning.

In three basic factors influencing economic growth, labor, capital and technology, the function of material capital and human capital is very notable, but the function of the labor force and technical level is weak for the rural economic growth of Liaoning. From a long-term view, the economic growth of one area mainly depends on the accumulation of technical advancement and human capital, and the accumulation of human capital is represented by the investment to education and scientific research. Therefore, to realize sustainable and stable rural economic growth and transformation of rural economic growth fashion of Liaoning, the government should fully increase science and technology investments and continually enhance the contribution of high-tech factors in economic growth.

The factor of consumption has important influences to rural economy of Liaoning, and the denizen consumption payout is the main body composing domestic demand. In exterior factors, overseas investments have important functions to improve rural economic growth of Liaoning, but at present, it is an urgent problem how overseas investments flow to rural domain as soon as possible. The import and export in foreign trade respectively rank the fifth and the eighth position, and in 2005 the Liaoning agricultural opening degree (the gross of farm products import and export/GDP) is only 3.67%, and the foreign trade has not become the main impetus to improve quick developments of rural economy. Liaoning should reasonably utilize geography predominance of eastern inshore province, strengthen the opening force, improve investment environment, actively introduce overseas investments, encourage import and export trade and improve economic developments.

In structure indexes, the function of industrial structure is not obvious to rural economic growth of Liaoning, and the function of urban-rural structure is outstanding, which respectively rank the tenth and the third position in regression coefficients. Through analysis of 100 countries with different income levels, famous economists Chenery and Kuznets at el educed conclusions that the core of economic growth process is the transformation process of industrial structure. The industrial structure of Liaoning should be further adjusted and enhanced to improve high speed growth of economy. The urban-rural structure represents the urbanization level of one country or region, and in 2005, the proportion of Liaoning town population is 48.45% of total population, and the urbanization level of Liaoning drives quick growth of

rural economy.

### 3. Conclusions and policy advice

From above analysis, we can see that those key factors which influence Liaoning rural economic growth obviously include investments (material capital and overseas investments), consumption and foreign trade, and those key factors which influence Liaoning rural economic growth lightly include the quality of human resource, industrial structure and technology. Therefore, to make Liaoning economy keep quick and stable growths, we think the government should continue to keep the level of predominant factors, mainly enhance the level of weak factors, actualize the transformation of economic growth fashion, and keep the sustainable development of economy. So we put forward following concrete advices and measures. First, the government should further encourage and stimulate social consumption, increase the accumulation of human capital through increasing investments to education and scientific research, and strengthen the contribution function of scientific research to economy. Second, the government should improve investment environment, actively introduce overseas investments, increase the opening power, especially further enlarge exports by means of utilizing the geography predominance of inshore northeast areas and increase commodity imports according to present economic developmental demands of Liaoning. Third, the government should actively adjust and optimize the industrial structure, expedite the developmental speed of the third industry, improve the developments of agriculture and country in virtue of the vitalization opportunity of old northeastern industrial bases to make the country fully enjoy advantages brought by the industrial structure updating. Last, the government should properly develop the level of urbanization, control population growth and enhance cultural quality of rural labor force.

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Table 1. Multivariate linear regression parameter estimation by OLS

Variable	Coefficient	T-Statistic	Prob.
C	7.104092	0.720997	0.4828
lnRL	0.267135	0.564120	0.5816
lnXF	1.315053	6.974209	0.0000
lnLDL	0.972353	0.831492	0.4197
lnCK	0.059478	1.197574	0.2510
lnJK	-0.099470	-1.266973	0.2258
lnWZ	-0.048202	-0.927480	0.3694
lnGZ	0.059378	0.574044	0.5750
LnRK	-1.502322	-1.749324	0.1021
LnJS	0.048957	1.061722	0.3063
lnCYJ	0.281946	1.033578	0.3189
lnCXJ	1.329392	4.635575	0.0004
R-squared	0.995380	F-statistic	274.2374
Durbin-Watson stat.	2.015340	Prob (F-statistic)	0.000000

Table 2. Multivariate linear diagnosis result of variables

Variable	VIF	Rk2
lnRL	24.39024	0.959
lnXF	111.1111	0.991
lnLDL	11.23596	0.911
lnCK	9.52381	0.895
lnJK	13.51351	0.926
lnWZ	10.86957	0.908
lnGZ	3.676471	0.728
LnRK	0.547046	-0.828
LnJS	7.246377	0.862
lnCYJ	5.025126	0.801
lnCXJ	29.41176	0.966

Table 3. Standard regression coefficient of various independent variables under different ridge parameters

K	LnRL	LnXF	LnLDL	LnCK	LnJK	LnWZ	LnGZ	LnRK	LnJS	LnCYJ	LnCXJ	R <sup>2</sup>
0.00	0.1205	1.0894	0.1100	0.0824	-0.1492	-0.1183	0.0518	-0.1271	0.1546	-0.2318	-0.1855	0.9950
0.10	0.1186	0.3367	-0.0307	0.0906	0.0274	0.0886	0.1700	-0.0645	0.1104	-0.1081	0.1551	0.9780
0.20	0.1136	0.2497	0.0133	0.1009	0.0515	0.0935	0.1571	-0.0584	0.0916	-0.0591	0.1401	0.9680
0.30	0.1096	0.2101	0.0343	0.1031	0.0631	0.0921	0.1469	-0.0575	0.0840	-0.0308	0.1304	0.9620
0.40	0.1065	0.1867	0.0463	0.1030	0.0696	0.0903	0.1389	-0.0579	0.0801	0.0023	0.1237	0.9580
0.45	0.1052	0.1782	0.0504	0.1026	0.0717	0.0895	0.1354	-0.0582	0.0789	0.0128	0.1210	0.9560
0.50	0.1040	0.1711	0.0538	0.1021	0.0734	0.0887	0.1322	-0.0586	0.0778	0.0182	0.1187	0.9540
0.60	0.1019	0.1597	0.0589	0.1008	0.0759	0.0874	0.1265	-0.0593	0.0763	0.0265	0.1148	0.9510
0.70	0.1001	0.1509	0.0624	0.0994	0.0774	0.0862	0.1216	-0.0599	0.0752	0.0327	0.1116	0.9480
0.80	0.0985	0.1439	0.0650	0.0980	0.0784	0.0852	0.1173	-0.0604	0.0744	0.0374	0.1089	0.9450
0.90	0.0970	0.1381	0.0668	0.0966	0.0790	0.0843	0.1135	-0.0609	0.0737	0.0411	0.1065	0.9420
1.00	0.0957	0.1332	0.0682	0.0953	0.0793	0.0834	0.1100	-0.0612	0.0732	0.0441	0.1044	0.9400

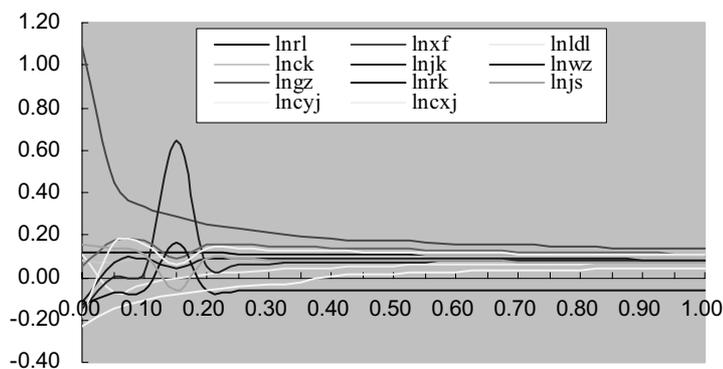


Figure 1. Ridge Trace of Rural Economic Growth Factors of Liaoning Province