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The Relation between Financial Expenditure for Agriculture (FEA) and Per Capita Net Income of Farmers (PCIF): A Case Study of Jiangsu Province

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Abstract Agricultural development is indispensable to financial support. On the basis of data of the financial expenditure for agriculture (FEA) and per capita net income of farmers (PCIF) of Jiangsu Province in 1990–2012, with the aid of software R, this paper established the linear regression model for the relation between financial expenditure for agriculture and per capita net income of farmers through the function lm. Using the function summary, this paper obtained the summary statistical data, and made diagnostic check of regression model from image command plot and variance analysis table. Finally, it came up with pertinent recommendations including increasing financial expenditure for agriculture, optimizing expenditure structure, and balancing regional development.

Key words Financial expenditure for agriculture (FEA), Per capita net income of farmers (PCIF), Software R

Agriculture is basic industry of China and agricultural development is indispensable to financial support. How to allocate financial revenues to build rural areas and support farmers is a wide concern. The core part of "three rural issues" (agriculture, rural areas and farmers) is farmers, while the core issue of farmers lies in the income. No. 1 Central Document 2014 stated that government will also establish a long-term mechanism for sustainable agricultural development and a new agricultural management system, and meanwhile balance rural and urban development. China should improve its national food security system, deepen rural land system reform and improve rural governance, while intensifying support and protection for agriculture and promoting financial support for rural areas. At present, the urban-rural income gap of Jiangsu Province is widening. Farmers have great difficulty in increasing their income, and infrastructure construction concerning vital interests of farmers and social public utilities develop slowly. In this situation, it is difficult to increase farmers' income only through their investment. Therefore, financial expenditure for agriculture becomes an inevitable choice. In this context, it is of great realistic significance to study the influence of financial expenditure for agriculture on per capita net income of farmers.

1 Documentary overview

1.1 Overview of foreign researches Foreign scholars have made in-depth researches on financial expenditure for agriculture from many perspectives, and their findings lay certain theoretical foundation for future researches. Many practical and feasible macroeconomic policies are also evolved from their findings. In *The Wealth of Nations*, Adam Smith stated that government should at-

tach great importance to agriculture, and capital should be invested in agriculture to bring agriculture with sufficient capital. Harrod and Domar applied dynamic analysis method and stated that higher investment repayment or investment scale can realize higher growth rate of agriculture. Rostow put forward the theory of stages of economic growth and stated that financial expenditure for agriculture has stages. In *Transforming Traditional Agriculture*, Schultz stated that traditional agriculture should be transformed to promote economic growth, government should increase investment in transforming traditional agriculture, and modern agriculture is favorable for economic growth.

1.2 Overview of domestic researches At present, domestic scholars have made extensive researches on financial expenditure for agriculture. The difference mainly lies in research points, methods and ranges. In major research points of financial expenditure for agriculture, Department of Agriculture of Ministry of Finance compared similarities and differences of agricultural subsidy policies between Italy and the UK, and came up with pertinent recommendations according to actual situations of China. From the perspective of contribution of financial expenditure of Gansu Province for farmers' income, Yang Linjuan and Dai Hengzhao concluded that expenditure for agricultural production, capital construction of agriculture, and agricultural science and technology is a motive force for increasing farmers' income^[1]. From the perspective of total amount and structure of financial expenditure for agriculture, Liu Han found that the total amount of financial expenditure for agriculture is insufficient and the structure needs further optimization and development^[2]. Feng Mingchuan and Wu Ping analyzed performance of financial expenditure for agriculture from the perspective of developing modern agriculture and found that the performance of financial expenditure for agriculture is low^[3]. From the difference of original endowment, Zhao Lu and Lu Jie analyzed performance of China's financial expenditure for agricul-

ture in different times and different economic regions, and elasticity of gross agricultural product (GAP) and respective output of agriculture for total financial expenditure for agriculture^[4]. Hu Yunxia studied the relation between financial expenditure for agriculture and growth of farmers' income, and found that there is long term stable positive relation between financial expenditure for agriculture and per capita net income of farmers, indicating that financial expenditure has promotion function for farmers' income^[5]. From the perspective of scale of financial expenditure for agriculture, Xu Qian made an empirical study on benefit brought by financial expenditure for agriculture taking Jiangsu Province as an example^[6].

In research methods of financial expenditure for agriculture, Li Huanzhang and Qian Zhonghao studied the relation between financial expenditure for agriculture and agricultural growth by causal analysis and structural analysis methods, and stated that agricultural growth is closely related with financial expenditure for agriculture^[7]. Chen Wei and Yang Chunhe, using C2R model of data envelop analysis (DEA) method, analyzed and evaluated technology and effect of fund input of development-oriented poverty reduction in Hebei Province^[8]. Using multiple regression and Granger Causality Test, Shen Kunrong and Zhang Jing studied the relation between rural public expenditure, growth of farmers' income, and urban-rural income gap^[9]. From stationarity of time series and lagging in effect of explanatory variables on explained variables, through distribution lagging model, Tan Cunna proved that there is long-term stable positive relation in between, and financial expenditure for agriculture of three periods (the period before earlier stage, earlier stage, and current stage) has significant influence on per capita net income of farmers at current stage^[10]. Through co-integration analysis, impulse response analysis and variance analysis, Zhao Lu and Lu Jie studied different contribution rate of financial expenditure at different stages to the gross agricultural product^[11]. Using Granger Causality Test, Yang Jianli and Yue Zhenghua found that increase in farmers' income is caused by increase in financial expenditure for agriculture; using Unit Root Test, they found that both farmers' income and financial expenditure for agriculture are non-stationary times series (stationary series can be obtained through calculating second-order difference), and farmers' income and financial expenditure for agriculture may be out of balance in short period, but has long-term co-integration relation^[12].

In the research range of financial expenditure for agriculture, there are basically two types: one is based on the whole country, and the other is based on provinces. Most researches based on the whole country took total amount of financial expenditure for agriculture as a variable influencing farmers' income, and reached the conclusion that financial expenditure for agriculture is positively correlated with farmers' income^[5,10,12]. Most researches based on provinces analyzed influence of financial expenditure for agriculture on agricultural development and increase in farmers' income, and they reached different conclusions^[5].

These extensive and detailed researches not only provide theoretical foundation for financial support for agriculture, but also provide scientific and reasonable basis for implementation of financial support for agriculture in China. Jiangsu Province is a large agricultural province in China, but few scholars have made researches on financial expenditure for agriculture in Jiangsu Province. Application of software R is also not common. The development of Southern Jiangsu, Central Jiangsu, and Northern Jiangsu is not balanced, similar to Eastern, Central, and Western regions of China. Therefore, research of Jiangsu financial expenditure for agriculture is of typical significance.

2 Current situation of financial expenditure for agriculture in Jiangsu Province

2.1 Although total absolute amount of financial expenditure for agriculture increases year by year, the proportion into total financial expenditure has high fluctuation Jiangsu Province's financial expenditure for agriculture is mainly used to support agricultural production, operating expenses of agriculture, water conservancy, forestry and meteorological departments, comprehensive development of agriculture, rural capital construction, and three categories of scientific and technological expenses. Since the reform and opening-up, especially in recent years, Jiangsu Province's financial expenditure for agriculture is increasing year by year. As shown in Table 1, financial expenditure of Jiangsu Province for "three rural issues" increased from 920 million yuan to 75 410 million yuan, having an annual growth of 31.6%. The total amount of financial expenditure for agriculture in 2012 reached 82.0 times that of 1990.

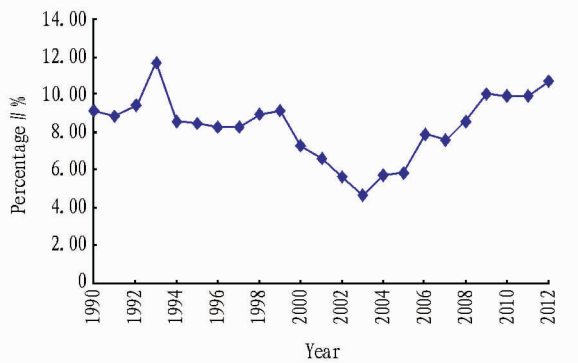
Table 1 Jiangsu Province's financial expenditure for agriculture in 1990 – 2012 (unit: 10⁸ yuan)

Year	FEA	Year	FEA
1990	9.2	2002	59.6
1991	11.4	2003	65.9
1992	11.9	2004	75.7
1993	19.1	2005	97.6
1994	17.1	2006	158.1
1995	21.5	2007	193.6
1996	25.6	2008	276.2
1997	30.1	2009	403.3
1998	37.9	2010	489.2
1999	44.5	2011	618.1
2000	46.8	2012	754.1
2001	51.9		

Data source: *Statistical Yearbook of Jiangsu Province*.

Although total absolute amount of Jiangsu Province's financial expenditure for agriculture increases year by year, the proportion into total financial expenditure has high fluctuation. As shown in Fig. 1, from 1990 to 1993, the percentage of financial expenditure for agriculture into total financial expenditure rises from 9.1% to 11.7%; from 1994 – 2003, the percentage takes on decline trend, due to local government eager for quick success, neglecting expenditure for fundamental agriculture, and lack of restraint

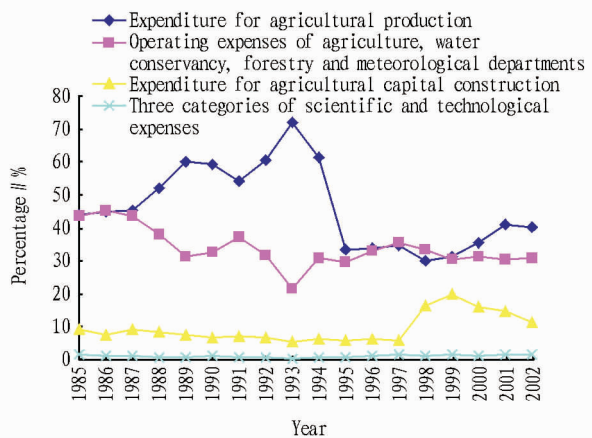
mechanism; from 2004 – 2012, the percentage takes on fluctuating rise trend.



Data source: Statistical Yearbook of Jiangsu Province.

Fig. 1 Percentage of Jiangsu Province's financial expenditure for agriculture into total financial expenditure

2.2 Structure of financial expenditure for agriculture is not balanced Jiangsu Province's financial expenditure for agriculture mainly includes support agricultural production, operating expenses of agriculture, water conservancy, forestry and meteorological departments, agricultural capital construction, and three categories of scientific and technological expenses, and other expenses. We only collected data of financial expenditure for agriculture in 1985 – 2002, because the Statistical Yearbook of Jiangsu Province has not listed detailed data of financial expenditure for agriculture since 2003.



Data source: Statistical Yearbook of Jiangsu Province.

Fig. 2 Changes of structure of Jiangsu Province's financial expenditure for agriculture

From Fig. 2, we can see that before 1995, the percentage of financial expenditure for agriculture has high fluctuation; in 1995 – 2002, it takes on rising trend; the percentage of operating expenses for supporting agricultural production and agriculture, forestry, water and gas departments takes on wavy decline trend; the change of expenditure for agricultural capital construction is relatively stable before 1997; later, it has slight rising, but finally it takes on decline trend; the percentage of three categories of scientific and technological expenses is relatively low. In 1985 – 2002,

the structure of Jiangsu Province's financial expenditure for agriculture has high fluctuation and takes on unstable state. Therefore, the structure of Jiangsu Province's financial expenditure for agriculture needs further optimization and development.

3 Empirical analysis on Jiangsu Province's financial expenditure for agriculture and farmers' income

3.1 Data source and variable selection Considering data availability, due to loss and discontinuity of data before 1990, we selected data of 1990 – 2012 to analyze. This period includes two groups of vectors, i. e. per capita net income of farmers (PCIF) and financial expenditure for agriculture (FEA). All data were selected from *Statistical Yearbook of Jiangsu Province* (1991 – 2013). Besides, we built model PCIF – FEA with total amount of financial expenditure for agriculture as explanatory variables and per capita net income of farmers as explained variable.

Table 2 PCIF – FEA of Jiangsu Province in 1990 – 2012 (unit: yuan)

Year	PCIF	FEA	Year	PCIF	FEA
1990	959.1	920000000	2002	3979.8	5960000000
1991	920.7	1140000000	2003	4239.3	6590000000
1992	1060.7	1190000000	2004	4753.9	7570000000
1993	1266.9	1920000000	2005	5276.3	9760000000
1994	1831.5	1710000000	2006	5813.2	15810000000
1995	2456.9	2150000000	2007	6561.0	19360000000
1996	3029.3	2560000000	2008	7356.5	27620000000
1997	3269.9	3010000000	2009	8003.5	40330000000
1998	3376.8	3790000000	2010	9118.2	48920000000
1999	3495.2	4450000000	2011	10805.0	61810000000
2000	3595.1	4680000000	2012	12202.0	75410000000
2001	3784.7	5190000000			

Data source: Statistical Yearbook of Jiangsu Province (1991 – 2013).

3.2 Model regression^[13] According to the above data:
> plot (FEA, PCIF)

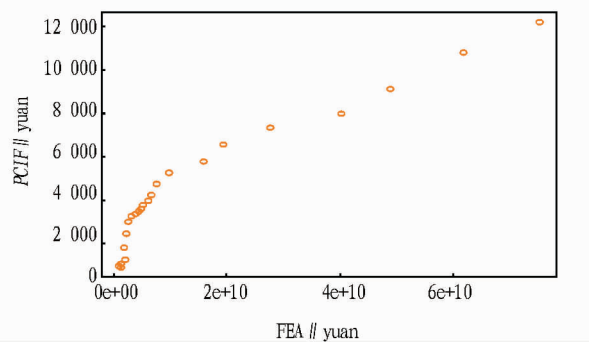


Fig. 3 Dot plot of per capita net income of farmers and financial expenditure for agriculture

From Fig. 3, we can see that the financial expenditure for agriculture is positively correlated with per capita net income of farmers. This means that the more financial expenditure for agriculture will bring the more per capita net income of farmers.

Establish the linear regression model with the function lm;
> lm (PCIF ~ FEA)
Call:

```
lm (formula = PCIF ~ FEA)
```

```
Coefficients:
```

```
(Intercept) FEA
```

```
2.529e+03 1.392e-07
```

Fit a linear regression model with the function `lm`: $PCIF = 2.529e + 03 + 1.392e - 07 FEA$, establish an object of linear model, and return respective variable coefficient and other different data.

```
> d.lm = lm (PCIF ~ FEA)
```

Calculate the following summary statistical data using the function `summary()`;

```
> summary (d.lm)
```

```
Call:
```

```
lm (formula = PCIF ~ FEA)
```

```
Residuals:
```

```
Min 1Q Median 3Q Max
```

```
-1766.8 -599.3 320.3 707.0 1388.5
```

```
Coefficients:
```

```
Estimate Std. Error t value Pr(>|t|)
```

```
(Intercept) 2.529e+03 2.648e+02 9.548 4.33e-09 *
```

```
**
```

```
FEA 1.393e-07 1.028e-08 13.543 7.59e-12 ***
```

```
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 1022 on 21 degrees of freedom
```

```
Multiple R-squared: 0.8973, Adjusted R-squared: 0.8924
```

```
F-statistic: 183.4 on 1 and 21 DF, p-value: 7.588e-12
```

The above results indicate that p -value is small ($7.588e - 12$), while the value of Multiple R-squared is high (0.8973); FEA is an excellent independent variable. It is suitable to use linear regression model to explain PCIF, and this model is ideal.

Finally, we make diagnostic check of the regression model:

```
> par(mfrow = c(2,2))
```

```
> plot(d.lm)
```

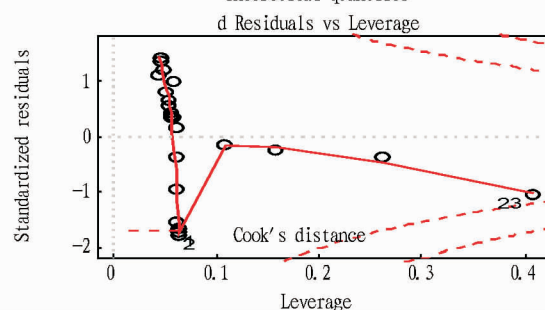
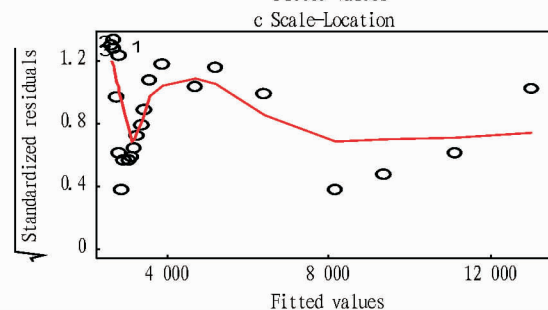
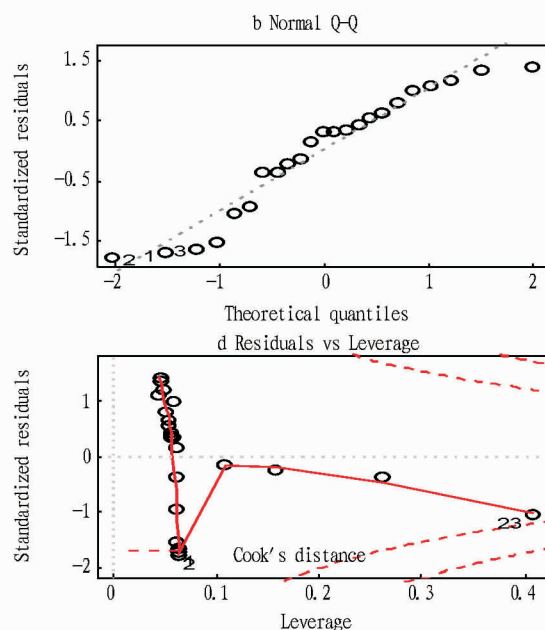
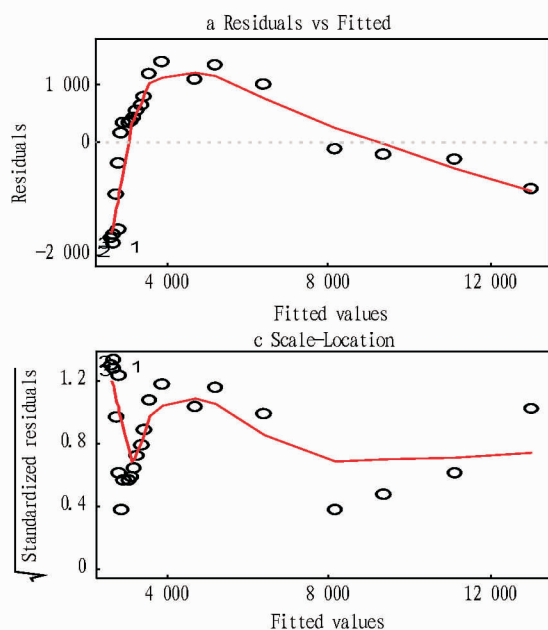


Fig.4 Diagnosis of the model

Through diagnosis, no significant problem is found and following regression model is obtained: $PCIF = 2.529e + 03 + 1.392e - 07 FEA$.

We conduct variance analysis of the regression model and obtain following results (ANOVA Table):

```
> anova(d.lm)
```

```
Analysis of Variance Table
```

```
Response: PCIF
```

```
Df Sum Sq Mean Sq F value Pr(>F)
```

```
FEA 1 191509023 191509023 183.41 7.588e-12 ***
```

```
Residuals 21 21927625 1044173
```

```
---
```

```
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

4 Conclusions and recommendations

4.1 Conclusions Through the above analysis, we reach following conclusions: the financial expenditure for agriculture is closely connected with growth of per capita net income of farmers; financial expenditure for agriculture is a factor influencing changes of per capita net income of farmers; financial policies of Jiangsu Province in agricultural production and development are effective, and financial expenditure for agriculture has become reliable guarantee for growth of farmers' income. Therefore, practically enforcing and constantly implementing the policy of financial expenditure for agriculture is still an important policy for promoting development of agriculture and increase of farmers' income in Jiangsu Province.

4.2 Recommendations Firstly, it is recommended to establish long-term stable growth mechanism for financial expenditure for

agriculture, guarantee stable growth of financial expenditure for agriculture, ensure fund utilization efficiency, bring into play gathering advantage of financial expenditure for agriculture, constantly improve integrated agricultural production capacity and overall agricultural development level, and effectively promote development of rural areas and agriculture and increase of farmers' income.

Secondly, it is recommended to optimize structure of the financial expenditure for agriculture and bring into play functions of the financial expenditure for agriculture to the maximum extent. Through increasing direct subsidy for farmers and reducing subsidy in circulation processes, it is recommended to increase support for three categories of agricultural science and technology and reduce percentage of various operating expenses, to optimize investment structure.

Finally, it is recommended to balance investment amount for agriculture in all regions. Since economy of Jiangsu Province takes on gradient development and there is a large gap between farmers' income, it is required to increase investment in Northern Jiangsu and Central Jiangsu. Then, it is expected to promote balance of Southern Jiangsu, Central Jiangsu and Northern Jiangsu, which will directly benefit farmers and promote increase of farmers' income.

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deep processing of walnut is being developed, and related suiting facilities should be considered.

2.4 WT strategies

2.4.1 Focusing on scientific research and optimizing management. Regarding the scientific research, it is imperative to establish scientific service system, strengthen technological service websites and suiting facilities, and improve scientific and technological level and service capacity. The construction of local walnut institute in Shangluo is becoming regular, based on which cooperation and institutions are established. As for the management aspect, walnut association is set up, and the walnut science and technology service stations in each place are strengthened.

2.4.2 Deepening processing part and improving facilities. It is suggested to develop local walnut processing industries, and the leading companies are supposed to stimulate local walnut processing industry. Roads leading each planning places are clear to guarantee the introduction of refined species, product output, and transportation of base construction.

3 Conclusions

The geography and climate in Shangluo is appropriate for walnut to grow. However, there are still some disadvantages to make up, such as bad species, low scientific management, and weak deep processing capacity, *etc.* For the development of walnut industry, it is necessary to foster strengths and circumvent weaknesses in order to make the industry develop better.

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