The efficiency of Chinese farmer cooperatives and its influencing factors

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Abstract
Based on the Bootstrap-DEA, this paper estimates technical efficiency, scale efficiency and pure technical efficiency for the farmer cooperatives in China’s Zhejiang Province and, employs a single truncated bootstrap procedure to identify the key determinants of efficiency. The empirical results suggest pure technical inefficiency was the main sources of the technical inefficiency. Two important factors may be responsible for efficiency: the entrepreneurship and human capital. The efficiency can only be increased by integrating cooperatives resources and increasing the entrepreneurship of the head and the human capital of the members.

Key Words: Farmer Cooperatives; Efficiency; Bootstrap-DEA, Truncated bootstrap

1. Introduction
Farmer cooperative is an important organization form in the agricultural field under the background of market economy. Cooperative can realize the collective functions which are unattainable by individual farmer household such as improving the bargaining power of farmers in the markets, lowering their risks and costs (Warman, 1998). With the centralization of produce selling outlets and opening of the world market, the relationship between the agricultural production and the food markets is getting closer. Produces have an easier access to the markets and farmer cooperatives play very important roles in this process (Galdeano, 2006). Competitiveness is key to the survival of farmer cooperatives as an economic organization in the market economy. Therefore, it will be an inevitable choice for farmer cooperatives to pursue their economic efficiency. The economic efficiency of farmer cooperatives has long been a hot topic in the field of agricultural economics. Especially, the measurement of efficiency and the analysis of its determinants have been a dominant research

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In China, with the promulgation of “Law on Farmer Cooperatives” on July 1, 2007, farmer cooperatives have undergone rapid development. By the end of June 2010, there had been over 310,000 farmer cooperatives in China, covering various produces such as grain, oil crops, vegetable and fruits. It is estimated that by the end of “the 12th Five-year Plan”, the production value of produces sold by the cooperatives will be more than 30 per cent of the gross value of the agricultural production in China.²

The birth and development of farmer cooperatives in China follows the development trend of the market economy and meets the requirements for the development of modern agriculture. It not only saves the transaction costs in the whole process from the production to the consumption but also keeps the economic surplus from the reduction of transaction cost within the agricultural sector, hence increasing the accumulation and development of agriculture (Du, 1998). However, as an economic organization in the market economy, farmer cooperatives are facing competition from their counterparts both at home and abroad. It’s an important research topic to study how to improve the economic efficiency of farmer cooperatives and consequently improve their market competitiveness.

On the basis of the literature review, the paper will study the efficiency of the farmer marketing cooperatives (hereafter called farmer cooperatives). The research focuses on the efficiency and its determinants of farmer cooperatives.³ The research adopts a two-phase analysis. First, it measures farmer cooperatives’ technological efficiency including pure technological efficiency and scale efficiency, with Bootstrap-DEA method; second, it test the determinants of efficiency with Truncated bootstrap model.

The empirical study takes Zhejiang as an example because Zhejiang is a province with the highest marketization in China. Zhejiang’s farmer cooperatives are characterized by long history, high diversity, standard operation and complete data. Zhejiang is also the first province to issue a special law on farmer cooperatives in China. Therefore, Zhejiang will provide a good example to conduct the research on the efficiency of farmer cooperatives and a good reference for the development of farmer cooperatives in other regions of China.

The paper is structured as follows. Section 2 discusses the methods to analyze efficiency and reviews the relevant literature. Section 3 estimates and analyzes the efficiency of farmer cooperatives in Zhejiang. Section 4 builds a single-side truncated bootstrap model to test our assumptions on the determinants of efficiency of farmer cooperatives. Section 5 concludes the paper with research conclusions and policy implications.

2. Reviews on methodology of efficiency analysis and related literature

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³ Farmer Marketing Cooperatives are cooperatives with the largest number, most rapid development and ultimate importance in China.
Productive efficiency includes allocation efficiency and technical efficiency (Farrell, 1957). The former is the capacity to realize optimal input (or output) combination, given fixed factor prices, while the latter refers to the capacity to produce maximum output under fixed input or realize minimum input under fixed output. Generally, firms tend to optimize the current resources usage rather than recombining resources. Measures of efficiency therefore more focus on technical efficiency which we are going to investigate in this paper.

A rigorous efficiency measuring method is an essential condition for evaluating efficiency of farmer cooperatives. There are both parametric methods (Boyle, 2004; Hailu, 2007) and non-parametric methods (Ariyaratne, 2000; Galdeano, 2006), either with merits and demerits. Parametric methods take into consideration the random errors and test the hypotheses. But models have to be established before assumption of stochastic frontier and it applies to productions with single product rather than multi-products. Non-parametric methods, mainly DEA, on the one hand conquer the demerits of parametric methods and on the other hand are not able to distinct the influences of random error and measurement error. Besides, non-parametric methods are subject to the effect of extremum. The Bootstrap method, initiated by Simar (1998, 2000), overcomes to a certain extent the shortage of traditional DEA method. The Bootstrap applies repeated self-sampling and deduces empirical distribution of DEA estimators which are consistent with actual values in loose conditions. Galdeano (2008) uses the Bootstrap-DEA to calculate productive efficiency of Spain horticulture marketing cooperatives with data from 1994 to 2001. Up to now, the Bootstrap in effect has been the only feasible method to repair the imperfection of DEA. So the Bootstrap-DEA method is applied in the current article to investigate efficiencies of farmer cooperatives.

Firstly, assume that each cooperative is a decision unit. \( \chi_i \) stands for the production set of cooperative \( i \) and the realizable point is \( (x, y) \). Then we have

\[
\Psi = \{ x, y \in R^p_x | x \text{ can produce } y \} \tag{1}
\]

Since DEA is a mature method, we are not going to elaborate the mathematics principles or calculation steps. Let \( \hat{\theta}(x, y) \) be the value of efficiency evaluated by DEA model.

Then bias of the estimated DEA values are repaired by smooth Bootstrap method. The essence is to replace primary sample \( \Phi \) with extracted sample \( \{x^*, y^*_i\} \). The basic idea is that let \( p \) be the data generating process of \( \Phi = \{x_i, y_i\} \) and if
\( \hat{p} \) is a consistent estimator of \( p \), then the real distribution can be simulated by the known Bootstrap distribution. Therefore we have

\[
(\hat{\theta}(x, y) - \hat{\theta}(x, y)) \approx (\hat{\theta}(x, y) - \theta(x, y)) p
\]

(2)

in which \( \hat{\theta}(x, y) \) is an efficiency value of extracted sample \( \Phi = \{ (x_i, y_i) \}_{i=1}^{n} \) generated through \( \hat{p} \) by Bootstrap method.

Knowing \( \hat{\theta}(x, y) \) and \( b = 1, \cdots, B \), we henceforth evaluate by Bootstrap the deviation of original estimator \( \hat{\theta}(x, y) \), that is

\[
bias_B[\hat{\theta}(x, y)] = B^{-1} \sum_{b=1}^{B} \hat{\theta}_b(x, y) - \hat{\theta}(x, y)
\]

(3)

And finally, the corrected estimator of \( \theta(x, y) \) is

\[
\hat{\theta}(x, y) = \hat{\theta}(x, y) - bias_B[\hat{\theta}(x, y)] = 2\hat{\theta}(x, y) - B^{-1} \sum_{b=1}^{B} \hat{\theta}_b(x, y)
\]

(4)

Another key issue of farmer cooperatives’ efficiency measurement is to define input and output. Just as in other industries, capital and labor are the main inputs of farmer cooperatives. Besides, some scholars regard raw materials, such as seeds, chemical fertilizer, pesticide, small machines and so on, as input variables as well (Ariyaratne, 2000; Galdeano, 2006, 2008). More input variables will of course contribute to more detailed and thorough functions, but can also cause risk of multicollinearity. In order to avoid the multicollinearity and at the same time be consistent with reality, we take capital, labor, and other expenses as input variables. Capital is measured by net value (ten thousand Chinese Yuan) of fixed assets, labor by working hours or quantity of labor force, while other expenses refers to cost (ten thousand Chinese Yuan) for production inputs purchased uniformly by cooperatives and management fee, et al. The labor input is measured the quantity of labor force, due to the difficulty in acquiring data of working hours. And the general income in corresponding year is adopted as the measurement value of output (ten thousand Chinese Yuan).

3. Efficiency estimation of farmer cooperatives

The dataset for the research consists of 896 farmer cooperatives. The descriptive statistics of their input and output see attached table 1. Seen from attached table 1,
there are huge gaps in the input and output among different cooperatives which indicates that the development of farmer cooperatives is unbalanced.

The research calculates the technological efficiency (TE), pure technological efficiency (PTE) with changing scale rewards and scale efficiency (SE) of 896 farmer cooperatives in Zhejiang in 2009 with R software. Table 1 is the results of the calculation.

<table>
<thead>
<tr>
<th>Efficiency range</th>
<th>Technological efficiency</th>
<th>Pure technological efficiency</th>
<th>Scale efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.2</td>
<td>49</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>0.2-0.3</td>
<td>102</td>
<td>76</td>
<td>8</td>
</tr>
<tr>
<td>0.3-0.4</td>
<td>188</td>
<td>111</td>
<td>29</td>
</tr>
<tr>
<td>0.4-0.5</td>
<td>234</td>
<td>148</td>
<td>47</td>
</tr>
<tr>
<td>0.5-0.6</td>
<td>125</td>
<td>101</td>
<td>56</td>
</tr>
<tr>
<td>0.6-0.7</td>
<td>97</td>
<td>125</td>
<td>85</td>
</tr>
<tr>
<td>0.7-0.8</td>
<td>80</td>
<td>140</td>
<td>122</td>
</tr>
<tr>
<td>0.8-0.9</td>
<td>18</td>
<td>93</td>
<td>149</td>
</tr>
<tr>
<td>&gt;0.9</td>
<td>3</td>
<td>89</td>
<td>398</td>
</tr>
<tr>
<td>Total</td>
<td>896</td>
<td>896</td>
<td>896</td>
</tr>
<tr>
<td>Average</td>
<td>0.4613</td>
<td>0.5939</td>
<td>0.7767</td>
</tr>
</tbody>
</table>

In 2009, the average technological efficiency, pure technological efficiency and scale efficiency of farmer cooperatives in Zhejiang are 0.4613, 0.5939 and 0.7767 respectively. The majority of cooperatives’ technological efficiency range between 0.3-0.6. Technological efficiencies of 49 cooperatives are below 0.2. Only 3 cooperatives’ technological efficiencies are above 0.9. The distribution of pure technological efficiencies is comparatively even, with 14 cooperatives lower than 0.2 and 89 cooperatives above 0.9. The scale efficiencies of most cooperatives are over 0.7, with 2 cooperatives below 0.2 and 398 cooperatives over 0.9. We have the following findings based on the above analysis.

First, the overall technological efficiencies of farmer cooperatives are comparatively low. The efficiency values obtained through Bootstrap-DEA method are relative values which are results of comparing the efficiencies of these cooperatives with that of the best practice. Therefore, the comparatively low average technological efficiencies indicates that there is huge gap in their abilities to manage input-output among different cooperatives and their development is unbalanced. Also, the results of Bootstrap-DEA analysis can help the cooperative managers to acknowledge the best practices. And high-efficiency cooperatives show the low-efficiency cooperatives how to improve their efficiencies.
Second, the fact that pure technological efficiencies are lower than scale efficiencies indicates that the low efficiencies of farmer cooperatives are the results of low pure technological efficiencies. Pure technological efficiency measures the cooperatives’ ability to get more output out of the fixed input. Such low efficiency may caused by over investment in the fixed assets or bad management.

Third, the low scale efficiencies also exist in farmer cooperatives in Zhejiang. There are scale economy for farmer cooperatives. Only cooperatives on a larger scale will achieve higher scale efficiencies. Despite the large number of farmer cooperatives in Zhejiang, most cooperatives are very small which is a root of their low scale efficiencies. It’s also the case throughout China. To improve the scale efficiency of farmer cooperatives, it’s necessary to coordinate the resources or endowments of cooperatives by merging or unifying to realize the reasonable resources utilization and improve the scale efficiency.

4. Influence factors of farmer cooperatives’ productive efficiency

The most important role of the Bootstrap-DEA is that it accurately calculates the efficiencies as well the capacity of efficiency improvement. However, sole efficiency is not enough to explain the efficiency variance between cooperatives. To answer this question, a regression model will be established in this section, which is the second stage for analyzing productive efficiency.

4.1 Literature review, research hypotheses, and model

Efficiency is affected by various factors. According to international literature, external environment, size of cooperatives, financial leverage, and board structure all have significant impact on the efficiency of farmer cooperatives. Krasachat (2009) finds that cooperatives in different areas have different efficiencies. Ariyaratne (1997, 2000) and Krasachat (2009) estimate the influence of organization size on efficiency. Ariyaratne (1997, 2000) and Hailu (2005, 2007) point out that higher financial leverage tend to lead to low efficiency. And board structure affects the performance of cooperatives (Henehan, 1999). Besides, there are also a lot of domestic studies investigating the factors which affect performance of farmer cooperatives in China. The main factors are ownership structure, board structure, managers of cooperatives (Huang et al., 2008; Xu and Wu, 2010). Additionally, human resources of cooperative members and government support may have impacts on efficiency as well. The impacts of ownership structure and government support on efficiency are not estimated in current paper because of the deficiency in related information. Some hypotheses are formulated based on the above literature review.

Hypothesis 1: The development level of regional economy has a positive impact on efficiency of marketing cooperatives.

Since the foundation and development of farmer cooperatives are definitely based on, grinded in and finally integrated into the regional economy, regional economy may
influence cooperatives’ efficiency positively.

Hypothesis 2: 

Size of cooperatives affects efficiency of marketing cooperatives.

Cooperatives of bigger size generally are more capable of processing, brand extension, differentiated marketing, and so on, whereas small size cooperatives have quicker response ability and sequentially are better at holding market opportunities. Hence the effect of size on technical efficiency can only be answered after quantitative test.

Hypothesis 3: 

Financial leverage has a negative influence on efficiency of marketing cooperatives.

The reason is that higher financial leverage increases agency costs, including costs of supervising, contracting, and incentive between principles and agents and which are derived from information asymmetry and imbalance in incentives (Jensen, 1976). Moreover, debt may cause improper inputs allocation and sequentially low efficiency (Featherstone, 1995).

Hypothesis 4: 

Efficiency of cooperatives is likely to be higher if there is bigger membership size of the board.

More persons can collectively draw on the wisdom of the masses and therefore improve performance of cooperatives (Huang, et al., 2008; Xu and Wu, 2010). Nevertheless, coordination cost is increasing as the size of board is being enlarged.

Hypothesis 5: 

Entrepreneurship of managers probably brings higher efficiency of cooperatives.

Xu and Wu (2010) point out that the impact of managers’ social position on performance of cooperatives is much bigger than that of ownership shares and culture. And those who have social positions, rather than pure farmers, have higher talent of cooperative entrepreneurship.

Hypothesis 6: 

Improvement of members’ human capital may enhance the efficiency of cooperatives.

Member training can not only improve members’ professional skill, but also strengthen members’ cooperation consciousness (Yuan, 2001). Member training therefore is beneficial to efficiency of cooperatives.

Based on the above hypotheses, we take farmers’ GDP per capital as the indicator of development level of regional economy, total assets as the indicator of cooperative size, the ratio of total assets and owners’ equity as the indicator of financial leverage, number of persons in the board as the indicator of membership size of the board, a dummy variable as the indicator of managers’ entrepreneurship, and training times every year as the indicator of members’ human capital.

The traditional regression procedure is invalid because of the presence of the inherent dependence among the DEA efficiency scores. Single truncated Bootstrap can overcome the shortage of traditional procedure, so this method is applied to examine
the influences of above mentioned factors on efficiencies of marketing cooperatives. According to Simar (2007), the influence factor model is

\[
T\hat{E}_j \approx a + \beta_1 \ln(RJGD\Pi)_j + \beta_2 \ln(ZZC)_j + \beta_3 (RZ)_j + \\
\beta_4 (LR)_j + \beta_5 (CN)_j + \beta_6 (PX)_j + \varepsilon_j \quad j = 1, \ldots, n
\]  

(5)

where \( j = 1, \ldots, n \), \( T\hat{E}_j \) refers to the technical efficiency (dependent variable) of cooperative \( j \) evaluated at the first stage, \( \ln(RJGD\Pi) \) and \( \ln(ZZC) \) refer to the logarithms of regional (county) GDP per farmer in corresponding year and total assets respectively, \( RZ \) refers to the ratio of total asset and owners’ equity, \( LR \) refers to the number of persons in the board, \( CN \) refers to the social position of cooperative managers and the value of \( CN \) is 1 if a manager has a social position, otherwise the value of \( CN \) is 0, \( PX \) refers to the times of member training in a cooperative in corresponding year, \( \beta_1, \ldots, \beta_6 \) are stay estimated parameters, \( a \) is a constant term, and \( \varepsilon_j \) stands for statistical error.

Besides, since \( \varepsilon_j \sim N(0, \sigma^2) \) and \( \varepsilon_j \geq 1 - a - Z_\sigma \delta \), the distribution of \( \varepsilon_j \) is truncated\(^4\). Maximum Likelihood Estimation method is used to evaluate \( (\delta, \sigma^2) \) and Bootstrap regression method is applied to estimate the confidence interval of estimator of \( (\delta, \sigma^2) \).

The quantification of various influence factors (explanatory variables) is described in Table 2. In addition, Pearson correlation tests on various explanatory variables are carried out in case that there are multicollinearities. Results are presented in Table 3. The correlation coefficients between various variables are low, implying that there is no multicollinearity.

4.2 Results and discussions

Results about the effects of various factors on technical efficiency, pure technical efficiency, and scale efficiency are described in table 2. The plus-minus symbol of parametric value shows the positive or negative impact. The estimated value is more meaningful when zero is not within the confidence interval.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Results of single truncated Bootstrap regression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explanatory variables</td>
<td>TE Intervals</td>
</tr>
</tbody>
</table>

\(^4\) \( Z_\sigma \) stands for explanatory variables, \( \delta \) means estimated parameter.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>95% Confidence Interval</th>
<th>Coefficient</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJGDP</td>
<td>0.0647***</td>
<td>[0.0375; 0.0918]</td>
<td>0.0436***</td>
<td>[0.0123; 0.0750]</td>
</tr>
<tr>
<td>ZZC</td>
<td>0.0000</td>
<td>[-0.0096; 0.0096]</td>
<td>-0.0368***</td>
<td>[-0.0478; -0.0258]</td>
</tr>
<tr>
<td>RZ</td>
<td>-0.0049</td>
<td>[-0.0109; 0.0011]</td>
<td>-0.0091**</td>
<td>[-0.0163; -0.0020]</td>
</tr>
<tr>
<td>LR</td>
<td>-0.0052</td>
<td>[-0.0120; 0.0015]</td>
<td>-0.0140***</td>
<td>[-0.0228; -0.0052]</td>
</tr>
<tr>
<td>CN</td>
<td>0.0574***</td>
<td>[0.0227; 0.0921]</td>
<td>0.0521**</td>
<td>[0.0102; 0.0941]</td>
</tr>
<tr>
<td>PX</td>
<td>0.0008**</td>
<td>[0.0001; 0.0015]</td>
<td>0.0014***</td>
<td>[0.0008; 0.0020]</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.0987</td>
<td>[-0.3383; 0.1410]</td>
<td>0.4127**</td>
<td>[0.1270; 0.6984]</td>
</tr>
</tbody>
</table>

Notes: TE, PTE, and SE stand for technical efficiency, pure technical efficiency, and scale efficiency respectively; “Intervals” refers to 95% confidence intervals; ‘***’, ‘**’, and ‘*’ represent the result is significant at 99% level, 95% level, and 90% level respectively; Values of TE, PTE, and SE are estimated parameters respectively at 95% level.

Economy development level has a positive impact on technical efficiency, pure technical efficiency, and scale efficiency. And hypothesis 1 is confirmed.

Size of cooperatives does not have a significant effect on efficiency, whereas has a negative effect on pure technical efficiency and a positive effect on scale efficiency. The results have some deep meanings. On the one hand, farmer cooperatives in China are still at the early development stage and there is low level management as well as entrepreneurship. Therefore it is difficult for cooperatives of big size to develop value added of products by branding and product differentiation, whereas it is relatively easier for small size cooperatives. Too big size causes over investment of input and resource wasting, and sequentially leads to low efficiency. On the other hand, scale efficiency will be improved as size gets bigger due to the presence of scale economy. Then it is probable that size does significantly affect technical efficiency, yet the effect is contradicted by positive impact on pure technical efficiency and negative impact on scale efficiency.

Neither financial leverage nor membership size of the board has any influence on technical efficiency or scale efficiency, whereas both have a negative influence on pure technical efficiency. Financial leverage causes increase of transaction cost and misallocation of resource. However, increase of membership size does not help to draw on the wisdom of the masses, implying that conclusions of Huang et al. (2008) and Xu and Wu (2010) in hypothesis 4 are not confirmed by current result. On the contrary, bigger size of membership of the board leads to higher coordination cost and sequentially lower pure technical efficiency. In spite of the negative but relatively small impacts of ratio of total capital and owners’ equity and size of board membership on pure technical efficiency, they do not have significant impacts on
Besides, entrepreneurship of managers and human resource of members in a cooperative are especially important, implying that hypothesis 5 and 6 are confirmed. Both higher entrepreneurship of managers and more training provided to members can enhance efficiencies of cooperatives. Investment in human resources therefore will bring up good return. In the mean time, the result indicates the shortage of managers with high entrepreneurship as well as necessity and urgency of more member trainings.

5. Conclusions and policy implications

Based on our research and analysis, we reach the following conclusions and policy implications.

First, the overall efficiencies of farmer cooperatives are low. The low pure technological efficiencies are the important reasons for the overall low efficiencies. Despite the rapid development and increasing number of farmer cooperatives, their scales are comparatively small, which is the root of the low scale efficiencies of cooperatives. To improve this, it’s necessary to coordinate the existing resources or endowments of cooperatives instead of enlarging their scales and increasing their numbers.

Second, the entrepreneurship of cooperative managers and human capital of their members are very important for the efficiencies of cooperatives. The scale of capital, financial beverage and the number of board members all have significant negative impact on the pure technological efficiencies. It indicates that the management of cooperatives is comparatively poor. Farmer cooperatives are different from both ordinary cooperatives and agricultural enterprises. The goals of cooperatives are to serve and satisfy their members within the cooperatives and sell their members products and maximize profits outside the cooperatives. Therefore the managers of cooperatives should have entrepreneurship, teamwork spirit, leadership, ability to reasonably allocate and utilize resources. Besides the professional skills, cooperative members should also have enthusiasm and teamwork spirits.

If governmental supports only confine to the legislation and capital, it will be difficult to achieve desired effects. To improve the overall operation efficiency of farmer cooperatives, the government should coordinate the resources of farmer cooperatives by macro regulation to prevent the blind increasing of number and scale and avoid wastes. The government should also apply the financial support to improving the human capital of cooperative managers and members to cultivate their entrepreneurship.

The environment factors also influence the efficiencies of cooperatives. It indicates that when guiding the development of farmer cooperatives, the local governments should not only refer to the successful experience both at home and abroad but also make
relevant policies based on their regional conditions.
### Table 1 Descriptive statistics of input and output variables of farmer marketing cooperatives

<table>
<thead>
<tr>
<th>Cooperatives</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input variable: Labor (LD)</td>
<td>72.78</td>
<td>17006.94</td>
<td>5.00</td>
<td>1509.00</td>
</tr>
<tr>
<td>Net fixed asset (FZ)</td>
<td>97.10</td>
<td>215216.48</td>
<td>1.00</td>
<td>8666.63</td>
</tr>
<tr>
<td>Input goods (TR)</td>
<td>494.95</td>
<td>1297063.51</td>
<td>1.73</td>
<td>18690.47</td>
</tr>
<tr>
<td>Output variable: total income (ZY)</td>
<td>554.61</td>
<td>1502105.29</td>
<td>3.50</td>
<td>19000.00</td>
</tr>
</tbody>
</table>

### Table 2 Descriptive statistic analysis of explanatory variables

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJGDP</td>
<td>8.89</td>
<td>0.43</td>
<td>8.08</td>
<td>10.31</td>
</tr>
<tr>
<td>ZZC</td>
<td>4.24</td>
<td>1.26</td>
<td>1.25</td>
<td>9.19</td>
</tr>
<tr>
<td>RZ</td>
<td>1.73</td>
<td>1.79</td>
<td>1.00</td>
<td>23.63</td>
</tr>
<tr>
<td>LR</td>
<td>3.75</td>
<td>1.59</td>
<td>1.00</td>
<td>15.00</td>
</tr>
<tr>
<td>CN</td>
<td>0.09</td>
<td>0.29</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>PX</td>
<td>7.67</td>
<td>22.18</td>
<td>0.00</td>
<td>420.00</td>
</tr>
</tbody>
</table>

### Table 3 Correlation matrix of explanatory variables

<table>
<thead>
<tr>
<th></th>
<th>RJGDP</th>
<th>ZZC</th>
<th>RZ</th>
<th>LR</th>
<th>CN</th>
<th>PX</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJGDP</td>
<td>1</td>
<td>0.1396</td>
<td>0.0091</td>
<td>-0.0499</td>
<td>0.0789</td>
<td>-0.0758</td>
</tr>
<tr>
<td>ZZC</td>
<td>0.1396</td>
<td>1</td>
<td>0.2053</td>
<td>0.1068</td>
<td>0.1621</td>
<td>-0.0096</td>
</tr>
<tr>
<td>RZ</td>
<td>0.0091</td>
<td>0.2053</td>
<td>1</td>
<td>-0.0003</td>
<td>0.0292</td>
<td>-0.0301</td>
</tr>
<tr>
<td>LR</td>
<td>-0.0499</td>
<td>0.1068</td>
<td>-0.003</td>
<td>1</td>
<td>0.1058</td>
<td>-0.0027</td>
</tr>
<tr>
<td>CN</td>
<td>0.0789</td>
<td>0.1621</td>
<td>0.0292</td>
<td>0.1058</td>
<td>1</td>
<td>0.0562</td>
</tr>
<tr>
<td>PX</td>
<td>-0.0758</td>
<td>-0.0096</td>
<td>-0.0301</td>
<td>-0.0027</td>
<td>0.0562</td>
<td>1</td>
</tr>
</tbody>
</table>
References


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