Study of supply side for China industrial textiles based on C-D function

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Abstract: For the sake of further pushing on with reform of the supply side in the China's industrial textiles during the 13th Five-Year Plan period, the industry can continue to keep overall steady growth and have a good development momentum. This paper starts from the quantitative point of view, using C-D production function of the industry's 14 listed companies to carry out research. Through the empirical analysis of capital, labor force, R&D expenditure and output relationship and explore the R&D expenditure has the lag effect and cumulative effect. The study can provide some facts. On the one hand, labor, R&D expenditure and output indicators existed obvious positive correlation; On the other hand, There was a negative correlation relationship capital input and output index; besides, R&D expenditure had lagged effect and cumulative effect. Based on the above research conclusion, this paper puts forward specific proposals. The study can provide reference to the development of industry.

Keywords: supply side, industrial textiles, R&D expenditure, textiles

1. Introduction

As China's economy into the new normal, the state proposed to moderate expansion of demand at the same time, efforts to promote the supply side of the structural reform1, the key is to go to capacity, to inventory, to leverage. Enhance the adaptability and flexibility of the supply structure to the demand change so as to promote the overall leap in the level of China's social productive forces. The industrial textiles industry has continued to implement supply-side reforms over the past decade, and the overall maintained steady progress, stability in a good development trend. At the same time, there are land, labor, capital and other factors of the plight of rising costs2. So it is one of the goals of the 13th Five-Year Plan for industrial textiles in the future to resolve the excess capacity, realize effective supply3 and improve the total factor productivity4.

Cai Fang, vice president of the Chinese Academy of Social Sciences believes that the supply side structural reform is from the perspective of economic growth, production function to solve the problem. Using the initial C-D production function, Chen Sirong5 used the initial C-D production function to study the largest factor that affect China's economic growth from the perspective of labor force and capital, the study found that the contribution of labor force to economic growth is greater than the contribution of capital increase to economic growth; At the same time, Yu et al.6 used the initial C-D production function to measure the quality and mode of China's economic growth, the results showed that labor force has more significant effect on China's economy than capital; Ren Yunhai, etc.7 by analyzing the performance of listed companies in manufacturing companies, found that R&D investment was significantly correlated. Therefore, this paper is based on the innovative C-D production function8-9, R&D expenditure10 as a new independent variable, from the angle of labor force, capital and R&D expenditure input three factors and output relations, through empirical analysis to identify the significant factors affecting the industry output, While exploring that R&D expenditure had lagged effect and cumulative effect. Finally, Provide effective suggestions for the supply side reform of the industrial textiles industry.

2. Theoretical basis and hypotheses

2.1 Model selection

The Cobb-Douglas production function is an economic mathematical model created by the American mathematician Charles Cobb and the economist Paul Douglas to explore the relationship between inputs and outputs, referred to as the C-D production function.

2.2. Related variables and assumptions

2.2.1 Output

Output refers to the sum of all kinds of useful goods or services created in the production process, uses for consumption or for further production. It is the enterprise to improve the level of sales revenue, but also the basis for economic growth.

2.2.2 Labor

Labor refers to the human ability to work, hides in the body of the sum of mental and physical. Broadly speaking, the labor force refers to the whole population; the narrow sense of the labor force is the ability to work with the population. Material production process is the role of labor acts on the means of production. Leaving the labor force, the means of production itself can not create anything.

Hypothesis one11: Labor input and output have a significant correlation and a significant impact.

2.2.3 Capital

Capital can buy means of production and the labor force. besides, it prepares conditions for the production of surplus value. The means of production and the labor force are the source of value creation and surplus value, also the basis for raising the level of output.

Hypothesis two12: Capital input and output have a significant correlation and a significant impact.

2.2.4 R&D expenditure

R&D expenditure is for basic research, applied research and experimental development of the expenditure. On the one hand, R&D expenditure is the material basis of scientific and technological progress and an important prerequisite, but also a direct impetus to scientific and technological progress; On the other hand, the enterprise's R&D activities13-14 are continuous and cumulative, from the input of funds to
Research results often require a time course. As early as 1986, the United States Harvard University professor Griliches has been put forward R&D expenditure has lagged.

Hypothesis three\(^{[15-16]}\): R&D expenditure and output have a significant correlation and a significant impact.

Hypothesis four\(^{[16]}\): R&D expenditure has lagged effect.

Hypothesis five\(^{[16]}\): R&D expenditure has cumulative effect.

3. Research design

3.1. Sample selection

In this paper, China's industrial textiles industry as a research object, but considering the data are not complete, so they are selected in line with the following conditions as samples of listed companies:

- As of 2014, the listed company's industrial textile-related business income accounted for more than 50% of total revenue.
- 2013-2014 years of continuous disclosure of R&D expenditure in listed companies.
- Elimination of the listed companies with incomplete financial data during the study period. Therefore, this paper selects 14 listed companies, as shown in Table1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Company Name</th>
<th>Main Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JSKD</td>
<td>Textile automotive interior</td>
</tr>
<tr>
<td>2</td>
<td>Savings</td>
<td>Textiles for filtration</td>
</tr>
<tr>
<td>3</td>
<td>Huafon Microfibre</td>
<td>Microfiber leather fabric, microfiber leather</td>
</tr>
<tr>
<td>4</td>
<td>China-Hemp</td>
<td>Clothing lining, in cloth</td>
</tr>
<tr>
<td>5</td>
<td>Hongda High-Tech</td>
<td>Textiles for transport</td>
</tr>
<tr>
<td>6</td>
<td>JUIDING</td>
<td>Textiles for structural reinforcement</td>
</tr>
<tr>
<td>7</td>
<td>Sinoma</td>
<td>Textiles for structural reinforcement, textiles for filtration</td>
</tr>
<tr>
<td>8</td>
<td>SELEN</td>
<td>Safety textiles, medical and health textiles</td>
</tr>
<tr>
<td>9</td>
<td>XinLong Holding</td>
<td>Spunlaced nonwoven fabric</td>
</tr>
<tr>
<td>10</td>
<td>TONGDA STOCK</td>
<td>Microfiber leather fabric, microfiber leather</td>
</tr>
<tr>
<td>11</td>
<td>CECEP COSTIN</td>
<td>Non-woven fabrics, filter textiles</td>
</tr>
<tr>
<td>12</td>
<td>HMT</td>
<td>Textiles for transport</td>
</tr>
<tr>
<td>13</td>
<td>SiJia Group</td>
<td>Textiles</td>
</tr>
<tr>
<td>14</td>
<td>TMMT</td>
<td>Ultra-microfiltration membrane and membrane components</td>
</tr>
</tbody>
</table>

Data sources: China Nonwovens & Industrial Textiles Association.

3.2. Model construction

This paper considers that the traditional C-D production function model only assets and labor of the two factors of production, Therefore, when analyzing the relationship between R&D expenditure and output, the generalized production function model is used to add R&D expenditure as a new variable into the model to get a new production function model.

First, the function representation of model 1 is obtained.

\[
Y = A L^\alpha K^\beta R^\gamma \quad (1)
\]

Where \(Y\) is the output, \(A\) is the comprehensive technical level, \(L\) is the labor input, \(K\) is the capital input, \(R\) is the R&D expenditure input, \(\alpha\), \(\beta\), \(\gamma\) are the elastic coefficients of labor input, capital input and R&D expenditure input to output.

In order to make the analysis more significant, this paper constructed a linear regression equation, the original equation was logarithmically processed, the measurement equation is as follows.

\[
\ln Y = \ln A + \alpha \ln L + \beta \ln K + \gamma \ln R \quad (2)
\]

Secondly, in the study of the lag effect of R&D expenditure, R&D expenditure input by 14 listed companies in 2013 input data to represent. the function representation of model 2 is shown as follows.

\[
Y = A L^\alpha K^\beta R_{t-1}^\gamma \quad (3)
\]

At the same time, the logarithm of the model 2 equation is taken, the equation is as follows.

\[
\ln Y = \ln A + \alpha \ln L + \beta \ln K + \gamma \ln R_{t-1} \quad (4)
\]

Finally, the cumulative effect of R&D expenditure is studied, and the total R&D expenditure is the sum of the total investment of 14 listed companies in 2013 and 2014. The function representation of model 3 is shown as follows.

\[
Y = A L^\alpha K^\beta (R_{t-1} + R)^\gamma \quad (5)
\]

At the same time, the logarithm of the model 3 equation is taken, the equation is as follows.

\[
\ln Y = \ln A + \alpha \ln L + \beta \ln K + \gamma \ln (R_{t-1} + R) \quad (6)
\]

According to the above model, this paper uses Spss19.0 and Excel 2007 software to analyze the statistical data of 14 listed companies in China's industrial textile industry in 2014, such as operating income, increasing in total fixed assets, the total amount of employees, R&D expenditure and R&D expenditure in 2013. Among them, the forecast variable has constant, increasing in total fixed assets, the total amount of employees and R&D expenditure; the dependent variable is the operating income. Among them:
Output. In theory, the output should be used to analyze the whole process of input and output. However, due to too many areas involved in the industry, product diversification, it is difficult to use physical quantity to represent the output, so this paper chooses 14 listed companies operating in 2014 as a measure of the output of indicators measured.

Labor. Combining with domestic and international research, the measure of labor input can be reflected in the number of workers, labor wages and working hours, etc. However, due to the imperfect wage system in our country, the total wage to reflect the labor input will cause the deviation of the study, and take the labor time to reflect the labor input will make the research more accurate, but there are incomplete data and other objective factors, leading to interference research results. Therefore, this paper selects 14 listed companies in 2014 the total amount of employees as a measure of labor input to measure.

Capital. Capital input refers to the total capital stock of enterprises directly or indirectly, including the fixed assets and current assets which are directly produced and provided with various kinds of material products and services. Based on the comprehensive consideration of the availability of data and the accuracy of calculation, this paper selects the 14 listed companies in 2014 the total amount of fixed assets increased[17] as a measure of capital input to measure.

R&D expenditure. This paper directly selects the 14 listed companies in 2014 the total investment in R&D to estimate. As China's current corporate accounting standards do not require companies to disclose annual investment in R&D expenditure, so the data used in this research are manually collected in the report of the Board of Directors of listed companies.

4. Data analysis

4.1. Research for the current year input and output

As shown in Table2 and Table3, the 14 listed companies paid great attention to investment in fixed assets and R&D expenditure; there is a significant correlation between the operating income and the increasing in total fixed assets, the total amount of employees and R & D expenditure.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating income</td>
<td>20.4564</td>
<td>0.72734</td>
<td>14</td>
</tr>
<tr>
<td>The total amount of employees</td>
<td>6.8593</td>
<td>0.84063</td>
<td>14</td>
</tr>
<tr>
<td>Increasing in total fixed assets</td>
<td>18.3700</td>
<td>1.23029</td>
<td>14</td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>16.9729</td>
<td>0.92789</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Pearson</th>
<th>Operating income</th>
<th>The total amount of employees</th>
<th>Increasing in total fixed assets</th>
<th>R&amp;D expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating income</td>
<td>1.0000</td>
<td>0.0000</td>
<td>0.0120</td>
<td>0.0010</td>
</tr>
<tr>
<td>The total amount of employees</td>
<td>0.0011</td>
<td>1.0000</td>
<td>0.0040</td>
<td>0.0260</td>
</tr>
<tr>
<td>Increasing in total fixed assets</td>
<td>0.0120</td>
<td>0.0011</td>
<td>1.0000</td>
<td>0.0080</td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>0.0012</td>
<td>0.0026</td>
<td>0.0080</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

As shown in Table4, $R^2 = 0.833$ 83.3% of the changes in the output function of listed companies can be explained by the estimated input-output function. The measurement equation is given below.

\[ \ln Y = 11.764 + 0.600\ln L - 0.113\ln K + 0.392\ln R \]

According to the basic assumptions of the C-D production function, the elasticity coefficients of labor and capital inputs to output are both positive and their values are less than 1. R&D expenditure as a new input variable into the equation, the output elasticity should be between 0 and 1. The empirical results show that the elasticity coefficients of labor input and R&D expenditure are positive, and the probability of regression coefficient T test are 0.003 and 0.014, which are all less than 0.05. Support the hypothesis of one and three in this paper. It shows that labor input and R&D expenditure of listed companies in China's industrial textile industry have significant significance to the output level of enterprises in the year, and they are positively correlated; However, the results also show that the elasticity coefficient of capital input to output is negative, and the correlation coefficient does not pass the 5% significance test, cannot support the hypothesis of two. It shows that capital input of listed companies in China's industrial textile industry have no significant significance to the output level of enterprises in the year.
The total amount of employees & 0.60 & 0.156 & 0.693 & 3.8 & 0.00 \\
Increasing in total fixed assets & 0.113 & 0.116 & -0.191 & 0.976 & 0.35 \\
R&D expenditure & 0.39 & 0.132 & 0.500 & 2.9 & 0.01 \\

\( R^2 \) & 0.833 \\

a. Predictors: (constant), R&D expenditure, increasing in fixed assets, The total amount of employees 
b. Dependent variable: operating income.

4.2. Research for the previous year’s R&D expenditure and the next year output

As shown in Table 5, the measurement equation is as follows.
\[
\ln Y = 10.467 + 0.460 \ln L - 0.076 \ln K + 0.489 \ln R_{-1}
\]
The elasticity coefficient of R&D expenditure is 0.489 > 0.392. And the correlation coefficient T test probability is less than 0.05, to support the hypothesis of four. It shows that R&D expenditure has lagged effect, and lag one year on the output of the impact is higher than the impact of the year.

<table>
<thead>
<tr>
<th>Model</th>
<th>Non-normalized coefficient</th>
<th>Normalized coefficient</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Standard deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(constant)</td>
<td>10.4 &amp; 67</td>
<td>1.891</td>
<td>5.5</td>
<td>0.00</td>
</tr>
<tr>
<td>The total amount of employees</td>
<td>0.46 &amp; 0</td>
<td>0.155</td>
<td>0.532</td>
<td>2.9</td>
</tr>
<tr>
<td>Increasing in total fixed assets</td>
<td>0.076 &amp; -</td>
<td>0.102 &amp; -</td>
<td>-0.129</td>
<td>-</td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>0.48 &amp; 9</td>
<td>0.141</td>
<td>0.581</td>
<td>3.4</td>
</tr>
</tbody>
</table>

\( R^2 \) & 0.857 \\
a. Predictors: (constant), R&D expenditure, increasing in fixed assets, The total amount of employees 
b. Dependent variable: operating income.

4.3. Research for a one-year R&D expenditure and output

As shown in Table 6, the measurement equation is as follows.
\[
\ln Y = 10.790 + 0.539 \ln L - 0.101 \ln K + 0.444 \ln (R_{-1} + R)
\]
The elasticity coefficient of R&D expenditure is 0.444 > 0.392. And the correlation coefficient passed the 5% significance test, to support the hypothesis of five. Indicating that there is a cumulative effect of R&D expenditure, and the cumulative impact of a year on output is higher than the impact on the year.

<table>
<thead>
<tr>
<th>Model</th>
<th>Non-normalized coefficient</th>
<th>Normalized coefficient</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Standard deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(constant)</td>
<td>10.7 &amp; 90</td>
<td>1.905</td>
<td>5.6</td>
<td>0.00</td>
</tr>
<tr>
<td>The total amount of employees</td>
<td>0.53 &amp; 9</td>
<td>0.152</td>
<td>0.623</td>
<td>3.5</td>
</tr>
<tr>
<td>Increasing in total fixed assets</td>
<td>0.101 &amp; -</td>
<td>0.108 &amp; -</td>
<td>-0.170</td>
<td>0.934</td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>0.44 &amp; 4</td>
<td>0.135</td>
<td>0.542</td>
<td>3.2</td>
</tr>
</tbody>
</table>

\( R^2 \) & 0.848 \\
a. Predictors: (constant), R & D expenditure, increasing in fixed assets, The total amount of employees 
b. Dependent variable: operating income.

5. Conclusion and suggestion

5.1. Conclusion
This paper constructs a new C-D function to study the 14 listed companies in China's industrial textile industry, and sums up the relationship between labor force, capital investment, R&D expenditure and output of listed companies. And find out the hysteresis effect and accumulative effect of R&D expenditure. The specific conclusions are as follows:

Based on Table4, 5, 6, the coefficient of labor input and R&D expenditure are always greater than 0, indicating that China's industrial textiles industry labor input and R&D expenditure have a positive effect on output, and the elasticity coefficient of labor force is the largest. Therefore, the listed companies to increase these two inputs will have a significant impact on output.

Based on Table2, the mean and standard deviation of fixed assets increase are much larger than that of R&D expenditure, which shows that listed companies invest in fixed assets much more than R&D expenditure, Indicating that listed companies attempt to increase the capital and labor input to drive output.

Based on Table4, 5, 6, the coefficient of capital investment is always less than 0, the capital investment has negative correlation to the output, which indicates that the investment of the listed company to the fixed assets does not necessarily lead to the output.

Based on Table5, the elasticity coefficient of R&D expenditure lagging behind one year is much larger than that of current year, which shows that R&D expenditure has obvious lagging effect and exceeds the contribution of labor force to output, which indicates that R&D expenditure in the year the output of the next year have a significant impact.

Based on Table6, the elasticity coefficient of R&D expenditure input accumulated one year is much larger than that of current year, which shows that R&D expenditure has accumulative effect, that each year of R&D expenditure for the subsequent annual output will have a significant impact, that sustained R&D expenditure will bring significant economic growth.

5.2. Suggestion

According to the conclusion of the empirical study, the paper proposes the following suggestions for the further reform of China's industrial textile industry.

1. Labor input to output has obvious positive impetus, so enterprises should accelerate the introduction and cultivation of independent innovation ability of leadership team and science and technology innovation team. Creating a competitive salary incentive system to stimulate the contribution of labor capital to production.

2. Enterprises appropriately reduce the amount of investment in fixed assets, and reduce corporate debt effectively, so as to gradually achieve the industry-wide "deleveraging" target; Actively guide the direction of investment in fixed assets, rational allocation of capital investment resources, improve the industrial structure, accelerate the industrial transformation and upgrading.

3. Improve the R&D expenditure input, effectively enhance the funding of the utilization rate and conversion rate, establish and improve the R&D expenditure efficiency evaluation system; Optimize the operating environment of the R&D activities, so that research results quickly transformed into real productive forces; As the R&D expenditure there is a lag effect and cumulative effect, By increasing the amount of investment will not only help to increase the capacity of sustainable development of enterprises, but also enable enterprises to rely on technological progress to gain competitive advantage, driving the entire industry's economic growth.

References
