Performance Measurement of Chinese Textile Industry in 1998

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ABSTRACT

In this thesis, a data envelopment analysis model with preference information about input and output targets is set up to evaluate the economic operational efficiency of the textile industry of Chinese 31 regions. Then the stochastic production frontier function of Chinese textile industry is obtained with the data set of all DMUs' projection points on the production frontier face by regressive analysis model. An econometric regressive model is set up to explain the difference among efficiency of different regions .A system analysis and assessment about the macroeconomic operational efficiency of China textile industry is carried through, and some conclusions are valuable for decision-making.
Keywords: Preference information; Data envelopment analysis: Stochastic production frontier; Performance measurement; Chinese textile industry

Preface

Chinese textile industry is one of the major conventional industries in China, and is a competitive industry. Now Gross national product per person is less than 800$, and agricultural GDP per person is only 200$. In regard to the fact that 70 present of the population of China are rural population, textile industry will play the fundamental important role in Chinese economy in future fifty years. China has produced the largest amount of fibre product, with about 10,000,000 tons of fibre every year. China also shares the most part, about 13 percent, of the export of world 's textile. On the other hand, the textile export of China contributes a lot, about 23%, to the total commodity export of China. Although Chinese textile has played an important role in the process of Chinese economic development, an important fact reveals that China textile industry was in declining financial situation among all industries from 1992 to 1998, What caused it? and what China textile industry should do to enhance economic return after China's entry into World Trade Organization? As we all known, China's entry into World Trade Organization has supplied some advantageous conditions to the future development of China textile industry, the textile export will arrive a new top. In order to answer these questions, we must carry a system analysis and a system evaluation to the running efficiency of China textile industry.

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We firstly apply a data envelopment analysis model to evaluate the economic operational efficiency of the textile industry of Chinese 31 provinces and cities. Then the stochastic production frontier function of Chinese textile industry is obtained by regressive analysis model. With the data set of all decision-making units (DMUs)' projection points on the production frontier face, which are the most efficiency artificial DMUs of China textile industry. We analyze which economic factors caused the significant difference between the DMUs' efficiency by an econometric regressive model. At last, we draw a conclusion.

Performance measurement of the textile industry of Chinese 31 regions

Data envelopment analysis / assurance region model

Since Prof. A Charnes, Cooper and Rhodes.(1978) put forth the data envelopment analysis model to calculate the relative efficiency of different DMUs with the same input and output targets, data envelopment analysis has been applied in many fields for evaluating efficiency or obtaining the production frontier function as a new non-parametric approach. Some new theoretical models have been made. Especially a lot of successful applications have been made by some scholars, such as Lawrence M. Seiford and Joe Zhu (1999), Toshiyuki sueyoshi and Yuichiro kirihara(1998), Andreas Soteriou and Stavros (1999), AS Camanho *et al*(1999), Biresh Kumar Sahoo *et al*(1999), Soung-hie Kim *et al* (1999), CS Sarrico and RG Dyson(2000), Abdul Wadud *et al*(2000), Chiang Kao(2000), C Kao and S-Tai Liu(2000), Toshiyuki Sueyoshi(2000), Hong Yan and Quanling Wei(2000) and so on.

A potential hypothesis of data envelopment analysis is that all DMUs choose the advantageous weight values of input and output targets for themselves, and no one input or output target is more important than another (Merja Halme *et a*l, 1999). A general game theory analysis framework for data envelopment analysis was suggested (G Hao, QL Wei and H Yan, 2000), which reveals the essence of competition among DMUs. Facing a decision, the decision-maker always has its preference structure for input or output targets, and it is sure to say that there must be some targets which are more important that others to some degree. Above all, the conventional data envelopment analysis model may lead to an improper results which can not be explained in views of economy or others. In order to make the evaluation work by data envelopment analysis more reliable, the subjective information such as preference structure for input or output targets should not be avoided in applications of data envelopment analysis.

CS Sarrico, SM Hogan *et al* (1997) developed a decision support system to help students to select the most satisfying university for them, which was based on data envelopment analysis model with weight restriction, the weight restriction was obtained by interactive operations. Charnes *et al.* (1989), Dyson *et al* (1988), Thompson *et al.*(1990) also gave some data envelopment analysis models, which include the weights restriction in order to reveal the preference information of decision-makers.

There are n decision-making units, namly $DMU_j, j=1,\cdots,n$. The input and output vectors of DMU_j are $x_j=(x_{1j},\cdots,x_{mj})^T \geq 0$ and $y_j=(y_{1j},\cdots,y_{sj})^T \geq 0$ respectively, $j=1,\cdots,n$. m is the number of input targets, and s is the number of output targets. In this paper, we select data envelopment analysis / assurance region model to perform a evaluation, which can embrace preference information by assurance region. The corresponding input-oriented model is as following:

$$
\begin{aligned}
&\text{Max } \sum_{r=1}^{s} u_r y_{r0} \\
&s.t. \\
&\begin{cases}
\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, j=1,\cdots,n. \\
\sum_{i=1}^{m} v_i x_{i0} = 1, \\
v^T c \leq \mathbf{0}, \\
u^T d \leq \mathbf{0}, \\
c = (c_1, c_2, \cdots, c_m) = \begin{pmatrix} c_{11} & c_{12} & \cdots & c_{1m} \\ c_{21} & c_{22} & \cdots & c_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ c_{m1} & c_{m2} & \cdots & c_{mm} \end{pmatrix}_{m\times m}, \text{ is a constant matrix.} \\
d = (d_1, d_2, \cdots, d_s) = \begin{pmatrix} d_{11} & d_{12} & \cdots & d_{1s} \\ d_{21} & d_{22} & \cdots & d_{2s} \\ \vdots & \vdots & \vdots & \vdots \\ d_{s1} & d_{s2} & \cdots & d_{ss} \end{pmatrix}_{s\times s}, \text{ is a constant matrix.} \\
v^T = (v_1, v_2, \cdots, v_m) \geq \mathbf{0}, \ u^T = (u_1, u_2, \cdots, u_m) \geq \mathbf{0}.
\end{cases}
\end{aligned}
\qquad [1]
$$

In above model, the input weight restriction $v^T c \leq \mathbf{0}$ and output weight restriction $u^T d \leq \mathbf{0}$ construct the assurance region. The constant matrixs c and d reaveal the preference structure of input and output targets, c and d can be obtained by interactive feedback between decision-makers and the system analysts.

The aim of this model is to analyze the economic operation efficiency of Chinese textile industry, we select the number of labors(L) and total assets(K) as the input targets, with the total industrial production value(Y) as system's output. We can not get some precise information to discriminate one of the two inputs, labors and total assets, is more imporetant than the other. On the other hand we are sure to know none of the two input targets' weight values are possible to be zero at any time, so we must give a weight restriction to realize this. For only two inputs especially, it is easy to understand that the symmetrical weight restriction can avoid to lead to zero weight value, such as an inequation, $\frac{1}{8} \le \frac{v_L}{v_K} \le 8$, in this model, v_L is the weight value of labors, v_K is the weight value of total assets. This inequation can also be rewrite as a matrix style like $(v_L, v_K)\begin{bmatrix} 1 & -8 \\ -8 & 1 \end{bmatrix} \le 0$. Matrix $\begin{bmatrix} 1 & -8 \\ -8 & 1 \end{bmatrix}$ is the input constant matrix c in model (1), which is used in our actual model.

Data computation and system analysis to the result

The statistic data of the textile industry of Chinese 31 regions in 1998 are in table 1., which are from the annals of Chinese textile industry. In order to find out the zero weight value phenomenon, we firstly use the data envelopment analysis model without weight restriction, then the weight restriction is added to the model. Table 2. gives the result of data processing.

Two basic data envelopment analysis models are CCR (Charnes, Cooper and Rhodes, 1978) and BCC (Banker, Charnes and Cooper, 1984), we use the CCR model to get the total efiicieny, and use the BCC model for purely technical efficiency. From the result, we can find out that there are 38.7 percent of input weight values are zero, which are 24 from 62 weight values for 31 DMUs in CCR model without weight restriction. Obviously it can not be complained properly for both inputs are important to the industrial production, and then the corresponding efficiencies can not be adopted for practical application. The efficiency series from the CCR without weight restriction are defined as symbol E1, and the efficiency series from the CCR with weight restriction are defined as symbol E2. A new series named E3 is produced by E2 minus E1. In the CCR model with weight restriction all weight values are not zero, which is accordance with the theoretical analysis. So this model is more efficient and credible. All values of E3 are less than zero, that is to say the efficiencies E2 are lower than E1, therefore model without weight restriction overrates practical efficiency.

For some DMUs the differences between E2 and E1 are very larger. For examples, the efiiciency of Hainan decreases from 93.43%(E1) to 33.92%(E2), from 100% (E1)to 78.95%(E2) for Shanghai. As we all known, the smaller combined inputs and the larger combined outputs can lead to high efficiency. From the original data, we can find that these two DUMs have relative superiority in labors compared with total assets. These two DMUs must choose the proper weight values for themselves, in orde to minimize the combined inputs and maximize the output for the sake of the essence of competition among all DMUs. Then they gave the larger weight values for relative superior input, labors, than total assets in order to minimize the combined inputs. To the extreme, their weight values for total assets both equal zero. That is the mechanism that causes the zero weight value phenomenon. When weight restriction is included, they have no chance to choose the zero weight value for total assets, so the combined inputs increase, and the efficiencies become low. This is the reason why the differences between E2 and E1 are very larger for Hainan and Shanghai.

Table 1. Statistic Datum of Chinese textile industry in 1998

Regions	Labors(L)/ 10, 000 persons	TotalAssets (K)/ 100 million RMB	Total industrial production value(Y)/ 100 million RMB	Sale Incomes(P)/ 100 million RMB	Aesset per person (K/L)/ (100 million RMB /10, 000 persons)	Foreign Direct Investment(W)/ 100 million RMB
Beijing	14.81	154.01	90.04	84.88	10.40	6.88
Tianjin	21.43	197.87	153.77	136.28	9.23	9.68
Hebei	37.69	372.93	258.1	227.67	9.89	3.84
Shanxi	10.69	83.47	36.19	28.75	7.81	0.16
Neimeny	7.94	101.06	48.58	44.18	12.73	3.87
Liaoning	32.05	266.96	144.26	131.79	8.33	10.6
Jilin	10.79	121.07	41.53	31.94	11.22	2.73
Heilongjiang	11.88	143.35	43.18	39.36	12.07	0.25
Shanghai	44.03	846.5	564.27	559.93	19.23	51.36
Jiangsu	139.61	1585.55	1611.28	1434.94	11.36	75
Zhejiang	87.3	1132.8	1078.41	994.85	12.98	24.9
Anhui	27.29	213.23	145.7	117.48	7.81	0.66
Fujian	22.15	254.04	225.91	201.20	11.47	10.57
Jiangxi	13.96	131.53	61.76	48.91	9.42	0.26
Shandong	86.49	1008.23	718.4	618.42	11.66	37.79
Henan	44.85	411.75	248.16	200.57	9.18	0.89
Hubei	50.1	386.71	345.31	275.50	7.72	1.25
Hunan	14.86	110.31	55.15	49.40	7.42	0.38
Guangdong	98.47	1246.42	1169.34	1032.76	12.66	47.26
Guangxi	7.19	66.23	28.11	25.33	9.21	0.4
Hainan	0.75	38.4	8.98	8.41	51.20	0.54
Chongqing	10.92	76.56	32.37	30.42	7.01	0.44
Sichuan	22.35	168.83	82.03	72.06	7.55	0.77
Guizhou	2.98	23.28	7.21	5.93	7.81	0.01
Yunnan	3.88	28.49	13.73	13.43	7.34	0.87
Xizang	0.16	1.08	0.17	0.15	6.75	0.01
Shanxi*	16.06	133.35	55.75	50.84	8.30	1.17
Gansu	4.43	39.13	18.25	15.66	8.83	0.02
Qinghai	1.01	8.05	3.58	2.27	7.97	0.01
Ningxia	1.17	10.81	3.09	2.81	9.24	0.01
Xinjiang	11.66	152.76	54.11	50.11	13.10	0.55

The average efficiency value of 31 regions is 54.99%. Only Jiangsu province is dea efficient. Because in south-east of China, enterprises scale, product structure and technology level have more stronger competitive ability than other parts of China, Jiangsu, Zhejiang, Guangdong, Fujian and Hubei five provinces' efficiencies , which are from 80% to 100%, are relative higher than other regions. These five regions are located in southeast of China, Jiangsu is one of the largest bases of textile industry in china, which dominant products are fibre, yarn, cloth and woolen cloth. Zhejiang's dominant products are silk and printing and dyeing cloth. About 5.144 billion pieces of costume are fabricated annually in Guangdong, sharing 31.97 percent share in China.

Table 2. Efficiency of DMUs and weight values of input and output targets

Regions	Efficiency in model with weight restriction		Weight values in model with weight restriction			Efficiency in model without weight restriction		Weight values in model without weight restriction		
	CCR (E2)	BCC	Labors	Total asset	Total industriall production value	CCR (E1)	E3 (E2-E1)	Labors	Total asset	Total industrial production value
Beijing	57.47%	58.04%	0.000802	0.006416	0.011106	57.53%	-0.06%	0	0.006493	0.011106
Tianjin	76.28%	76.70%	0.000623	0.004986	0.006503	76.47%	-0.19%	0	0.005054	0.006503
Hebei	67.99%	68.20%	0.000331	0.002648	0.003874	68.10%	-0.11%	0	0.002681	0.003874
Shanxi	42.45%	43.53%	0.001474	0.011792	0.027632	42.67%	-0.21%	0	0.01198	0.027632
Neimeny	49.51%	50.73%	0.048609	0.006076	0.020585	50.03%	-0.53%	0.060227	0.005163	0.020585
Liaoning	52.97%	53.28%	0.000461	0.00369	0.006932	53.18%	-0.21%	0	0.003746	0.006932
Jilin	33.75%	34.56%	0.001021	0.008169	0.024079	33.76%	0.00%	0	0.00826	0.024079
Heilongjiang	30.38%	31.23%	0.033558	0.004195	0.023159	30.55%	-0.17%	0.041374	0.003547	0.023159
Shanghai	78.95%	79.06%	0.006674	0.000834	0.001772	100.0%	-21.05%	0.022712	0	0.001772
Jiangsu	100.0%	100.0%	0.000078	0.000624	0.000621	100.0%	0.00%	0	0.000631	0.000621
Zhejiang	98.77%	98.81%	0.004369	0.000546	0.000927	100.0%	-1.23%	0.009669	0.000138	0.000927
Anhui	66.91%	67.30%	0.000577	0.004616	0.006863	67.24%	-0.33%	0	0.00469	0.006863
Fujian	87.86%	88.28%	0.018551	0.002319	0.004427	87.94%	-0.08%	0.022764	0.001952	0.004427
Jiangxi	46.10%	46.77%	0.000938	0.007503	0.016192	46.21%	-0.10%	0	0.007603	0.016192
Shandong	70.87%	70.94%	0.004705	0.000588	0.001392	71.04%	-0.17%	0.005783	0.000496	0.001392
Henan	59.15%	59.34%	0.000300	0.002396	0.00403	59.31%	-0.15%	0	0.002429	0.00403
Hubei	87.42%	87.61%	0.000318	0.002545	0.002896	87.87%	-0.45%	0	0.002586	0.002896
Hunan	48.92%	49.72%	0.001114	0.008915	0.018132	49.20%	-0.28%	0	0.009065	0.018132
Guangdong	96.41%	96.44%	0.003933	0.000492	0.000855	97.39%	-0.98%	0.00487	0.000418	0.000855
Guangxi	41.66%	43.02%	0.001862	0.014897	0.035575	41.77%	-0.11%	0	0.015099	0.035575
Hainan	33.92%	38.57%	0.180180	0.022523	0.111359	93.43%	-59.51%	1.333333	0	0.111359
Chongqing	41.33%	42.50%	0.001604	0.012833	0.030893	41.61%	-0.28%	0	0.013062	0.030893
Sichuan	47.55%	48.07%	0.000728	0.005827	0.012191	47.81%	-0.26%	0	0.005923	0.012191
Guizhou	30.33%	34.25%	0.005285	0.042279	0.138696	30.48%	-0.15%	0	0.042955	0.138696
Yunnan	47.14%	50.33%	0.004314	0.034513	0.072833	47.42%	-0.28%	0	0.0351	0.072833
Xizang	15.38%	100.0%	0.113637	0.909091	5.882353	15.49%	-0.11%	0	0.925926	5.882353
Shanxi*	40.98%	41.64%	0.000923	0.007388	0.017937	41.14%	-0.16%	0	0.007499	0.017937
Gansu	45.75%	48.07%	0.00315	0.025199	0.054795	45.90%	-0.14%	0	0.025556	0.054795
Qinghai	43.56%	54.92%	0.015288	0.122305	0.27933	43.76%	-0.20%	0	0.124224	0.27933
Ningxia	28.06%	36.54%	0.011409	0.091272	0.323625	28.13%	-0.07%	0	0.092507	0.323625
Xinjiang	36.89%	37.70%	0.032515	0.004064	0.018481	37.54%	-0.65%	0.079034	0.000514	0.018481

Shanghai, Tianjin, Shandong, Hebei and Anhui five provinces' efficiencies, which are from 60% to 80%, other 21 regions' efficiencies are less than 60%. All these regions except Shanghai are in west-middle of China. As we all known, resources and raw materials in west -middle of China are abundant, but the capital, advanced technology and management, optimum product structure, good market environment are of shortage, which lead that superiority in resources can not be translated into superiority in product. So how to integrate the different superiority of south-east and west-middle of China to make use of technology and resources is an exigent problem, and it is also a new development tendency in Chinese textile industry.

Cobb-Dauglas Stochastic Production Frontier function of China textile industry

All inefficient DMUs' projection points on the production frontier face

The dual Linear programming of model [1] is :

$$\text{Min } \theta$$
$$s.t.$$
$$\begin{cases} \sum_{j=1}^{n} \lambda_j y_j + \sum_{l=1}^{s} d_l \eta_l - s^+ = y_0 \\ \sum_{j=1}^{n} \lambda_j x_j + \sum_{l=1}^{s} c_k \xi_k + s^- = \theta x_0 \\ \lambda_j \geq 0, j = 1,2,\cdots,n, \\ \eta_l \geq 0, l = 1,2,\cdots,s, \\ \xi_k \geq 0, k = 1,2,\cdots,m. \\ \theta \in R \end{cases} \qquad [2]$$

Supposing θ^* is the optimum value of model [2], and s^{*-}, s^{*+} are the slack vectors of model [2], $\hat{x}_0 = \theta^* x_0 - s^{*-}$, $\hat{y}_0 = y_0 + s^{*+}$. According to the theory of data envelopment analysis, the virtual DMU $\langle \hat{x}_0, \hat{y}_0 \rangle$ is DMU $\langle x_0, y_0 \rangle$' projection point on the production frontier face, and $\langle \hat{x}_0, \hat{y}_0 \rangle$ is DEA efficient. All inefficient DMUs' projection points on the production frontier face are calculated, the result is in Table 3.

Estimate the parameters of Cobb-Dauglas stochastic production function

All inefficient DMUs' projection points on the production frontier face and efficient DMUs construct the data set for estimating parameters. The regressive equation is as following:

$$Ln(Y) = 0.413638519 + 0.194785812\ Ln(L) + 0.812263787\ Ln(K)$$
$$(0.029722122)\quad (0.012908384)\qquad (0.012585607) \qquad [3]$$
$$\overline{R}^2 = 0.999817952, F = 82382.02644$$

All parameters pass the T test at 95% significant level, The sum of output elasticity of labors and capital is 1.007049599, which nearly equals 1, this means all DMUs are in constant return to scale, which is accordance with CCR model's condition. Output elasticity of capital is 4.17 times that of labors.

This Cobb-Dauglas stochastic production function can be used to calculate the frontier outputs of some new DMUs and the relative efficiency that equals the ratio of practical output to frontier output. The result is also in table 3.

We also find that DEA efficacy can be replaced by the relative efficiency, which is easier to be calculated. The errors between them are within 6 percent, so the Cobb-Dauglas stochastic production function is credible to be used to estimate the frontier output directly.

Some economic factors' effect on the DMUs' efficiency

In order to explain the efficiency, we se up an econometric regressive model to analyse how many important economic factors affect it. Three targets are considered, which are sale income (P), asset per person (K/L) and foreign direct investment (W). Sale income indicates the scale of enterprises, which is an important factor to efficiency. Asset per person is used to find if the density of asset has an effect on efficiency. Renuka (2000) used the former two targets to analyse the efficiency of Singapore 's manufacture industry. For foreign direct investment has made a great promotion to economic rising in China, we adopt it to testify this fact quantitatively. The data of three targets are in table 1.

For econometric regressive model requires that stochastic errors and dependent are in normal distribution. The efficient (E) from 0 to 1 does not accord with normal distribution condition, so the dependent variable- efficiency must be transformed into some form. Then we take $Ln(E/(1-E))$ as the dependent variable (Renuka, 2000) , it is easy to know that $Ln(E/(1-E))$ increases with E rising, and that $Ln(E/(1-E))$ is possible to be any real number. Three independent variables, which are W, P and K/L, take the logarithm form directly. The result is as following equation:

$$Ln\left(\frac{E}{1-E}\right) = 0.15143626\ Ln(W) + 0.37323061\ Ln(P) - 0.4764945\ Ln(K/L)$$
$$(0.090564534)\qquad (0.121833089)\qquad (0.214680082) \qquad [4]$$
$$\overline{R}^2 = 0.64462684, F = 16.93013932.$$

Table 3. Slacks in model [2], inefficient DMUs'projection points on production frontier face, and frontier output based on stochastic production fumction, relative efficiency, errors of efficiency between DEA efficiency and relative efficiency

Regions	Slacks(S)(CCR with weight restriction)			Projection points(CCR with weight restriction)			Stochastic production function		
	Labors(L) / 10，000 persons	TotalAssets(K)/ 100 million RMB	Total industrial production value(Y)/ 100 million RMB	Labors(L) / 10，000 persons	TotalAssets(K)/ 100 million RMB	Total industrial production value(Y)/ 100 million RMB	Total industrial production value(Y)/ 100 million RMB	Relative efficiency	Errors of efficiency between DEA efficiency and relative efficiency
Beijing	0	0	0	8.51	88.51	90.04	152.94	58.87%	2.44%
Tianjin	0.000007	0	0	16.35	150.94	153.77	201.45	76.33%	0.07%
Hebei	0	0	0	25.63	253.57	258.1	376.28	68.59%	0.88%
Shanxi	0.000001	0	0	4.54	35.44	36.19	87.27	41.47%	-2.32%
Neimeny	0	0	0	3.93	50.03	48.58	96.20	50.50%	2.01%
Liaoning	0.000004	0.000001	0.000001	16.98	141.40	144.26	277.89	51.91%	-1.99%
Jilin	0	0	0	3.64	40.86	41.53	118.26	35.12%	4.05%
Heilongjiang	0	0.000001	0	3.61	43.55	43.18	138.22	31.24%	2.84%
Shanghai	0	0	0	34.76	668.30	564.27	754.79	74.76%	-5.31%
Jiangsu	0	0	0	139.61	1585.55	1611.28	1573.37	102.41%	2.41%
Zhejiang	0	0.000003	0.000001	86.23	1118.88	1078.41	1092.70	98.69%	-0.08%
Anhui	0.000006	0.000001	0.000001	18.26	142.67	145.7	224.38	64.93%	-2.95%
Fujian	0	0	0	19.46	223.20	225.91	248.38	90.95%	3.52%
Jiangxi	0.000001	0	0	6.44	60.64	61.76	133.00	46.44%	0.72%
Shandong	0	0	0	61.30	714.53	718.4	992.24	72.40%	2.16%
Henan	0.000013	0	0.000001	26.53	243.57	248.16	421.85	58.83%	-0.55%
Hubei	0	0	0	43.80	338.06	345.31	409.62	84.30%	-3.57%
Hunan	0.000003	0	0	7.27	53.96	55.15	116.70	47.26%	-3.39%
Guangdong	0.000001	0.000009	0.000002	94.94	1201.71	1169.34	1208.94	96.72%	0.32%
Guangxi	0	0	0	3.00	27.59	28.11	66.94	41.99%	0.80%
Hainan	0	0	0	0.25	13.03	8.98	27.68	32.44%	-4.37%
Chongqing	0	0	0	4.51	31.64	32.37	81.69	39.62%	-4.12%
Sichuan	0.000004	0	0	10.63	80.28	82.03	178.54	45.94%	-3.38%
Guizhou	0	0	0	0.90	7.06	7.21	24.12	29.89%	-1.43%
Yunnan	0.000001	0	0	1.83	13.43	13.73	29.92	45.89%	-2.65%
Xizang	0	0	0	0.02	0.17	0.17	1.13	15.09%	-1.85%
Shanxi*	0.000002	0	0	6.58	54.64	55.75	138.22	40.34%	-1.56%
Gansu	0	0	0	2.03	17.90	18.25	39.73	45.94%	0.41%
Qinghai	0	0	0	0.44	3.51	3.58	8.25	43.42%	-0.33%
Ningxia	0	0	0	0.33	3.03	3.09	10.78	28.66%	2.15%
Xinjiang	0	0	0	4.30	56.35	54.11	145.01	37.31%	1.16%

For the constant in equation is not significant in T test, it is deleted from equation. All coefficients are significant in 90% level of T test. Th equation [4] is significant in 90% level of F test. The efficiency can be explained by three economic factors to 65% degree.

From equation [4] we can get the following expression:

$$Ln\left(\frac{E}{1-E}\right) = a + bLn(W) + cLn(P) + dLn(K/L)$$

$$\frac{dE}{E} = (1-E)\left[b\frac{dW}{W} + c\frac{dP}{p} + d\frac{d(K/L)}{K/L}\right] \qquad [5]$$

The efficiency elasticities of $W, P\ and\ K/L$ are $(1-E)b, (1-E)c, (1-E)d$ respectively, which are descending functions of efficiency E. This reveals the marginal efficiency descending law , that is to say when the efficiency on a top situation, it is more difficult to enhance it. For $(1-E)$ is positive, if b, c and d are positive, we can say the efficiency elasticity of $W, P\ and\ K/L$ are positive, and the contributions of $W, P\ and\ K/L$ to efficiency are positive. Otherwise, if b, c and d are negative, we can say the efficiency elasticity of $W, P\ and\ K/L$ are negative, and the contributions of $W, P\ and\ K/L$ to efficiency are passive.

From the result, we can conclude that sale income and foreign direct investment have positive effects on efficiency, and that Asset per person has a passive effect on it. Larger scale of industry can save inputs and increase outputs by integrating the superiority of resources, technology and management.

From 1992 to 1998 Chinese textile industry was to the bad. China textile industry took some actions to deal with it, such as cutting down the number of labors, which led to the capital per person increasing, but the benefit of this action would be seen in next years, in fact Chinese textile industry began to make a profit since 1999. Another fact is that capital from individuals, companies and foreign direct investment also increase the total capital, at the same time some new technologies and equipments, which require high skilled and powerful workers, were introduced into China. This also led capital per person increasing and labors do not match the capital. So in 1998 Chinese textile industry did not make full use of capital. Foreign direct investment in China always brings advanced technology, management experience, and new products, so it contribute a lot to efficiency of Chinese textile industry.

Conclusion

In this paper, we give a framework to study the performance measurement of Chinese textile industry. Firstly, data envelopment analysis / assurance region model with preference information about input and output targets is used to get the efficiencies of Chinese textile industry. This model may avoid the phenomenon that there are a lot of weight values of input and output targets of DMUs that equal 0, and give a more precise evaluation to competitive DMUs. Secondly, we set up the production frontier face of Chinese textile industry by the above data envelopment analysis model, then we get the data set of all DMUs' projection points on the production frontier face, which are the most efficiency artificial DMUs of China textile industry. With the date set the stochastic production frontier function of Chinese textile industry is obtained by regressive analysis model, which can be directly used to forecast frontier output of some new DMUs. At the last part, an econometric regressive model is set up to explain the difference between the DMUs' efficiency.

By above experiential analysis, we find out that the efficiency of Chinese 31 regions ' textile industry is completely different from one another, and that the average efficiency is very low. This means that all resources do not be properly allotted and fully utilized especially for the west-middle of China. Now China has made some prior policies to accelerate the development of the west-middle of China, so textile industry of the west-middle of China will be booming in future years.

The output and export of Chinese textile product are both ranked 1 in global textile market now. China is abundant in human resources and raw materials, and textile industry is one of leading industries in China. China's entry into World Trade Organization brings some new opportunities for the development of Chinese textile industry. The first thing for Chinese textile industry is to impel technological progress, industrial update, and adjustment of product structure and improvement of the quality of textile product in order to take part in international competition in global textile market.

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