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Cost Efficiency Analysis of Listed Logistics Enterprises in China

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Abstract

This paper takes 57 listed logistics enterprises in China as research samples, takes the fixed assets input price, operating cost input price and labor price as input index, takes the main business income and total profit as the output index, and uses the stochastic frontier analysis method (SFA) to calculate the cost efficiency. The results show that: on the whole, the cost efficiency of listed logistics enterprises in China is low, and the cost efficiency level gap between different industries is large, but the overall trend is rising. Although the cost efficiency value of logistics enterprises in different industries is increasing year by year, the cost efficiency levels of different industries are seriously differentiated, which shows that the trend and degree of changes in different industries are heterogeneous.

Keywords

Listed Logistics Enterprises; Cost Efficiency; SFA; Influencing Factors.

1. Introduction

Under the new development pattern of double cycle strategy, the transformation of economic growth mode from rapid growth to quality type has become the theme of the times. One of the important contents of the transformation from economy to quality is the transformation of efficiency. In 2021, the total cost of social logistics in China reached 16.7 trillion yuan, accounting for 14.6% of the GDP, while less than 9% in developed countries such as Britain, the United States and Japan, and there is still a distance from the global average (12%). A series of data highlights that China still faces great challenges in reducing cost and efficiency in logistics industry. Therefore, according to the current situation of logistics industry in China, the paper analyzes the cost efficiency and influencing factors of listed logistics enterprises by constructing the input-output index system, and finds out the reasons for the low cost efficiency. It can accelerate the development of modern logistics industry, improve the efficiency of industrial operation, realize the cost reduction and efficiency of enterprises, and improve the overall competitiveness of logistics enterprises, regions and even the country, it is of great practical significance to promote mutual benefit and win-win among all sectors of national economy [1].

Based on DEA, Ding et al. Estimates the technical efficiency, pure technical efficiency and scale of 21 coastal small and medium ports. The results show that the scale efficiency has a significant positive effect on the operational efficiency of the ports [2]; Based on non-radial DEA preference model and the analysis of the rate of return based on variable scale, Jiasen sun, etc., mainly evaluates the operational efficiency of Chinese listed port enterprises [3]; Park et al. Used data envelopment analysis to calculate the cost efficiency of 14 logistics enterprises in Korea from 2007 to 2011. In the study, based on DEA window analysis, the cost efficiency of the enterprises was analyzed by combining Malmquist index method. Finally, the factors influencing the technological efficiency of enterprises are analyzed from the perspective of market structure [4]. The domestic research on efficiency evaluation is relatively backward. Compared with domestic and foreign countries, domestic efficiency evaluation has taken a

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short time, and the related research has not been systematic. However, domestic scholars have carried out a lot of research on the evaluation methods of operational efficiency. Zhongzuchang takes 28 listed logistics enterprises in China as the research object, chooses Three-stage DEA method to calculate and analyze its operation efficiency. The empirical results show that the technical efficiency value of logistics enterprises in China is only 0.668, and the reason for this result is that the logistics industry is low in scale, and there are obvious differences in technical efficiency of different types of enterprises, among which the technical efficiency value of warehousing industry is the best [5]; Zou Jiawei and others made horizontal and vertical evaluation on the operation efficiency of 20 airlines in China from 2008 to 2015 based on super SBM model [6]; Liu Dan et al. Selected 14 port enterprises as the research object, selected the multi period network data envelopment analysis model for analysis, and concluded that the overall operation efficiency of port logistics enterprises from 2010 to 2014 was low. If only the loading and unloading sub process or port service sub process were considered, the overall operation efficiency would be low, otherwise the overall efficiency would be high, this means that the two sub processes jointly determine the overall operation efficiency of port enterprises[7];Based on the non-radial SBM-DEA model, Feng Feng measured the operation efficiency of 17 port listed enterprises in China. The calculation results show that the overall operation efficiency of domestic port listed companies is good. At the same time, he understands the relative efficiency of each port listed company and the adjustment path of input-output efficiency[8]. Liu Yanxia put forward a six step AHP analysis method from a theoretical perspective. Taking the maximum and minimum transaction price as the core, she analyzed the operation efficiency of four commercial logistics enterprises in Changsha, pointed out the reasons for the low efficiency and put forward relevant improvement suggestions [9]. At the same time, there are many domestic literature studies that focus more on the qualitative issues related to the factors affecting the efficiency of logistics enterprises. For example, fan min and others conduct empirical analysis on the logistics efficiency of representative cities that can objectively reflect the differences in the logistics level of urban agglomerations in the East, Central and western regions and Northeast China in combination with DEA-BCC, VAR model and DEA Malmquist productivity index, the empirical results show that optimizing the external business environment, integrating enterprise innovation resources and promoting linkage development play a positive role in promoting the development of logistics industry in China's urban agglomeration [10].

2. Index Selection and Model Construction

According to the availability of data, in guotai'an database, 57 listed logistics companies whose industry is "logistics industry" in the 2012 edition of industry classification of listed companies issued by the CSRC are selected.

Through sorting and screening the indicators, and combined with the characteristics of the logistics industry, based on the selection of cost efficiency evaluation indicators by Lu Xinhua [11]and Chi Guotai [12], the input indicators selected in this paper are as follows: net value of fixed assets; Operating costs; Labor costs. Output indicators: main business income; Total profit.

In the input index, we learn from Zhang Aiwu's method of selecting the price of fixed assets when measuring the cost efficiency of banks, that is, the price of fixed assets is equal to the depreciation of fixed assets in the current year divided by the original value of fixed assets[13]. The depreciation of fixed assets in the current year and the original value of fixed assets can be obtained directly from the annual report of listed logistics enterprises.

The operating cost input price is equal to the operating cost divided by the total assets. Among them, the new accounting standards in 2007 changed the operating expenses to sales expenses, and removed the employee compensation indicators to eliminate the impact of labor costs. This

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index draws lessons from Liu Zhiying and other practices in the study of bank cost efficiency[14].The total asset in the denominator replaces the average total asset, because the total asset amount can indicate the impact of asset changes on cost.

Table 1. Sample enterprises

Industry classification	Sample enterprise
Railway transportation industry (3)	Daqin Railway, Guangzhou Shenzhen railway and Tielong Logistics
Road transportation industry (21)	Yantian port, Jiangxi Guangdong Expressway, Hunan investment, urban development environment, modern investment, Fulin transportation industry, Zhongyuan expressway, Jiangxi Guangdong Expressway, Chutian Expressway, Shandong Expressway, Nanjing Shanghai Expressway, Shenzhen Expressway, Wuzhou transportation, mass transportation, Longjiang transportation, Shentong Metro, Jiangxi Changyun, Sichuan Chengdu Chongqing, Jiaoyun Co., Ltd., Jinjiang online, foreign service holding, modern investment, Zhongyuan Expressway
Water transport industry (18)	Zhuhai port, Xiamen port, HNA, Straits Co., Ltd., Huaihe energy, Jinzhou port, liaogang Co., Ltd., Ningbo port, Rizhao Port, Shanggang group, Tangshan port, China Merchants ship, COSCO Haifa, COSCO Haikong, COSCO Haikong, COSCO Haineng, COSCO Haite, Chongqing port and Zhuhai Port
Air transport industry (7)	Shenzhen airport, Changhang Phoenix Airport, Baiyun Airport, Shanhang airlines, Shanghai airport, China Eastern Airlines, Air China
Storage, loading, unloading and handling (4)	Bonded technology, Xinning logistics, China storage Co., Ltd. and Antong Holdings
Postal industry	Shentong express, SF holdings, Yuantong express and Yunda Co., Ltd

Labor price=total salary/assets payable to employees, and the total assets can reflect the operation status and scale of the enterprise, while the payable employee compensation means the capital investment of logistics enterprises to labor force. Therefore, the index can show the labor input of logistics enterprises comprehensively and accurately.

Total income and profit of main business. The main business income index can measure the income of the company products and the output of the enterprise; Total profit refers to the final result of the enterprise operation in a certain period, and its level mainly reflects the operating efficiency and market competitiveness of the company. Tao Xueping and others choose these two indicators as their output indexes when measuring the operational efficiency of transportation enterprises in China.[15]

The most common production functions in stochastic frontier models are Cobb Douglas (C-D) function and transcendental logarithmic production function. The parameters of Cobb Douglas production function are less, the form is simple and easy to estimate, but it is necessary to assume that the elasticity of element substitution remains unchanged; The transcendental log production function allows the existence of non neutral technology progress, which eases the setting of the substitution elasticity between the elements, and considers the interaction effect of each input factor on the cost efficiency. Therefore, SFA model in the form of transcendental logarithm function is selected in this paper, and its specific function is as follows:

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$$\begin{aligned}\mathrm{Ln}\left(\frac{TC_{it}^{*}}{w_{1it}}\right) = \alpha + \sum_{p=1}^{2}\alpha_p \ln\left(\frac{Y_{pit}}{w_{1it}}\right) + \sum_{q=2}^{3}\beta_q \ln\left(w_{qit}^{*}/w_{1it}\right) \\ + \frac{1}{2}\sum_{r=1}^{2}\sum_{n=1}^{2}\beta_{rn}\ln\left(Y_{rit}/w_{1it}\right)\ln\left(Y_{nit}/w_{1it}\right) \\ + \frac{1}{2}\sum_{k=2}^{3}\sum_{m=2}^{3}\gamma_{km}\ln\left(w_{kit}^{*}/w_{1it}\right)\ln\left(w_{mit}^{*}/w_{1it}\right) \\ + \sum_{k=1}^{2}\sum_{l=2}^{3}\delta_{kl}\ln\left(Y_{kit}/w_{1it}\right)\ln\left(w_{lit}^{*}/w_{1it}\right) + lnv_{it} - lnu_{it}\end{aligned}$$

TC_{it}^{*}represents the total cost of standardization, Y_{1it} is the main business revenue, and $Y_{2it}$is the total profit. $W_{2it}^{*}$is the standardized labor price; $W_{3it}^{*}$is the standardized operating input price; $v_{it}$is random term, u_{it} is non negative inefficient term, if it obeys truncated normal distribution. the price W_1 of fixed assets is regarded as the standardization benchmark, and the other input-output indexes are standardized respectively. After logarithm, the square term and interaction term are constructed, and 14 explanatory variables are totally included.

3. Analysis of Empirical Results

3.1. The Overall Average Cost Efficiency of Listed Logistics Enterprises

From Figure 1, the average cost efficiency value of 57 listed logistics enterprises increased from 2010 to 2020, which means that logistics enterprises have more and more strong resource allocation and operation capability.The period of significant increase in cost efficiency is 2015-2016. It is also a series of supporting documents issued by the government since 2015, and the logistics industry in urban areas of each province has been developed rapidly.Through simple calculation, it can be seen that the average cost efficiency value of 57 listed logistics enterprises in 2010-2020 is only 41.12%, which is far from 100% of the theoretical optimal efficiency value. On the side, it shows that the overall level of logistics operation in China is low, and the improvement of industry efficiency still has a large development space.

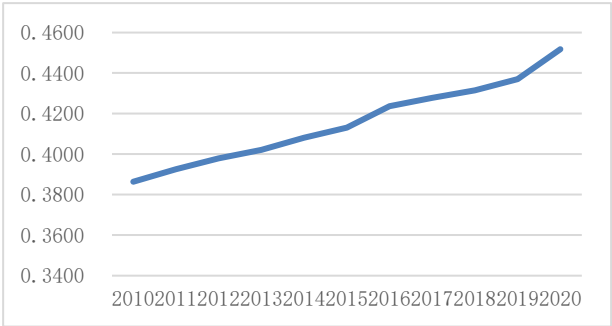

Fig 1. Overall cost efficiency

3.2. Average Cost Efficiency of the Listed Logistics Enterprises in the Segment Industry

According to the calculation results, there are 21 road transportation enterprises. From Table 2, it can be seen that the cost efficiency value of the road transportation enterprises is increasing year by year. It can be seen that the cost efficiency of Jinjiang online is relatively high, while the cost efficiency of Longjiang transportation company has been relatively low. In the

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past 11 years, the cost efficiency of other road transportation enterprises has fluctuated occasionally, but it has been maintained at a relatively high level. Overall, the cost efficiency of Jinjiang online, foreign service holding, Shenzhen Expressway and Fulin transportation industry is relatively good.

Table 2. Cost efficiency value of road transportation industry

enterprise	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Urban development environment	0.4684	0.4729	0.4773	0.4818	0.4862	0.4906	0.4950	0.4994	0.5038	0.5081	0.5125
Chutian Expressway	0.5710	0.5750	0.5790	0.5830	0.5870	0.5909	0.5949	0.5988	0.6026	0.6065	0.6103
Mass transportation	0.4617	0.4662	0.4707	0.4752	0.4797	0.4841	0.4885	0.4929	0.4973	0.5017	0.5061
Fulin transportation industry	0.6122	0.6160	0.6197	0.6235	0.6272	0.6309	0.6346	0.6382	0.6418	0.6454	0.6490
Jiangxi Guangdong Expressway	0.2037	0.2078	0.2119	0.2161	0.2203	0.2245	0.2287	0.2330	0.2373	0.2416	0.2459
Hunan Investment	0.4058	0.4104	0.4150	0.4196	0.4242	0.4288	0.4333	0.4379	0.4425	0.4470	0.4515
Jiangxi Changyun	0.5525	0.5566	0.5607	0.5648	0.5689	0.5729	0.5769	0.5809	0.5849	0.5889	0.5928
Transportation shares	0.5470	0.5512	0.5553	0.5594	0.5635	0.5676	0.5716	0.5757	0.5797	0.5837	0.5876
Jinjiang Online	0.8989	0.9001	0.9013	0.9025	0.9037	0.9049	0.9060	0.9071	0.9083	0.9094	0.9105
Longjiang traffic	0.1880	0.1920	0.1960	0.2000	0.2041	0.2082	0.2123	0.2165	0.2207	0.2249	0.2291
Nanjing Shanghai Expressway	0.3243	0.3289	0.3335	0.3382	0.3428	0.3474	0.3520	0.3567	0.3613	0.3660	0.3706
Shandong Expressway	0.3021	0.3066	0.3112	0.3158	0.3204	0.3250	0.3296	0.3342	0.3388	0.3435	0.3481
Shentong Metro	0.2770	0.2814	0.2860	0.2905	0.2950	0.2996	0.3041	0.3087	0.3133	0.3178	0.3224
Deep high speed	0.5773	0.5813	0.5853	0.5893	0.5932	0.5971	0.6010	0.6048	0.6087	0.6125	0.6163
Chengdu Chongqing, Sichuan	0.5609	0.5650	0.5691	0.5731	0.5771	0.5811	0.5851	0.5891	0.5930	0.5969	0.6008
Foreign service holding	0.7429	0.7457	0.7485	0.7512	0.7539	0.7566	0.7593	0.7619	0.7646	0.7672	0.7697
Wuzhou transportation	0.2590	0.2635	0.2679	0.2724	0.2768	0.2813	0.2858	0.2903	0.2949	0.2994	0.3040
Modern investment	0.4285	0.4331	0.4377	0.4422	0.4468	0.4513	0.4558	0.4603	0.4648	0.4693	0.4738
Yantian Port	0.3847	0.3893	0.3939	0.3986	0.4032	0.4078	0.4124	0.4170	0.4216	0.4262	0.4308
Investment in the Yangtze River	0.3372	0.3418	0.3465	0.3511	0.3557	0.3604	0.3650	0.3696	0.3743	0.3789	0.3836
Zhongyuan high speed	0.2301	0.2344	0.2387	0.2430	0.2474	0.2517	0.2561	0.2605	0.2650	0.2694	0.2739
mean value	0.4444	0.4485	0.4526	0.4567	0.4608	0.4649	0.4690	0.4730	0.4771	0.4811	0.4852

Cost efficiency analysis of railway transportation industry. From table3, it can be seen that the cost efficiency of Tielong logistics is relatively high and keeps the overall growth trend. The logistics cost efficiency of Daqin has experienced a process of first decreasing and rising. Its cost efficiency has reached the lowest point in recent years, and gradually rebounds after the short-term low tide. Overall, the cost efficiency of railway transportation enterprises is gradually increasing.

Table 3. Cost efficiency value of railway transportation industry

enterprise	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Daqin Railway	0.2083	0.2124	0.2066	0.2108	0.2250	0.2292	0.2335	0.2378	0.2421	0.2464	0.2508
Guangzhou Shenzhen railway	0.2101	0.2142	0.2184	0.2226	0.2268	0.2311	0.2354	0.2397	0.2440	0.2483	0.2527
Tielong Logistics	0.3068	0.3114	0.3160	0.3206	0.3252	0.3298	0.3344	0.3390	0.3436	0.3483	0.3529
mean value	0.2417	0.2460	0.2470	0.2513	0.2590	0.2634	0.2677	0.2722	0.2766	0.2810	0.2855

Analysis of cost efficiency of air transportation industry. Table 4 shows that except for Southern Airlines and Air China, other Airport Airlines have relatively high cost efficiency, among which,

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the cost efficiency of Shanhang and Shanghai airport is the most excellent. Cost efficiency of other Airport Airlines has been steadily increasing in recent years.

Table 4. Cost efficiency value of air transportation industry

enterprise	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Baiyun Airport	0.4431	0.4476	0.4522	0.4567	0.4612	0.4657	0.4702	0.4747	0.4791	0.4836	0.4880
Southern airlines	0.3449	0.3495	0.3542	0.3588	0.3634	0.3681	0.3727	0.3774	0.3820	0.3866	0.3913
Shanhang	0.6770	0.6804	0.6837	0.6870	0.6902	0.6935	0.6967	0.6998	0.7030	0.7061	0.7092
Shanghai Airport	0.5671	0.5712	0.5752	0.5792	0.5832	0.5872	0.5911	0.5950	0.5989	0.6028	0.6066
Shenzhen Airport	0.3551	0.3597	0.3644	0.3690	0.3736	0.3783	0.3829	0.3875	0.3922	0.3968	0.4014
China Eastern Airlines	0.3859	0.3905	0.3952	0.3998	0.4044	0.4090	0.4137	0.4183	0.4229	0.4243	0.4320
Air China	0.3480	0.3527	0.3573	0.3619	0.3666	0.3712	0.3759	0.3805	0.3851	0.3898	0.3944
mean value	0.4459	0.4502	0.4546	0.4589	0.4632	0.4676	0.4719	0.4762	0.4805	0.4843	0.4890

Analysis of postal cost efficiency. There are 4 postal enterprises, and the cost efficiency is shown in table 5.The cost efficiency of these four companies is on the rise, indicating that the development of postal industry in China is stable and positive.

Table 5. Post cost efficiency value

enterprise	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Shentong express	0.4815	0.4860	0.4904	0.4948	0.4992	0.5036	0.5079	0.5122	0.5166	0.5209	0.5251
Shunfeng holding	0.3824	0.3870	0.3917	0.3963	0.4009	0.4055	0.4101	0.4147	0.4193	0.4239	0.4285
Round Express	0.5123	0.5166	0.5209	0.5252	0.5295	0.5337	0.5380	0.5422	0.5463	0.5505	0.5546
Yunda shares	0.4918	0.4962	0.5006	0.5050	0.5093	0.5137	0.5180	0.5223	0.5265	0.5308	0.5350
mean value	0.4670	0.4715	0.4759	0.4803	0.4847	0.4891	0.4935	0.4979	0.5022	0.5065	0.5108

Table 6. Cost efficiency value of water transportation industry

enterprise	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
maritime aviation	0.3214	0.3260	0.3306	0.3352	0.3398	0.3445	0.3491	0.3537	0.3584	0.3630	0.3676
Straits shares	0.3582	0.3628	0.3674	0.3721	0.3767	0.3814	0.3860	0.3906	0.3953	0.3999	0.4045
Huaihe River Energy	0.2994	0.3040	0.3086	0.3131	0.3177	0.3223	0.3269	0.3315	0.3362	0.3408	0.3454
Jinzhou Port	0.2697	0.2741	0.2786	0.2831	0.2876	0.2921	0.2967	0.3012	0.3058	0.3103	0.3149
Liaogang shares	0.3359	0.3406	0.3452	0.3498	0.3545	0.3591	0.3637	0.3684	0.3730	0.3777	0.3823
Ningbo Port	0.1921	0.1961	0.2002	0.2043	0.2084	0.2125	0.2167	0.2208	0.2251	0.2293	0.2336
Rizhao Port	0.3355	0.3401	0.3447	0.3493	0.3540	0.3586	0.3633	0.3679	0.3725	0.3772	0.3818
Xiamen Port	0.4304	0.4350	0.4396	0.4441	0.4487	0.4532	0.4577	0.4622	0.4667	0.4712	0.4757
Shanggang group	0.3034	0.3080	0.3125	0.3171	0.3217	0.3263	0.3309	0.3356	0.3402	0.3448	0.3494
Tangshan port	0.3349	0.3395	0.3442	0.3488	0.3534	0.3581	0.3627	0.3673	0.3720	0.3766	0.3813
CSC Phoenix	0.2521	0.2565	0.2609	0.2653	0.2698	0.2742	0.2787	0.2832	0.2877	0.2922	0.2968
China Merchants ship	0.4337	0.4382	0.4428	0.4473	0.4519	0.4564	0.4609	0.4654	0.4699	0.4744	0.4788
COSCO hair	0.2266	0.2308	0.2351	0.2394	0.2437	0.2481	0.2524	0.2568	0.2612	0.2657	0.2701
COSCO marine control	0.2833	0.2878	0.2923	0.2969	0.3014	0.3060	0.3105	0.3151	0.3197	0.3243	0.3289
COSCO energy	0.2447	0.2490	0.2534	0.2578	0.2622	0.2666	0.2711	0.2755	0.2800	0.2845	0.2890
COSCO Haite	0.3836	0.3882	0.3929	0.3975	0.4021	0.4067	0.4114	0.4160	0.4206	0.4252	0.4297
Chongqing Port	0.1148	0.1180	0.1212	0.1244	0.1277	0.1310	0.1344	0.1378	0.1413	0.1448	0.1483
Zhuhai Port	0.4013	0.4059	0.4105	0.4151	0.4197	0.4243	0.4289	0.4335	0.4381	0.4426	0.4472
mean value	0.3067	0.3111	0.3156	0.3200	0.3245	0.3290	0.3334	0.3379	0.3424	0.3469	0.3514

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Water transportation. Based on the cost efficiency calculation results of 18 water transportation enterprises, it is found that the cost efficiency value is about 0.329, which is slightly floating but still in a stable state. Table 6 shows that the cost efficiency values of Zhuhai port, China Merchants ship, Straits stock and COSCO Haite are higher than those of other listed logistics enterprises, while the cost efficiency values of Chongqing port and Ningbo port are the last. Most enterprises still have a growing cost efficiency.

Cost efficiency analysis of storage and handling enterprises. According to table 7, there are 4 warehousing and handling enterprises, and the cost efficiency values of bonded technology and Xinning logistics are on the rise all the time. Although the cost efficiency of Anton holdings and China storage shares has been reduced, the overall efficiency value is improving. In general, the cost efficiency of storage and handling enterprises is on the rise.

Table 7. Cost efficiency value of storage and handling enterprises

enterprise	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Antong Holdings	0.2695	0.2739	0.2784	0.2829	0.2874	0.2919	0.2965	0.3010	0.3056	0.3102	0.3147
Bonded technology	0.4480	0.4526	0.4571	0.4616	0.4661	0.4706	0.4750	0.4795	0.4839	0.4884	0.4928
Xinning Logistics	0.5758	0.5798	0.5838	0.5877	0.5917	0.5956	0.5995	0.6034	0.6072	0.6110	0.6148
China reserve	0.3570	0.3616	0.3662	0.3709	0.3755	0.3802	0.3848	0.3894	0.3941	0.3987	0.4033
mean value	0.4126	0.4170	0.4214	0.4258	0.4302	0.4346	0.4390	0.4433	0.4477	0.4521	0.4564

4. Analysis of the Factors Influencing the Cost Efficiency of Listed Logistics Enterprises

(1) Influencing factor variable

1. Explanatory variable

Cost efficiency (CE) is the explanatory variable, and the above calculation results are used.

2. core explanatory variable

Traffic density (TRAF).Transportation facilities mainly include roads, railways, airports and seaports, reflecting to a certain extent the level of local economic development[16]The current theory holds that the developed transportation can optimize the logistics pattern, improve the logistics efficiency, shorten the transaction cycle, save the transportation cost, and then promote the economic efficiency of local enterprises[17].Transport facilities also change the spatial model of education through economic activities[18].Transportation facilities will drive the surrounding areas' economy in the way of spatial centralized economic activities, and use effective urban density to produce stable production benefits[19].At the same time, some arguments also pointed out that the improvement of transportation facilities will improve productivity[20].This paper uses the traffic density to calculate the traffic infrastructure by referring to the practice of zhouliping and zhangyuqing. In short, the traffic density=(highway mileage + railway mileage + inland waterway mileage) / land area of each province[21].[21]

3. control variable

The selection of control variables mainly refers to the practices of relevant documents such as jihongyun and ganxingdi, zhangshujuan and wangxiaotian Wenjun and fenggenfu[22,23,24]. The following indicators that may affect the cost efficiency of enterprises are selected as control variables.Among them are: regional gross product (LGDP), enterprise scale (lnasset), management efficiency (me), enterprise nature (char), product uniqueness (uniq).[21][21]

Regional gross domestic product (LGDP).The development level of regional economy plays a key role in the development of logistics companies in the region. Different provincial governments issue different policies to ensure the development of logistics industry, good geographical location and transportation conditions will affect the efficiency of logistics

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enterprises. Therefore, this paper adopts the regional GDP of the provinces where the logistics listed enterprises are located, and carries out logarithmic treatment when they are brought into the model.

Enterprise size (lnasset). Wang believes that expanding the scale of enterprises can improve the operation efficiency of some state-owned enterprises, but many enterprises increase management costs due to scale expansion, and do not achieve the expected efficiency improvement. This also shows that the scale of enterprises has a certain impact on the operation efficiency of enterprises[25]. Fenggenfu believes that the enterprise scale is an important internal factor to improve the efficiency of Chinese enterprises[24]. This paper takes the logarithm of total assets as an explanatory variable to measure the size of enterprises. As a control variable, the total assets of an enterprise include fixed assets, current assets, long-term assets and other assets, which means to a certain extent the market share and the size of the logistics enterprises. On the one hand, it is affected by the business decision-making of the enterprise, on the other hand, it is also related to the internal organization, and also related to the input-output efficiency of the logistics enterprises. Therefore, it is significant to take the enterprise scale as the control variable to monitor the actual situation of logistics enterprises.[25]

Management efficiency (me): management efficiency refers to the effectiveness of managers engaged in management activities. The difference between management and labor efficiency is mainly reflected in the use and play of wisdom by managers. In the field of economics, management efficiency is mainly divided into organizational efficiency, management system efficiency and management mechanism efficiency. The management efficiency of enterprises is reflected through all links of the management process, which are also shown in the management system, organization and management mechanism. If the management efficiency of the enterprise is good, it will make the business activities orderly, so as to ensure the improvement of the enterprise labor productivity, save the production and operation costs, and further improve the cost efficiency of the enterprise. As a kind of enterprise, logistics enterprises' operating efficiency is also affected by management efficiency. This paper uses the ratio of total profit to management cost to measure cost efficiency.

Business nature (char). The literature on the efficiency of equity cost generally believes that state-owned holding has two functions on the company's operation and management[26]. On the one hand, state-owned enterprises enjoy convenient policy and economic benefits, but on the other hand, state-owned enterprises may also bring negative impact on the production and operation of enterprises, which leads to the failure of improving the efficiency of enterprises due to the lack of independence of individuals. Therefore, by referring to the practices of Yang Zhen and others, this paper empirically analyzes the impact of the nature of the enterprise on the cost efficiency of the enterprise: according to the proportion of state-owned enterprises in the industry and judged by the documents of the controllers of listed companies, if the actual controllers are state institutions, Central institutions, state-owned enterprises and administrative organs, they are considered to be state-owned enterprises [27]. The nature of enterprises is introduced into the model in the form of virtual variables, which are assigned as 1 and 0 respectively to identify state-owned enterprises and non-state-owned enterprises. [26] [27]

Product uniqueness (uniq): product uniqueness is one of the determinants of enterprise operation efficiency. Through the research of Titman and Wessels in 1988, it is found that if the products produced by the company have unique functions, the suppliers, employees and even customers of the enterprise will suffer higher costs in the liquidation process. This is because the uniqueness of the product makes the employees and suppliers of the enterprise must have special work skills and capital. If the enterprise goes bankrupt, it is difficult for the employees to change their skills immediately, and the demand for the supplier's products will be reduced

ISSN: 2688-9323

accordingly. For customers, they can find alternative services in a short time. Therefore, this paper adopts Xiao Zuoping's approach: product uniqueness is the ratio of sales revenue to operating revenue [28].[28]

(2) Regression analysis

The panel data model expression (1) is shown as follows:

$$CE_{it} = a_{it} + \beta_1 CE_{it-j} + \beta_2 LnGdp + \beta_3 Traf_{it} + \beta_4 lnasset_{it} + \beta_5 ME_{it} + \beta_6 uniq_{it} +$$

$$\beta_7 Char_{it} + \mu_{it} (i = 1, \dots N; j = 1, \dots N; t = 1, \dots T) \quad (1)$$

CE_{it} is the explained variable, which represents the cost efficiency of listed logistics enterprises; LnGDP represents regional GDP, $Traf_{it}$ represents traffic density, $lnasset_{it}$ represents enterprise scale, ME_{it} represents management efficiency, $uniq_{it}$ represents product uniqueness, $Char_{it}$ represents enterprise nature, all of which are explanatory variables; Subscript i indicates enterprise; t is the year; β indicates the parameter to be estimated; μ_{it} stands for random disturbance term.

Table 8. Descriptive statistics of variables

variable	N	Min	Max	SD	mean
CE	627	0	0.910	0.149	0.411
Lngdp	627	-1.578	2.405	0.705	1.058
Char	627	0	1	0.365	0.842
Traf	627	0.344	2.529	0.620	1.451
ME	627	0.00608	0.397	0.0718	0.0805
LnAsset	627	1.412	8.090	1.474	4.896
uniq	627	2.74e-05	0.128	0.0237	0.0175

Table 8 shows the descriptive statistical results. The sample size, maximum value, minimum value, mean value and standard deviation of the explained variable and explanatory variable are given in the table. Among the selected influencing factors, we can see that there are great differences among some factors, and the differences of these factors indirectly reflect the differences between enterprise cost efficiency. Specifically, the following aspects:

Cost efficiency value of logistics enterprises: the average cost efficiency of listed logistics enterprises in China is 41.1%, indicating that most enterprises have low operation efficiency and have great development prospects in the future. It is necessary to further strengthen the management level of logistics enterprises and improve cost efficiency.

Regional gross domestic product (lnGDP): the maximum value is 240.5 million yuan and the minimum value is 20.6 million yuan, with a difference of 219.9 million yuan, indicating that there is a large gap in the external economic environment of logistics enterprises, which has a certain impact on the changes in the cost efficiency of listed logistics enterprises. Listed logistics enterprises have great differences in management efficiency (me) and enterprise scale (lnasset). The reason may be that there is a serious development imbalance among enterprises, which directly leads to the low operation efficiency and management level of enterprises.

(3) Metrological Inspection

In order to avoid the deviation of regression results, this paper uses stata16 measurement software to test the data, mainly using heteroscedasticity correction and Vif test.

ISSN: 2688-9323

Correction of heteroscedasticity.Considering the large sample size but short time span, in order to ensure that the empirical results are not affected by heteroscedasticity, this paper uses robust to adjust the variance of variables before regression analysis.

Multiple collinear tests. Because of the large number of observation variables and most of the data are derived from the financial data of enterprises, in order to prevent the interference of multiple collinearities, this paper conducts multiple collinear tests on the factors influencing cost efficiency. The average value of the expansion factor of Vif is 1.17, the overall expansion factor of Vif is far less than the critical value 10, and the expansion factor value is not greater than 2. at the same time, Pearson test is carried out for all measurement indexes. Table 9 shows that, in general, the correlation coefficient of each influencing factor is low. Through the above test, we can find that there is no multiple collinearity among the indicators in this study, and the index system and model construction of the model are relatively reasonable.

Table 9. Table of correlation coefficients of various variables

ID		time	lngdp	mean	traf	CE	me	lnasset	uniq
ID	1								
time	0	1							
lngdp	-0.227***	0.350***	1						
mean	0.259***	-0.0410	-0.0650	1					
traf	0.0660	0.115***	0.214***	0.116***	1				
CE	-0.160***	0.085**	0.207***	-0.181***	0.203***	1			
me	-0.252***	-0.135***	0.00600	-0.167***	-0.175***	0.103***	1		
lnasset	0.356***	0.225***	0.083**	0.365***	0.174***	-0.284***	-0.405***	1	
uniq	-0.161***	-0.0610	-0.0200	-0.137***	0.089**	0.319***	0.099**	-0.103***	1

Table 10. Collinearity test results of each variable

Variable	VIF	1/VIF
Inasset	1.37	0.729931
me	1.23	0.815749
mean	1.19	0.840027
traf	1.12	0.892811
Ingdp	1.07	0.932096
uniq	1.04	0.956436

In order to verify the effectiveness of the results of dynamic panel regression model, this paper uses Arellano and river as reference for two verification methods for GMM Estimation: verification tool variables and effectiveness of estimation results [24]. Firstly, AR (2) is a second-order sequence correlation test. Its main function is to test whether there is sequence correlation in the residual estimation of GMM. If the two-stage autoregressive sequence correlation is related, it means that the estimation result of the equation is invalid; Secondly, the over recognition constraint test is used to identify whether the tool variables used in GMM estimation are effective in general. In the empirical study, sargan test is used to verify. Table 4.4 reports the regression results of total sample that take cost efficiency ce of listed logistics enterprises as explanatory variables. The p value of AR (2) is greater than 0.1, and the original assumption that the second order autocorrelation coefficient of disturbance term is 0 in regression model is accepted, that is, the difference second order sequence of disturbance term does not exist correlation; Sargan test has a p value of more than 0.1, and the original assumption that all tool variables are valid cannot be rejected. The two important test results agree that the GMM two-step model selected in this paper is reasonable.

ISSN: 2688-9323

Table 11. Regression results of full sample

	Estimate	Standard error
CEt-1	0.761***	0.00392
me	0.124***	0.00868
lnasset	0.00738***	0.000359
Char	-0.0314***	0.00401
traf	0.0557***	0.00266
lngdp	0.0140***	0.000892
AR(2)	0.5527	
Sargan	0.7274	

Note: * * *, *, * in the model indicates that it is significant at the statistical level of 1,5% and 10%.

The regression results show that the first order coefficient of cost efficiency of logistics enterprises is positive and has passed the 1% significance level test. This shows that the cost efficiency of the last logistics enterprises can promote the cost efficiency of the current logistics enterprises, which means that the cost efficiency of logistics enterprises has time continuity and is positively promoted by the previous value.

The level of regional economic development (lnGDP) is positively correlated with the cost efficiency of logistics listed enterprises, that is, every 1% increase of lnGDP will promote the cost efficiency of enterprises by 0.0174%. Therefore, in recent years, the logistics industry in China has developed rapidly, the gross logistics product has been increasing, and the service quality of the industry has also been improved obviously. In addition, with the economic development, the people's living standard has been improved and the social infrastructure is improved, so the demand for Logistics has increased significantly. When the economic level of a region has been developed. It is inevitable to provide better development platform and bigger development platform for the development of local logistics enterprises. The theory of regional economic growth points out that the key indicators of the research on regional economic development level are regional GDP, and the improvement of GDP directly reflects the rise of regional economic level, the steady development of regional economy will certainly play a certain role in promoting the development of local logistics enterprises, and promote the development of logistics enterprises to match the development status of local economy, so local GDP has a significant positive effect on the cost efficiency of logistics enterprises.

TRAF is positive at the level of 1% significance. With the increase of TRAF, the cost efficiency of logistics enterprises will be increased by 0.0433 units. This shows that the development of logistics industry is closely related to the perfect logistics transportation network. The foundation of logistics enterprises is logistics transportation network. Generally speaking, the construction level of transportation infrastructure in a certain area is positively related to the logistics transportation network. The more perfect the construction of traffic infrastructure, the more developed the logistics transportation network is. Therefore, from the economic point of view, to improve the cost efficiency of listed logistics companies, the government and relevant departments must pay attention to the construction of local traffic infrastructure, make necessary economic investment for related construction.

The reason for this is that the listed logistics enterprises have a large market scale, which shows that the enterprises have strong resource integration ability, high asset utilization rate and advanced supply chain management ability, and the efficient production and operation improve the cost efficiency of the enterprises.

With the improvement of management efficiency (me) and the operation efficiency of enterprises by 0.0505%, so me has a significant positive correlation with the cost efficiency of logistics enterprises. Therefore, in order to promote the healthy development of enterprises

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and improve the overall income of enterprises, listed logistics enterprises should reasonably increase their investment in the relevant fields of enterprise management, at the same time, we should pay attention to ensure that the management cost of enterprises is effectively and efficiently implemented. But the improvement of management efficiency is not only affected by the management environment and conditions of the enterprise, but also the management efficiency is greatly affected by the managers' own ability and knowledge level. Therefore, when logistics enterprises improve their own cost efficiency, it is not only necessary for the enterprises to make great efforts to create good operation and management conditions and improve the management system of the enterprise, we should also pay attention to the improvement of management quality and management ability of managers themselves, create better management conditions by using favorable environment, so as to improve the management efficiency of enterprises. At the same time, we should encourage the employees of enterprises, integrate into the enterprise environment, maintain management system, improve work efficiency, ensure the steady progress of enterprise production, and improve the cost efficiency of the enterprise under the efforts of all parties.

There is a negative correlation between the nature of enterprise and the cost efficiency of logistics enterprises. In terms of cost efficiency, private enterprises are not necessarily lower than state-owned enterprises. The main reasons are as follows: firstly, in the current situation of China, railway, aviation and other related transportation are mostly state-owned, controlled by the state, so they have certain monopoly advantages, such enterprises have weak innovation ability and low economic benefits; Secondly, the state-owned enterprises are separated from the ownership and management rights, and the market orientation is poor, and they pay more attention to the social responsibilities such as the value-added of enterprises and employment. It is not conducive to the improvement of cost efficiency of enterprises.

The coefficient of uniq is 0.0493, which is positively correlated with the cost efficiency of logistics enterprises. With the product uniqueness, the cost efficiency value of logistics enterprises will also be improved. This means to improve the entry barrier of logistics transportation, the price will decrease due to fierce competition, and the possibility of profit decline will be reduced, and the cost efficiency can be effectively improved.

5. Summary

The cost efficiency of logistics enterprises is affected by regional logistics infrastructure, and the development level of logistics industry in this area will be limited and affected to a certain extent.Therefore, in the process of logistics infrastructure construction, we should pay attention to the coordination of planning and give strong supervision on the macro-economic level, give full play to the advantages of classification guidance and local conditions, coordinate with regional economy and plan reasonably to prevent waste of land resources caused by disorderly enclosed land and waste of human and public resources in low-level construction quality. For the construction of large logistics centers and parks, special attention should be paid to the structural optimization and timely and reasonable adjustment in the layout during the construction process. Meanwhile, the construction of a common transportation system matching the needs of regional economic development and logistics development should be promoted simultaneously, and the comprehensive transportation network layout should be further adjusted and improved, The logistics system in different regions can achieve a smooth docking effect, and complete the comprehensive and matching of logistics infrastructure construction, thus greatly improving the efficiency of logistics transportation.

The state-owned logistics enterprises should pay attention to the upgrading of industrial structure and accelerate the reform of the state-owned enterprises' share-holding system. The government should strengthen the policy support of the merger and reorganization of state-

owned assets, encourage logistics enterprises to improve the concentration of industry through the form of asset restructuring, solve the problem of overcapacity, improve the management of water products and strengthen the social responsibility of enterprises.

Logistics enterprises should adjust the enterprise scale appropriately, pay close attention to the market trend, and strive to achieve the optimal scale of the enterprise on the premise of ensuring the quality of scale expansion. In addition to integrating the internal resources of the industry and improving the management efficiency of enterprises, the linkage between logistics enterprises and production related enterprises can be strengthened and the organic combination of supply chain can be promoted. In order to realize efficient and consistent cooperative operation in the supply chain network composed of production, procurement, sales and reverse logistics, we should pay attention to the guidance of modern logistics concept and strengthen the study of advanced supply chain management knowledge. To speed up the transformation of modern logistics enterprises, we should pay attention to the functional adjustment and integration among warehousing and freight, multimodal transport and express delivery enterprises, strengthen service extension and improve the operation efficiency of enterprises.

References

[1] Kongwei, Ni Ming, Xiejiaping. Empirical Study on the factors influencing the operation efficiency of logistics enterprises [J] Management modernization, 2021,41 (06): 72-76DOI: 10.19634/j.cnki.11-1403 /c.2021.06.017.

[2] Ding Z Y, JoGS, Wang Y, etal. There lative efficiency of container terminals in small and medium-sized portsin China [J]. the Asian Journal Shipping and Logistics,2015,31(2):231-251.

[3] Jiasen Sun, Yang Yuan, Rui Yang,etal.Performance evaluation of Chinese portent erprises under significant environmental concerns: Anextended DEA-based analysis[J].Transport Policy, 2017, 60: 75-86.

[4] Park H G, Lee Y J. The efficiency and productivity analysis of large logistics providers services in Korea [J]. The Asian Journal of Shipping and Logistics, 2015, 31(4): 469-476.

[5] Zhongzuchang. An empirical study on the efficiency of Logistics Listed Companies in China [J] Business economy and management, 2011 (04): 19-26+43DOI:10.14134/j.cnki.cn33-1336/ f. 2011. 04.006.

[6] Zou Jiawei, xuyuefang. The evaluation of the operational efficiency of air transport enterprises in China based on super SBM modelModern commerce, 2017, (32): 23-26.

[7] Liu Dan, Pan Xiao, gongyanfeng, etc. The evaluation of port enterprise operation efficiency based on multi period network DEA [J] Journal of Wuhan University of technology, 2017, (5): 587-592.

[8] Feng Feng, Chen Lei, Huang Han. The measurement and improvement path of the operational efficiency of China port listed companies based on SBM DEA model [J]China circulation economy, 2017, 31 (06): 106-112DOI:10.14089/j.cnki.cn11-3664/f.2017.06.013.

[9] Liu Yanxia. Study on the efficiency of business logistics based on six step AHP analysis [J]Business economics research, 2018 (7): 102-104.

[10] Fan min. The efficiency analysis and development strategy of logistics industry in China Urban Agglomeration -- Based on the perspective of industrial operation and linkage development [J]Soft science, 2010,24 (05): 11-16.

[11] Lu Xinhua. The efficiency measurement and influencing factors of commercial banks in China [D]Southwest University of Finance and economics, 2014.

[12] Chi Guotai, sun Xiufeng, Ludan. An empirical study on cost efficiency of commercial banks of China [J]Economic research, 2005 (06): 104-114.

[13] Yang Daqiang, Zhang Aiwu. Efficiency evaluation of commercial banks of China 1996-2005: An Empirical Analysis Based on cost efficiency and profit efficiency [J]Financial research, 2007 (12): 102-112.

[14] Liu Zhiying, sunwenping, Li Jing. An empirical study on the cost efficiency and influencing factors of China property insurance industry [J]Financial research, 2007 (04): 87-99.

[15] Tao Xueping, Wang Ping and Zhu help Energy efficiency of APEC based on SBM undesirable and meta frontier models [J]. Journal of Beijing University of Technology (SOCIAL SCIENCE EDITION), 2015, 17 (02): 20-28DOI:10.15918/j.jbitss1009-3370.2015.0204.

[16] Cao Guo, Liu Lu, should be blessed. An empirical analysis of the production efficiency of listed logistics enterprises [J]Statistics and decision, 2016 (16): 184-188. DOI: 10.13546/ j.cnki. tjyjc. 2016. 16. 050.

[17] Taotao Deng. Impacts of Transport Infrastructure on Productivity and Economic Growth: Recent Advances and Research Challenges[J]. Transport Reviews,2013,33(6).

[18] Douglas Gollin, Richard Rogerson. Productivity, transport costs and subsistence agriculture[J]. Journal of Development Economics, 2014,107.

[19] Qin Y, Zhang X.. The Road to Specialization in Agricultural Production: Evidence from Rural China[J]. World Development, 2016, 77: 1-16.

[20] In the morning, Liu Jun, Zheng Yi. Empirical analysis of traffic infrastructure, FDI and industrial agglomeration in China [J]Statistics and decision, 2013 (08): 88-92. DOI: 10.13546/ j.cnki. tjyjc. 2013. 08.031.

[21] Zhouliping, zhangyuqing. How the host country's transportation facilities affect the overseas M & A of Chinese Enterprises - based on the real effect of the belt and road initiative [J]Contemporary finance, 2019 (11): 14-24DOI:10.13676/j.cnki.cn36-1030/f.2019.11.003.

[22] jihongyun, dry Xingdi. The effect of industrial structure adjustment of monetary policy in China -- Based on panel data analysis of listed companies [J]Shanghai Economic Research, 2014 (02): 3-10+22. DOI:10.19626/j.cnki.cn31-1163/f.2014.02.001.

[23] zhangshujuan, Wang Xiaotian. A study on the dual asymmetry of the industrial effect of monetary policy -- Nonlinear Analysis Based on stvec model [J]Financial research, 2016 (07): 17-32.

[24] Ren Haiyun, fenggenfu. Is the technology innovation ability of listed companies of affiliated enterprise groups stronger--Empirical evidence from Listed Companies in China manufacturing industry [J]China soft science, 2018 (09): 130-137.

[25] Wang Huanming, Zhu Dajian. Study on the governance mode and operation efficiency of urban public transport service in China -- Taking the public transport service of urban agglomeration in Yangtze River Delta as an example [J]. Journal of public management, August, 2011 (02): 52-62+126.

[26] Li Jinglin, Yang Town, Chen Jin. Mixed ownership reform and social responsibility of state-owned enterprises: a study from the perspective of quantity and quality [J]Shanghai Economic Research, 2021 (11): 35-47DOI:10.19626/j.cnki.cn31-1163/f.2021.11.004.

[27] Yang Zhen, cuiyanbing. The research on the asymmetric effect of monetary policy: taking manufacturing as an example [J]Macroeconomic research, 2018 (08): 5-16DOI:10.16304/j.cnki.11-3952/f.2018.08.002.

[28] Xiao Zuoping, liuchenyan. Bargaining power, product uniqueness and business credit of upstream and downstream enterprises: Empirical Evidence from Listed Companies in China manufacturing industry [J] Securities Market Herald,2017(09):33-41.