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Research on Financial Management Ability Evaluation of Real Estate Enterprises based on DEA –Take China Evergrande Group as an Example

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Abstract: Since China's reform and opening-up, real estate, as a new industry, has developed rapidly and become the pillar industry of the national economy. Because the real estate industry is a capital-intensive high-risk industry with huge investment, slow recovery and rich returns, it has always been the focus and hot spot of social attention. If real estate enterprises want to gain a firm foothold in the fierce market, they should pay attention to financial management. As the top priority of real estate enterprises, financial management is conducive to the good operation of enterprises and the improvement of economic benefits. This paper adopts DEA method for empirical analysis. Taking China Evergrande Group as an example, the strength of enterprise financial management ability is obtained through analysis and calculation, which provides a reference method for evaluating enterprise financial management ability. Policy suggestions are proposed according to the empirical results.

Keywords: Real Estate Industry; Financial Management Ability; Data Environment Analysis

1. Introduction

As a capital-intensive industry, the real estate industry has a strong dependence on finance. Real estate finance linked to real estate refers to the general term for investment, financing and related financial services through currency circulation and credit channels in the process of real estate development, construction, operation, circulation and consumption. While supporting the development of the real estate industry, real estate finance realizes and strengthens financial functions through the special carrier of real estate, which forms the main source of financial risks. At present, China has initially formed a real estate financial system that is based on commercial banks and serves real estate development and housing consumption. The real estate finance industry has also played a positive role in supporting urban residents to purchase houses, boosting housing vestment, expanding domestic demand, and promoting the development of the national economy. However, in the rapid development of real estate finance, a series of problems such as imperfect market, single financing channel and weak product innovation ability are also exposed.

Financial control and management is the main link of optimizing the capital structure of contemporary enterprises, which is closely related to all aspects of enterprise development. Especially in the state of the comprehensive reform of the domestic economic system, the orderly implementation of the internal financial control work of enterprises can play a multi-dimensional integration of resources. Especially at present, the real estate industry is in the most severe period of regulation and control in history, so it is particularly important and urgent to improve the level of financial internal control in an orderly manner.

Compared with other enterprises, real estate enterprises have a great demand for capital, so it is very important to strengthen the financial management. The real estate enterprise financial management is mainly the following several aspects: first, the property involved in the up and down the industrial chain is long and profound money supply is much greeted. Long cycle in development and fluctuation in policy influence are aeriform in exacerbating the complexity and diversity of the real estate enterprise financial management. Second,

during the operation of real estate, both external and internal risks are relatively high, which requires financial managers to make predictions about relevant risks in advance so that leaders can make correct, scientific and reasonable decisions. Third, the internal and external relations of real estate need financial management personnel to do the corresponding work in advance, such as: straighten out the relationship between creditors and investors. If it is not properly handled, it will bring numerous losses to real estate enterprises, and even affect the stable operation of real estate enterprises in the later period.

2. Literature review

In the 1930s, the input-output theory began to appear in western countries. Basis on the input-output theory, Charnes *et al.* (1978) constructed the first DEA model in the theoretical field, that is, the CCR model that is still widely used today, which can conduct effectiveness analysis on decision-making units with multiple inputs and multiple outputs. Golany *et al.* (1985) derived and expanded CGS2 model basis on previous studies, which could analyze the technical effectiveness among different production departments.

Based on previous researches, Zhang (2014) further expand the content of financial management ability and summarize it as the basic work, financial budget, financial investment and financing activities, working capital management, capital operation, with melting 10 aspects to build a set of evaluation system for assessing and improving enterprise financial management ability to provide the reference. The financial core competitiveness comes from the special skills and knowledge of enterprise financial management, which cannot be copied or hidden. Such competence cannot be directly described in language, nor can it be traded, which makes it difficult for other competitors to imitate (Wang, 2014). By sorting out the development status of financial management and various existing problems and deficiencies, Zhou (2015) pointed out the root causes of the problems, and proposed targeted improvement measures. Chen (2015) analyzed from the perspective of financial management objectives and capital structure optimization, and discussed the optimization path of capital structure under financial management objectives. Jing *et al.* (2015) classified the financial capacity of enterprises into four capacities, including debt paying capacity, operating capacity, profitability and development capacity. Gao (2018) used DEA model to conduct specific analysis in the evaluation of domestic hospital operating efficiency and found that this model plays an important role in the evaluation of hospital operating efficiency. The results provide real and effective financial quantitative index data for hospital management accounting in a timely manner and thus contributing to the comprehensive improvement of hospital budget management level. Sun (2020) evaluated the financial performance of enterprises from two aspects: horizontal and vertical. Firstly, eight indicators such as the liquidity ratio, total asset turnover as input index, with main business revenue growth, total assets of 10 indexes such as the net interest rate, the net interest rate of the sale as output indicators, the evaluation index system was constructed using the factor analysis method to extract the common factor, through the BCC model of DEA model analysis data for the dimensionless. Yang (2020) applied the fuzzy DEA model to evaluate the financial performance of listed companies. The financial indicators of profitability and growth were treated as output indicators and the financial indicators of leverage as input indicators, the efficiency value of financial performance was calculated through DEA method and the corresponding ranking of financial performance was listed. It verifies the importance of considering uncertainty in the process of financial performance evaluation.

At present, there is no unified view on the definition of financial management ability in the academic circle, and there are many cross and different understandings. The first view is that based on the traditional financial theory, the enterprise's financial management ability is the comprehensive performance of the enterprise's financial condition, which can be measured by calculating various financial ratios, including debt paying ability, operating ability, development ability and profitability, and is the concentrated embodiment of the enterprise's overall business activities. The second view is further expanded based on the first view, that the enterprise financial management ability is one of the core capabilities of the enterprise, including financial activity ability, financial management ability and financial performance ability. The third view, from the perspective of corporate strategy, also considers risk management and senior management. To sum up, this paper defines financial management ability as the concentrated performance of knowledge related to financial management, and takes operational ability, debt paying ability, development ability and profitability as the basic elements of enterprise financial management ability.

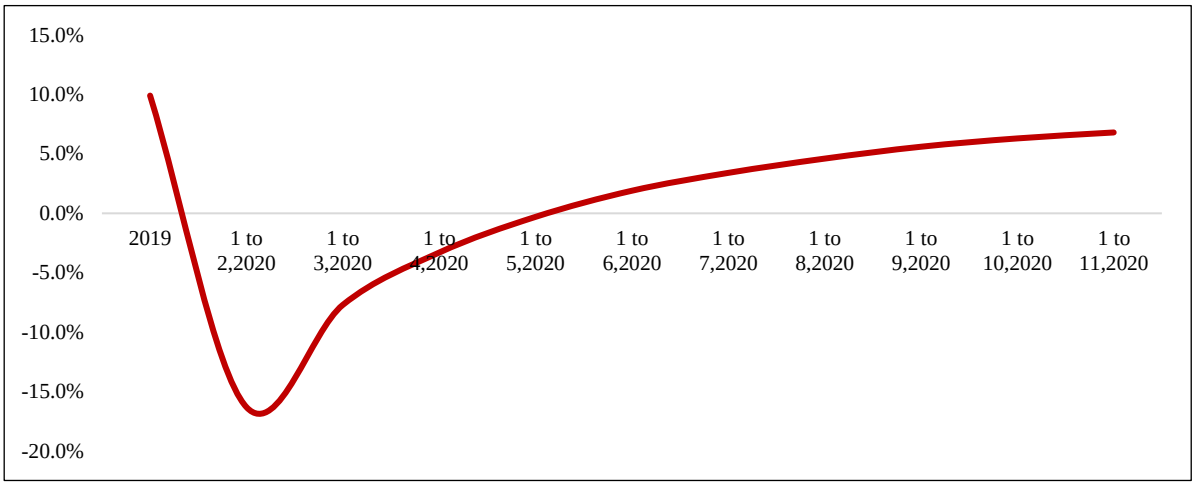
This paper takes China Evergrande Group as the research object to conduct data processing and calculation. Vertical analysis is performed based on various indicators of China Evergrande Group from 2012 to 2020. Combining with China Evergrande group and the relevant data of listed companies in 2020 real estate

enterprises, horizontal analysis is conducted based on 15 companies. Factor analysis and principal component analysis are used to decrease the complex degree of the data processing and the DEA method is applied to empirically evaluate the operation efficiency of financial management ability.

3. Case Analysis

3.1. Current Situation Analysis of Real Estate Industry

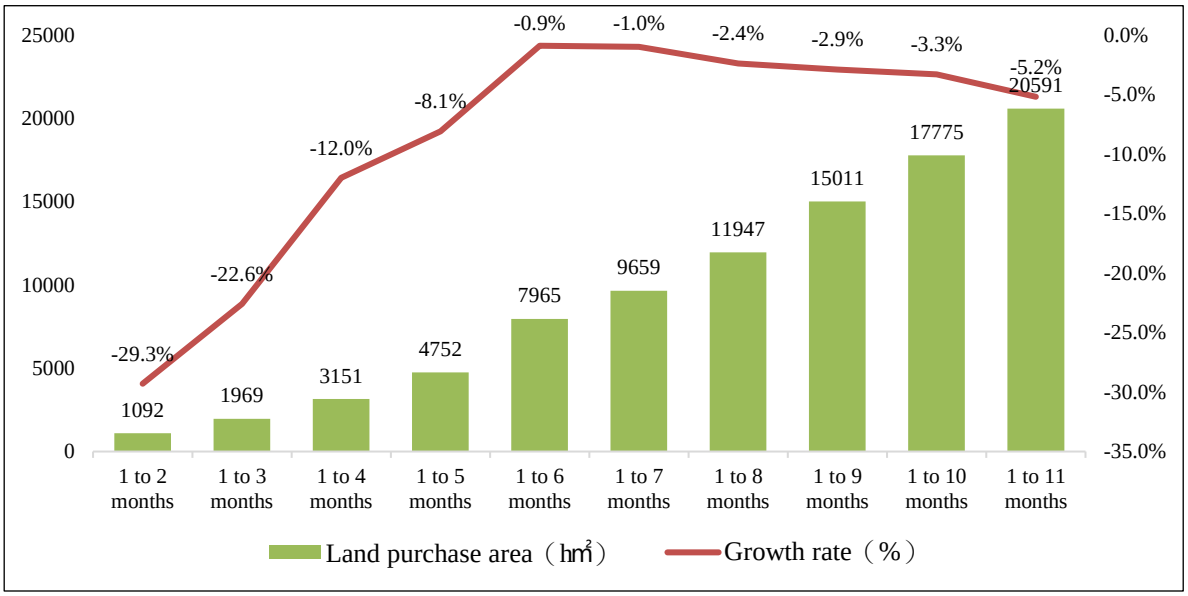
With the impact of national macro policies and the improvement of the epidemic situation, China's economy shows obvious signs of recovery. Meanwhile, the growth rate of national real estate investment is also picking up with growth reaching 6.8% on November 2020 (Figure 1).



Data Sources: National Bureau of Statistics

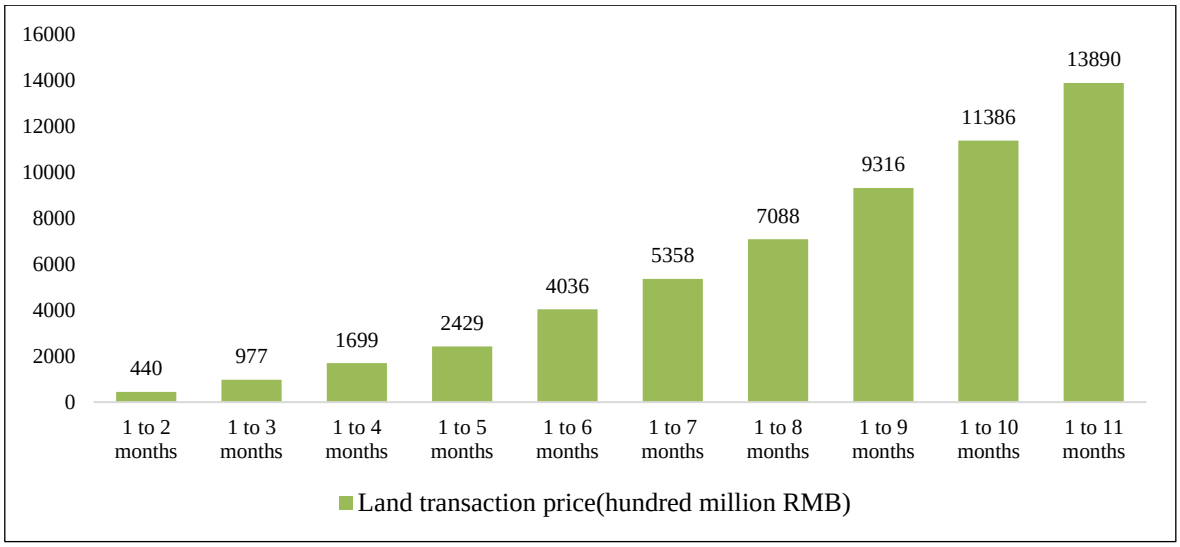
Figure 1. Growth rate of China's real estate development investment from 2019 to 2020.

Since 2020, the land purchase area of real estate development enterprises in China has decreased, and the transaction price has also decreased, showing an overall downward trend (Figure 2). It is worth noting that as time goes by, there will be signs of a pick-up (Figure 3).



Data Sources: National Bureau of Statistics

Figure 2. Land purchase area and growth rate of national real estate development enterprises from Jan to Nov 2020.



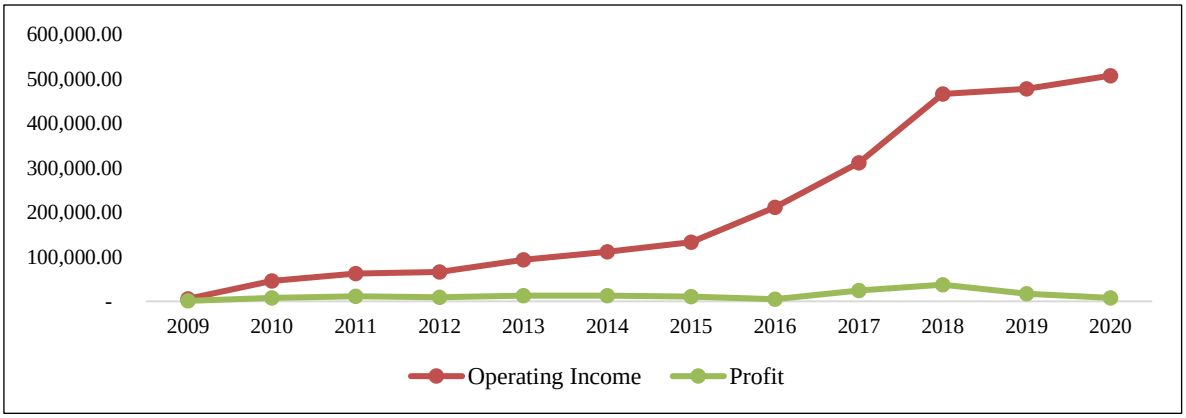
Data Sources: National Bureau of Statistics

Figure 3. Land transaction prices of national real estate development enterprises from Jan to Nov 2020.

In general, China's real estate industry will continue its downward trend in the short term, especially the land purchase area and land transaction price. However, with the recovery of China's economy and the support of national policies, the industry will gradually pick up. The development trend of the real estate industry can be summed up in three aspects: the growth rate of national real estate investment began to pick up, the land purchase area showed negative growth, and the land transaction price dropped.

3.2. Current Situation Analysis of China Evergrande Group

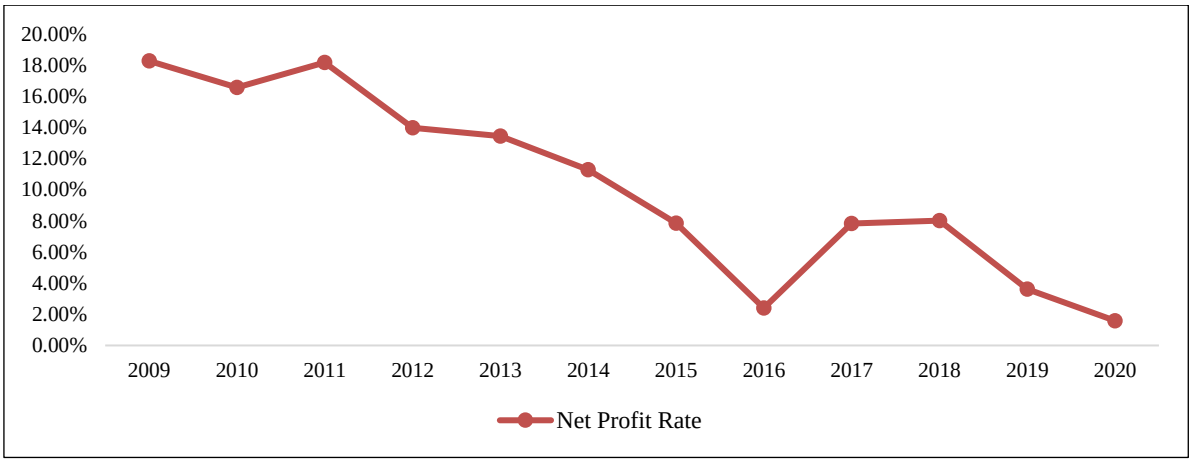
China Evergrande Group is an international enterprise group listed on the main board of the Hong Kong Stock Exchange, integrating real estate planning and design, development and construction, and property management. The historical data of China Evergrande Group refer to the following two charts (Figure 4 and Figure 5).



Data Sources: https://www.fortunechina.com/fortune500/c/2021-08/02/content_394571.htm

Figure 4. Operating income and profit of China Evergrande Group.

Operating income refers to the sum of main business income and other business income, which is an important guarantee for enterprises to obtain profits and an important part of corporate cash inflow. In recent years, the company has developed rapidly and expanded its business scale. According to the data analysis in Figure 2, the operating income of China Evergrande Group has been increasing year by year in recent years, with a large increase.



Data Sources: https://www.fortunechina.com/fortune500/c/2021-08/02/content_394571.htm

Figure 5. Net profit ratio of China Evergrande Group.

Net Profit Rate = Net Profit / Operating Revenue. Scientific calculation and analysis of net profit margin can help enterprises avoid blindly expanding production and sales scale. According to the data analysis in Figure 5, it reflects that the increase and decrease of the net profit of China Evergrande Group in China is unstable. The net profit margin of China Evergrande Group has declined significantly in recent years, indicating that the profitability of enterprises is weaker.

Next, the financial indicators of China Evergrande Group will be analyzed from four aspects: solvency, operating ability, profitability and growth ability (Table 1).

Table 1. Calculation formula.

	Financial Indicators (%)	Calculation Formula
1	Quick Ratio	(Total Current Assets - Inventories) / Total Current Liabilities
2	Asset-liability Ratio	Total liabilities / total assets
3	Inventories Turnover Ratio	Inventory cost of sales / Total Inventories
4	Total Asset Turnover Ratio	Net sales revenue / Average total assets
5	Operating Profit Ratio	Profit / Revenue
6	Net Profit Ratio	Net Profit / Sales Revenue
7	ROE	Net profit / average shareholders' equity
8	Gross Profit Ratio	Gross profit on sales / Sales revenue
9	Operating Revenue Growth	(Revenue from Current Business - Prior Period Major Business Income) / Revenue from Prior Period Business
10	Net Asset Growth Ratio	(Net Assets at the End of the Period - Net Assets at the Beginning) / Net Assets at the Beginning of the Period

Data Sources: https://caibaoshuo.com/

The first is debt paying ability. Enterprises have good solvency, which means that the level of income created by their corporate capital is relatively stable, and the overall control of financial risks is also strong, which can enable enterprises to achieve sustainable development. In the following, the solvency of China Evergrande Group will be analyzed in terms of current ratio and quick ratio. The quick ratio measures a company's ability to meet its short-term obligations with its most liquid assets. The higher the quick ratio, the better the liquidity of the company. It can be known that the part of the company's existing liquidity that can be used directly to repay debts directly reflects the short-term solvency of the enterprise. In general, 1:1 is the quick ratio of the best financial situation. According to Table 2, the quick ratio of China Evergrande Group continued to decline between 2016 and 2020 (always below 1), indicating that its project liquidity is more and resulting in a low level of debt repayment. Asset-liability ratio is a key factor in banks' decisions on whether to lend to companies. In general, enterprises with lower asset-liability ratio have higher debt profitability and stronger debt paying ability, so it is easier to get loans. It is normal when the asset-liability ratio is 40%~70%.

As can be seen from Table 2, the asset-liability ratio of the company has been on the rise year by year in 9 years and reached 84.77% by the end of 2020. The asset-liability ratio of the company has been much higher than 70% and increasing year by year, indicating that the company's ability to repay debts for a long time is declining and the loans are not safe.

Table 2. China Evergrande Group annual financial indicators.

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Solvency Indicator (%)									
Quick Ratio	44.7	68.5	64.2	61.6	73	61.9	52.1	48	42.9
Asset-liability Ratio	82.56	77.21	76.31	81.22	85.75	86.25	83.58	83.75	84.77
Operational Capability Indicator (%)									
Inventories Turnover Ratio (sub / year)	0.4	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Total Asset Turnover Ratio (sub / year)	0.31	0.32	0.27	0.21	0.2	0.2	0.25	0.23	0.23
Profitability Indicator (%)									
Operating Profit Ratio	18.3	20	16	13.4	15.1	25.1	28.6	17.8	12.5
Net Profit Ratio	14.1	14.2	15.2	11.7	2.4	7.8	8	3.6	1.6
ROE	24.4	22.1	17.5	12	3	11.5	13.3	5.1	2.4
Gross Profit Ratio	27.9	29.5	28.5	28.1	28.1	36.1	36.2	27.8	24.2
Growth Ability Indicator (%)									
Operating Revenue Growth	5.7	43.6	18.5	19.7	58.8	47	50.1	2.3	6.3
Net Asset Growth Ratio	24	95.4	39	21.3	26.4	33	22.1	13.8	4.1

Data Sources: https://caibaoshuo.com/

Second, Operational capacity refers to the ability of an enterprise to carry out normal production and operation in different internal and external environments. Improving operational capabilities can help improve corporate profitability and cash flow generation capabilities to improve the solvency of enterprises and reduce financial risks. In the following, this article will analyze the operating capacity of China Evergrande Group through the accounts receivable turnover rate, survival turnover rate and total asset turnover rate. A higher level of inventory turnover means that enterprises invest more money in other aspects, the use of funds is efficient, and the operation management of survival is more effective. As can be seen from the above chart, from 2016 to 2020, the inventory turnover efficiency of China Evergrande Group has remained at a low level, with a small turnover and a high level of resource occupation. It shows that the management efficiency of the company's inventory is low and the liquidity is poor. It is true that too many commercial houses for sale will result in capital occupation. If it cannot be recovered in time, the pressure on enterprise funds will increase. Total asset turnover ratio is an important indicator to measure the utilization rate of enterprise assets. A higher total asset turnover rate means that an enterprise can achieve higher sales revenue with a lower total asset; conversely, it means that the efficiency of production and operation of the enterprise is poor, which will eventually affect the profitability of the enterprise and easily induce financial risks of the enterprise. In general, the total asset turnover rate is less than 1, which means that the company is a capital-intensive or luxury industry (a money-burning industry). According to the above chart, the total asset turnover rate of China Evergrande Group from 2016 to 2020 is at a low level, indicating that the company's sales capacity has weakened. This shows that in recent years, the overall sales situation of Evergrande Group is not in good shape, and the income created by corporate assets is low, reflecting the poor overall operating capacity of the group. It is necessary to timely explore the reasons for this situation and improve them to reduce the financial risk of the entire group.

Third, the level of asset appreciation that an enterprise can achieve in a fixed business cycle is manifested as its profitability. From the performance of profitability indicators, the level of investment returns and the

strength of financing capabilities of enterprises, as well as the level of debt repayment capabilities can be monitored. Below, this article will analyze the profitability of China Evergrande Group through operating margin, net profit margin on sales and return on net assets.

Operating profit ratio can most directly reflect the production and operation results of the enterprise, and the higher the operating profit margin, the higher the production and operation efficiency of the enterprise. As shown in Table 2, the operating profit margin from 2018 to 2020 shows a downward trend, which shows that the operating profit margin of China Evergrande Group is decreasing year by year, mainly because the sales revenue of China Evergrande Group is decreasing year by year. In the case of reduced sales revenue, the cost is improperly controlled, and the ratio of expenses is not well controlled. The overall level of profitability of the enterprise was low during this period. Through scientific calculation and analysis of net profit margin on sales, it can help enterprises avoid blindly expanding the scale of production and sales. The higher its value, the higher the company. In the case of a certain sales revenue, it can create higher profits, that is, higher profitability. According to Table 2, we can see that the overall net profit margin of China Evergrande Group did not fluctuate much from 2017 to 2018, and the overall trend tended to be moderate. In 2019, there was a sharp decline compared with the previous year, and it plummeted to 1.6% in 2020. This shows that the profitability of China Evergrande Group is not stable enough and tends to weaken. A higher return on equity (ROE) means that a company can generate higher returns under a given asset condition, that is, a higher level of profitability. According to data analysis, China Evergrande Group's return on net assets in 2018 was 13.3%, an increase of 1.8% compared with 2017. However, in the following two years, it showed a downward trend year by year, reaching 2.4% in 2020. After 2018, the overall ROE level of China Evergrande Group was low, resulting in opportunity cost losses. Gross profit margin on sales is the ratio of gross profit on sales to sales revenue, reflecting how much gross profit a product can get for every 1 yuan of sales revenue, that is, how much profit can be generated from sales revenue after deducting sales cost and expenses of each period. The higher the gross margin on sales, the stronger the profitability of the product. It can be seen from the above table that China Evergrande Group's gross profit margin has been stable at more than 24% in the past 9 years, which is generally stable. In 2017, the main reason for the higher sales gross margin is the national policy incentive. China Evergrande Group's gross profit margin in 2020 was 24.2%, indicating that every 100 yuan of sales revenue can create a gross profit of 24.2 yuan for the company.

Lastly, if an enterprise can maintain a relatively stable development momentum in different external market environments and the operating efficiency of the enterprise is continuously improved, the enterprise is considered has a good growth ability. In the following, this article will evaluate the growth ability of China Evergrande Group through the growth rate of operating income, net profit and total assets. Operating Revenue Growth is an important indicator to measure the development scale of a company, and the sustained high growth rate of operating income shows that the company has achieved significant growth in operating income compared with the previous business cycle, and the future development momentum is good. According to the above chart, although the operating income growth rate of China Evergrande Group from 2016 to 2020 is positive, the overall operating income is trending downward. The fluctuation range for operating income is large (up to 58.8%) but is less than 10% in 2019 and 2020. Net asset growth ratio is an important indicator to measure the scale of production and operation of enterprises. The higher the growth rate of total assets (indicating that the higher the capital investment of enterprises), the larger the scale of production and operation, which reflects the good trend of enterprise development. As can be seen from the above chart, the total asset growth rate of China Evergrande Group between 2016 and 2020 is the highest (33%) at the end of 2017, and the development gradually declines in the following years.

Based on the analysis of the above indicators, it can be analyzed that the operation of China Evergrande Group in recent years is unexceptional, and the specific reasons need to be analyzed.

4. Financial Management Ability Evaluation based on DEA Method

The main content of this chapter is to extract the common factors of input and output indicators, evaluate and measure the financial management ability of China Evergrande Group and the real estate industry, obtain the final efficiency value, and conduct horizontal and vertical comparison.

4.1. Construction of Evaluation System

In this paper, factor analysis and principal component analysis are used to process data (Song, 2020) and common factors are extracted so that the extracted factors reflect the original data as much as possible. Since DEA method has a principal requirement for the number of input-output indicators, this paper selects original indicators with appropriate number to extract common factors.

4.1.1. Extracting Common Factors of Input Indicators

The SPSS software is used to extract the input common factor of the data of China Evergrande Group from 2012 to 2020. The KMO and Bartlett tests are firstly developed, and the results are shown in Table 3 below:

Table 3. Input index KMO and Bartlett test.

KMO sampling suitability quantity		**0.548**
Bartlett sphericity test	Approximate chi-square	26.449
	Degree of freedom	15
	Significance	.034

Data Sources: Homemade data

As can be seen from Table 3, the KMO result is 0.548 (greater than 0.5). The significance was 0.034, much less than 0.5, indicating that these indicators could be used to perform factor analysis.

Table 4. Input index common factor variance.

	Initial	**Extract**
Current ratio (%)	1.000	.957
Asset-liability ratio (%)	1.000	.950
Inventories Turnover Ratio (sub / year)	1.000	.915
Total asset turnover ratio (sub / year)	1.000	.941
Operating Revenue Growth (%)	1.000	.972
Net asset growth ratio (%)	1.000	.880
Extraction method: principal component analysis.		

Data Sources: Homemade data.

The extracted variance is shown in the second column of the above table. The extracted common factor variance of all indicators is greater than 0.5, indicating that the extracted common factor represents most indicators with less information loss and explanatory power.

Table 5. Total variance explanation of input indicators (%).

Composition	**Initial Eigenvalue**			**Extract the sum of squares of loads**			**Square and sum of the rotating load**		
	Total	Variance	Cumulative	Total	Variance	Cumulative	Total	Variance	Cumulative
1	3.233	53.882	53.882	3.233	53.882	53.882	2.923	48.718	48.718
2	1.331	22.182	76.065	1.331	22.182	76.065	1.641	27.347	76.065
3	1.050	17.499	93.564						
4	.218	3.630	97.194						
5	.116	1.932	99.126						
6	0.052	0.874	100.000						
Extraction method: principal component analysis									

Data Sources: Homemade data

As can be seen from Table 5, the cumulative variance contribution rate of the first three indicators has reached 93.564%, which can basically reflect most information of the original input indicators. The first three factors can be extracted as common factors and call them X1, X2.

Table 6. Input index component matrix.

	Composition	
	1	2
Current ratio (%)	.133	-.634
Asset-liability ratio (%)	-.764	.559
Inventories Turnover Ratio (sub / year)	.887	-.355
Total asset turnover ratio (sub / year)	.914	.153
Operating Revenue Growth (%)	.033	.879
Net asset growth ratio (%)	.835	-.052
Extraction method: principal component analysis		
Extracted three components.		

Data Sources: Homemade data

The component matrix mainly reflects the extent to which each icon can explain itself, and the result is bounded by 0.5, and more than 0.5 can explain itself better. From Table 6, the inventory turnover rate, total asset turnover rate, and total asset growth rate have larger absolute values in component 1, all exceeding 0.8, so the factor is named X1 internal management ability factor; the rest has a larger absolute value in component 2, so the factor is named X2 external development ability factor.

Table 7. Input indicator component score coefficient matrix.

	Composition	
	1	2
Current ratio (%)	-.117	.019
Asset-liability ratio (%)	-.230	.315
Inventories Turnover Ratio (sub / year)	.285	-.074
Total asset turnover ratio (sub / year)	.394	.099
Operating Revenue Growth (%)	.092	.746
Net asset growth ratio (%)	.262	.324
Extraction method: principal component analysis.		
Rotation method: Kaiser maximum variance method of normal chemistry.		

Data Sources: Homemade data.

Table 8. input metric metrics scores.

X1	X2
.73775	1.25083
2.18658	-.27446
.51258	-1.42439
-.4656	-1.34159
-.83242	-.00143
-.82731	.07510
-.32558	.59498
-.82884	-.31800
-.15715	1.43895

Data Sources: Homemade data.

4.1.2. Extract the Output Metric Public Factor

As can be seen from Table 9, the KMO result is 0.622 (greater than 0.6). The significance is 0 (much less than 0.5), indicating that these indicators can and are suitable for factor analysis.

Table 9. Output index KMO and Bartlett test.

KMO sampling suitability quantity		**.622**
Bartlett sphericity test	Approximate chi-square	25.889
	Degree of freedom	6
	Significance	.000

Data Sources: Homemade data.

Table 10. Variance of output index common factor.

	Initial	**Extract**
Operating Profit Ratio (%)	1.000	.939
Net profit ratio (%)	1.000	.927
ROE (%)	1.000	.998
Gross profit ratio (%)	1.000	.974
Extraction method: principal component analysis		

Data Sources: Homemade data.

As can be seen from the above table, the variance of the common factor after extraction of all indicators is greater than 0.6, indicating that the extracted common factor represents most indicators with less information loss and explanatory power.

Table 11. Total variance interpretation of output indicators (%).

Composition	**Initial Eigenvalue**			**Extract the sum of squares of loads**			**Square and sum of the rotating load**		
	Total	Variance	Cumulative	Total	Variance	Cumulative	Total	Variance	Cumulative
1	2.976	74.399	74.399	2.976	74.399	74.399	2.730	68.248	68.248
2	.862	21.552	95.951	.862	21.552	95.951	1.108	27.703	95.951
3	.125	3.129	99.080						
4	.037	.920	100.000						
Extraction method: principal component analysis.									

Data Sources: Homemade data

As can be seen from the above table, the cumulative variance contribution rate of the first two indicators has reached 95.951%, which can basically reflect most of the information provided by the original output indicator data. The first two factors can be extracted as common factors and call them Y1, Y2.

Table 12. Component matrix of output indicators.

	Composition	
	1	2
Operating Profit Ratio (%)	.950	.191
Net profit ratio (%)	.928	.257
ROE (%)	-.489	.871
Gross profit ratio (%)	.987	.005
Extraction method: principal component analysis.		
Extracted two components.		

Data Sources: Homemade data

The model is rotated in space to better extract factors. The component matrix after rotation is shown in Table 12. The rotation converges after 3 iterations.

Table 13. Component matrix after rotation.

	Composition	
	1	2
Operating Profit Ratio (%)	.958	-.144
Net profit ratio (%)	.960	-.074
ROE (%)	-.162	.986
Gross profit ratio (%)	.929	-.332
Extraction method: principal component analysis method.		
Rotation method: Kaiser maximum variance method of normal chemistry.		
The a-rotation has converged after 3 iterations.		

Data Sources: Homemade data

The rotated component matrix can explain the index more directionally. As can be seen from the above table, operating profit margin, net profit margin and gross profit margin have large absolute values in component 1 (all exceeding 0.9), so this factor is named Y1 profitability factor. ROE has a large absolute value in component 2, so this factor is named Y2 equity capacity factor.

Table 14. Component score coefficient matrix of output indicators.

	Composition	
	1	2
Operating Profit Ratio (%)	.376	.100
Net profit ratio (%)	.395	.174
ROE (%)	.190	1.006
Gross profit ratio (%)	.314	-.107
Extraction method: principal component analysis.		
Rotation method: Kaiser maximum variance method of normal chemistry.		

Data Sources: Homemade data

Table 15. Common factor scores of output index.

Y1	Y2
-.38486	.05269
-.17326	-.14593
-.59035	-.56292
-.93998	-1.07192
-.36599	.50752
1.45530	-.69105
1.76594	-.46881
.29681	2.35681
-1.06361	.02361

Data Sources: Homemade data

4.1.3. Establishment of Index System

Through the above processing steps, a total of 4 common factors are extracted, representing 4 kinds of abilities, and their factor scores are taken as the input and output data of DEA model, as shown in Table 16.

Table 16. Common factor scores.

X1	X2	Y1	Y2
.73775	1.25083	-.38486	.05269
2.18658	-.27446	-.17326	-.14593
.51258	-1.42439	-.59035	-.56292
-.4656	-1.34159	-.93998	-1.07192
-.83242	-.00143	-.36599	.50752
-.82731	.07510	1.45530	-.69105
-.32558	.59498	1.76594	-.46881
-.82884	-.31800	.29681	2.35681
-.15715	1.43895	-1.06361	.02361

Data Sources: Homemade data

4.2. Evaluation of Longitudinal Financial Management Capabilities based on DEA

4.2.1. Indicator Data Processing

Since the DEA model requires that all data must be positive in order to be calculated, the various common factors need to be processed before the efficiency value is calculated, and all the data are transformed into the interval of [0.1,1] according to a certain functional relationship, using the following formula (Song, 2020):

$$\begin{Bmatrix} \boldsymbol{X'_{ij} = 0.1 + \dfrac{X_{ij} = min\{X_{ij}\}}{max\{X_{ij}\} - min\{X_{ij}\}}} \end{Bmatrix} \times \boldsymbol{0.9}$$
$$\boldsymbol{X_{ij} \in [0.1, 1]} \quad (1)$$

Table 17. Dimensionless input and output data.

	Input indicators		Output indicators	
DMU	X1	X2	Y1	Y2
2012	0.5681	0.9409	0.3159	0.3952
2013	1.0000	0.4614	0.3832	0.3431
2014	0.5010	0.1000	0.2505	0.2336
2015	0.2094	0.1260	0.1393	0.1000
2016	0.1000	0.5473	0.3219	0.5146
2017	0.1015	0.5713	0.9012	0.2000
2018	0.2511	0.7347	1.0000	0.2583
2019	0.1011	0.4478	0.5327	1.0000
2020	0.3013	1.0000	0.1000	0.3876

Data Sources: Homemade data

4.2.2. Efficiency Calculation

This paper selects the BCC model in DEA and uses DEAP software to import data into the BCC model for calculation. After DEA calculation, the efficiency value of China Evergrande Group's financial management capability from 2012 to 2020 is shown in Table 18.

After calculation, the comprehensive efficiency value, pure technical efficiency value and scale efficiency value of China Evergrande's financial management ability from 2012 to 2020 are obtained. According to the comprehensive efficiency value of each year, the efficiency ranking of each year is marked at the back.

First, starting from the crste analysis. It can be found that the crste of China Evergrande Group in 2014, 2017 and 2019 is 1, and the vrste and scale are also 1, indicating that China Evergrande Group has excellent financial management ability and matching input-output efficiency in these years. The crste in 2018 is between [0.7,0.9], indicating that these years have a good performance in both vrste and scale, but there is still room for slight improvement. The crste in 2015 and 2016 is between [0.5,0.7], indicating that there is still a large room

for growth and improvement of the overall efficiency under the existing input conditions. The crste of other years are all less than 0.5, indicating that there is no corresponding good output efficiency under the existing input conditions, and there is a large space for income growth. China Evergrande Group still has the problem of poor financial management ability. Although it has been stable above 0.5 in more than half of the years, it has not reached a very excellent level. For years with low scale and vrste, such as 2012 and 2020, indicating that the management mode of these years is poor and inefficient. It is necessary to reform the original operation and management mode, vigorously carry out management innovation, and adjust the industrial scale.

Table 18. Efficiency value of financial management capability.

DMU	crste	vrste	scale	Returns to scale	crste rank
2012	0.240	0.285	0.842	irs	8
2013	0.448	0.471	0.950	drs	7
2014	1.000	1.000	1.000	-	1
2015	0.617	1.000	0.617	irs	5
2016	0.569	1.000	0.569	irs	6
2017	1.000	1.000	1.000	-	1
2018	0.846	1.000	0.846	drs	4
2019	1.000	1.000	1.000	-	1
2020	0.173	0.395	0.439	irs	9

Data Sources: Homemade data

Second, vrste refers to the production efficiency of enterprises affected by factors such as management and technology. High vrste indicates high management level, while low vrste indicates low management level (Xu and Li, 2017). As can be seen from the above table, the vrste of China Evergrande Group has been effective in 6 of the 9 years, respectively in 2014, 2015, 2016, 2017, 2018 and 2019, accounting for 67% of the samples. The remaining years are all less than 0.5. Overall, the management level of Evergrande Group in China is not stable, and there are great differences in different years. From 2012 to 2013, China Evergrande Group has high scale and low vrste，indicating that the enterprise has a good level of operation scale, but low level of operation management and insufficient capacity of resource allocation. From the above analysis, China Evergrande Group’s performance is relatively average in vrste. This shows that China Evergrande Group’s technological innovation and management activities are undeserving. It should increase R&D investment or improve management level in years with low pure technical efficiency, and adjust in combination with projection analysis by referring to years with high efficiency.

Finally, scale efficiency refers to the production efficiency affected by the scale factor of an enterprise. The greater the scale efficiency is, the more reasonable the scale is, whereas the scale is not reasonable (Zhang, 2016). As can be seen from the table, the scale efficiency of China Evergrande Group from 2012 to 2020 is effective for only three years, namely 2014, 2017 and 2019, accounting for 33% of the total sample size. In 2013, 2014, 2017 and 2019, it was in the range [0.9,1]; in 2012 and 2018, it was in the range [0.8,0.9], and in other years, it was lower than 0.8. It can be seen from the above results that among these invalid decision-making units, 2013 and 2018 are in diminishing returns to scale with low management efficiency, and the percentage of input increase is greater than the percentage of output increase. If input continues to increase, resource waste and comprehensive technical efficiency may be reduced. The remaining years show increasing returns to scale, indicating that China Evergrande Group should increase investment and further expand its industrial scale in these years. 2015 and 2016 have high pure technical efficiency and low efficiency of scale, and the focus of improvement lies in how to better play its economies of scale in order to improve comprehensive efficiency.

4.3. Evaluation of Horizontal Financial Management Ability based on DEA

At the completion of the longitudinal financial performance evaluation of China Evergrande group analysis, 2020 Hong Kong listed companies in China Evergrande group of 15 companies in the financial data of real estate industry are collected, together with the China Evergrande group as the research object to

analyzing China Evergrande group in 2020 in response to the industry's financial performance. The results are shown in Table 19.

Table 19. Horizontal financial performance evaluation.

DMU	crste	vrste	scale	Returns to scale	crste rank
China Evergrande Group	1	1	1	-	1
Shimao Group Holding Co. LTD	1	1	1	-	1
China Tianbao Group Development Co. LTD	1	1	1	-	1
China Vanke Co., Ltd.	1	1	1	-	1
Poly Real Estate Group Co. LTD	1	1	1	-	1
Yuzhou Group Holding Co. LTD	1	1	1	-	1
Country Garden Holdings LTD	1	1	1	-	1
Zhongjun Group Holding Co. LTD	1	1	1	-	1
Zhengshang Industrial Co., LTD	1	1	1	-	1
Longshi Green Real estate Co., LTD	1	1	1	-	1
Rongxin China Holdings Co. LTD	0.995	1	0.995	irs	11
Hongyang Real Estate Group Co. LTD	0.973	1	0.973	irs	12
Greentown China Holdings Co. LTD	0.958	0.993	0.964	irs	13
Dafa Real Estate Group Co. LTD	0.935	0.994	0.941	irs	14
C&d International Investment Group	0.893	0.967	0.924	irs	15

Data Sources: Homemade data.

5. Conclusion

5.1. Problems of China Evergrande Group

Through comprehensive analysis and evaluation of various indicators in China Evergrande Group Real Estate's financial statements, the following conclusions can be drawn:

Lack of profitability. From core and Evergrande sales net profit margin and net operating assets operating margins metrics, such as China Evergrande group profit ability and the quality is not ideal, and the rest of the industry compared to the first step of real estate enterprises has much difference. China Evergrande group has been paying attention to the high growth of income and cost control. However, in recent years, the control of sales expenses and financial expenses has been lax, leading to profit data not as encouraging as income. Therefore, China Evergrande Group Real Estate not only pursues high growth of operating income, but also needs to constantly control costs and expenses to achieve benefit growth rather than simple scale growth.

Solvency needs to be improved. In terms of liquidity ratio, quick ratio and cash ratio as well as asset-liability ratio as indicators of short-term solvency of China Evergrande Group. The short-term solvency of China Evergrande Group, as a capital-intensive real estate industry, needs to be improved, especially the amount of cash and currency reserves. China Evergrande Group needs to realize more cash inflows from continuous operations rather than obtaining large financial liabilities through large-scale external financing. Otherwise, it will lead to the coexistence of high operating risks and high financial risks, which is not conducive to the steady development of the enterprise.

5.2. Make Suggestions on Improving Financial Management Capabilities

For existing problems. In order to improve the financial management of real estate enterprises, the following measures should be taken:

Operational efficiency needs to be improved. The construction and operation cycle of real estate enterprises is special, and it basically takes 3-5 years from land acquisition to development, construction and operation. For China Evergrande Group, compared with other real estate enterprises, the operating efficiency also need to revitalize the capital in order to speed up the development of project and the construction to speed up the debt collection and management of cash flow into, to get real cash flow. For the capital turnover and use, it can really give full play to the enterprise the competitive ability.

Take a steady road of operation. In the development of diversification, it is necessary for China Evergrande Group to consolidate the real estate as the leading business. Only a firm foundation can ensure the stability and speed of upward development. The supply and demand of the real estate market is very large, but

as a big country with 1.4 billion people, the housing demand of Chinese people is still very large, and the demand for real estate will not decrease significantly in the next few years. In recent five years, the sales scale of China Evergrande Group has grown rapidly. However, the quality of realized gross profit and core profit is not high, so that the speed of land consumption is greater than the speed of replenishment by increasing the amount of development of existing projects or buying less land or directly cashing out land. Increasing cash through land realization can improve profit quality and debt level. In the process of development, the acquisition of high-quality large projects and land has been unswervingly carried out the "cash is king" strategy to maintain adequate operating cash flow. It is always adhering to the principle of "stability first, development second". For the new development of the field and industry, all decisions are based on stability to gradually realize the diversification of real estate to tourism, culture, service development.

Speed up turnover. China Evergrande Group has always upheld the concept of people's livelihood real estate, insisted on benefiting the people, positioned at the rigid needs, and created high-quality links. Standardization of quality products is the way to create pipeline-type all links of standardized quality products and to shorten the development cycle. The development cost of real estate development is getting higher and higher and "fast" has become a magic weapon for real estate to seize market share and improve profit margin. Real estate competition is fierce, and only by speeding up can we win "fast". Due to the relationship between all parties involved in real estate development projects, each additional month will lead to the corresponding increase in capital cost and related period expenses, and the return on investment of the project will be reduced. Therefore, in the face of the current fierce real estate market environment, accelerating turnover and improving asset turnover efficiency will be the most effective method for real estate to increase profits. In order to realize the mode of high turnover, it is necessary to speed up the construction and opening sales quickly and realize the recovery of operating cash flow quickly based on quality control in the whole stage from project land acquisition to construction and development to construction and final project sale.

Control costs and expenses. As the main business of China Evergrande Group, real estate needs to achieve a substantial increase in core profit. In order to achieve the target of core profit, it is very essential to strengthen the management of costs. First, the quality of each link standardization. Real estate development and construction covers all aspects of the project, planning and design, bidding, material supply, engineering construction and quality, as well as the completion of the building and other links. Each link is very important and each link can seek benefits. It is critical to establish a more unified and standardized business model to reduce the cost and expenses caused by non-standardization. Second, three expenses must be reduced: selling expenses, administrative expenses, and financial expenses. China Evergrande Group has high sales expenses, administrative expenses, and financial expenses, mainly due to the continuous high growth of Evergrande's performance in recent years, the substantial growth of sales, and the substantial increase of corresponding advertising, event planning and other marketing expenses. China Evergrande Group should continue to reduce the cost of sales and promotion and adopt its own media platform for promotion. As far as administrative expenses are concerned, it is mainly the salary of employees. Scientific and reasonable incentive mechanism and restraint mechanism should be implemented in this respect. Evergrande Real Estate Group has incurred a large amount of financing costs due to a large amount of external financing. The primary task is to reduce financing costs. If the interest rate is reduced by one point, billions of financing costs can be saved. There are mainly the following methods: First, enterprises should pay the perpetual debt that produces a lot of financial expenses even if they repay it to avoid the high interest expense of "2+N". The second is to increase deposit interest. China Evergrande Group always adopts the strategy of "cash being king". It can deposit temporarily idle funds in demand deposit, which can effectively increase profits. Third, use the brand effect. The implementation of strategic cooperation can be used to acquire low-cost land. Land resources as a limited resource, will be increasingly scarce. Good projects and land often need to bid and can be acquired only with high price, resulting in a substantial increase in land costs. Jointly developing projects with strategic partners will greatly reduce costs. Reducing operating costs can be realized through developing industry-leading SAP and ERP systems as well as using information technology.

To sum up, if real estate enterprises in today's competitive real estate market need to achieve long-term development, strengthening the financial management and supervision, improving the level of financial management, establishing perfect financial management mechanism, and preventing and controlling the risks are essential for business operators as the macroscopic control tool. Only by strengthening financial management can we reduce the cost and improve the economic benefits of enterprises.

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