Performance Evaluation of Internet Monetary Fund Based on Super-efficient DEA

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Abstract

Since 2013, China's Internet money fund market has entered a new era. On June 17, 2013, Yu'e Bao, jointly launched by Alipay and Tianhong Fund Company, was the first to go public. In just a few short years, the Internet money fund market has developed in full swing, and Tencent, Baidu, and JD have also participated in the development of related change wealth management businesses. This article uses super-efficiency DEA to evaluate fund performance. Through the validity test of 16 sample fund products in 2019, 7 sample funds are valid according to the DEA; and 16 sample fund products in 2020 are tested for validity, 9 sample funds are valid according to the DEA. The research found that most of the Internet financial products have not yet reached their effectiveness, which is mainly reflected in the fund's custody and management fees. There is still a lot of room for development in China's Internet fund market.

Keywords: Internet money fund; Fund performance; Super-efficient DEA; Sharpe ratio.

1. Introduction

In 2010, Internet payment entered a new era. Third-party payments such as WeChat Pay and Alipay Pay have also received legal protection and social recognition. Internet fund products have also emerged with third-party payments. Fund sales have broken the traditional sales model and presented a diversified development pattern. Users can Online investment and financial management is faster than offline procedures; at the same time, there is a certain amount of financial management income, which is even more popular with investors. However, there is no risk-free asset. It is irrational to blindly pursue returns. Taking Yu'ebao as an example, the 7th annualized rate of return dropped from 6% in 2013 to 2.5% in 2017, and the return fluctuated. It is still very huge. Researching and analyzing the performance of Internet money funds can help investors to better choose the money funds suitable for their spare money management after simply identifying risks, so as to maximize the use of spare money funds for investors.

Sun Ning (2019), studied the rapid development of Internet currency funds represented by Yu'ebao, and compared the development of traditional banking, and put forward the difference and connection between the two. Chen K. and Zhang (2017), triggered thoughts on whether Internet monetary funds match their high-risk and low-return nature, and analyzed their risk spillover mechanism. Zhao (2016), believes that in the era of rapid development of the fund industry, how to make investors invest more effectively is very necessary, so he analyzed the operating performance of the fund. Yu (2016), promoted the production of related Internet financial products by considering the rapid development of Internet finance, and analyzed the innovation mechanism and characteristics of Yu'e Bao. (Zhuang et al., 2015) believe that the continuous innovation of interconnected financial products has had an impact on the volatility of the bond market. Huang et al. (2015), studied the nature of Internet money market funds with the emergence of completely different from traditional money markets. Yan (2014), found that the Internet currency fund also brought some hidden dangers when it showed a situation of rapid development, so he carried out related explorations on its development prospects. Chen H. Y. et al. (2021), explored the connection between funds and global information and analyzed the related manifestations of funds. Chongren et al. (2019),

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analyzed and studied the problems between customer churn predictions in the Internet fund industry. Jessica (2019), evaluated the performance of open-end funds. Tarashev *et al.* (2010), attributed systemic risks to the research economy of individual institutions.

Based on this, we understand that Internet money funds are the products of the times that have been developed with the development of Internet finance. They came into being based on the development of big data and information technology. How to let investors choose effective Internet money funds for investment is the focus of this article .This article selects the Internet financial products of China's public offering funds through the Tiantian Fund Network database, and finally selects 16 Internet financial products, and uses super-efficient DEA to analyze the data of 16 funds during the period from 2019.1.1 to 2020.12.31. Finally, draw conclusions and give investors corresponding suggestions.

2. Research Methods
2.1. Sample Selection and Data Sources

The time period studied in this article is from January 1, 2019 to December 31, 2020.As of the beginning of 2021,there are about 300 Internet financial products in China's public offering funds .Exclude short-term financial products and monetary funds with an establishment period of less than 5 years ,and then select them based on the scale、 proportion of retail accounts、 and type A funds .According to the standard, 16 Internet fund products were finally selected, namely Tianhong Yu'ebao、 E Fund Everyday A、 Minsheng Plus Bank Cash Bank A、 Huitian Fu and Jubao、 E Fund Easy Wealth Management、 Harvest Salary、 GF Money Bag A、 Wealthy Rich and Strong. There are 16 funds including Bao、 Huitianfu Yu'ebao、 ICBC Credit Suisse Salary A、 Southern Salary、 GF Tiantianhong A、 Mid-term Cash Po、 Bank of China Salary Money、 Huitianfu Cash Po A and Huaan Hui Caitong .The above screening process is all Completed through Tiantian Fund.com.

Table-2.1. Code of each fund

Number	Fund abbreviation	Fund code
1	E Fund Everyday A	000009
2	Celestial Yu'e Bao	000198
3	Huitianfu cash treasure	000330
4	E Fund Easy Finance	000359
5	Minsheng plus silver cash treasure	000371
6	GF Everyday Red A	000389
7	Huitianfu Yu'ebao	000397
8	GF Money Bag A	000509
9	ICBC Credit Suisse Salary A	000528
10	Mid-term current treasure	000539
11	Huitian Fu and Jubao	000600
12	Harvest Salary	000618
13	Rich country rich money treasure	000638
14	Southern Salary	000687
15	Bank of China Salary	000699
16	Huaan Hui Caitong	000709

2.2. Selection of Production Indicators

When using the DEA model, the selection of different input and output indicators may have a corresponding im pact on the evaluation results of the effectiveness of the selected samples. This article combines the previous use of t he DEA model to evaluate the performance of the fund. Therefore, the following 5 indicators were selected for relev ant analysis:

1. Input indicator: standard deviation of the rate of return, which measures the relative degree of deviation of the daily rate of return of the fund from its average rate of return; sales service fee, which refers to a certain percentage of the service fee drawn by the fund manager from investors according to the agreement of the fund contract. It is used to pay the daily expenses of the sales organization; the custody fee refers to the fee charged by the fund custodian for investors to keep the corresponding capital property; the manager's remuneration is the remuneration drawn from the fund assets to the fund manager.

2. Output indicators: total income refers to the value created by workers in the material production sector in a certain period of time; net profit refers to the total profit of the enterprise minus the relevant income tax, which is the after-tax profit of the enterprise; The net value of fund assets at the end of the period refers to the value of the total assets of the fund at the end of the period minus its liabilities.

Table-2.2. Input and output indicators of super-efficiency DEA

Indicator type	Indicator	variable
Invest in	Administrator remuneration(100 million yuan)	x1
	Custody fee(100 million yuan)	x2
	Administrator remuneration(100 million yuan)	x3
	Standard deviation of return	x4
output	Total revenue(100 million yuan)	y1
	Net profit(100 million yuan)	y2
	Net asset value at the end of the period(100 million yuan)	y3

2.3. Super Efficiency DEA

Data envelopment analysis is generally divided into two basic models: the C^2R model and the BC^2 model. The C^2R model is also called the constant return to scale model, which was proposed by A.Charnes, E.Rhodes and WWCooper in 1978 , To be able to evaluate the overall technical efficiency of the decision-making unit. BC^2 is also known as the variable return to scale model, which was proposed by A. Charnes and W.W. Cooper in 1985.The BCC-DEA model is decomposed into comprehensive efficiency, and further decomposed from comprehensive efficiency into pure technical efficiency and scale efficiency. The pure technical efficiency index represents the allocation and utilization efficiency of industrial development factor resources, and the scale efficiency index represents the scale agglomeration efficiency of industrial development factor resources. The BCC model is suitable for evaluating the efficiency of multiple inputs and multiple outputs, so how to improve and how much The BCC model is more suitable for related questions about improving the operating efficiency of Internet funds. The formula is as follows:

Assuming that there are n decision-making units, each decision-making unit has m inputs and s outputs, which are represented by input variables x and output variables y respectively, then the expression of the super-efficiency DEA model is :

$$\min\left[\theta - \varepsilon \; \left(\sum\nolimits_{i=1}^{m} S_i^- + \sum\nolimits_{r=1}^{s} S_r^+\right)\right] \quad (1)$$

$$s.t. \sum\nolimits_{j=1}^{n} X_{ij}\lambda_j + S_i^- = \theta X_{ij0} \quad (2)$$

$$\sum\nolimits_{j=1}^{n} Y_{rj}\lambda_j - S_r^+ = \theta Y_{rj0} \quad (3)$$

$$\sum\nolimits_{j=1}^{n} \lambda_j = 1 \quad (4)$$

$$\lambda_j, \theta, S_i^-, S_i^+ \geq 0 \quad (5)$$

In the formula, θ is the efficiency value of the decision-making unit, and the sum is the slack variable. It is the weight vector corresponding to each decision-making unit. It represents the i-th input variable of the k-th decision-making unit and represents the j-th output of the k-th decision-making unit. variable.

2.4. Sharpe Ratio

The Sharpe ratio is one of the three classic indicators that can comprehensively consider returns and risks at the same time. There is a conventional feature in investment, that is, the higher the expected return of the investment target, the higher the volatility risk that investors can tolerate; conversely, the lower the expected return, the lower the volatility risk.

3. Empirical Result Analysis
3.1. Index Sharpe

Table-3.1. Sharpe Index ranking

Fund code	2019		2020	
	shape	Sort	shape	sort
000009	5.31	11	6.17	16
000198	4.26	16	5.44	13
000330	5.68	8	6.40	14
000359	5.53	10	6.63	10
000371	4.62	14	7.52	2
000389	4.91	13	7.33	3
000397	5.75	5	6.71	9
000509	5.72	6	6.48	12
000528	5.63	9	7.01	5
000539	6.10	3	6.98	6
000600	6.34	1	7.86	1

000618	6.17	2	7.05	4
000638	5.70	7	6.80	8
000687	5.94	4	6.84	7
000699	4.50	15	6.60	11
000709	5.14	12	6.34	15

Judging from the values and rankings in the table, the top four funds using the Sharpe index in 2019 are Huitianfu and Jubao, Harvest Salary, Mid-term Demand and Southern Salary. The bottom three are Tianhong Yu'ebao. Bank of China Salary and Minsheng Plus Silver Cash; the top four funds using the Sharpe Index in 2020 are Huitian Fu and Jubao, Bank of China Salary, GF Tiantianhong and Harvest Salary. The bottom three are Yifangda Tiantian A , Huaan Huicaitong, Huitianfu and Jubao. The Sharpe index considers the total risk. Under the same return , the smaller the risk, the better. In this case, the Sharpe ratio is also higher. The larger the Sharpe ratio, the higher the risk return of the fund's unit risk. The sharp changes in the ranking of the Sharp Index in 2019 and 2020 may be related to the market risk of the year and the way the fund manager's portfolio is invested.

3.2. Super Efficiency DEA

Table-3.2. Evaluation Table of Fund Efficiency in 2019

DMU	Comprehensive efficiency value	Technical efficiency value	Scale efficiency Rate value	Return to scale	Return to scale	Super efficiency DEA value	Efficiency ranking
000009	0.8890	1.0000	0.5237	0.3625	Increase	0.5236	7
000198	1.0000	1.0000	0.0395	0.0395	Increase	0.0028	13
000330	1.0000	0.6581	0.9641	0.8630	Increase	0.0049	12
000359	0.9985	1.0000	1.0000	1.0000	constant	0.0175	10
000371	0.8367	0.9927	0.9665	1.1063	Increase	0.2293	9
000389	0.7249	1.0000	1.0000	1.0000	constant	0.7246	5
000397	0.8169	1.0000	1.0000	1.0000	constant	0.6543	6
000509	1.0000	1.0000	1.0000	1.0000	constant	0.0010	15
000528	0.7865	1.0000	1.0000	1.0000	constant	1.7865	1
000539	0.6671	0.9167	0.7277	0.6869	Increase	0.0100	11
000600	1.0000	1.0000	1.0000	1.0000	constant	1.7284	2
000681	0.7363	1.0000	1.0000	1.0000	constant	0.8278	4
000638	0.8563	1.0000	1.0000	1.0000	constant	0.0011	14
000687	1.0000	0.9698	0.9194	0.9004	Increase	0.3466	8
000699	1.0000	1.0000	1.0000	1.0000	constant	0.0001	16
000709	1.0000	1.0000	1.0000	1.0000	constant	1.0900	3

Table-3.3. Evaluation Table of Fund Efficiency in 2020

DMU	Comprehensive efficiency value	Technical efficiency value	Scale efficiency Rate value	Return to scale	Return to scale	Super efficiency DEA value	Efficiency ranking
000009	1.0000	1.0000	1.0000	1.0000	constant	1.3133	3
000198	1.0000	1.0000	0.0461	0.0377	Increase	0.0009	16
000330	1.0000	0.9689	0.9856	0.5198	Increase	0.0033	14
000359	0.7362	1.0000	1.0000	1.0000	constant	0.2117	10
000371	1.0000	0.9600	0.8587	0.8243	Increase	1.3942	2
000389	1.0000	1.0000	1.0000	1.0000	constant	1.2853	4
000397	0.9558	1.0000	1.0000	1.0000	constant	0.4520	8
000509	1.0000	1.0000	1.0000	1.0000	constant	1.0329	5
000528	0.6137	1.0000	1.0000	1.0000	constant	0.9564	6
000539	0.6615	0.9994	0.7369	0.7103	Increase	0.0048	12
000600	1.0000	1.0000	1.0000	1.0000	constant	1.4310	1
000681	1.0000	1.0000	0.6611	0.6010	Increase	0.4012	9
000638	0.8973	1.0000	0.9973	0.8358	Increase	0.0014	15
000687	0.6845	1.0000	0.5753	0.2534	Increase	0.0035	13
000699	0.7183	1.0000	1.0000	1.0000	constant	0.0082	11
000709	1.0000	1.0000	0.9763	0.3876	Increase	0.5838	7

From the results in Table 3-2, it can be seen that among the 16 sample funds, there are 7 funds with an efficiency value equal to 1. Rich Cash Treasure A and GF Money Bag A, that is, these 9 funds are DEA effective compared to the other 16 funds. Secondly, 0.80≤efficiency value≤1 indicates relatively high operating efficiency; 0.6≤efficiency value<0.80 indicates average relative operating efficiency. It can be concluded that the operating efficiency of Fortune Rich Treasure、Yifangda Tiantian A and Yifangda Easy Finance are relatively high.

Indicating that the company has a strong ability to create profits, and that this type of Internet-based networking funds has relatively strong ability to create value; and Minsheng Plus Bank Cash Po A、 Huitian Fu Yu'e Bao、 ICBC Credit Suisse Salary、 Harvest Salary and GF Tian Tianhong A, the operating efficiency of these funds is relatively average, indicating that the ability of such Internet funds to create value is relatively poor, and investors need to carefully consider when investing and financial management.

It can be seen from the results in Table 3-3 that among the 16 sample funds, there are 9 funds with an efficiency value equal to 1. Tianhong Yu'e Bao、 Harvest Salary、 China Huitianfu Cash Bao A and GF Money Bag A, that is, these 9 funds are DEA effective compared to the other 16 funds. Secondly, 0.80≤efficiency value≤1 indicates relatively high operating efficiency; 0.6≤efficiency value<0.80 indicates average relative operating efficiency. It can be concluded that the operating efficiency of Fu Guo Fu Qiang Bao and Huitian Fu Yu'e Bao is relatively high. Strong profit-making ability, this type of Internet fund has a relatively strong ability to create value; and the operating efficiency of the Bank of China Payroll、 E Fund Easy Wealth Management ICBC Credit Suisse Salary Mid-term Current Payroll and Southern Payroll Pay is relatively average, indicating this The ability of Internet-like funds to create value is relatively poor, and investors need to consider carefully when making investment and financial management. When the DEA model is used for analysis, if the efficiency value of the fund is smaller, it indicates that the fund is less effective, and the value of the output relative to the input is smaller. This type of fund even costs higher fees and suffers higher risks. Its investment returns will be even lower. Overall, 43.75% of the sample funds have not reached DEA effectiveness, indicating that there are still many funds in my country currency fund market that need to be improved.

3.3. Slack Variable Value of Each Indicator

Table-3.4. 2019 slack variable value of each indicator

Fund code	X1	X2	X3	X4	Y1	Y2	Y3
000009	1.414	0.453	0.370	0.000	8.246	6.468	0.000
000198	26.734	7.521	21.975	0.000	0.000	0.000	2.015
000330	0.562	0.012	0.653	0.000	12.223	10.030	0.000
000359	0.723	0.136	0.921	0.000	2.285	1.960	0.000
000371	0.139	0.062	0.466	0.000	11.444	0.050	0.000
000389	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000397	0.366	0.072	0.439	0.000	0.000	4.991	0.000
000509	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000528	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000539	0.791	0.169	0.909	0.000	7.463	5.678	0.000
000600	0.360	0.110	0.270	0.000	0.880	0.410	0.040
000618	0.065	0.016	0.046	0.000	2.085	1.722	0.123
000638	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000687	0.008	0.000	0.004	0.000	2.116	1.578	0.120
000699	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000709	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table-3.5. 2020 slack variable value of each indicator

Fund code	X1	X2	X3	X4	Y1	Y2	Y3
000009	0.378	0.213	0.115	0.000	6.961	0.000	0.003
000198	32.344	8.938	26.707	0.000	0.000	0.004	1.635
000330	0.134	0.030	0.146	0.000	0.000	7.769	0.000
000359	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000371	0.160	0.020	0.170	0.000	1.400	1.270	0.150
000389	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000397	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000509	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000528	0.170	0.000	0.000	0.000	0.000	0.161	0.031
000539	11.955	0.053	11.225	0.000	6.551	4.979	0.000
000600	0.000	0.000	0.000	0.000	0.000	0.000	0.000
000618	0.095	0.024	0.074	0.000	2.455	2.038	0.107
000638	0.000	0.000	0.000	0.000	4.264	2.320	0.000
000687	0.014	0.000	0.012	-0.001	1.338	1.044	0.050
000699	0.053	0.000	0.067	0.000	0.000	0.285	0.000
000709	0.009	0.000	0.058	-0.001	0.286	0.218	0.000

Through further analysis on the table 3-4 and table 3-5, it can be seen that the economic meaning of the slack variable value of the input index is the input redundant value of the input index at the current output level, and the economic meaning of the slack variable value of the output index is at the current input level, The missing quantity of output elements, that is, the quantity of output that needs to be increased if the sample fund reaches DEA

effectively. From the value of the slack variable, the slack variables of the custody fee and return standard deviation of most Internet money funds are 0, while the slack variables of the two input indicators of manager compensation and sales service fee are almost all greater than 0, which shows that there is still a lot of room for the reduction of the fund's remuneration and sales service fees. Let's take China Huitian Cash Bank A as an example.In the input indicators for 2019, the management fees, sales service fees and income of the slack variables of the standard deviation are 0.562、0.012、0.653、 and 0,respectively.This shows that China Huitianfu Cashbao A, compared with other relatively effective money funds, should reasonably reduce costs in the process of fund operation and effectively increase the fund's net asset value and profit.In the input indicators for 2020, the slack variables of the management fee, sales service fee and income standard deviation of Huitianfu Cashbao A are 0.134、0.03、0.146, and 0, respectively.This shows that compared with 2019, the cost of the fund has been significantly reduced, and the net profit and the net asset value of the fund have been improved accordingly.

In summary, significant changes have taken place in the DEA rankings of Internet funds in 2019 and 2020, especially the changes in the top ones, indicating the effectiveness of the fund and the fund's service fees, custody fees, the risk level of the fund, and the rate of return. Relevant, grasping the balanced relationship between these types of indicators is the key to effective investment by Internet funds.

4. Conclusions and Recommendations

4.1. Conclusion

Based on the previous empirical analysis, the DEA model is used to test the effectiveness of 16 Internet fund products. It is concluded that in 2019, 7 financial products are effective, and 9 financial products are effective in 2020. This shows that still some fund products in the fund market that have not been relatively effective in my country. Therefore, the fund sales and management fees of the fund market in my country still need to be improved in order for investors to conduct investment and financial management more effectively.

4.2. Suggestion

For investors, they should not blindly use the pursuit of high returns as the only criterion. They should analyze the related risks to a certain degree, and conduct a comprehensive analysis of fund products from different financial indicators. The risks and returns are matched. At the same time, investors should enrich relevant financial knowledge in order to better invest in scattered funds. Combined with the previous DEA results, the findings indicate that the cost of fund management companies, such as fund custody fees、 sales service fees、 and other input indicators, need to be further improved, seeking lower costs to achieve higher performance.

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