

Research on the Path of Regional Financial Resources Allocation Considering Fairness and Efficiency

Based on the Data of 31 Provinces of China*

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Abstract—This paper firstly constructs an analysis framework for the allocation of regional financial resources with fairness and efficiency. Firstly, the extended Markov chain model is used to compare the “Matthew effect” of regional financial resource allocation fairness and efficiency. Subsequently, based on the two-dimensional matrix diagram, the regional financial resource allocation path that takes into account fairness and efficiency was designed, and the 31 provinces in China were taken as an example to be analyzed in 2003–2016. The results show that the fairness and efficiency of regional financial resources allocation in China are obviously incompatible. The former's Matthew effect is far greater than the latter. This conclusion is robust both in indicators and in methods. Therefore, this paper believes that the government should focus on supporting high-efficiency but low-fairness areas, which can alleviate the Matthew effect of financial resources fairness, and achieve the dynamic coordination of regional financial resources fairness and efficiency.

Keywords—*financial resources; fairness; efficiency; Matthew effect; coordinated allocation*

I. INTRODUCTION

Financial, as the "core institution of resource allocation" in modern market economy, financial resource allocation is the key to economic resource allocation [1]. The report of the 19th National Congress of the Communist Party of China pointed out that “Socialism with Chinese Characteristics has entered a new era, and the main contradictions in our society have been transformed into the contradictions between people's growing needs for a better life and the unbalanced and inadequate development.” The coordinated development of the region is of great significance for building a moderately prosperous society in all respects and for winning

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the great victory of socialism with Chinese characteristics in the new era. The fair allocation of financial resources is an important guarantee for the coordinated development of regional economy. However, the profit-seeking nature of financial markets makes some regions unable to obtain financial resources due to lack of profit or small profits [2], which will inevitably affect local economic development and even fall into the vicious circles, increase the regional development difference continuously, which is disaccord with the national regional coordinated development policy. Simultaneously, the issue of financial resource allocation efficiency is also very crucial. The overall economic efficiency is largely determined by the level of financial efficiency [1]. Therefore, it is extremely critical and urgent to maintain the coordination of regional financial resources allocation and fairness in China, so as to better promote regional economic development. The report of the 18th National Congress clearly stated: "A modern financial system that can effectively allocate financial resources plays a vital role in supporting the long-term growth of the entity economy." So how should China implement the coordinated allocation of regional financial resources that balances fairness and efficiency? This has critical and practical significance for promoting regional economy and maintaining coordinated and efficient development.

II. LITERATURE REVIEW

With the development of financial function theory, people began to realize that finance not only has the economic function of promoting economic growth, but the fair allocation of financial resources can also promote the fair allocation of social resources, and then maintaining social equity, promoting social development, and achieving regional coordination etc. On the one hand, the fair allocation of financial resources enables the subjects with their own qualifications to have the opportunity to use the financial market to reach development and share

development results. On the other hand, the fair allocation of financial resources can use the rational operation of financial market mechanisms to reduce the negative externalities of market activities, and through positive incentives, market activities are conducive to the overall welfare of society [3]. Financial ethics scholars have a more in-depth study of financial fairness all along. Shefrin and Statman [4] believe that financial fairness is the guarantee of financial market effectiveness, and Shan Yuhua [5] believes that fairness criterion is the basic criterion of financial ethics. Under the influence of ethics of finance, financial institutions can restrain their behavior to a certain extent, so that vulnerable groups and regions can obtain development opportunities, thus promoting the fair allocation of financial resources [3]. Whereas, the profit-seeking nature of financial institutions will lead to the dissatisfactions with financial needs of poor groups, backward areas, and vulnerable industries. The scholars believe that the state should be in the perspective of maintaining social equity, and it is extremely necessary to allocate financial resources, by providing certain compensation and relief to individuals and regions that are disadvantaged in the process of attaining financial resources to ensure fair results¹ [2]. In addition, as the problems of China's binary financial structure have been emerging constantly, the fairness of financial resource allocation has also been considered and studied by financial law theory researchers. Feng Guo and Yuan Kang [6] have been advocating and appealing the concept of financial fairness, to reconciling the problem of seeking long-term balance between financial security and financial efficiency in traditional financial law. He holds that finance is not a purely rich game, and accessing to financial resources is a development right that everyone should enjoy. Tian Chunlei [2] also concurs with the value of financial law should be positioned as the unity of financial security, financial efficiency and financial fairness.

Research on the efficiency of financial resource allocation is significantly more research than financial equity, and it is mainly based on the economic function of financial resources. For example, a large number of scholars have explored the relationship between financial efficiency and economic growth [7]. Such scholars hope to understand the role of finance in economic growth by opening the black box of the transition between financial efficiency and economic growth, and thus propose suggestions for improvement. Mario [8] believes that the financial efficiency can promote the financial stability. Levine [9] believes that the function of the financial system is to gather savings, allocate resources, and coordinate goods and services. Financial efficiency can effectively promote capital accumulation and technological innovation, and thus effectively promote economic growth. Xu Xiaowen [10] found that the improvement of financial efficiency has the positive effect of promoting economic growth through the test of the relationship between China's financial efficiency and economic growth, and presents

¹ For the country, the fairness of financial resource allocation is reflected in the fairness of the rulemaking and the fairness of the results (Tian Chunlei, 2013). This paper focuses on the latter, that is, the fairness of financial resources allocation in this paper refers to the fairness of results.

certain regional differences. Starting from the internal connection, Zou Xinyue [11] found that total factor productivity has a significant positive correlation with financial scale financial efficiency and government financial intervention, which affects the speed of economic growth and affects economic growth mode and efficiency. Furthermore, many scholars have studied it from the perspective of regional differences in the efficiency of financial resource allocation [12], [13] and the imbalance of financial resources allocation and its efficiency loss [14], [15].

In the evaluation method of financial resource allocation efficiency, the existing researches mainly focus on two aspects, one is based on the indicator method. Levine [9] proposed to use the credit ratio of commercial banks and private enterprises, the savings-investment conversion rate, the proportion of state-owned banks' assets, etc. to evaluate the allocation efficiency of financial resources; and some scholars use comprehensive evaluation methods to assess financial efficiency by constructing index system [14]; the other method is to use the Data Envelopment Analysis (DEA) for measurement [16].

It can be seen that some scholars have made in-depth research on the fairness and efficiency of financial resources allocation, which laid a solid foundation for this paper, but it still needs further improvement: First, in the research framework, the researches in the existing literatures is more theoretically discussed, and the empirical researches are more from the perspective of allocation efficiency, but lacks empirical researches on financial resource allocation that balances fairness and efficiency. Hence, this paper, for the first time, constructs an empirical analysis framework for regional financial resource allocation that combines fairness and efficiency. Firstly, by comparing the level of Matthew effect of financial resources allocation fairness and efficiency, to examine the coordination of the two and investigate the need for priority adjustment. Furthermore, a regional financial resource allocation approach that combines fairness and efficiency is designed. Secondly, in terms of research methods, the paper uses the Markov chain model to measure the level of the Matthew effect between fairness and efficiency, and extend the 1-year duration transition probability matrix in existing studies to variable duration, so that the Matthew effect of fairness and efficiency of financial resources can be detected and compared more deeply and accurately.

III. RESEARCH DESIGN

A. Analysis Framework

In the real economy, due to the incomplete factors of the market, the regional allocation of financial resources will have financial viscosity, which will hinder the regional flow of financial resources, and thus become an important factor affecting the regional economic imbalance [17]. Therefore, in order to bring into play the social function of financial resources and realize coordinated development of the regional economy, the government must improve the coordinated allocation of regional financial resources. On the other hand, giving play to the economic function of a

country's finance and improving its financial efficiency can significantly promote its technological progress, economic productivity, economic structure, and export growth [18]. Therefore, if the financial efficiency of some regions is at a low level for a long time, the state must take the responsibility for intervention and adjustment.

Then, under the double requirements of the coordinated development of regional economy and the efficient use of financial resources, how to better allocate financial resources?

This paper starts from the perspective of long-term dynamics. In the long term, the financial resource allocation level in some regions may be at a low level for a long time, but if the region can continuously improve the allocation efficiency of financial resources under limited financial resources, and finance effectively promotes economic growth, the government should adjust the fairness of financial resources in these regions to solve the problem of non-equilibrium allocation of financial sectors. Otherwise, in the long run, the financial efficiency of some regions is inefficient for a long time, the economic function of financial resources is less effective, and there is a problem of serious

waste and insufficient support for economic growth. At this time, the government should give priority to solving the problem of regional financial resource allocation efficiency.

Therefore, the research ideas of this paper are: Firstly, analyze and compare the seriousness of the problem of "long-term low level" and the problem of "long-term inefficiency" in the process of regional financial resource allocation. If the former is more serious than the latter, the government should give priority to solving the imbalanced allocation of financial resources. On the contrary, in the economic development of the financial region, the government should solve the problem of medium- and long-term inefficiency imbalance in the allocation of regional financial resources, so as to balance the fairness and efficiency of regional financial resources allocation. And under the joint effect of government power and market power, financial resources will realize the coordination of allocation fairness and allocation efficiency, and realize the coordinated and effective development of regional economy by exerting the social and economic functions of financial resource allocation. The specific ideas are as shown in "Fig. 1":

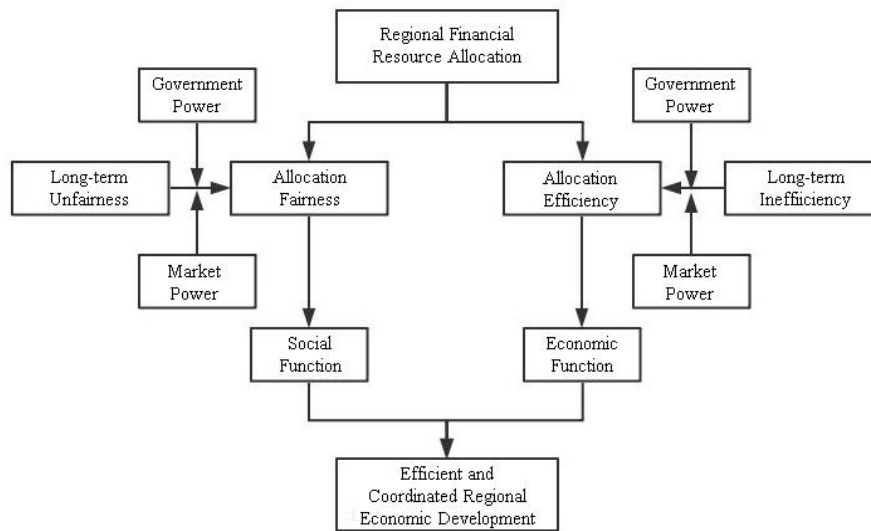


Fig. 1. The research ideas in this paper.

Under this idea, this paper will calculate the "level Matthew effect"² of regional financial resource allocation fairness and allocation efficiency based on Markov chain model, and combine it with China's carbon emission "fairness-efficiency" two-dimensional matrix diagram (as shown in "Fig. 2"). Design an allocation path to solve the one that the solidification problem of financial resource allocation in the priority area is more serious, and realize the dynamic coordination between the two.

² The Matthew effect consists of the quantitative Matthew effect in the narrow sense and the Matthew effect in the generalized level. The former refers to "the more (rich) will become the more, the less (poor) will become the less", the latter is the "high Constant high, and the low is constant low." Unless otherwise stated, the Matthew effect of this paper refers to the level Matthew effect (the latter).

Path 1: If the Matthew effect of China's regional financial resources allocation is more obvious, it indicates that there is a more serious "long-term unfairness" problem in regional financial resource allocation. At this time, the resource allocation path is as follows: It should focus on supporting areas with low fairness and high efficiency in allocation of financial resources (C area), increase the investment of financial resources in these areas, and achieve the rational allocation of financial resources by improving the fairness of financial resources allocation, then enter the D area. The significance is: First, it can mitigate the solidification problem of the current financial resources allocation fairness in China, and avoid the "long-term low-level" trap problem in some areas. Second, it can stimulate those areas where financial resources allocation is at a low level and the allocation efficiency is low, too (B area), to strengthen limited management of financial markets and improves the

efficiency of allocation, then enter the C area. Afterwards, obtain the support from the state and enter the D area, that is, implement the allocation path of B→C→D, so as to realize the dynamic coordination of the fairness and efficiency of financial resource allocation in China.

Path 2: If China's Matthew effect of regional financial resource allocation efficiency is more obvious, the resource allocation path is as follows: Focus on supporting the provinces in Area B, assisting its efficiency improvement, and improving the efficiency of its financial resources allocation, and then entering C area. Its significance is as follows: First, it can moderate the solidification problem of China's current financial resource allocation efficiency, and prevent some areas falling into the trap of "long-term inefficiency". Second, it can also achieve the dynamic coordination of the fairness and efficiency of financial resources allocation. Because the liquidity of regional financial resources in this situation is relatively high, under the influence of market power, the C area will attract more financial resources, especially the financial resources in the A area, so that it can prosperously enter the D area, achieve the allocation path of B→C→D; At the same time, A area enters the B area due to the outflow of financial resources, and then also enters the C area with the support of the state, and finally enters the D area under the market power, finally take the allocation path of A→B→C→D.

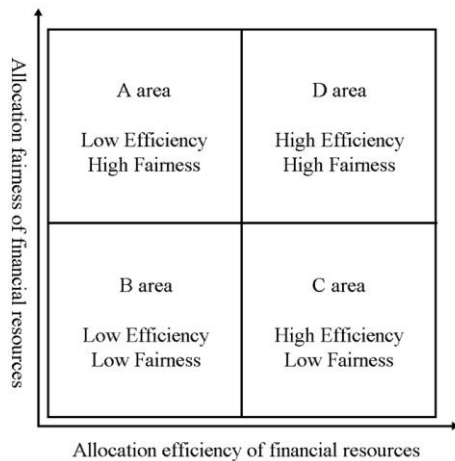


Fig. 2. Two-dimensional matrix diagram of regional financial resource allocation fairness efficiency.

B. Research Method

1) *Super-DEA Model*: Data Envelopment Analysis (DEA) was a linear programming model to evaluate the input-output performance of decision-making units which originally proposed by Chames, Cooper, and Rhode in 1978, also it can be used to evaluate the relative effectiveness between different departments. Their first model was named CCR model. Because the DEA method can evaluate the efficiency of decision-making units under multiple inputs and multiple outputs, it is widely used in different fields. However, the traditional CCR-DEA model cannot further evaluate many effective decision-making units. In 1993,

Andersen and other scholars formally proposed the super-efficient data envelopment analysis (SUPER-DEA) method. The idea of this method is: when evaluating each decision-making unit, its own input-output data does not participate in modeling, Because the process, which inefficient decision-making unit is measuring the efficiency value, relies on the effective production frontier which does not include itself, so the efficiency result is consistent with the CCR-DEA model, also the original effective decision unit has an efficiency value greater than one at this time. Considering that this study is to classify the efficiency values of all provinces to make the classification results more accurate, this paper chooses the super-efficient DEA model.

2) *Markov Chain Model*: The Markov chain is a Markov process with discrete time and state, which mainly applied in the fields of modern physics, biology and management science. Considering the economic phenomenon and the dynamic nature of regional resource allocation after government intervention, this method also provides a new perspective for the study of regional economy and regional resource allocation [19]. When measuring the Markov transition probability matrix, the first step is to discretize the continuous variables. This paper refers to Zhou Di's [20] thinking which is discretizing the regional financial scale, and discretizing the fairness and efficiency of financial resources allocation in each province into four types. The specific method is based on the average level of each province in the current year, less than 50% of which is recorded as a low level type, higher than the average value of 150% is a high level, record between 50%-100% as medium to low level and 100%-150% as a medium to high level type. In this way, the allocation of financial resources in various provinces of China is completely divided into 4 types. With time changes, the allocation of financial resources in each region will change (or transfer), and by measuring its transition probability between different types, especially the high and low levels of transition probability can test whether the regional financial resource allocation has the Matthew effect and its extent.

This paper constructs a transition probability matrix of variable duration, transition probability of m years $P_{ij}^{t,t+m} = P\{X_{t+m} = j | X_t = i\}$, indicates the transition probability of a region, which belongs to type i in the year of t, transfers to type j after m years, that is:

$$P_{ij}^{t,t+m} = \frac{\sum_{t=2003}^{2016-m} n_{ij}^{t,t+m}}{\sum_{2003}^{2016-m} n_i^t}$$

Among them, n_i^t indicates the number of regions where belongs to type i in t year, $n_{ij}^{t,t+m}$ indicates the number of regions, which belongs to type i in the t year, and transfer to type j in t+m year throughout the inspection period.

Obviously, for specific i and m , $\sum_j P_{ij}^{t,t+m} = 1$. So, the authors implement significance test for the Markov transition probability matrix at different time lengths by using the Q-statistic³:

$$Q = -2 \log \left\{ \prod_{l=1}^2 \prod_{i=1}^k \prod_{j=1}^k \left[\frac{P_{ij}^{t,t+m}}{P_{ij}^{t,t+m}(l)} \right]^{n_{ij}(l)} \right\}$$

$P_{ij}^{t,t+m}$ is the transition probability value that combines fairness and efficiency respectively. $P_{ij}^{t,t+m}(l)$ and $n_{ij}(l)$ are the estimated values of the two types of annual transition probability and the corresponding number of regions, respectively. k is a different level type, Q-statistic progressively obeys the chi-square distribution with a degree of freedom of the difference between $k \times (k-1)$ and the number of zero transition probabilities.

3) *The selection and processing of indicators and data:* The research period of this paper is from 2003 to 2016. The cross-section units of the study are 31 provinces, municipalities and autonomous regions (abbreviate as provinces) in mainland China. About the selection of financial resources allocation fairness indicators, because the financial scale stock can greatly measure the abundance of financial resources in various regions, also it can reflect the fairness condition of China's financial allocation⁴. Use the reference of the ideas of Zhu Yujie and Ni Yuran [22], the paper uses the balance of per capita loans of financial institutions in various regions (100 million yuan/10,000) to measure the fairness of financial allocation. In the selection of regional financial resource allocation efficiency indicators, for the sake of making the results robust, this paper uses two types of efficiency indicators. The efficiency index I is measured based on the data envelopment analysis (DEA) framework. In the selection of specific input-output indicators, Zhang Yumiao [23] believes that the finance input-output credit resources elements and human resources elements should be used as input indicators, also the added value in financial industry is used as an output indicator. Therefore, the paper selects the input factors including human and material resources, corresponding to the fixed assets investment of the finance (100 million yuan)⁵, and the number of employees in the finance (10,000 people), moreover, the output indicators includes the added value of the finance (100 million yuan). For accuracy of

measurement, in this paper, the data related to price factors is adjusted to the value which compares with the base period. The efficiency indicator II applies the methods of Zhu Yujie and Ni Yuran [22] and uses the deposit-loan ratio of financial institutions to measure it. These data come from the statistical yearbooks of each province from 2004 to 2017, China Statistics Information Network and China National Bureau of Statistics website.

IV. COORDINATION ANALYSIS OF REGIONAL FINANCIAL RESOURCES ALLOCATION FAIRNESS AND EFFICIENCY FROM DYNAMIC PERSPECTIVE

A. Fairness and Efficiency of Matthew Effect Investigation

The Markov transition probability matrix can measure the probability of each region transferring between different levels. By analyzing the high and low levels of transition probability to investigate whether there is a Matthew effect. Also, by comparing the Matthew effect of financial resources allocation fairness and efficiency, the coordination of the two from a dynamic perspective can be examined. "Table I" gives the results of the amount of per capita deposit and loan which can measure fairness, and the Markov transition probability matrix that measures two types of efficiencies, with durations ranging from 1-5 years.

According to the meaning of the Markov transition probability matrix, the elements of the main diagonal indicate the probability that no state transition will occur in all regions with different levels, which is our main concern value, especially in the case of high-level and low-level transitions. It can be known from "Table I" that there are certain degrees of Matthew effect in the fairness and efficiency of China's financial resources allocation, but the degrees are different. Among them, the Matthew effect is the highest when under the fairness indicator, followed by the efficiency I, and Efficiency II's Matthew effect is the weakest. It shows that the "quantity" and "quality" of financial resource allocation in different regions of China are inconsistent, and the overall financial resource allocation fairness and allocation efficiency in China are not uniform and coordinated.

Specifically, for the indicators of financial resources allocation fairness, the value of the transition probability matrix on the main diagonal is relatively large, which indicates that the distribution of regional financial resources is solidified, and the level of financial resources between regions is difficult to compete? Due to the free flow of financial resources oriented by marginal remuneration, financial resources in the central and western of China have flowed out to the eastern, also, due to the local financial resources of these provinces are not well developed locally, the central and western regions have been in a low level for a long time, and the levels between the regions are quite similar [24]. This also leads to the obvious polarization of China's financial resource allocation. The probability that a region with a low-level per capita deposit and loan amount remains at low level after one year is 0.895, while the solidification degree of high-level regions, which is still

³ For a detailed introduction to Q statistics, please refer to Gallo (2004)^[21]

⁴ For the country, the fairness of financial resource allocation is reflected in the fairness of the rulemaking and the fairness of the results (Tian Chunlei, 2013). This paper focuses on the latter, that is, the fairness of financial resources allocation in this paper refers to the fairness of results.

⁵ In the process of data collection, some regions adopt the total fixed assets investment of financial industry and insurance industry. In view of the small proportion and small error of insurance industry, it is directly used as the fixed assets investment of financial industry.

higher, is more obvious than that of low-level regions, with a probability of 0.981.

TABLE I. THE RESULTS OF MARKOV CHAIN TRANSITION PROBABILITY MATRIX

D	T	Fairness					Efficiency I					Efficiency II				
		n	L	ML	MH	H	n	L	ML	MH	H	n	L	ML	MH	H
1	L	95	0.89 5	0.10 5	0.00 0	0.00 0	91	0.69 2	0.29 7	0.01 1	0.00 0	6	0.833 7	0.16 7	0.00 0	0.00 0
	ML	21	0.00	0.99	0.00	0.00	18	0.05	0.83	0.08	0.02	19	0.005	0.87	0.11	0.00
	M	7	5	1	5	0	6	4	9	1	7	9	9	6	6	0
	H	37	0.00	0.00	1.00	0.00	66	0.01	0.16	0.65	0.16	19	0.000	0.14	0.85	0.00
	H	54	0.00	0.00	0.01	0.98	60	0.00	0.05	0.20	0.75	7	0.000	0.00	1.00	0.00
2	L	91	0.82 4	0.17 6	0.00 0	0.00 0	90	0.53 3	0.45 6	0.00 0	0.01 1	6	0.667 3	0.33 3	0.00 0	0.00 0
	ML	19	0.00	0.99	0.00	0.00	16	0.04	0.78	0.14	0.03	18	0.011	0.83	0.15	0.00
	M	7	5	0	5	0	8	2	6	3	0	3	0.011	6	3	0
	H	34	0.00	0.00	1.00	0.00	57	0.00	0.29	0.49	0.21	18	0.000	0.17	0.81	0.00
	H	50	0.00	0.00	0.04	0.96	57	0.00	0.01	0.28	0.70	2	0.000	0.00	1.00	0.00
3	L	87	0.77 0	0.23 0	0.00 0	0.00 0	89	0.38 2	0.60 7	0.01 1	0.00 0	6	0.500 0	0.50 0	0.00 0	0.00 0
	ML	17	0.00	0.99	0.00	0.00	15	0.04	0.72	0.18	0.05	16	0.018	0.77	0.20	0.00
	M	7	0	4	6	0	0	7	0	0	3	7	0.018	8	4	0
	H	31	0.00	0.00	1.00	0.00	50	0.00	0.30	0.40	0.30	16	0.000	0.22	0.76	0.00
	H	46	0.00	0.00	0.04	0.95	52	0.00	0.05	0.30	0.63	7	0.000	0.00	1.00	0.00
4	L	83	0.69 9	0.30 1	0.00 0	0.00 0	87	0.31 0	0.65 5	0.00 0	0.03 4	6	0.333 7	0.66 7	0.00 0	0.00 0
	ML	15	0.00	0.99	0.00	0.00	13	0.03	0.70	0.19	0.05	15	0.026	0.75	0.22	0.00
	M	7	0	4	6	0	6	7	6	9	9	3	0.026	2	2	0
	H	28	0.00	0.00	1.00	0.00	39	0.00	0.20	0.41	0.38	15	0.000	0.25	0.74	0.00
	H	42	0.00	0.00	0.04	0.95	48	0.00	0.10	0.37	0.52	0	0.000	0.00	1.00	0.00
5	L	78	0.62 8	0.37 2	0.00 0	0.00 0	83	0.25 3	0.71 1	0.02 4	0.01 2	5	0.200 0	0.80 0	0.00 0	0.00 0
	ML	13	0.00	0.99	0.00	0.00	12	0.04	0.66	0.23	0.06	14	0.029	0.72	0.24	0.00
	M	8	0	3	7	0	4	0	1	4	5	0	0.029	9	3	0
	H	25	0.00	0.00	1.00	0.00	27	0.00	0.11	0.48	0.40	13	0.000	0.27	0.71	0.00
	H	38	0.00	0.00	0.05	0.94	45	0.00	0.11	0.35	0.53	3	0.000	0.00	1.00	0.00

^a Note: D represents the duration; T represents the type;

^b "n" represents the number of samples used to calculate the transfer probability of the line;

^c L, ML, MH, and H refer to low level, medium low, medium high, and high level, respectively.

Considering that the allocation of regional financial resources requires time accumulations, here are investigations at the different time spans. It can be seen that the probability that low-level regions are still at low level after 2-5 years are 0.824, 0.770, 0.669 and 0.628, respectively. The probability of still being high after experiencing the same time accumulation is 0.960, 0.957, 0.952 and 0.947. It can be seen that with the accumulation of time, the Matthew effect has improved. But even within five-year period, the solidification problem of financial resources allocation in high level regions is still serious. The probability of solidification reaches 0.947; the probability in low-level areas is also close to 65%; and that in medium-high and medium-low level regions are even closer to 100% in five years! This illustrates that the problem of the solidification of regional financial resources allocation in

China is indeed serious. The Matthew effect of regional financial resources allocation really exists. So the government needs to pay attention to this phenomenon.

From the perspective of financial resource allocation efficiency, although the efficiency I also has the Matthew effect, the degree and the fairness are quite different. When duration is one year, the solidification probability of each type is below 0.9. In terms of time accumulation, low-level areas have a strong degree of solidification in the short term (1-2 years), but in the long run (3-5 years), they have dropped to 0.253. It can be found that with the accumulation of time, the degree of solidification in each regions with various level is continuously weakening, and the reduction in the low-level areas is the largest, which indicates that there is strong competition in the efficiency of financial resource

allocation in all levels of regions, also shows that all regions pay more attention to efficiency. This is consistent with the research results of Lu Yuanquan and Zhang Degang [25], who found that with the continuous development of China's finance, the financial efficiency has not only improved as a whole, but also the backward areas have improved faster in the speed of financial efficiency. The situation of efficiency II is similar to that of efficiency I. The overall Matthew effect is weaker, and it does not exist when the duration is accumulated to 5 years. The probability of solidification in low-level areas is still high at 0.833, while the probability of high-level areas, which maintain high level, is basically 0. With the increase of time span, the degree of solidification of each level shows a fluctuation downward. In particular, the low-level solidification probability decreases to 0.2 after five years. While the high-level area remains at 0, and there is no Matthew effect. Of course, this is also related to the fact that the number of provinces which are at the high and low level is less, but it also proves to some extent that the Matthew effect of the regional financial resource allocation efficiency in China is relatively weak.

B. Difference Test of Matthew Effect of Fairness and Efficiency

From the above analysis, it can be seen that the transition probability matrixes of regional financial resource allocation fairness and efficiency show a certain difference, the Matthew effect of fairness is the highest, followed by efficiency I and efficiency II. To further examine whether the difference between fairness and efficiency is statistically significant, the following test is carried out with the aid of formula.

$$Q = -2 \log \left\{ \prod_{l=1}^2 \prod_{i=1}^k \prod_{j=1}^k \left[\frac{P_{ij}^{t,t+m}}{P_{ij}^{t,t+m}(l)} \right]^{n_{ij}(l)} \right\}$$

Considering that when the two sets of data are mixed, different sequencing results in different $P_{ij}^{t,t+m}$, then get different test results. Therefore, for making the result robust, in this paper, two kinds of arrangement of the two groups of test data are tested, then obtain 4 combinations of test results at annual intervals. As shown in "Table II".

TABLE II. CHI-SQUARE SIGNIFICANCE TEST OF MATTHEW EFFECT DIFFERENCES

Duration	Type	Q value	Degree of freedom	Critical value of Chi-square statistics	P value
1	Fairness — Efficiency I	57.99	34	48.60236737	0.01
	Efficiency I — Fairness	57.91	34	48.60236737	0.01
	Fairness — Efficiency II	24.18	32	46.19425952	0.84
	Efficiency II — Fairness	27.43	32	46.19425952	0.70
2	Fairness-Efficiency I	57.06	34	48.60236737	0.01
	Efficiency I — Fairness	52.62	34	48.60236737	0.02
	Fairness — Efficiency II	40.05	32	46.19425952	0.16
	Efficiency II — Fairness	45.83	32	46.19425952	0.05
3	Fairness-Efficiency I	61.25	34	48.60236737	0.00
	Efficiency I — Fairness	60.99	34	48.60236737	0.00
	Fairness — Efficiency II	48.76	32	46.19425952	0.03
	Efficiency II — Fairness	61.42	32	46.19425952	0.00
4	Fairness-Efficiency I	67.46	34	48.60236737	0.00
	Efficiency I — Fairness	67.84	34	48.60236737	0.00
	Fairness — Efficiency II	60.54	32	46.19425952	0.00
	Efficiency II — Fairness	72.25	32	46.19425952	0.00
5	Fairness-Efficiency I	63.35	35	49.80184957	0.00
	Efficiency I — Fairness	68.84	35	49.80184957	0.00
	Fairness — Efficiency II	64.82	33	47.39988392	0.00
	Efficiency II — Fairness	78.28	32	46.19425952	0.00

It can be clearly seen from the above test results that the four types of "fairness-efficiency I", "efficiency I-fairness", "fairness-efficiency II" and "efficiency II-fairness" have passed the significance test. Therefore, it can be considered that the significance of Matthew effect of regional financial resources allocation fairness is more than the allocation efficiency. China's regional per capita deposit and loan levels

have a more serious solidification phenomenon, which also shows that when facing the market powers, the current government's does not have enough adjustments to the fair allocation of regional financial resources, so it is necessary to strengthen government power. At the same time, it also shows that there is an uncoordinated phenomenon between the fairness and efficiency allocation of regional financial

resources. The key problem in the process of financial resources allocation that balances fairness and efficiency is to ensure the fair allocation of financial resources in various regions.

V. REGIONAL FINANCIAL RESOURCE ALLOCATION PATH CONCERNING FAIRNESS AND EFFICIENCY

A. Two-dimensional Matrix Analysis

In order to give a regional financial resource allocation path that balances fairness and efficiency coordination, the paper firstly presents the financial resource allocation of 31 provinces in China between 2003 and 2016 in a two-dimensional matrix (see “Fig. 3” and “Fig. 4”). In the figure,

the value of financial resources allocation fairness and efficiency of the provinces are the average value during the investigation period, and the dotted line is the average of the provinces in the figure. Thus, all provinces are divided into four types by two dotted lines, and are marked as A, B, C, D. In order to make the divisions of the provinces more clearly, some provinces are omitted. “Fig. 3” omits Beijing, Shanghai, and Tianjin in the type D; “Fig. 4” omits Beijing and Shanghai in the type A, Tianjin in the type D, and Fujian and Guangxi in the type C. Comparing “Fig. 3” and “Fig. 4”, it can be found that the grouping results are slightly different. Therefore, the following is an in-depth analysis using “Fig. 3” as an example.

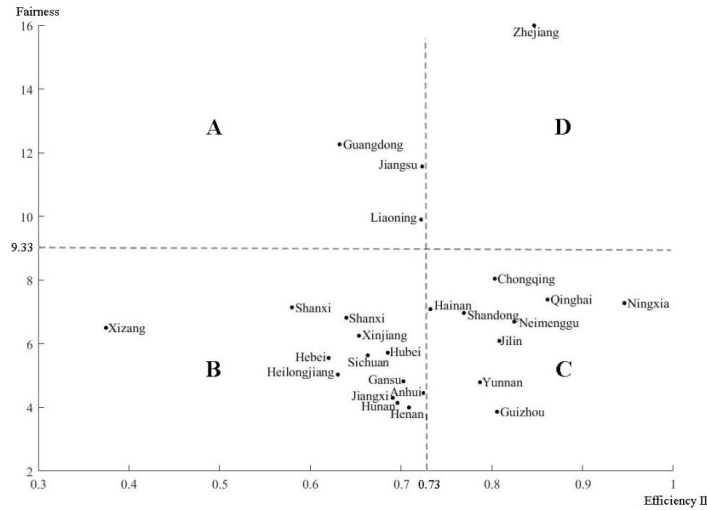


Fig. 3. "Fairness-Efficiency I" matrix diagram.

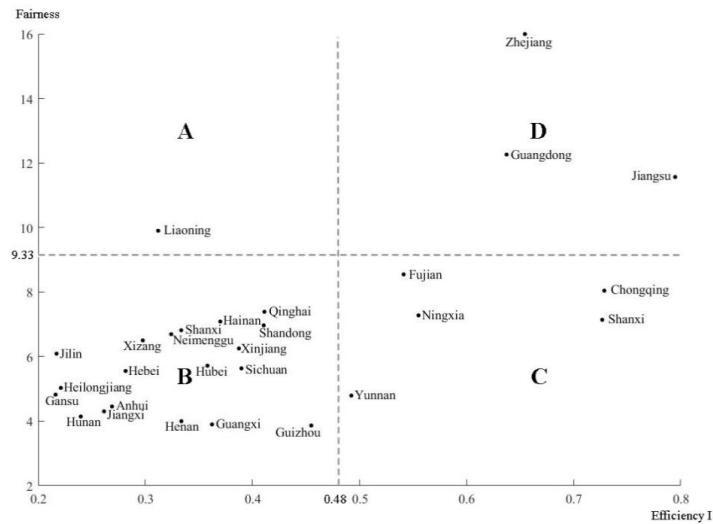


Fig. 4. "Fairness-Efficiency II" matrix diagram.

1) Type A area — high fairness and low efficiency: The area it represents is Liaoning, which belongs to the traditional heavy industry base, the capital is relatively abundant, but its own development efficiency is relatively low. So there may be problems such as redundant

investment, unreasonable use of financial resources or lack of attention to financial market regulation and other issues, leading it to a high fair and inefficient environment dilemma.

2) Type B area — low fairness and low efficiency: The representative areas are Hunan, Gansu, Jiangxi,

Heilongjiang and Anhui. Most of these areas are located in the central and western area of China, accounting for about two-thirds of the provinces in China, which indicates that the level of financial industry development in most areas of China is low. Due to the imperfect financial market system in these areas, on the one hand, financial resources circulation capacity is weak and financial resources are limited. On the other hand, it also makes it impossible for capital to be allocated to high-efficiency industries, with low return on capital and inefficient allocation of financial resources, which also makes financial resources flow out to other areas, resulting in these regions being in a dilemma of unfairness and inefficiency of financial resources allocation.

3) *Type C area — low fairness and high efficiency*: The regions represented are Chongqing, Shanxi, Fujian, and Ningxia. These areas are mainly located in the central and western regions of China. These regions tend to be underdeveloped in the financial system, and capital is often idle in an environment where the financial system is not developing. Because when the financial system of a region is extremely underdeveloped, the best place to save will be the bed bottom and the closet ^[26]. Although the level of financial resources is relatively low, financial supervision in these areas is perfect and financial resources are used efficiently. The state should attach great importance to such areas. It should increase the deflection of financial resources in such areas and expand the scale of its financial resources. From the analysis of the previous papers, this approach has important significance.

4) *Type D — high fairness and high efficiency*: The regions represented are Beijing, Tianjin, Shanghai, and Guangdong. These regions are all developed coastal economic areas in China, with financial resources flowing into the region and abundant funds. At the same time, the financial development of these regions is mature, the financial market is standardized, and financial resources can be effectively allocated. Moreover, the financial transformation efficiency of the financial sector is also high. This makes the financial efficiency in such regions a national model, and can play a leading role, becoming the benchmark for other regions.

B. Path Analysis of Coordinated Allocation of Regional Financial Resources Fairness and Efficiency

Based on the results of the fourth part of the paper and the research ideas of the third part, considering that the degree of Matthew effect of regional financial resource allocation fairness in China is significantly greater than the allocation efficiency, this paper believes that the country should adopt the allocation path 1 to achieve the balance and coordination of the fairness and efficiency of regional financial resources in China. Specifically, it is necessary to provide precise support for those areas where financial resources are allocated more efficiently, but financial resources are not fair enough (C area). And improve it from the fairness of allocation, support the construction of

financial market systems in these areas, or give more policy and financial incentives to make the financial system in this region more comprehensive and financial resources more abundant. This is of great significance to the rational allocation of regional financial resources in China. First of all, because the long-term unfairness problem in China's financial resource allocation process is more serious than the long-term inefficiency problem, some regions have achieved good results in efficiency improvement, and have played a good role in financial economic function. However, due to insufficient policies, there is no corresponding follow-up on the investment of capital, and it has long been trapped in a situation of scarcity. To this end, the strengthening of the state power can weaken this solidification phenomenon to a certain extent, weaken the Matthew effect level in the fairness allocation of financial resources, and achieve a coordinated development of fairness and efficiency. Secondly, the adoption of such targeted support policies by the state can also produce a positive demonstration role, encouraging the enthusiasm of financial market supervision in areas where resource allocation is unfair and inefficient, and motivating them to improve the efficiency of financial resource allocation. Get the central government's key and precise support to achieve dynamic coordination and balance of financial resources fairness and efficiency.

Finally, other regions should take targeted measures to adjust their own financial resources allocation according to their own circumstances. First of all, for the A areas where the fairness and efficiency imbalance are serious, a precise breakthrough should be adopted, that is, according to its strengths and weaknesses to adopt different coping methods to make it develop to D area. For A area, it has abundant financial resources, but the efficiency of resource allocation is insufficient. Therefore, it is necessary to increase financial resource management and financial market supervision in response to such situations. The government should pay attention to the efficiency of the financial industry in the region to promote economic growth, guide capital flows to industries with high return on capital, and improve the efficiency of financial resource allocation.

VI. CONCLUSION

For the first time, the paper constructs a regional financial resource allocation analysis framework that balances fairness and efficiency, and takes the data of 31 provinces in China from 2003 to 2016 as an example. Also, it applies super-efficiency (DEA) model and deposit-loan ratio index to measure the efficiency of regional financial resource allocation in China, and uses per capita deposit and loan as a measure of the fairness of regional financial resources allocation. Then, the Markov chain model is constructed to compare the degree of Matthew effect of fairness and efficiency. Finally, based on the two-dimensional matrix diagram, the path of the coordinated allocation of regional financial resources' fairness and efficiency is designed.

The research finds that: firstly, there is obvious inconsistency in the fairness and efficiency of regional financial allocation in China. The former's Matthew effect is

significantly greater than the latter. This conclusion is rational whether it is under the measurement of two types of financial efficiency indicators or the calculation of the Markov chain model which for many years, the conclusion is also robust. It shows that the "long-term unfairness" problem of regional financial resources allocation in China is more serious than the "long-term inefficiency", which is not conducive to exert the social function of financial resources, that is, to the coordinated development of regional economy. Secondly, With the help of two-dimensional matrix diagram, the financial resources allocation of provinces can be divided into four types, among which there are more provinces in the "low fairness and low efficiency" type, which indicates that there is still much room for improvement in the allocation of resources in China's financial market, and local governments should take targeted measures to improve the financial development of the region.

In order to achieve the coordinated allocation of fairness and efficiency financial resources in China, this paper believes that the state should focus on solving the problem of unfair allocation of regional financial resources in China, and strengthen support and regulation for regions with long-term low level of financial resources. In particular, priority should be given to supporting those areas where financial resources are unfairly allocated but with high allocation efficiency, to assist in the improvement of their financial markets and solve the credit demand in the economic development under the realistic conditions. This will have multiple significances: First, this can alleviate the Matthew effect in the allocation of regional financial resources in China, and achieve the coordinated development of financial allocation fairness and efficiency; Second, the precise support strategy adopted by the state can effectively encourage those provinces with unfair and inefficient financial resources allocation to strengthen management and improve allocation efficiency under limited financial resources, and thus can receive support from government. Thereby forming a set of positive incentive mechanism and competition mechanism, then promoting economic development and realizing the coordinated and efficient development of China's regional economy.

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