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RESEARCH ON FINANCING ECOLOGY AND FINANCING EFFICIENCY OF STRATEGIC EMERGING INDUSTRIES IN CHINA

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Abstract. After integrating external ecological and endogenous factors of the development of the industry, the paper builds a financing ecology index system, and analyses the financing ecology of strategic emerging industries in recent years. Then the paper further analyses the influence of external and internal financing ecology on financing efficiency. The results show that the financing ecology of the strategic emerging industries, external financing ecology in particular, is in the continuous improvement. The financing efficiency is significantly positively correlated with the macro-economy level and the internal financing ecology, and significantly negatively correlated with the role of government. There is a positive but non-significant correlation between financial development and financing efficiency, meanwhile a negative and non-significant correlation between credit environment and financing efficiency. The internal and external financing ecology can be replaced to some extent. Therefore, the strategic emerging industries should give full consideration to the synergistic optimization of the endogenous factors and external financing ecology so as to improve the financing efficiency.

Keywords: external financing ecology, internal financing ecology, financing efficiency, strategic emerging industries, entropy method, super SBM DEA.

JEL Classification: G32, L25, M13, O16, Q57.

Introduction

Since the official document "The Decision of the State Council on Accelerating Fostering and Development of Strategic Emerging Industries" issued in 2010, the strategic emerging industries have been developing continuously. At the end of 2016, the Chinese government announced the 13Th Five-Year Development Plan for Strategic Emerging Industries, which marks a new wave of development in China's strategic emerging industries. After the implementation of the plan, the strategic emerging industries have become an important force in

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macro economy at the background of China's new normal. However, due to the characteristics of high investment and uncertainty, the financing problem has become an important factor restricting the development of strategic emerging industries. Therefore, how to obtain the capital for development and use it efficiently has become the key to the healthy development of strategic emerging industries.

The enterprise's financing behavior is closely related to financing ecology. On the one hand, the enterprises are in certain external financing ecology. On the other hand, determined by the factors of enterprise itself, the internal financing ecology influences the adaptation to external financing ecology. The strategic emerging industry in China is still in the stage of cultivation and development, and the financing ecology in different regions and different industries has significant differences. Therefore, favorable external and internal financing ecology plays an important role in promoting the development and expansion of strategic emerging industries.

There are few literatures on financing efficiency in western countries because the enterprises' financing is often efficient due to mature property system and property rights' system. Most scholars focus on the efficiency of capital allocation. Wurgler (2001) believes that effectiveness of financial market has a great influence on the capital allocation. He builds a model to analyze the capital allocation efficiency of global manufacturing. Almeida and Wolfenzon (2005) construct a modified model on the basis of Wurgler, and finds that whether capital allocation is effective depends on external investor protection and external financing needs of firms. Habib (2008) analyses the influence of transparency and financial development on capital allocation, and finds that the transparency of finance has a positive and significant effect on the effective allocation of capital. Gomariz and Ballesta (2014) study financing efficiency in some Spanish companies and revealed that the improvement of debt maturity structure can raise financing efficiency.

Foreign scholars began to pay attention to the influence of external environment on enterprise financing at an early stage. Hannan and Freeman (1977) emphasize the dependence of enterprises on external financing environment. From the perspective of financial environment, some scholars reveal the level of financial development can ease the financing dilemma (Porta, Lopez-De-Silanes, Shleifer, & Vishny, 1998; Khurana, Martin, & Pereira, 2006). The political and economic environment is also an important factor influencing the financing behavior of enterprises (Bushman, Piotroski, & Smith, 2004; M. L. Rocca, Staglianò, T. L. Rocca, Cariola, & Skatova, 2018). In addition to the external environment, including economic, political and financial environment mentioned above, some scholars focus on the internal characteristics of enterprises (Fernandes, 2011; Rossi, Lombardi, Siggia, & Oliva, 2015; Coleman, Cotei, & Farhat, 2016). The firm characteristics can affect the acquisition of external sources of financing (Gartner, 2012; Rocca et al., 2018). Some scholars suggest the importance of internal controls in financing decisions (Elbannan, 2009).

Researches on financing efficiency in China outnumber those in western countries. However, present studies are mainly about the financing efficiency of small and medium-sized enterprises (Song, Li, & Xu, 2017; Yang, Zhang, & Chen, 2017; Yuan, Wang, & Zhou, 2018). With the development of strategic emerging industries, researches on financing efficiency are mainly conducted from the following aspects. First, some scholars analyze the overall

financing efficiency of strategic emerging industries (Zeng & Geng, 2018a). Second, some scholars investigate the financing efficiency in a specific industry, such as new energy automobile industry (Wang & Geng, 2016a; Li, Chen, & Xu, 2016), new energy industry (Wang & Geng, 2018), biological medicine industry (Shao & Chen, 2013) and energy conservation and environmental protection industry (Deng, Wei, & Tang, 2013; Pan, Yu, & Zhu, 2016). Third, other scholars study the financing efficiency of strategic emerging industries in different regions. For example, Wang and Geng (2016b) use six stages super SBM model to calculate the efficiency of strategic emerging industries in Jiangsu province. Li, Wang, and Yang (2014) analyze the financing efficiency of 51 listed companies of strategic emerging industries in Beijing. Wei, Li, and Cheng (2016) build an empirical model to analyze the financing efficiency of strategic emerging enterprises in Gansu province. These scholars mainly adopt DEA method, fuzzy evaluation method and grey relational degree to evaluate the financing efficiency.

As to the influence factors of financing efficiency, most scholars focus on the analysis of internal factors such as enterprise scale, financing costs, capital utilization and so on (Wang, 2015). With the introduction of "enterprise ecosystem" and "financial ecology" concepts, some scholars begin to study the relationship between external ecological environment and enterprise financing, especially the financial environment. Zhang and Chen (2005) propose that the construction of regional financial ecological environment should start from the establishment of a sound social credit system, a legal guarantee system, a sound financial supervision system, an effective financial self-discipline system, a standard intermediary service system and a strict audit and supervision system. Wei, Zeng, and Li (2014) indicates that a good financial ecological environment consisted of financial development, government governance, economic foundation and institutional culture. According to the content of financial ecology, different indexes are chosen to form the financial ecology index, and most scholars come to the conclusion that a good financial ecological environment is helpful for enterprises to obtain external financing and improve financing efficiency (Wang & Geng, 2007; Wang & Du, 2009; Xiao, 2011; Li & Kuhn, 2015; Wang & Geng, 2017; Xiong & Geng, 2017). Nevertheless, most researches carry out from only one perspective, few scholars have combined the internal and external factors to discuss the systematic influence of financing ecology on the financing efficiency.

In general, the domestic research on the financing efficiency of listed companies is abundant in literature while western scholars focus more on the efficiency of capital allocation. And with the development of strategic emerging industries, more and more scholars have started to study the financing efficiency of strategic emerging industries based on DEA method, super SBM DEA method, fuzzy evaluation method, grey relational degree and so on. Most literatures indicate that the financing efficiency of strategic emerging industries is not optimistic. Therefore, it is inevitable to analyze the factors affecting the financing efficiency and find ways to improve the financing efficiency. Some scholars explain the low efficiency from internal factors such as financing cost and enterprise nature, while others focus on the influence of external environment such as economic, financial and political environment. But in reality, the financing efficiency is both affected by external environment and internal factors. Therefore, this paper integrates external ecological and endogenous factors of the

development of the industry and builds a financing ecology index system. The financing ecology of strategic emerging industries in recent years is analyzed based on the entropy method. Meanwhile, the financing efficiency is estimated using SBM DEA method. Then a regression model is established to further analyze the influence of external and internal financing ecology on financing efficiency in order to provide effective reference to optimize the financing ecology and promote the financing efficiency of strategic emerging industries.

The remainder of this paper is organized as follows. In Section 1, we present a theoretical analysis that explains the influence of external and internal financing ecology on financing efficiency. In Section 2, we describe the index, method and samples used in the study. In Section 3, we discuss the results of empirical research. In the last Section we summarize our main findings.

1. Theoretical analysis

As the status of the enterprise's financing conditions to obtain external funds, financing ecology refers to the integration of external environment and internal characteristic factors which influence the enterprises' ability to obtain external capital. Therefore, this term can be divided into external financing ecology and internal financing ecology. The external financing ecology means the external environment status of enterprises, including macro-economic development, the role of government, financial development and credit environment. The internal financing ecology refers to the factors that affect the financing behavior within the enterprise, including the size of the enterprise, profitability, growth ability, corporate governance structure and so on.

1.1. External financing ecology and financing efficiency

Macro-economic development reflects the region's overall economic strength and development level. Good macro-economic development means that the economy of a certain region runs smoothly and has strong economic development momentum, thus the market capital supply is usually large enough, which facilitates the financing for the enterprises (Beck & Torre, 2007; Geng, Li, & Hai-Tao, 2018). The role of government plays an important role in the development of a certain industry, and the rapid development of strategic emerging industries is inseparable from the government's support. Through the formulation of planning and policy, the government guides the development of the industry and provides fiscal funds for the strategic emerging industries directly (Rodrik, 1996). However, whether the government's support is positively or negatively related to financing efficiency has not come to a conclusion. Financial development has important effect on enterprise's financing behavior. A good financial market provides diversified financing means for enterprises, and the support from banking, securities and other financial institutions improve the efficiency of financing (Wang & Geng, 2017). Credit is the basis of lending. A good credit environment can reduce the information asymmetry between the supply and demand of funds, and is helpful for enterprises to raise debt capital smoothly. At the same time it can reduce the transaction cost and improve financing efficiency. In conclusion, the external financing ecology has an

important influence on the financing efficiency of strategic emerging industries, and different external factors may have different effect on financing efficiency.

1.2. Internal financing ecology and financing efficiency

There are many factors influencing financing behavior within the enterprise, including company size, credit status, corporate governance, financing risk, profitability and development capability. The larger the company is, the easier it will be for the company to obtain funds from financial institutions such as banks, and the more assets can be used as collateral for financing, so the financing capacity is strong. At the same time, it is easy for large companies to attract high-quality talents, which is conducive to the improvement of financing efficiency (Jalilvand & Harris, 1984). Creditworthy enterprises are more likely to obtain financing and reduce financing costs, thus improve the financing efficiency. Enterprises with high profitability and development ability and low financing risk are more likely to be favored by banks and other financial institution to obtain funds. Besides, unreasonable corporate governance may lead to ownership concentration and information asymmetry between shareholders, and result in the lack of effective supervision and low efficiency. In conclusion, the internal financing ecology has a positive influence on the financing efficiency of strategic emerging industries.

1.3. Comparative analysis of the influence of external and internal financing ecology on financing efficiency

Although both external financing ecology and internal financing ecology have important effects on financing efficiency, the latter is more significant than the former. Reasons are as follows: Firstly, the external financing ecology has regional characteristics. Although the enterprise's external financing ecology is similar in the same area, the financing efficiency differs greatly. Thus it can be concluded that the financing efficiency is more affected by the internal financing ecology. Secondly, external financing ecology is relatively stable, and it takes time to be improved through the efforts. However, the internal financing ecology is mainly affected by the enterprise itself, of which the change is fast and fluctuant. Thirdly, the internal financing ecology reflects the adaptability of enterprises to external financing ecology, and the external financing ecology plays a role by influencing the internal factors of the enterprise.

2. Methodology

2.1. Index design

2.1.1. Financing ecology index system

So far, some scholars have analyzed external and internal factors influencing financing efficiency. For example, Gartner (2012) reveals firm characteristics, such as the potential sales revenue, the qualification and legitimacy of the business will affect the acquisition of external sources of financing. Others have done similar analysis (Rossi et al., 2015; Coleman et al.,

2016). Rocca et al. (2018) points out that the firm-specific and macroeconomic moderators moderate the baseline relationship between cash holdings and SME performance. Wang and Du (2009) constructs a financial ecosystem structure model, including the internal environment of producers, consumers and decomposers, and the external factors of government management, judiciary environment, financial market environment and economic environment. Xiao (2011) focuses on four factors, including the economic level, credit level, financial level and legal level of finance, and uses 16 indicators to evaluate the financial ecological environment of the 3+5 cities of Hunan province in China. Li and Kuhn (2015) analyze the financial environment of 291 cities in China from nine factors, such as judiciary environment, government management and credit basis. Xiong and Geng (2017) selects three major factors to measure financing ecological environment, which is economic development, financial development, as well as system and honesty.

Based on the theoretical analysis and the research of existing scholars, this paper integrates external ecological and endogenous factors of the development of the industry and constructs the evaluation index system of financing ecology. The related external factors include the impact of macro-economy, the government's role, financial development and credit environment. Internal factors mainly focus on the size, profitability, growth ability, corporate governance and so on. The specific indicators selected are shown in Table 1 and Table 2.

Table 1. Evaluation index system of external financing ecology

Indicators		Calculate formula
Macro-economic Development	Lever of economic development	GDP per capita
		Growth rate of GDP
	Degree of economic openness	Total value of import and export /GDP
		Growth rate of the amount of foreign capital actually utilized
	Inflation	Consumer price index
Role of Government	Fiscal self-sufficiency	General budget revenue / General budget expenditure
	Emphasis on innovation of government	Intensity of R&D investment
Financial Development	Development of bank	The balance of deposits of banks
		The balance of loans of banks
	Development of securities market	The amount raised by issuing A shares during a certain year
		Number of listed companies
	Development of insurance	Insurance premium income of all insurance institutions
		The depth of the insurance
Credit Environment	Government credit	Government transparency index
	Social credit	The non-performing loan ratio of financial institutions

Table 2. Evaluation index system of internal financing ecology

Indicators		Calculate formula
Scale of company	The natural log of total assets	LN (total assets)
Company credit	Credit rating	Information disclosure examination grade of Shenzhen stock exchange
Corporate Governance	Ownership concentration	Share proportion of the largest shareholder
	Equity restriction	The shareholding ratio of the second to fifth largest shareholder/ the largest shareholder
Financing Risk	Asset-liability ratio	Total liabilities/ Total assets
	Degree of financial leverage	Earnings before interest and taxes/(Earnings before interest and taxes – interest)
Profitability	Return on assets	Net profit/Average balance of assets
	Return on equity	Net profit/Average balance of equity
Growth Ability	Increase rate of operating revenue	(Operating revenue in the current period – Operating revenue from the previous period) / Operating revenue from the previous period
	Increase rate of total assets	(Total assets in the current period – Total assets in the previous year) / Total assets in the previous year

2.1.2. Input-output index system of financing efficiency

There are few literatures on financing efficiency in western countries, and relatively more in China. Most scholars study the financing efficiency of strategic emerging industries based on DEA method, super SBM DEA method, fuzzy evaluation method, grey relational degree, and so on. Among them, data envelopment analysis is the most popular method, so it is necessary to select input and output indexes appropriately. Table 3 shows the input and output indexes adopted by some scholars to evaluate the financing efficiency of enterprises based on DEA.

Table 3. Input and output indexes adopted by some scholars based on DEA

Literatures	Input indexes	Output indexes
Deng et al. (2013)	Operating costs; Total assets; Asset-liability ratio	Return on equity; Growth rate of main business income; Growth rate of intangible assets; Total assets turnover; Tobin's Q ratio
Li et al. (2014)	Total Asset; Asset-liability ratio; Operating costs; Proportion of outstanding shares	Return on equity; Total assets turnover; Growth rate of gross operating income; Earnings per share; Current ratio
Li et al. (2016)	Ratio of restricted stock to total equity; Ownership concentration; Asset-liability ratio; System risk	Return on equity; Growth rate of gross operating income; Growth rate of earnings per share; Price-to-book rate
Wang and Geng (2016a)	Financing cost; Financing risk; Financing time	Profitability; Operation ability; Growth ability

End of Table 3

Literatures	Input indexes	Output indexes
Wang and Geng (2016b)	Internal financing; Debt financing; Equity financing	Total operation revenue; Net profit
Wang and Geng (2017)	Ratio of outstanding shares; Asset-liability ratio; Return on total assets; Operating cost ratio	Total assets turnover; Net profit margin on sales; Return on equity
Yang et al. (2017)	Total Asset; Asset-liability ratio; Operating costs; Financial expense	Return on equity; Total assets turnover; Growth rate of gross operating income
Zeng and Geng (2018b)	Account receivable; Surplus public accumulation; Undistributed profit	Total operation revenue; Net profit

Based on the studies above, this paper chooses three indicators which reflect the source of funds as input indicators. The size of external financing reflects the ability of enterprises to obtain external funds. The main source of external financing is debt financing and equity financing, and non-current liability is the embodiment of debt financing, while paid-in capital and capital reserve measure the scale of equity financing. Internal financing, represented as retained earnings, is also an important source of funds.

On the other hand, the other three indicators which reflect the operation ability, growth ability and profitability are chosen as output indicators. The turnover of total assets is an important index to evaluate the operation quality and utilization efficiency of assets. Generally speaking, the faster the turnover of total assets is, the faster the invested capital is recovered and the higher operating efficiency the enterprise enjoys. Return on equity measures the efficiency of the capital invested by shareholders and reflects the return level of the raised funds. The growth rate of total assets is an important index to evaluate the enterprise's growth ability. Assets are the resources of enterprises to obtain income and the guarantee of debt repayment. Highly developed enterprises can generally maintain the stable growth of assets. The input and output index system is shown in Table 4.

Table 4. Input and output index system

Index categories	Name of index	Calculate formula	Notation
Input Index	Non-current liability	The balance of non – current liabilities in balance sheet	Reflect the funds provided by the liabilities
	Equity capital	Paid-in capital + Capital reserve	Reflect the funds provided by the equity
	Retained earnings	Surplus public accumulation + Undistributed profit	Reflect the sources of internal funds
Output Index	Turnover of total assets	Operating revenue / Average balance of total assets	Reflect operation ability
	Return on equity	Net profit / Average balance of equity	Reflect profitability
	Growth rate of total assets	(Total assets in the current period – Total assets in the previous year) / Total assets in the previous year	Reflect growth ability

2.2. Modeling method

2.2.1. Evaluation of financing ecology

Based on the index system in Table 1, the first step is to normalize the data. In order to compare financing ecology among different years, data standardization is conducted in the first year as base year. And then the entropy method is used to give weight and the financing ecology of an enterprise can be calculated.

2.2.2. Evaluation of financing efficiency

Data envelopment analysis (DEA) method is a method to evaluate relative effectiveness of multiple inputs and output indexes, which is often used in the evaluation of financing efficiency. This paper analyzes the financing efficiency of strategic emerging industries based on super SBM (slacks-based measure) DEA model. SBM DEA model was proposed by Kaoru Tone in 2001, and it can effectively overcome the deviation brought by radial and angle compared with traditional DEA model. But it had disadvantage that the efficiency cannot be effectively evaluated and sorted. Therefore, super SBM DEA model was proposed in 2002, which allowed the efficiency value to be greater than 1, and the effective unit could be sorted.

2.2.3. The model of the influence of financing ecology on financing efficiency

In order to further analyze the influence of external and internal financing ecology on financing efficiency, the paper takes the financing efficiency as the dependent variable, and four subentry scores of external financing ecology and internal financing ecology as the independent variables, to build Model 1 as follows. The definitions and measurement of variables in the model are shown in Table 5.

$$\text{Eff} = \propto + \beta_1 \text{Mac} + \beta_2 \text{Gov} + \beta_3 \text{Fin} + \beta_4 \text{Cre} + \beta_5 \text{IFE} + \sum \text{Year} + \varepsilon \ . \quad (1)$$

Table 5. Definition and measurement of variables

Variable Categories	Definition of variables	Variable symbol	Measurement of variables
Dependent variable	Financing Efficiency	Eff	Based on super SBM DEA model
Independent variables	Macro-economic Development	Mac (EFE1)	Based on the evaluation of financing ecology
	Role of Government	Gov (EFE2)	
	Financial Development	Fin (EFE3)	
	Credit Environment	Cre (EFE4)	
	Internal financing ecology	IFE	
Control variable	Year (2012–2016)	Year	Virtual variables are set as 1 when belongs to the year, and 0 when not, and 2012 as the base year

As analyzed in Section 1.3, since external financing ecology is the constraint for enterprise financing, and enterprises in the same area are in the same starting line, so the internal financing ecology is more important than external financing ecology. Good internal financing ecology can help the enterprises to better adapt to the external financing ecology, and to make use of favorable factors while avoiding the influence of adverse conditions (Geng et al., 2018). Therefore, it can be concluded that internal financing ecology plays a role in regulating external financing ecology, and external financing ecology influences the financing efficiency through internal factors.

In order to test the interaction between internal financing ecology and different external financing ecology on the financing efficiency of strategic emerging industries, based on Model 1, the interaction term is introduced in Model 2 as follows.

$$\text{Eff}=\alpha+\beta_1\text{Mac}+\beta_2\text{Gov}+\beta_3\text{Fin}+\beta_4\text{Cre}+\beta_5\text{IFE}+\beta_6\text{EFE}_i\times\text{IFE}+\sum\text{Year}+\varepsilon. \quad (2)$$

In the formula, EFE_i refers to four subentry scores of external financing ecology, including Mac, Gov, Fin and Cre. β_6 is a coefficient of interaction terms of external financing ecology and internal financing ecology, and it is used to test the regulation role. Considering that the existence of interaction terms in Model 2 can lead to the existence of multicollinearity, the data is centralized.

2.2.4. Sample choice and data sources

The paper takes the 200 sample companies from the Strategic Emerging Industries Index (index code 399641) issued by Shenzhen Stock Exchange in China as the research sample. Since some listed companies' 2017 annual reports are not issued in public, and 2018 statistical yearbook has not released at the time of writing this paper, the paper chooses 2012–2016 as study period. The samples in Tibet, and the samples with less than five years of listing time or with missing data are excluded. Finally, we get 188 sample companies. Table 6 shows the region distribution of the samples and we can see that the samples are distributed in 25

Table 6. Region distribution of sample companies

Regions	Guangdong	Beijing	Zhejiang	Jiangsu	Shanghai	Shandong	Anhui
Sample Number	47	43	15	12	10	6	6
Regions	Sichuan	Henan	Hubei	Hebei	Yunnan	Chongqing	Jiangxi
Sample Number	6	5	5	4	3	3	3
Regions	Liaoning	Guizhou	Hei Longjiang	Hunan	Jilin	Fujian	Tianjin
Sample Number	3	3	2	2	2	2	2
Regions	Xinjiang	Shanxi	Shaanxi	Guangxi			
Sample Number	1	1	1	1			

regions, in which Beijing and Guangzhou accounted for almost half of the sample. External financing ecology index data are from the Chinese financial yearbook, China statistical yearbook, China's regional financial operation report, and internal financing ecology indicators data associated with financing efficiency evaluation are from the CSMAR database.

3. Results

3.1. Descriptive statistics

The descriptive statistics of the main variables are shown in Table 7, which illustrates the great differences in financing efficiency of strategic emerging industries. There are eight listed companies whose financing efficiency is effective every year, but there are a few enterprises with low financing efficiency which under 0.1. The standard deviation of external financing ecology is larger than that of internal financing, indicating that the external financing ecology has changed greatly since 2012. This is due to the local governments' efforts to the development of strategic emerging industries in recent years. The change of internal financing ecology is not as obvious as external financing ecology, but the distribution is not balanced. The minimum value of internal financing ecology is –0.0343, implying that compared with the base period in 2012, the internal financing ecology of individual enterprises is backward.

Table 7. Descriptive statistics of main variables

Variables	Number of samples	Minimum	Maximum	Average	Standard deviation
Eff	940	0.0812	2.0645	0.5309	0.2454
EFE	940	0.0518	0.6626	0.3612	0.1688
Mac	940	–0.0117	0.1155	0.0751	0.0289
Gov	940	–0.0019	0.0863	0.0451	0.0255
Fin	940	0.0075	0.5088	0.2182	0.1284
Cre	940	0.0025	0.0318	0.0228	0.0064
IFE	940	–0.0343	0.2951	0.0958	0.0257

For further analysis of financing ecology, as we can see in the following Figure 1, the financing ecology of strategic emerging industries is in the continuous improvement since 2012. This is mainly because the local governments take various measures to promote the development of strategic emerging industries, so the external financing ecology has been improved greatly. The internal financing ecology also has been improved, but not as greatly as external financing ecology. In terms of regions, the external financing ecology in Beijing, Guangdong, Shanghai, Jiangsu, Zhejiang and Shandong remained in the top six during 2012–2016, but the sequence is slightly different each year. These regions also have a large number of samples of the strategic emerging industry, indicating that the industrial development environment is better. The sample companies which get the highest assessment of internal financing ecology is in Beijing, of which the stock code is 000725, and the evaluation of internal financing ecology of different sample companies in the same area differ greatly.

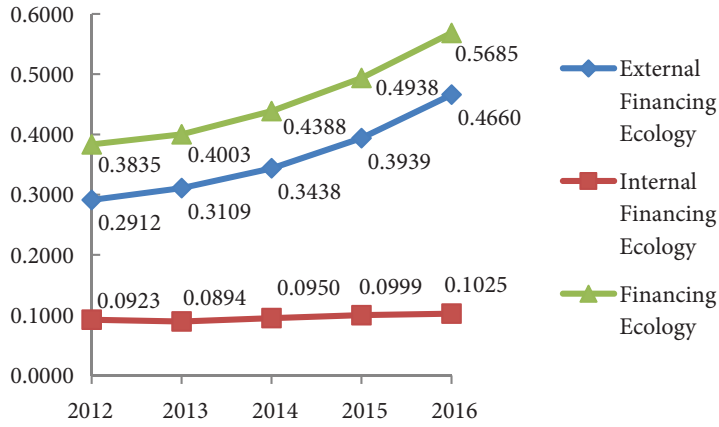

Figure 1. Financing ecology during 2012–2016

3.2. Empirical results of total samples and grouping samples

The results of Model 1 based on total samples are shown in Table 8. The results are as follows: (1) Macro-economic level and the financing efficiency have a significant positive correlation at 1% level. Enterprises which are located in regions with better economic condition, higher degree of opening to the outside world, and lower inflation, are more likely to obtain the capital and improve the financing efficiency. (2) Role of government is negatively correlated with the financing efficiency of strategic emerging industries at 10% level. That is because most local governments have financing gap, and there is not enough fund to support the development of enterprises. In additional, the marketization degree of configuration of government fund also needs to be improved, so the role of government on the financing efficiency has not been fully made use of. (3) Financial development is positively related to financing efficiency of strategic emerging industries, but it is not significant. Developed financial markets can provide diversified financing methods for enterprises, and effectively meet the needs of capital. However, due to the immature financial development in China, it is not obvious that financial development will promote the financing efficiency. (4) The credit environment is negatively correlated with the financing efficiency of strategic emerging industries, but it is not significant. This mainly because the construction of China's social credit system is far from perfect, and effective constraint mechanism of credit is not formed, thus affecting the improvement of financing efficiency. (5) There is a significant positive correlation between the internal financing ecology and the financing efficiency of strategic emerging industries at the 1% level. The enterprises with large scale, low debt level, proper corporate governance structure, low financing cost and risk, good profitability and growth ability are usually have higher financing efficiency.

In order to further analyze the impact of the internal and external financing ecology on the financing efficiency, the samples are grouped for analysis. Specifically, the paper uses median of external financing ecology, internal financing ecology and comprehensive evaluation of financing ecology each year as dividing line, the samples with higher evaluation

Table 8. Results of Model 1

	(1)Total samples	(2)External Financing ecology		(3)Internal financing ecology		(4)Financing ecology	
		High	Low	High	Low	High	Low
Mac	3.947 （0.000）	5.814 (0.019)	4.017 (0.000)	4.178 (0.001)	2.539 (0.055)	5.763 (0.022)	3.871 (0.000)
Gov	–3.317 （0.064）	39.627 (0.016)	–4.388 (0.022)	2.816 (0.293)	–6.346 (0.011)	24.073 (0.058)	–4.428 (0.020)
Fin	0.165 （0.227）	0.385 (0.315)	0.188 (0.451)	–0.163 (0.416)	0.182 (0.346)	0.363 (0.312)	0.163 (0.528)
Cre	–0.156 （0.930）	–14.693 (0.085)	–0.756 (0.745)	–1.069 (0.672)	3.006 (0.237)	–9.738 (0.153)	–0.089 (0.970)
IFE	1.258 （0.000）	0.891 (0.093)	1.480 (0.000)	3.053 (0.000)	–1.435 (0.105)	1.111 (0.046)	1.545 (0.000)
Year	0.115 （0.472）	0.280 (0.204)	0.061 (0.798)	–0.213 (0.396)	0.846 (0.001)	0.220 (0.320)	–0.016 (0.949)
Constant term	–0.094 （0.828）	–3.177 (0.007)	0.082 (0.895)	0.282 (0.670)	–1.611 (0.020)	–2.127 (0.028)	0.274 (0.666)
R-sq	0.014	0.015	0.058	0.094	0.004	0.013	0.043
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: the significance of the coefficient is in parentheses.

are defined as the high-level group, and those with lower evaluation are viewed as low-level group. Then the empirical test of grouping samples based on Model 1 is carried out, the results are also shown in Table 8.

For the high-level group of external financing ecology, the macro-economic level, role of government and credit environment have significant influence on financing efficiency, while financial development has a positive but non-significant influence on financing efficiency. The absolute values of these four coefficients are higher than the low-level group, indicating that the external financing ecology is an important factor affecting financing efficiency. For the enterprises in the regions with good external financing ecology, the effect of external financing ecology on the financing efficiency is more obvious than that in the regions with low external financing ecology.

For the high-level group of internal financing ecology, the macro-economic level and the internal financing ecology have the most significant impact, and the positive effect of internal financing ecology on financing efficiency is larger than that of the three factors of external financing ecology, second only to macro-economic level. It is shown that for enterprises with better internal financing ecology, the positive influence of internal financing ecology on financing efficiency can be brought into full play compared to enterprises with poor internal financing ecology, but the financing efficiency is still influenced by external factors, especially the external macro-economy.

For the high-level group of financing ecology, the results are similar to the high-level group of external financing ecology. Because when the entropy method is used to weight the

secondary indexes of financing ecology, the weight of external financing ecology is higher than that of internal financing ecology.

Based on the comparison of the three grouping samples, we find macro-economic level and internal financing ecology pass the significance test, and they both have significantly positive correlation with financing efficiency in the high-level group, indicating that these two factors play significant and positive roles in improving the financing efficiency. Besides, the main difference between high and low level groups is the effect of the government role on the financing efficiency. In the high-level group, the government plays a positive role in promoting the financing efficiency, yet a hindrance in the low-level group.

3.3. Empirical results of interaction between external and internal financing ecology

The results based on Model 2 are shown in Table 9. The results are listed as follow: (1) The symbol of coefficients of the independent variable have not changed in the four models when interaction terms are added to Model 1, and the significance level also change little, indicating that the external and internal financing ecology has a stable effect on the financing efficiency. (2) The interaction terms of macro-economic level and internal financing ecology pass 10% significance test, and the interaction terms of financial development and internal financing ecology, the credit environment and internal financing ecology pass 1% significance test, but the interaction terms of the government's role and internal financing ecology fail the significance test. All the four coefficients of the interaction terms are negative, indicating the internal financing ecology regulates the external financing ecology and the role of external financing ecology in financing efficiency decreases with the increase of internal financing ecology. In other words, the internal and external financing ecology can be replaced to some extent. (3) The external financing ecology and internal financing ecology have interactive substitutability when they affect the financing efficiency, that is, enterprises with low external financing ecology can improve the financing efficiency by promoting internal financing ecology, and enterprises with low internal financing ecology can alleviate the problem of low financing efficiency by the improvement of external ecology. Therefore, enterprises should attach importance to the interaction between external and internal financing ecology, and promote the coordinated development of external and internal financing ecology to improve the financing efficiency.

Table 9. Results of Model 2

	(1)	(2)	(3)	(4)
Mac	4.074 (0.000)	3.945 (0.000)	3.929 (0.000)	3.956 (0.000)
Gov	–3.097 (0.084)	–3.299 (0.066)	–3.201 (0.073)	–3.127 (0.078)
Fin	0.202 (0.143)	0.193 (0.162)	0.244 (0.080)	0.217 (0.111)
Cre	–0.339 (0.849)	–0.252 (0.887)	–0.396 (0.823)	–0.409 (0.816)

End of Table 9

	(1)	(2)	(3)	(4)
IFE	1.202 (0.000)	1.207 (0.000)	0.960 (0.003)	1.082 (0.000)
Year	0.134 (0.402)	0.132 (0.408)	0.131 (0.409)	0.136 (0.389)
Mac × IFE	–16.226 (0.069)	–	–	–
Gov × IFE	–	–15.706 (0.165)	–	–
Fin × IFE	–	–	–5.860 (0.006)	–
Cre × IFE	–	–	–	–134.628 (0.000)
Constant term	0.159 (0.703)	0.162 (0.696)	0.168 (0.685)	0.154 (0.707)
R-sq	0.015	0.012	0.018	0.013
Prob > F	0.000	0.000	0.000	0.000

Note: the significance of the coefficient is in parentheses.

Conclusions

This paper integrates external ecological and endogenous factors of the development of the industry and builds a financing ecology index system. The financing ecology of strategic emerging industries in recent years is analyzed based on the entropy method. Then, super SBM DEA model is adopted to analyze the financing efficiency, and the regression model is constructed to further analyze the influence of external and internal financing ecology on the financing efficiency. The conclusions are drawn as follows: (1) The financing ecology of strategic emerging industries is in the continuous improvement since 2012. This is mainly attributed to the rapid development of external financing ecology. The internal financing ecology also has been improved, but not as obvious as external financing ecology. In terms of regions, the external financing ecology in Beijing, Guangdong, Shanghai, Jiangsu, Zhejiang and Shandong is better than that in other regions, and the internal financing ecology of different companies in the same area differ greatly. (2) The financing ecology of strategic emerging industries has important influence on financing efficiency. In particular, the financing efficiency is significantly positively correlated with the macro-economy level and the internal financing ecology, and significantly negatively correlated with the role of government. There is a positive but non-significant correlation between financial development and financing efficiency, meanwhile a negative and non-significant correlation between credit environment and financing efficiency. (3) The internal financing ecology has a regulating effect on the external financing ecology, which means the role of external financing ecology in financing efficiency decreases with the increase of internal financing ecology. In other words, the internal and external financing ecology can be replaced to some extent.

Based on the above conclusion, strategic emerging industries should place emphasis on the optimization of external financing ecology and internal financing behavior, at the same time, they should attach great importance to the interaction of external and internal financing ecology, because only in this way can the strategic emerging industries form a driving force to improve financing efficiency and promote industrial development. Our suggestions are as follows: (1) The government should maintain regional economic stability. On the one hand, local government should transform the development model of economic growth and accelerate the pace of scientific and technological innovation. On the other hand, governments should optimize the industrial structure, upgrade and transform the traditional industries, and promote the development of new industries. (2) Governments should strengthen the financial support for the strategic emerging industries and attach importance to the investment in science and technology innovation. (3) The governments should improve the multi-tiered financial market system and encourage financial innovation in order to give full play to the role of finance in supporting enterprise development. (4) The government should improve the credit environment further. We should establish a sharing mechanism of credit information, improve the credit rating system for enterprise, speed up the construction of social credit system, and create a better credit environment. (5) The enterprises should regulate financing behavior. Enterprises cannot change the restriction of external financing ecology, but they can strengthen the adaptability of external financing ecology to reduce the impact of adverse factors on them. Therefore, enterprises should constantly improve the corporate governance structure, improve enterprise management level, reduce the financing risk and improve profitability and development capabilities.

Some innovations are applied in this study. First, with the development of the strategic emerging industries, it is necessary to study the relationship between financing ecology and financing efficiency in order to further promote strategic emerging industries. Second, this study put emphasis on both external and internal factors while others focus on the influence of external financial environment on financing efficiency. Third, external ecological and endogenous factors are synthesized to build financing ecology index system, and then the paper further analyzes the influence of external and internal financing ecology on financing efficiency, and the interaction of external and internal financing ecology on financing efficiency. However, this study also has some limitations. First, due to limited sample data taken from Strategic Emerging Industries Index disclosed by Shenzhen Stock Exchange in China, a full sample of strategic emerging industries needs to be concluded in the future study. Second, the assessment of financing ecology is based on entropy method, which helps to avoid deviation of man-made factors but neglects the importance of different index itself. Therefore, the combination of subjective and objective way to give weight will be taken into account in the future. Third, the conclusion focuses primarily on the use of results in the Chinese territory, the application of the conclusions in other economic ecosystems needs to be further studied.

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