Combining Big Data to Study the Impact of Decentralization Reform on Enterprise Innovation

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Abstract. Decentralization is an important initiative of government reform, aiming to stimulate the innovation vitality of market players. Through the collection of government service level big data, This paper study the impact of government decentralization on enterprise innovation. It is found that decentralization has a significant promoting effect on corporate innovation, and there are regional differences in this effect, with the promoting effect of decentralization on enterprise innovation mainly in the eastern and central regions. We should deepen decentralization reform to improve the government's ability to serve enterprise innovation, and strengthen government performance management through the construction of big data platform.

Keywords: big data; decentralization reform; enterprise innovation; R&D investment

1 Introduction

Decentralization is an important measure to deepen government reform, which improves the efficiency and fairness of resource allocation and stimulates the vitality of various market players. The past decade Chinese government has made remarkable achievements in decentralization reform, especially in the reform of administrative approval: the State Council departments have cancelled and decentralized nearly 40% of the approval items, many approval items in provincial region have reduced by 50%, making a breakthrough in administrative approval. [1]

Innovation and creation capability are important manifestation of the vitality of market entity, and one of the purposes of decentralization reform is to promote "mass entrepreneurship and innovation initiative" [2]. Statistical data from National Bureau of Statistics show that the growth rate of China's R&D investment remains high, of which enterprises account for 76%, becoming the main force of China's scientific and technological innovation, while the innovative behavior of enterprises is influenced by the government, especially the approval of many new projects is directly subject to government departments. [3] Therefore, it is important to analyze the impact of decentralization on enterprise innovation.

With the development of economy and society, digital government construction has become a trend in the government decentralization reform. The 14th Five-Year Plan and the 2035 Vision Goals Outline issued in 2021 pointed out that through the application of digital technology, we

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should deepen the "Internet + government services", promote the construction of online service platforms, and improve the effectiveness of digital government.

Big data play an important role in government reform. Through the support of big data technology, government service evaluation system set up by State Council collects government service level data from all levels of government, which reflect the effectiveness of government reform. Data from evaluation system shows that general level of government service has improved in recent years. Therefore, it is of great significance to analyze the impact of decentralization reform on enterprise innovation using government service level big data.

2 Theoretical analysis and hypothesis

2.1 Impact of Decentralization Reform on Enterprise Innovation

Many scholars have studied the impact of decentralization reform on enterprise innovation from different perspectives. Wang Yongjin et al. took the establishment of administrative approval centers as a "quasi-natural experiment", and found that the reform of administrative approval system had a significant effect on improving the innovation level of enterprises. [4] Zheng Ye et al. applied empirical methods to prove that decentralization had a positive promoting effect on improving enterprise vitality, and then having a positive impact on enterprise innovation performance. [5] Wang Xiaoxiao et al. believed that as an important means of government reform, the digital government has a significant role in promoting enterprise innovation. [6]

During the past decade, governments across the country have successively carried out the construction of e-government service platforms. As a supplement to the traditional administrative approval departments, e-government service platform is an important carrier to further promote the decentralization reform. Therefore, hypothesis can be put forward:

H1: Decentralization has a positive impact on enterprise innovation performance.

2.2 Regional differences in decentralization

Since uneven levels of economic and social development in China, the levels of decentralization differ among different regions, which may lead to regional differences in the effect of decentralization on enterprise innovation. Ma Shengli et al. concluded that decentralization has a significant promotion effect on the innovation quality of high-tech enterprises, and the promotion effect is more significant in the eastern economically developed regions due to the relatively perfect marketization mechanism and better resource base. [7] Wang Xiaoxiao et al. concluded that the digital government in the central and western regions has no significant impact on enterprise innovation.

Due to its economic and social foundation, the eastern region has become a pilot area for decentralization. The "Guiding Opinions on Further Promoting the Convenience of Examination and Approval Services", put forward typical experiences and practices of six regions, five of which belong to the eastern region. [8] Compared with central and western region, eastern region has rich experience in decentralization reform. Therefore, hypothesis can be proposed:

H2: Impact of decentralization in eastern regions is greater than that in central and western regions on the innovation performance of enterprises.

3 Research method and design

3.1 Data sources

The big data on government service level come from the government service evaluation system, which is set up by the State Council. The big data include 5 dimensions: effectiveness, maturity, completeness, coverage, and accuracy. Firstly, the effectiveness dimension includes evaluation management system, user usage, user experience, service satisfaction, and innovation service. Secondly, the maturity dimension includes process depth, collaboration process, integrated management, and application support. Thirdly, the completeness dimension includes integrated construction, mobile service, service homologation, online and offline integration. In addition, the coverage dimension includes guideline release and degree of event standardization. Finally, the accuracy dimension includes basic information, application materials, procedure, and template download. [9]

All the big data was consolidated and showed by "Survey and Evaluation Report on the Integrated Government Service Capability of Provincial Governments and Key Cities", which is published by the E-Government Research Center of Party School of the CPC. Through scientific statistical methods, the report processes big data on five dimensions into one value for each province, which shows overall government service level in provincial regions. For independent variable, this paper selects Chinese A-share listed companies from 2015 to 2020 as the enterprise sample, and processes the sample as follows: ST or *ST company samples are excluded; The samples missing main research variables are removed; The continuous variables are treated with the tail indentation in 1% quantile. The final sample of 3 853 companies with 17 308 observations was obtained. Company data are from CSMAR database. All sample panel data are sorted out and statistically analyzed by Excel2019 and Stata16.

3.2 Variable definition

1) Dependent variable

Table 1 shows the specific definition of each variable. The innovation of enterprises includes both input and output, among which the innovation input reflects the innovation behavior of enterprises directly. Since the absolute amount of R&D investment is affected by the size of the enterprise, "R&D investment/Operating revenue" is used as the variable to measure the enterprise innovation in this paper.

2) Independent variable

The government service level data of 31 provincial governments from 2015 to 2020 form the report is used as the measurement of decentralization reform.

3) Control variable

According to existing studies, other variables affecting the company innovation are controlled, including: company age, company size, asset-liability ratio, operating-profit ratio, return on assets, return on equity. At the same time, year and industry dummy variables are controlled.

Table 1. Variable definition

Variable types	Variable symbol	Variable name	Formula calculation
Dependent variable	Inn	Innovation	R&D investment/operating revenue
Independent variable	Dec	Decentralization	Data from the report
Control variable	Age	Company age	Current date -Establishment date
Control variable	Size	Company size	Ln (Total asset)
Control variable	Lev	Asset-liability ratio	Total liabilities/Total asset
Control variable	Opr	Operating-profit ratio	Profit/Operate revenue
Control variable	Roa	Return on assets	Profit/Total asset
Control variable	Roe	Return on equity	Profit/Shareholders Equity

3.3 Model design

According to the research theme and data collected, a panel fixed-effects model is set as follows:

$$Inn_{it} = \beta_0 + \beta_1 Dec_{it} + \beta 2 Age_{it} + \beta 3 Size_{it} + \beta 4 Lev_{it} + \beta 5 Opr_{it} + \beta 6 Roa_{it} + \beta 7 Roe_{it} + \varepsilon_{it} . \quad (1)$$

$$Inn_{it} = \beta_0 + \beta_1 Dec_{it} + \beta 2 Age_{it} + \beta 3 Size_{it} + \beta 4 Lev_{it} + \beta 5 Opr_{it} + \beta 6 Roa_{it} + \beta 7 Roe_{it} + \sum year + \sum industry + \varepsilon_{it} \quad (2)$$

i stands for company; t stands for year; β_0 represents constant term; ε_{it} is the random error term. On the model (2) year and industry effects are fixed to exclude factors that do not vary over time and industry characteristics, while it is not on the model (1) .

To test H2, drawing on Hua sheng et al, the 31 provincial administrative regions are divided into 3 groups and regression is based on each subsample. [10]

4 Results and discussion

4.1 Descriptive statistics

Table 2 shows the results of descriptive statistics. The mean of Inn is 0.049,which means the R&D investment of Chinese enterprises is generally low. It can also be inferred from the extremum value and standard deviation of Dec that there are obvious differences in the decentralization.

Table 2. Descriptive statistical results

variable	N	mean	sd	max
Inn	17308	0.049	0.048	0.0003
Dec	17308	0.873	0.076	0.6317
Age	17308	18.254	5.443	7
Size	17308	9.605	0.566	8.477
Lev	17308	0.400	0.198	0.0059
Opr	17308	0.076	0.220	-1.268
Roa	17308	0.039	0.075	-0.36
Roe	17308	0.059	0.154	-0.916

4.2 Regression analysis

1) Basic regression

Table 3 shows the results of basic regression. Model (1) shows the effect of decentralization on enterprise R&D input without fixing the control year and industry. The coefficient of Dec is 0.01. Model (2) shows that the coefficient of Dec is 0.013 and passes the test at 1% significance level after fixing the year and industry effects, thus proving H1, indicating that decentralization reform of Chinese government has a positive promoting effect on enterprise innovation.

In terms of control variables, the coefficient of Size is positive, indicating that enterprise size can promote enterprise innovation to a certain extent. The coefficient of Lev of enterprises is significantly negative, indicating that the capital structure of company with high debt is not conducive to enterprise innovation. The coefficients of Opr and Roa are positive, while the coefficient of Roe is negative.

Table 3. Basic regression results

Variable	(1) Inn	(2) Inn
Dec	0.010**	0.013***
	(2.31)	(3.08)
Age	0.001***	-0.001
	(8.90)	(-0.91)
Size	0.001	0.002
	(0.65)	(1.42)
Lev	-0.021***	-0.021***
	(-10.38)	(-10.41)
Opr	0.005	0.004
	(0.84)	(0.69)
Roa	0.003*	0.004*
	(1.66)	(1.94)
Roe	-0.035***	-0.035***
	(-21.95)	(-21.67)
Constant	0.023**	0.046*
	(2.11)	(1.81)
Year,industry fixed effect	NO	YES
N	17308	17308
R-squared	0.108	0.139
F	24.32***	16.46***

*** p<0.01, ** p<0.05, * p<0.1

2) Grouped regression

In order to test the impact of differences in decentralization in different regions on enterprise innovation, the sample is divided into three groups: eastern, central and western ones for regression.

Table 4 shows the results of grouped regression. The coefficient of Dec in the western region is small and insignificant, while those in the eastern and central regions are significantly higher than that in the western region and passes the 1% significance test. This shows that there are regional differences in the effect of decentralization. In detail, the regional differences are mainly between the eastern and central regions and the western region; the differences between the east and the

central regions are small. This may be the fact that the western provinces generally lag behind the central and eastern provinces in the implementation of administrative approval reform and the e-government construction, which may lead to ineffectiveness of decentralization in the western region. It can be concluded that there are regional differences in the impact of decentralization on enterprise innovation, which in the eastern and central regions are significantly higher than that in the western regions.

Table 4. Grouped regression results

Variable	Eastern Inn	Central Inn	Western Inn
Dec	0.016***	0.016**	0.002
	(2.71)	(2.15)	(0.18)
Age	-0.086	0.146	-0.409
	(-0.88)	(0.83)	(-0.99)
Size	0.369**	-0.357	0.255
	(2.38)	(-1.31)	(0.71)
Lev	-1.982***	-2.776***	-1.545***
	(-8.08)	(-6.29)	(-2.68)
Opr	-3.036***	-2.272***	-3.149***
	(-16.82)	(-8.08)	(-7.99)
Roa	-0.692	-2.630**	3.599**
	(-0.94)	(-2.15)	(2.22)
Roe	0.584**	-0.115	0.095
	(2.46)	(-0.35)	(0.22)
Constant	2.999	2.585	5.135
	(1.09)	(0.63)	(0.63)
Year,industry fixed effect	YES	YES	YES
N	12277	2998	2033
R-squared	0.137	0.216	0.153
F	17.02	17.27	11.94

*** p<0.01, ** p<0.05, * p<0.1

5 Conclusion

Through empirical study on the data of A-share listed companies from 2015 to 2020 and the decentralization level form the report, this paper analyzes the impact of decentralization on enterprise innovation, focuses on the regional differences in the impact, and draws the following conclusions: decentralization has a positive promoting effect on enterprise innovation input; there are regional differences in the impact of decentralization on enterprise innovation. The positive effect mainly exists in eastern and central regions, while the effect of decentralization in western regions is not significant.

Based on the conclusion, following suggestions are made:

1)Deepening reform to motivate R&D investment

Innovation is the first driving force for development. According to the analysis results, the coefficient value of decentralization is low, the effect on innovation needs to be further improved. In order to realize the strategy of building an innovative country, the Chinese

government needs to continuously deepen "reform of government functions". All region across the country especially western region should seize the opportunity of digital government to narrow the regional gap. In this way, government could better motivate enterprises to increase R&D investment.

2)Using big data technology to improve government service

Information technology should be used to strengthen government management and improve the capacity of government. Big data platform construction can improve the government service evaluation system, which is an important tool to prompt the government to continuously promote reform. It is necessary to continuously improve the big data management and bring into play the value of big data. Through the big data-based evaluation system, the government can find problems from the data and then improve its service level.

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