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Article

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MANAGEMENT | RESEARCH ARTICLE

Institutional environment, technical executive power and agricultural enterprise innovation performance

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Abstract: The interaction between the organization and the institutional environment leads to organizational change or innovation. As the basic industry of China's national economy, agricultural enterprises are transmitted from the institutional environment to the internals of the enterprise and are transformed into innovative behaviors, which ultimately form performance. Based on the research paradigm of "institution-behavior-performance", it is of great significance to promote the association between formal and informal institutions, technical executive power and agricultural enterprise innovation performance. This article studied a sample of 164 listed agricultural enterprises from 2009 to 2017 and adopted the negative binomial regression to determine the relationship between institutional environment and innovation performance of these enterprises. The results of the studies show that the more perfect the formal system, the better the innovation performance of agricultural enterprises, while the informal system inhibits the innovation performance of enterprises. The technical executives play a positive intermediary role between formal institutions and innovation performance.



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PUBLIC INTEREST STATEMENT

In recent decades the agriculture sector of China has relied on a gradual change, as the No.4 document issued by the general office of the state council in 2018 indicated that the agricultural H-Tech accounted for 56.65%. In order to promote the innovation of agricultural enterprises and create a good institutional environment, the government should improve the legal system, use the system to protect technological innovations, the crackdown on intellectual property infringements, and prevent plagiarism between the same industry. The remuneration for technical executives in agricultural enterprises and improve the matching between decision-making power and innovation performance. The external environment and internal governance complement each other, and only the adaptability of the two can promote the realization of the company's strategic goals. This article explores the relationship between the institutional environment and the innovation performance, from the perspective of agricultural enterprise. The power of technical executives to influence the innovation performance of the enterprise.

However, it does not have a significant intermediary effect between informal institutions and innovation performance.

Subjects: Management of Technology & Innovation; Management of Technology; Innovation Management

Keywords: institutional environment; technical executive power; innovation performance; agriculture enterprise

1. Introduction

Innovation implies the utilization of existing information and material to improve or make new things. Technological advancement depends on new innovation creation or development dependent on logical information and the asset it makes. The report of nineteenth National Congress of the Communist Party of China (CPC) expressed that advancement is the main thrust for advancing improvement and is the vital help for China's economy related advancement in the period of information economy. Improving advancement execution has built up a significant need for undertakings. Organization structure has become a key component of arrangements being sought after to accomplish prevalent financial advancement and remote challenge in many created and rising economies (Campbell, 2007; Berrone et al., 2013). One field where government intervention can have positive effects is the use of its monopolistic regulatory power to ensure that the structured institutional environment in which businesses operate is conducive to development. The institutional framework has been described as a critical element of firm conduct and success (Peng, 2002; Peng et al., 2008; Delmas & Montes-Sancho, 2011).

Entrepreneurial companies find themselves in a very unpredictable setting. Given the effect of the administrative climate on entrepreneurial businesses, enterprises are conducive to better assessing the origins of success and encouraging the healthy and orderly growth of enterprises. At the same time, prospects for creative development are helpful for entrepreneurs to deal with the effects of the competitive climate so that they can recognize and understand the opportunity for profit and shape the basis of the innovation success of industry (Chen et al., 2014; Hemlin & Olsson, 2011; Zhang & Wang, 2016; Zhu & Li, 2018). Studies in Chinese high-tech firms indicated institutional environment have a favorable impact on innovation performance. Their article suggested that Eastern Province industries should invest more in R&D (Hu, 2015; He et al., 2015). In demand to promote mass entrepreneurship and innovation in 2014, the government has issued relevant policies and provided financial support. Innovation has not only created a new wave among the whole people but also became a hot topic for scholars. Among them, how to achieve innovation goals and improve innovation performance is the focus of research. Long operating cycles and high risks are bottlenecks that the agricultural industry cannot avoid. However, the low government investment and weak profits, venture capitalist has little interest in venture firms, and there is a general situation of small scale and difficult innovation (Li & Tao, 2012; Liu & Wu, 2014).

For years now, the state's increased support for agriculture is an opportunity for agricultural enterprises. Executives tend to increase their R&D investment intensity and use their products to capture more market share, reflecting their operational and management capabilities (Luo & Ge, 2018; Sariol & Abebe, 2017; Core et al., 2008). A well-established institutional environment will promote the desire innovation performance. In 2017, the contribution rate of China's agricultural science and technology progress was 56.65%. This figure means that scientific and technological advances contribute more to agricultural growth than the sum of land, capital, and all other factors. The central government attribute great significance to technological innovation in the agricultural industry. The guidance of the No. 4 Document issued by the General Office of the State Council in 2018 on the development of agricultural high-tech industry demonstration zones, under the guidance of scientific and high-tech innovation. The establishment of enterprise-based innovation system, promote the integration and transformation of agricultural technical and technological successes, and cultivate agricultural high-tech enterprises. Therefore, modern agriculture is not

only traditional farming, forestry, animal farming, and sideline fishing. Traditional agriculture and related industries have realized industrial docking and integration. Therefore, well-educated workers and a skilled workforce are conducive to creativity. This article argues that the operational technical executive power plays a central role in transforming the absorptive potential of a company into creativity (Franco et al., 2012; Martin-deCastro et al., 2013; Zhao, 2006). While most people search their institutional environment, it may be easier for technical executives to find possibilities contained in that areas (Urban & Wood, 2015; Svetozar, 2008).

It is necessary to re-examine the scope of agricultural enterprises and study a series of problems in the new category of big agriculture. In the period of economic transformation, the traditional extensive model of development in the past, at the expense of excessive consumption of resources and environmental damage, and relying on demographic dividends to obtain profits has become unsustainable. Can a huge institutional environment change stimulate technological innovation in agricultural enterprises and form innovative performance? With the separation of the two powers of Chinese enterprises, executives are important strategic decision-makers within the enterprise, and executive power is the basis for executive decision-making, affecting the company's technological innovation decision-making behavior. Technical executives have a professional background and corresponding technical skills. Can technical executive power become an important internal driving force for technological innovation performance? Are technical executives in agricultural companies showing the same technological innovation decision-making preferences and preferences as other industries? Taking big agriculture as the research object, exploring the answers to this series of questions has far-reaching significance for promoting the technological innovation development of China's agricultural enterprises.

2. Literature review

2.1. Institutional environment and innovation performance

Technological innovation has experienced the theoretical changes of the neoclassical school, the new Schumpeterian school, the institutional innovation school, and the national innovation system school. From the Solow surplus to Schumpeter innovation to Davis and North's institutional innovation theory, and Freeman and Nelson's national innovation system, all-around how technological innovation is generated, influenced by factors, and the mechanism of action the mainline extends development. The institutional perspective of integrated economics and sociology has an important impact on corporate strategy and performance (Kwan, 2015; Peng & Qi, 2014). The institutional environment has greatly affected the survival, performance and a series of strategic decisions of enterprises, such as corporate innovation, governance mechanisms and social responsibility Zhou et al. (2012).

No enterprise can be separated from environmental development. Therefore, changes in the institutional environment play a vital key role in the development of enterprises. Its changes can bring more favorable opportunities for enterprises, obtain more resources, and expose enterprises to a crisis. It can be said that the development and growth process of any enterprise is also a process of adapting to the institutional environment. In order to advance its innovation performance, enterprises must always adapt to changes in the institutional environment. Foreign studies on institutional environment and innovation performance have mostly proved that the institutional environment stimulates innovation activities (Chakraborty & Chatterjee, 2017; Colwell & Joshi, 2013), thereby improving innovation performance. However, some researchers agreed that the institutional environment cannot performance a role in promoting innovation performance (Triguero et al., 2016). The institutional environment between countries and within a country is not a whole or the same state, and the innovation behavior and output of enterprises are affected by diverse industry logics (Gittelman, 2006). The high-level institutional development environment is categorized by an interest-oriented incentive structure, strong property rights protection, and laws and regulations. This institutional environment will promote the advance of innovative products, thereby increasing the profits of enterprises. Also, the relationship between institutional development and the profitability of new products is regulated by the transitional economic

situation. Compared with non-transition economies, the positive impact of institutional development on the profitability of new products in the transition economy will be weakened (Shinkle & McCann, 2014). From a knowledge perspective, innovation output is observed as a multidimensional structure, including knowledge creation, knowledge influence, and knowledge dissemination. Democratic law and political institutions that protect the independence of expression and intellectual property of innovators can foster broad-based trust, network relationships, knowledge sharing, and communication to achieve higher quantitative and qualitative innovations. They surveyed 120 companies and suggested that institutional support has positive impact on innovation output. Berrone et al. (2013) discussed the impacts of environmental regulation and monitoring pressures on the company's environmental innovation and performance. They analyzed the number of environmental patents applied by 326 polluting companies in the US, and the results showed that institutional pressure can lead to innovation. Especially for companies with serious pollution defects. The conclusions of the domestic research system environment and innovation performance are also different. Li and Tao (2012) verified the influence mechanism of the institutional environment and equity payments and balances on the innovation performance of enterprises through empirical evidence. The institutional environment can significantly improve the innovation performance of enterprises, and the internal driving force plays an intermediary role; Chan et al. (2014), the research environment of institutional environment-opportunity-innovation performance is discussed. The 109 research samples prove that the institutional environment contributes to the improvement of enterprise innovation performance, and confirms that entrepreneurial opportunities play an intermediary role in the connection between institutional environment and innovation performance. Role; Gao and Wu (2014) studied the internal and external institutional environment of the National High-tech Zone, the pursuit of "legality" of enterprises has a positive effect on the innovation performance of enterprises, but the coupling mechanism of internal and external institutional environment to the innovation performance of enterprises. There is no understandable influence; Shao (2015) proves that the institutional environment has a significant effect on improving the innovation performance of enterprises. Compared with the regions with the poor institutional environment, the government financial subsidies play more greater role in promoting the innovation performance of enterprises in areas with good institutional environment. Great role Shi and Chen (2015) based on the panel data of China's high-technological industry from 2000 to 2012, found that the institutional environment has had a significant positive impact on the high-tech industry innovation performance in 30 provinces and regions across the country, and the impact was higher than the R&D investment. Expenditure and new product development expenditures; according to the division of the East, Central and West regions, the influence of the institutional environment on innovation performance of high-tech industries and the evolution of the institutional environment show different strengths. In the western part of China, the institutional environment is relatively lagging behind, and the institutional environment has a significant positive effect on the innovation performance of high-tech companies. In the eastern region where the institutional environment is relatively superior, the positive impact of the institutional environment is no longer obvious for the innovation performance of high-tech companies. Zhang and Wang (2016) believe that for Chinese enterprises, market economy reform is still in its infancy, the degree of marketization is not high, various market systems are still imperfect, and government intervention is excessive. They comprehensively portrayed government regulation from the viewpoint of government and enterprises and used the data of China's private enterprises published by World Bank in 2012 to confirm that government regulation has significantly weakened the innovation effect of enterprises. In addition, Yi et al. (2018) found that the formal institutional distance can significantly improve the level of innovation of OFDI enterprises, that is, there is a "formal institutional distance paradox" between the two, while the informal system hinders overseas subsidiaries from knowledge, and the transfer of technology to domestic parent companies has curbed the improvement of corporate innovation performance. Yao and Gao (2014) studied tourism companies as the research object, the study was on relationship between formal and informal institutional embeddedness and corporate innovation performance, and found that the formal system was embedded. Innovation performance has significant positive effect, while the positive role of informal system embedding is not significant.

2.2. Executive power and innovation performance

Since Comte Long proposed the concept of entrepreneurship, he experienced the theory of Say entrepreneurs in classical economics, the entrepreneurial theory of Marshall, Schumpeter, and Knight of neoclassical economics, and the theory of North entrepreneurs in institutional economics. The most common point of view is, innovation is the soul of entrepreneurship. Although there are many researches on executive power in developed and developing emerging economy, it mainly verifies the significant influence of managerial power from the aspects of executive compensation, equity incentives, internal control, corporate performance and investment efficiency, and on the influence of executive power on innovation performance. This research is relatively rare. Regarding research in other countries, some scholars believe that executive power is conducive to promoting enterprise innovation. David and Kochhar (2006) found that with the increase in executive power, their investment preferences can be maximized. Executives tend to increase their R&D investment intensity and use their products to capture more market share, reflecting their operational and management capabilities. That is to say, executive power can significantly and positively influence technological innovation investment. Thompson (2007) further found that the improvement of management power in private enterprises is more conducive to technological innovation. Sariol and Abebe (2017) selected data from 150 US companies. The results show that the greater the CEO power, the easier it is to develop and explore innovation. Some scholars hold the contrary view. Jiraporn et al. (2012) believe that the power of the CEO will increase the agency cost, which is not conducive to company performance, especially when the company's capital structure changes, the negative impact of CEO power will more obvious. In addition, there are studies that prove that there is a nonlinear relationship. Kim and Lu (2011) proposed from the viewpoint of external governance that when external governance is weak, CEO power and firm performance are U-shaped. Regarding research in China, the conclusions obtained are not consistent. Zhu and Wang (2017) empirically research on the effects of technical and non-technical executive power on corporate performance. The study result indicated that technical executives' structural power, ownership power, and corporate performance are relative to non-technical executives. The hump relationship is more significant, the positive correlation between expert power and firm performance is more significant, and the relationship between reputation power and firm performance is not obvious. Wu and Lin (2017) studied the relationship between the executive power under the duality of the system and the overseas innovation performance of the enterprise. It was found that the management defensive effects of the two-in-one and the equity ratio of the private enterprise executives were all correct. Overseas innovation performance has played a more significant negative impact. The human capital pricing function of executive reward has a more significant positive effect, and the re-election of state-owned enterprise executives will have an adverse impact on overseas innovation performance. Luo and Ge (2018) found that the differences in the level of education, gender differences and the innovation performance of executive teams were significantly negatively correlated. At the same time, the imbalance of the power distribution of the senior management team on the level of the senior management team education. The relationship between sex, gender differences, and corporate innovation performance has a significant unfavorable adjustment effect. Hu (2015) takes the listed companies in the Shanghai and Shenzhen A-share markets from 2009 to 2012 as a sample empirically studies the relationship between management power, technology innovation investment and corporate performance, and draws structural power in technology innovation investment. The relationship between corporate performance plays a negative regulatory role. Structure power will increase the agency cost between shareholders and executives. Therefore, it is not conducive to the effective implementation of technological innovation investment; reputation power plays a positive role in regulation, and the general manager can reduce the part-time job. Agency cost is conducive to the effective implementation of enterprise technology innovation investment; expert power and ownership power have no obvious adjustment effect, but there is a significant positive connection with technological innovation investment and enterprise performance. Expert power and ownership power contribute to direct choice and strong Innovative and higher-performing companies invest.

In summary, research on innovation performance, most of the research samples are concentrated in high-tech enterprises, and research on agricultural enterprises is rare. Although the role of the institutional environment in innovation performance has been widely recognized, because the institutional environmental indicators are not subdivided, it is still impossible to clearly determine the role of different types of institutional environments in the role of innovation performance. In addition, most of the existing research only examines the impact of executive power on corporate innovation or corporate performance, and there is less research on executive power and innovation performance. How does the institutional environment affect the innovation performance of enterprises in China's modern agricultural enterprises? What role do technical executives play in this role? This paper has conducted in-depth research and analysis on these two issues. To this end, the study divides the institutional environment into formal and informal systems and introduces technical executive power as an intermediary variable to test the mechanism of the institutional environment in China's context on the innovation performance of large agricultural enterprises.

2.3. Theoretical basis and research assumption

2.3.1. Institutional environment and innovation

Institutional environment refers to a series of political, social and legal basic norms and rules used to determine the basis of creation, exchange, and distribution (Nelson & Nelson, 2002; North, 1994; Igor, 2014). Which can be divided into formal and informal institutions. The formal system mainly refers to a series of laws, regulations and rules and policies formulated by the government and relevant departments, while the informal system mainly refers to the various traditional cultures, customs, and practices that have been accumulated in different countries and regions for a long time, usually unwritten. Or intangible, mainly under the influence of non-mandatory forces or "soft constraints", such as social opinion and self-discipline of members of society (Aldrich, 2011).

The new institutional economics believes that regional innovation systems require institutional arrangements for regulation. A good institutional environment can guide and motivate enterprises to actively carry out innovation activities and achieve optimal allocation of economic resources, thereby improving the innovation performance of enterprises (Nelson & Nelson, 2002). A good institutional environment can obtain the required resources at a lower transaction cost, and also help to reduce the cost of protecting enterprise innovations, thereby effectively reducing the external constraints of corporate innovation activities and the uncertainty of resource support for enterprises to obtain their own development. Encourage enterprises to carry out innovative activities to promote the improvement of corporate innovation performance.

Public policy is legal, universal and mandatory. Although the formal system puts pressure on companies, companies will be forced to participate in adjusting their behavior and innovating according to social expectations (Scott, 2008; Swaminathan & Wade, 2016). However, a good formal institutional environment can reduce the risk of external environmental uncertainty faced by corporate innovation investment and uncertainty of innovation investment returns. Enterprise innovation far outweigh the costs, enterprises are more willing to make innovation investment, and the awareness of patent protection is stronger, with patent application. The technological innovation of the agricultural enterprise itself is difficult. It needs a good institutional environment to protect and support it (Shao, 2015; Stephen, 2017; Svetozar, 2008; Peng & Qi, 2014; Gao & Wu, 2014). The more perfect the formal institutional environment, the more beneficial it is to promote innovation, thus improving the innovation performance of enterprises. Therefore, the following assumptions are made:

H1: The formal institutional environment has a positive effect on the innovation performance of agricultural enterprises. That is, the more complete the formal institutional environment, the higher the intensity of innovation investment and output performance of agricultural enterprises.

A good institutional setting, formal as well as informal, can protect the innovations of the business. Even without a compulsory and punitive system of legal and legal functioning, the mechanisms of paradox and reputation formed by informal institutions still affect corporate innovation (Bei & Terence, 2017; Helmke & Levitsky, 2004; Swaminathan & Wade, 2016; Svetozar, 2008). On the one hand, according to the market pressure hypothesis, the strong market pressure carried by media supervision forces enterprises to make practical and innovative strategic decisions. At the same time, the lack of innovation or excessive innovation or even the irrational control of innovation funds will bring losses to the enterprise and ultimately affect the reputation. The reputation mechanism also urges companies to pay more attention to media reports and respond in a timely manner. Resourceful behavior is limited by social supervision and helps to improve innovation performance (Michael & Kai, 2015; Chan et al., 2014; Helmke & Levitsky, 2004). At the same time, under the asymmetry of information, people will be more willing to believe in the negative reports of the media and form a kind of adverse selection. Negative reports have more significant amplification effects than positive reports. Once a company fails to innovate, the negative effects are far greater than the benefits of innovation. Due to the uncertainty and untimeliness of innovation output, in order to reduce the risk of technology R&D failure, companies will be more cautious in making innovative decisions, and defensive psychology will reduce R&D investment, and the innovation output will be reduced accordingly. Therefore, under the constraints of the informal system, companies may treat innovation negatively and reduce unnecessary losses (Bin et al., 2015; Igor, 2014; Kim & Lu, 2011; Nelson & Nelson, 2002; Shao, 2015; Shinkle & McCann, 2014). Agricultural products are closely related to the daily life of the public, and the media is extremely concerned about it. In particular, some food safety incidents are immediately followed by extensive reports. Agricultural enterprises are constrained by the informal system. Enterprises may actively innovate and change due to reputational effects, and may also passively deal with unnecessary losses due to the spotlight effect. Based on this, the assumptions are made:

H2-1: The informal institutional environment has a positive effect on the innovation performance of agricultural enterprises;

H2-2: The informal institutional environment has an inhibitory effect on the innovation performance of agricultural enterprises.

2.4. Mediating role of technical executive power

Executive power refers to the ability of executives to suppress different ideas, achieve goals, and execute their will (Finkelstein, 1992). According to the source of power, technical executive power is defined as the structural power, ownership power, expert power, and reputation power owned by executives with relevant technical functions. Enterprise innovation performance will not only be affected by the institutional environment but will also be affected by internal factors. The institutional environment not only directly affects the innovation performance of the enterprise but also indirectly affects innovation performance through the internal driving force that influences the innovation of the enterprise (De Jong, 2007; Elenkov & Manev, 2009; Hemlin & Olsson, 2004). As the maker and implementer of corporate strategy, executives play an important role in corporate innovation activities. The high-order theory treats executives as limited rational people whose decisions are influenced by their own experiences and values. According to the management power theory, the size of management power determines the ability of managers to influence decisions according to their own will. The institutional environment affects the performance of enterprises, and it also affects the decision-making and behavior of the executives on the institutional environment (Gao & Wu, 2014; Shang & Huang, 2011; Shi & Chen, 2015). Therefore, executive power will play a role in the process of institutional environment affecting corporate innovation performance. Due to the high degree of complexity and professionalism of innovation, professional technicians must be required. Technical executives have the expertise in product technology to be more acutely aware of environmental trends, and technology executives can quickly make correct innovation decisions when they are in both positions; the more shares a technology executive has, the more efficient to develop their own innovative talents, actively seek

innovative projects. Which will help improve the effectiveness of corporate innovation investment; the higher the academic level, management ability and social experience of technical executives, the stronger the control of the company. The more able to master more internal and external information about the company's operations helps to make the right innovation decisions. Under the effective system supervision mechanism, it is possible to avoid short-sighted behavior of executives and facilitate R&D activities. In order to promote fame, technical executives will also focus on individual performance, and more actively make innovation market-oriented and conducive to innovation output (Petress, 2003; Tauceana et al., 2016). The technological innovation required by modern agricultural enterprises is more difficult, and it is more necessary for technical executives to exert their talents. Technical executives' specialization is mainly technology research and development and creativity that is responsive to the technology climate that impacts corporate technological innovation and that represents environmental changes in a timely manner (Peng & Qi, 2014; Wang et al., 2017; Wu & Lin, 2017 and Zhu & Wang, 2017). A sound institutional environment can enhance the internal driving force of technological innovation. The institutional environment affects the power of technical executives, and executive power affects innovation performance. Therefore, the following assumptions are made:

H1a: The power of technical executives mediates the relationship between the formal institutional environment and the innovation performance of agribusiness;

H2a: The power of technical executives mediates the relationship between the informal institutional environment and the innovation performance of agribusiness.

3. Research design

3.1. Sample selection

Based on the definition of the big agricultural concept studied by the MBA Center of China Agricultural University, large agriculture is the integration of the first, second and third generations, including the agriculture, forestry, animal husbandry and fishery in the primary industry (narrow agriculture), the agricultural and sideline products processing industry in the secondary industry, pesticides and fertilizers. Manufacturing, wood processing, beverage manufacturing, food manufacturing, special equipment manufacturing for agriculture, forestry, animal husbandry, and fishery, agricultural resources, agricultural products, and agricultural machinery circulation, rural finance, tourism, and tourism agriculture, agricultural technology promotion and agricultural business chain and other service industries. Taking into account the specific circumstances of the listed company, the research sample finally selected the listed companies in the first and second industries of the above-mentioned large-scale agriculture and the listed companies in the agriculture, forestry, animal husbandry, and fishery services, catering and retail industries in the tertiary industry. The data mainly comes from the Guotai'an database, China Information Bank Economic News Library and "China's Provincial Marketization Index Report 2016". In order to ensure the validity of data collection and the accuracy of the research results, this paper intends to screen the data collected by China's large agricultural listed companies from 2009 to 2017 as follows: (1) Excluding companies with incomplete data; (2) Excluding ST, * ST, PT listed companies. Finally, 1312 samples of 164 listed companies were selected for empirical testing. See Table 1 for details. In order to eliminate extreme outliers, this paper takes 1% Winsorize processing for all continuous variables, and the statistical software used is SPSS 23.0. The principal component analysis showed that the value of KMO was 0.564. In addition, the Bartlett sphericity test was significant at 0.01 level, and the total variance of the technical executive power variables was 75.859%, and the rotation component matrix results were highly consistent with the expected analysis. This judgment determines that the selected variable is suitable for factor analysis, and finally obtains a comprehensive indicator to measure the power of technical executives. The patent variable in innovation performance is a non-negative counting variable. It is not appropriate to use a linear regression model, so a nonlinear regression is used. Non-linear regression models include the Poisson regression model and a negative binomial regression model. However, the

Table 1. Sample selection

Sample classification	Primary industry	Secondary industry	Tertiary Industry	Total
Sample size	236	1012	64	1312
Proportion (%)	17.99	77.13	4.88	100

conditions of the Poisson regression model are relatively strict, and the mean and standard deviation must be equal. However, the negative binomial regression model does not have this condition. Therefore, this paper chooses a negative binomial regression model for empirical analysis to determine the relationship between the institutional environment, the power of technical executives and the innovation performance of agricultural enterprises.

3.2. Model construction

The model was constructed by the above analysis, and each hypothesis was tested by a negative binomial regression method. The above regression verification model is as follows: Model 1 verifies H1, H2, and Model 2, and Model 3 jointly verify H1a and H2a.

$$EI = \alpha_0 + c \text{ FS (IFS)} + \alpha_1 \text{Control} + \varepsilon \tag{1}$$

$$\text{POWER} = \beta_0 + a \text{ FS (IFS)} + \beta_1 \text{Control} + \varepsilon \tag{2}$$

$$EI = \gamma_0 + c \text{ FS (IFS)} + \beta_1 \text{POWER} + \gamma_1 \text{Control} + \varepsilon \tag{3}$$

3.3. Main variables

3.3.1. Dependent variable

Drawing on the research of (Ramani & de Looze, 2002; L. Xu et al., 2017; Q. Xu et al., 2013; Zhang & Wang, 2016), this paper takes the patent application quantity as the proxy variable of innovation performance, that is, the innovation performance is equal to the application for invention patent and utility model patent, and the total number of design patents. In addition, scholars also consider R&D investment intensity and financial indicators as proxy variables for innovation performance. Based on the existing studies of Zhu and Li (2018), this paper uses innovative input intensity (R&D) and patent application (Patents) indicators to comprehensively evaluate enterprise innovation performance from both input and output perspectives. The greater the investment in innovation, the more patent output, the better the innovation performance.

3.3.2. Independent variable

The formal system (FS) is mainly laws and regulations. Combined with the special institutional background and related literature research of China's transitional economy (Shao, 2015; Liu & Wu, 2014), the development of market intermediaries in the "China's Provincial Marketization Index Report 2016" edited by Wang Xiaolu, Fan Gang and Yu Jingwen was adopted. Legal system environmental index. However, because the data of the "China's Provincial Marketization Index Report 2016" is only counted in 2014, the data of the relevant indicators of 2015–2018 will be used by referring to the calculation method of He et al. (2015). According to the relevant index of the previous period, the calculation is carried out (Table 2). For example, the 2015 index is equal to the 2014 index plus the average of the three years of 2012, 2013 and 2014 relative to the previous year's index increase, and so on.

The Informal System (IFS) is primarily a social norm that uses media oversight as a proxy variable. Referring to the construction method of Peng and Qi (2014) and Core et al. (2008), the media supervisor selected the number of news reports related to large agricultural listed

Table 2. Names, symbols and calculation methods of variables

Variable	Name	Symbol		Calculation method
Dependent variable	Innovation performance	EI	R&D	Company's R&D expenditure/operating income for the year
			Patents	Patent filing
Independent variable	Formal system	FS		Market Intermediary Organization Development and Legal System Environmental Index
	Informal system	IFS		In (1+ Number of media reports)
Technical executive power metrics	Two jobs	Dual		Technical executives serve 1 at the same time in the board of directors, the board of supervisors, and the management. Otherwise, they are 0.
	Salary	Pay		Technical executive compensation exceeds the industry average of 1, otherwise 0
	Shareholding ratio	SH		The shareholding ratio of technical executives exceeds the industry average of 1, otherwise, it is 0.
	Term of office	Tenure		Technical executives have a term of more than the industry average of 1, otherwise 0
	Education	Edu		Technical executives have an industry average of 1, otherwise 0
	Part-Time	PT		Technical executives take part-time job 1, otherwise, take 0`
	Technical executive power	POWER		Extracting principal components for six sub-indicators, constructing a composite component of principal components
Mediator variable	Business scale	SIZE		Natural logarithm of total assets
	Capital Structure	LEV		Total liabilities/total assets
Control variable	Business growth	GROWTH		Operating income growth rate
	Age	AGE		Year of study—time of establishment +1
	Nature of property	SOE		The nature of the shareholding of the controlling shareholder is 1 for the state-owned, otherwise 0
	Year	YEAR		Year dummy variable

companies as substitute indicators and searched according to the title in the China News Bank Economic News Library. $IFS = \ln(1 + \text{The number of reports on the media by the title in the China Economic News Library})$.

3.3.3. Mediating variables

3.3.3.1. *Technical executive power (POWER)*. Drawing on the theory of Finkelstein (1992), the executive powers with relevant technical functions are divided into four categories: ownership power, structural power, reputation power, and expert power according to the source of power. The executives of this study are broadly defined and include board members, members of the board of supervisors, and other senior management. The technical executives are mainly referred to as the methods of work by Hu et al. (2016). The specific criteria are as follows: (1) having working experience in R&D and technical positions or having invention patents; (2) having technology Relevant titles, such as engineers, technicians, senior agricultural technicians, etc.; (3) Senior managers in technology or as principals in related technical industry associations. The technical executives identified in this paper meet at least one of the criteria.

According to the important and commonly used indicators of existing research, draw on the practices of Wang et al. (2017) and Zhu and Wang (2017) and combine Chinese agricultural listed companies and technical executives to select two jobs, salary, the shareholding ratio, term of appointment, education and part-time job are indicators of executive power measurement. Each subdimension cannot fully measure executive power, so this paper conducts principal component analysis to synthesize a comprehensive indicator (POWER).

3.3.4. Control variables

Learning from previous research on corporate innovation performance will be influenced by the control variables such as SIZE, LEV, GROWTH, AGE, and SOE. Therefore, this study controls these variables while controlling the effects of the year effect.

4. Results and discussion

4.1. Descriptive analysis

It can be seen from Table 3 that the minimum values of R&D and Patents are 0, and the maximum values are 6.97 and 216, respectively. The mean value is average, indicating that the innovation

Table 3. Descriptive statistics

Variable	Mean	Standard deviation	Min	Max
R&D	1.372013	1.741938	0	6.97
Patents	21.38567	37.84777	0	216
FS	7.448868	4.665877	1.04	19.15333
IFS	1.69633	1.038411	0	4.369448
Dual	0.5091463	0.500107	0	1
Pay	3.32787	3.458671	0	36.8425
SH	0.0130475	0.0474193	0	0.513391
Tenure	4.544621	2.731732	1	17.5
Edu	3.13229	0.900492	0	5
PT	0.7134146	0.4523385	0	1
Size	21.85492	1.021076	19.70724	24.74433
LEV	0.4033592	0.1894477	0.047825	0.860814
GROWTH	0.481	1.869321	-0.700798	13.79636
AGE	15.83918	5.159919	4	28
SOE	0.3910061	0.4881618	0	1

performance of agricultural enterprises is relatively general and the gap is relatively large. The gap between the minimum value and the maximum value of the formal system and the informal system is also large, indicating that there is a big difference in the institutional environment between agricultural enterprises. Among the agricultural enterprises, the total number of technical executives is 51%, the shareholding ratio is only 1.3%, the average salary is 300,000, the average value of the term is 4.5 years, the education level is undergraduate, and the technical executives are part-time agricultural. Enterprises accounted for 71%, and the gaps between the various control variables also existed. Therefore, it is very necessary to control them; in addition, the average value of property rights is 39%, indicating that the proportion of state-owned holdings is relatively small.

4.2. Regression analysis

4.2.1. Institutional environment and innovation performance relationship test

From the model-regression results in Table 4, it can be seen that the coefficient of the formal system is 0.082, and the T value is 8.25, indicating that the formal system passed the significance test and was significantly positive at the 1% level. That is, the more complete the formal system, the higher the investment in agricultural enterprises. A good formal institutional environment can give certain support and protection to risky and long-term agribusinesses, reduce environmental uncertainty and promote innovation. The coefficient of the informal system is -0.008 , and the T value is -1.72 , indicating that the informal system also passed the significance test, which is significantly negative at the 10% level, indicating that the informal system inhibits enterprises from making innovative investments. Excessive media attention leads to higher pressures and thus more cautious, thereby reducing innovation activities that are risky and slow. It can be seen from

Table 4. Regression results

Variable	Model 1		Model 2		Model 3	
	R&D		POWER		R&D	
FS	0.082***		0.0054*		0.079***	
	(8.25)		(1.72)		(8.06)	
IFS		-0.008^*		0.0014		-0.008^*
		(-1.72)		(1.05)		(-1.94)
POWER					0.538***	0.577***
					(6.21)	(6.50)
SIZE	-0.232^{***}	-0.173^{***}	0.128***	0.118***	-0.301^{***}	-0.241^{***}
	(-5.09)	(-3.07)	(8.92)	(6.83)	(-6.51)	(-4.27)
LEV	-1.440^{***}	-1.733^{***}	-0.043	-0.035	-1.417^{***}	-1.713^{***}
	(-5.95)	(-6.81)	(-0.56)	(-0.44)	(-5.94)	(-6.83)
GROWTH	.118***	.095***	-0.007	-0.009	.122***	.100***
	(5.11)	(4.05)	(-1.02)	(-1.22)	(5.36)	(4.34)
AGE	-0.032^{***}	-0.032^{***}	-0.005	-0.005	-0.029^{***}	-0.029^{***}
	(-3.32)	(-3.27)	(-1.59)	(-1.58)	(-3.09)	(-3.03)
SOE	-0.276^{***}	-0.289^{***}	.006	.003	-0.279^{***}	-0.291^{***}
	(-2.99)	(-3.05)	(0.22)	(0.11)	(-3.07)	(-3.12)
Cons	6.097***	5.438***	-2.695^{***}	-2.469^{***}	7.548***	6.862***
	(6.34)	(4.68)	(-2.69)	(-6.89)	(7.73)	(5.89)
YEAR	Control	Control	control	Control	Control	Control
R2	0.2151	0.1759	0.0588	0.0574	0.2372	0.2013

Note: ***, **, and * indicate significant (two-sided) at the 1%, 5%, and 10% levels, respectively; the T values for the corresponding coefficients are shown in parentheses.

Table 5. Regression results

Variable	Model 1		Model 2		Model 3	
	R&D		POWER		R&D	
FS	0.054*** (5.07)		0.0054* (1.72)		0.046*** (4.44)	
IFS		-0.099** (-2.08)		0.0014 (1.05)		-0.010** (-2.23)
POWER					0.520*** (5.97)	0.570*** (6.51)
SIZE	0.750*** (14.82)	0.802*** (13.35)	0.128*** (8.92)	0.118*** (6.83)	0.669*** (13.21)	0.715*** (12.10)
LEV	-0.202 (-0.74)	-0.512* (-1.85)	-0.043 (-0.56)	-0.035 (-0.44)	-0.071 (-0.26)	-0.336 (-1.24)
GROWTH	-0.095*** (-3.93)	-0.110*** (-4.61)	-0.007 (-1.02)	-0.009 (-1.22)	-0.095*** (-3.87)	-0.109*** (-4.47)
AGE	9.71e-07 (0.00)	-0.0006 (-0.07)	-0.005 (-1.59)	-0.005 (-1.58)	0.002 (0.31)	0.004 (0.39)
SOE	-0.290*** (-3.07)	-0.317*** (-3.31)	0.006 (0.22)	0.003 (0.11)	-0.339*** (-3.66)	-0.358*** (-3.84)
Cons	-13.84*** (-13.20)	-14.43*** (-11.81)	-2.695*** (-2.69)	-2.469*** (-6.89)	-12.24*** (-11.65)	-12.795*** (-10.63)
YEAR	control	Control	Control	Control	control	control
R2	0.0348	0.0325	0.0588	0.0574	0.0384	0.0368

Note: ***, **, and * indicate significant (two-sided) at the 1%, 5%, and 10% levels, respectively; the T values for the corresponding coefficients are shown in parentheses.

the regression results of the model in Table 5 that the more complete the formal system, the better the innovation output of the agricultural enterprise, and the informal system inhibits the innovation output of the enterprise. Explain that a good formal institutional environment can reduce the cost of public relations in agribusiness, and can use more resources to innovate to improve innovation performance. But the stronger the informal system, the more the agricultural enterprises will choose activities that are less risky and less costly, thus reducing innovation output. According to this, H1 and H2-2 can be established.

4.2.2. Test of the role of the technical executive in mediation

The most commonly used mediation test method is divided into three steps: (1) the independent variable has an effect on the dependent variable; (2) the independent variable has an effects on the intermediate variable; (3) after controlling the intermediate variable, the influence of the independent variable on the dependent variable disappears or is significantly weakened (Aldrich, 2011). Model 1, Model 2 and Model 3 jointly verify the role of technical executives in mediating. In the first step, Model 1 has confirmed that there is a significant positive connection between formal institutions and innovation performance, while informal institutions have a significant negative correlation with innovation performance. In order to further examine the mediating role of technical executives, a step-by-step regression test is required. In the second step, the institutional environment (formal and informal) conducts a regression analysis of the power of technical executives. The third step introduces the technical executive power as a mediator variable and the institutional environment to make a regression analysis of the agricultural enterprise innovation performance. The regression results are shown in Tables 4 and 5. It can be found from Model 2 that the formal system passes the significance test on the technical executive power, while the informal system does not pass the significant test on the technical executive power. Continue to carry out the third step test. From Model 3, it can be found that the formal system and technical executives have significant powers, and the formal institutional coefficient has decreased,

and the fitness R2 has also improved, indicating the mediating effect of technical executive power. Significant and can promote the positive impact of formal institutions on corporate innovation performance. In summary, it can be concluded that H1a is established and H2a is not established. That is, the power of technical executives plays a positive intermediary role between formal institutions and innovation performance, and does not have a significant intermediary role between informal institutions and innovation performance. The greater the power of technical executives, the more resources and fewer constraints, the perfect formal system will enable technical executives to make decisions that are consistent with policy trends, pay more attention to the benefits of innovation, but the informal system exists. Subjective factors, thus failing to achieve the corresponding driving effect.

4.3. Robustness check

The innovation performance measurement index replaces the Patent with a patent application amount (Patent lag) that is one year behind. The test results are shown in Table 6.

It can be seen that the results of the robustness test indicate that the original hypothesis is still established, so the conclusions obtained are effectively supported.

4.4. Discussion on findings

Our results show that formal systems have significant positively connection with innovation performance of the studies agricultural companies, but informal system indicated an adverse influence on firms' innovation performance. In addition, technical executive power plays a vital intermediary role between formal system and innovation performance. This research does support the works of Zhu and Wang (2017), whose studies of the A-share of listed Chinese companies found that technical executive power had a significant positively effect on risking taking by firms. on the side of institutional environment and corporate innovation performance, our results show a significant relationship. Following the research work of Li and Tao (2012), who's researched on the institutional environment and equity balance of innovation performance of 359 companies, concluded that there is a positive link between the institutional environment and innovation performance of firms. Also, studies by Shi and Chen (2015) on institutional environment and innovation performance of high-technology companies for the period 2002–2012, indicated that institutional environment had a significant positive impact on innovation performance. These studies confirm with our studies that institutional environment has a significant positive effect on corporate innovation performance. The finding of this study was able to be achieved the hypotheses developed. However, except informal system which had a negative association with innovation performance. Can a huge institutional environment change stimulate technological innovation in agricultural enterprises and form innovative performance? With the separation of the two powers of Chinese enterprises, executives are important strategic decision-makers within the enterprise, and executive power is the basis for executive decision-making, affecting the company's technological innovation decision-making behavior. Technical executives have a professional background and corresponding technical skills. Can technical executive power become an important internal driving force for technological innovation performance? Are technical executives in agricultural companies showing the same technological innovation decision-making preferences and preferences as other industries? The researchers can now confidently say that these questions which was the objective of the study has been achieved.

5. Conclusion and suggestions

Based on the empirical research on the data of large agricultural listed companies in 2009–2017, this paper introduces the technical executive power as a mediator on the basis of studying the relationship between institutional environment and agricultural enterprise innovation performance. The formal system has a significant positive relationship with the innovation performance of agricultural enterprises, while the informal system has a negative relationship with the innovation performance of enterprises; the technical executives play a positive intermediary role between the formal system and the innovation performance, in the informal system and innovation. There is no significant intermediary role in the relationship of performance. The significant relationship between institutional environment and corporate innovation performance is reflected in the fact that the institutional environment directly affects the

Table 6. Robustness test regression results

Variable	Model 1		Model 2		Model 3	
	Patent lag		POWER		Patent lag	
FS	0.0578***		0.0054*		0.048***	
	(4.85)		(1.72)		(4.16)	
IFS		-0.09**		0.0014		-0.007
		(-1.97)		(1.05)		(-1.57)
POWER					0.503***	0.549***
					(5.19)	(5.66)
SIZE	0.774***	0.818***	0.128***	0.118***	0.712***	0.737***
	(13.52)	(12.47)	(8.92)	(6.83)	(12.56)	(11.37)
LEV	-0.070	-0.444	-0.043	-0.035	0.071	-0.214
	(-0.23)	(-1.43)	(-0.56)	(-0.44)	(0.24)	(-0.70)
GROWTH	-0.076***	-0.091***	-0.007	-0.009	-0.073***	-0.087***
	(-2.95)	(-3.58)	(-1.02)	(-1.22)	(-2.83)	(-3.39)
AGE	-0.0038	-0.005	-0.005	-0.005	-0.001	-0.001
	(-0.37)	(-0.52)	(-1.59)	(-1.58)	(-0.10)	(-0.14)
SOE	-0.249**	-0.258**	0.006	0.003	-0.26**	-0.258**
	(-2.31)	(-2.36)	(0.22)	(0.11)	(-2.49)	(-2.45)
Cons	-14.417***	-14.799***	-2.695***	-2.469***	-13.283***	-13.354***
	(-11.95)	(-10.86)	(-2.69)	(-6.89)	(-11.13)	(-9.97)
YEAR	control	Control	control	Control	control	Control
R2	0.0337	0.0311	0.0588	0.0574	0.0371	0.0351
Variable	Model 1		Model 2		Model 3	
	Patent lag		POWER		Patent lag	
FS	0.0578***		0.0054*		0.048***	
	(4.85)		(1.72)		(4.16)	

(Continued)

Table 6. (Continued)

Variable	Model 1		Model 2		Model 3	
	Patent lag		POWER		Patent lag	
IFS		-0.009** (-1.97)		0.0014 (1.05)		-0.007 (-1.57)
	POWER				0.503*** (5.19)	0.549*** (5.66)
SIZE	0.774*** (13.52)	0.818*** (12.47)	0.128*** (8.92)	0.118*** (6.83)	0.712*** (12.56)	0.737*** (11.37)
	-0.070 (-0.23)	-0.444 (-1.43)	-0.043 (-0.56)	-0.035 (-0.44)	0.071 (0.24)	-0.214 (-0.70)
GROWTH	-0.076*** (-2.95)	-0.091*** (-3.58)	-0.007 (-1.02)	-0.009 (-1.22)	-0.073*** (-2.83)	-0.087*** (-3.39)
	-0.0038 (-0.37)	-0.005 (-0.52)	-0.005 (-1.59)	-0.005 (-1.58)	-0.001 (-0.10)	-0.001 (-0.14)
SOE	-0.249** (-2.31)	-0.258** (-2.36)	0.006 (0.22)	0.003 (0.11)	-0.26** (-2.49)	-0.258** (-2.45)
	-14.417*** (-11.95)	-14.799*** (-10.86)	-2.695*** (-2.69)	-2.469*** (-6.89)	-13.283*** (-11.13)	-13.354*** (-9.97)
YEAR	control	Control	control	Control	control	Control
R2	0.0337	0.0311	0.0588	0.0574	0.0371	0.0351

Note: ***, **, and * indicate significant (two-sided) at the 1%, 5%, and 10% levels, respectively; the T values for the corresponding coefficients are shown in parentheses.

innovation performance of enterprises, and the hard constraints of formal institutions encourage enterprises to actively innovate, and because enterprises consider the risk of a bad reputation, the soft constraints of informal institutions. On the other hand, the institutional environment indirectly affects the innovation performance of the enterprise by influencing the internal driving force of the enterprise. The formal system can significantly enhance the internal driving force of enterprise innovation, and the informal system represented by the media report has certain non-objectiveness. Factors failed to produce the corresponding driving effect. Based on this, the following suggestions are made:

First, improve the formal institutional environment and promote the innovative development of agricultural enterprises. In order to promote the innovation of agricultural enterprises and create a good institutional environment, the government should improve the legal system, use the system to protect technological innovations, the crackdown on intellectual property infringements, and prevent “plagiarism” between the same industry. At the same time, improve the market-oriented platform for research and development results, enhance the confidence of enterprises in research and development and innovation activities, and play an internal driving force to improve the innovation performance of enterprises.

Second, regulate the supervision of the media. The downstream customers of agricultural enterprises are a wide range of people. In the modern network era, the public is more willing to believe in negative information, resulting in faster and more influential negative reports. In the correct transmission of network information, due to the interests of the industry, in order to win the attention of the public, the media can easily disseminate non-objective facts in the network society to achieve the strong effect of sensational society. Therefore, it is urgent to regulate the objective reports of the media, guide the healthy development of the media industry, and enable the media to play its due role in social supervision.

Third, enrich the incentives for technical executives in agricultural enterprises and improve the matching between decision-making power and innovation performance. The external environment and internal governance complement each other, and only the adaptability of the two can promote the realization of the company’s strategic goals. In order to enhance the innovation ability of agricultural enterprises, technical executives should be encouraged to make bold innovations and make technology-based executives free to make decisions.

There are still some limitations in this paper: this article only considers large agricultural listed companies, and subsequent studies may consider expanding the sample to make the research results more universal. In addition, the innovation performance indicators and technical executive power indicators are further improved to make them more in line with the actual situation of large agricultural enterprises.

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