

A Study on the Influence of Dual Innovation on Enterprise Innovation Performance Under the Ecosystem of Enterprise Innovation

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Abstract—Dual innovation and innovation performance have always been the subject of much concern in the academic community, and there is still much controversy about whether dual innovation improves innovation performance. This paper constructs a conceptual model of enterprise innovation ecosystem, dual innovation and enterprise innovation performance, and takes electronic information industry enterprises as the research object to empirically test the effect of enterprise innovation ecosystem and dual innovation on enterprise innovation performance. The empirical results are as follows. The enterprise innovation ecosystem has a positive impact on the dual innovation, the enterprise innovation ecosystem has a promoting effect on the enterprise innovation performance, the dual innovation has a promoting effect on the enterprise innovation performance, and the dual innovation has a regulating effect in the process of the enterprise innovation ecosystem's effect on the enterprise innovation performance. The incentive effect of Exploitative innovation on corporate innovation performance is more significant. The effect of exploratory innovation on corporate innovation performance is not obvious. The conclusion of this paper enriches and expands the theory of enterprise innovation performance, and has guiding significance for the construction and operation of enterprise innovation ecosystem, and has practical value for dual innovation.

Keywords: *corporate innovation ecosystem, dual innovation, corporate innovation performance*

I. INTRODUCTION

Against the background of economic transformation, the degree of environmental uncertainty is getting higher and higher, and innovation has become the primary driving force for development. In the new era, innovation and its speed of popularization have become effective means for enterprises to create differentiated competitive advantages. However, in the Internet environment, Self-innovation is difficult to match with the fast-changing innovation. Building an enterprise innovation ecosystem has become the best way for enterprises to improve innovation efficiency. In the enterprise innovation ecosystem, companies can use contradictory and compatible dual innovation to enhance innovation capabilities. However, there is a lack of in-depth

discussion on whether the corporate innovation ecosystem has a positive impact on dual innovation, lack of in-depth research on whether the corporate innovation ecosystem promotes corporate innovation performance, and whether dual innovation has an incentive effect on corporate innovation performance. No consensus has been reached, and the relationship between dual innovation in the corporate innovation ecosystem and corporate innovation performance has not been thoroughly analyzed.

Based on the research shortage of existing theories and the importance of practice, this paper attempts to integrate the enterprise innovation ecosystem, dual innovation and enterprise innovation performance into a theoretical framework. This paper explains the function path and mechanism of enterprise innovation ecosystem on enterprise innovation performance. This paper reveals the microscopic mechanism of the influence of dual innovation on enterprise innovation performance. This paper empirically proves the regulatory effect of dual innovation in the role of enterprise innovation ecosystem on enterprise innovation performance. This paper is helpful to theoretically open the "black box" of enterprise innovation performance improvement and has important theoretical value and practical guiding significance for the construction and operation of enterprise innovation ecosystem.

II. LITERATURE REVIEW

The corporate innovation ecosystem is a paradigm shift in innovation management. Dual innovation is the ability of enterprises to make use of exploitative and exploratory innovation capabilities at the same time. The collaborative integration mechanism in the innovation ecosystem can integrate the innovation results of each member company in the system into customer-oriented solutions (Fukuda and Watanabe, 2008)[1], The innovation ecosystem can provide enterprises with the conditions and market relationships needed for survival and development (Lichtenstein et al., 1974) [2], Intensive R&D interaction between enterprises can be achieved through the innovation ecosystem (Persaud, 2005)[3], Competition between enterprises can support new product development and meet consumer demand (Moore,

1993) [4], Enterprises establish various cooperative relationships with other organizations or individuals to meet customers' increasingly complex and diversified needs through service innovation or product innovation (Jiang Shimei et al., 2015) [5]. Exploratory innovation is a type of radical innovation (Benner and Tushman, 2003) [6], Finding new organizational practices and discovering new technologies, new businesses, new processes, and new products are the main characteristics of exploratory innovation. Exploratory innovation focuses on changes made in emerging markets and customers (Wang Fengbin et al., 2012) [7], Exploratory innovation has fundamentally changed the existing technology path (Jansen et al., 2008) [8]; Exploitative innovation is a kind of incremental innovation (Lin and Chang, 2015)[9], Strengthening existing skills and processes based on existing technologies, existing customers, and existing markets are the main characteristics of exploitative innovation (Kortmann, 2015) [10], Enterprises use and integrate existing resources and knowledge to improve and expand existing products and services, and to meet existing market needs and existing customer needs by improving organizational processes, organizational structures, and organizational efficiency. Exploratory innovation requires acquiring new resources, and exploitative innovation requires developing existing resources. Exploratory and exploitative innovation is the two endpoints of a continuum (March, 1991) [11], Exploration ability and exploitative ability are compatible and mutually exclusive (Cao et al., 2009) [12], Exploratory innovation and exploitative innovation are two different ways of knowledge and technology innovation.

Under the role of the innovation ecosystem, companies can find ways to reduce costs and increase value through the upstream and downstream of the production process and its supply chain (Esty and Porter, 1998) [13], Enterprise performance is increasingly dependent on external resources not directly controlled by the enterprise (Iansiti and Levien, 2004) [14], Innovation performance refers to the innovation performance of core companies in the ecosystem, not the overall innovation performance of the system or the innovation performance of member companies (Hu Ling, 2014) [15], The innovation ecosystem describes the impact of knowledge management on innovation performance from three aspects: "knowledge storage, knowledge sharing, and knowledge creation" (Li Yan and Ding Yingying, 2018) [16].

The relationship between dual innovation and enterprise innovation performance is still controversial and the research conclusions are quite different. Dual innovation is the enterprise's synchronous pursuit and integration of exploratory innovation and exploitative innovation to achieve higher financial performance (Lin and Mc Donough, 2014) [17].

Dual innovation plays an important role in improving the short-term performance and long-term development of enterprises. Exploratory innovation has a significant positive impact on a company's new product performance; exploratory innovation focuses on meeting the needs of emerging customers and new markets by providing new

designs, creating new products or services, and developing new sales channels. The imbalance between exploratory and exploitative innovation has a negative effect on corporate performance. There is a positive relationship between exploratory innovation and performance; exploratory innovation has a significant effect on performance. Developmental innovation promotes the short-term benefits of enterprises; the relationship between exploratory and exploitative innovation and performance is very important and valuable. Exploitative innovation, exploratory innovation, and network embeddedness also have a significant positive impact on innovation performance (Li Jingxun and Jin Yiyi, 2017) [18]. Both balanced binary and combined binary have an inverted U-shaped relationship with the innovation performance of the hospital (Belixin, 2018) [19].

To sum up, the academic circle has discussed the relationship between innovation ecosystem and innovation performance, and the relationship between dual innovation and innovation performance, and the research conclusion has important theoretical value for understanding the mechanism and effect of them. However, in order to better understand the intrinsic mechanism of action between the three, future researches need to be expanded from four aspects. First is how the corporate innovation ecosystem affects dual innovation. Second is how the corporate innovation ecosystem affects corporate innovation performance. Third is how dual innovation affects corporate innovation performance. Fourth is whether dual innovation is the specific path of enterprise innovation ecosystem to affect enterprise innovation performance. Therefore, the study of the relationship between dual innovation and corporate innovation performance in the corporate innovation ecosystem is of theoretical value and practical significance.

III. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

The enterprise innovation ecosystem is an open system established to achieve co-creation, co-existence, win-win, sharing, self-organization, and dynamic evolution in order to achieve the goals of enterprise innovation and development. From the perspective of the network structure of the innovation ecosystem, the enterprise innovation ecosystem can be divided into an innovation ecosystem with a core enterprise and an innovation ecosystem without a core enterprise. Elements of the corporate innovation ecosystem include suppliers, consumers, distributors, consulting agencies, financial institutions, proprietary public sectors, competitors, etc. In the enterprise innovation ecosystem, the relationships among factors, talents, values, information, innovation diffusion, and production activities are interactively adapted and co-evolved. Technological advancement, profit attractiveness, entrepreneurship, and market consumer demand are the driving forces for the evolution of corporate innovation ecosystems.

Dual innovation refers to the coexistence or combination of two types of contradictory innovation activities in a changing environment. Two types of contradictory innovation activities include exploratory innovation and

exploitative innovation. Exploratory innovation is a transformational innovation activity that learns and explores new technologies, new knowledge, and new products in order to meet the new needs of the future. Exploitative innovation is a progressive innovation activity that continuously improves and innovates existing technologies, products, and services in order to meet existing customers or develop existing market needs. Exploratory innovation can break through the internal limitations of the organization, chase new knowledge and generate new technologies, and explore new resources and sources of long-term competitive advantages to promote long-term development of enterprises. Exploitative innovation is to strengthen skills, processes and structures on the basis of existing knowledge, and promote the short-term survival of enterprises. Factors such as knowledge endowment, organizational culture, environmental dynamics, and network relationships affect dual innovation. The survival and development of a single company does not entirely depend on dual innovation. Dual innovation of a single enterprise also needs to be incorporated into the innovation ecosystem. The operating mechanism of the enterprise innovation ecosystem includes mechanisms such as formation, operation, self-evolution, and knowledge sharing. Members of the innovation ecosystem and partners inside and outside the system achieve common progress, mutual benefit and win-win results through knowledge, technology, products, and services.

The enterprise innovation ecosystem realizes the goals of technological progress, knowledge acquisition, service improvement, and efficiency improvement through the flow of value, information, material, and energy among system members. The corporate innovation ecosystem realizes the evolution of the "synergistic" relationship between industry, university, and research institutes to the "symbiotic relationship" of industry, university, and research institutes through symbiotic innovation. Enterprise dual innovation can obtain system members' support in new knowledge, new ideas, new opportunities, new products, new services, funds, etc. in the enterprise innovation ecosystem. Companies can experiment and explore new skills, technologies and new business opportunities within the innovation ecosystem. Enterprises can also optimize and upgrade existing technologies, products, and capabilities. Depending on the innovation ecosystem, companies can also expand existing product and service markets. The enterprise innovation ecosystem can provide member companies with novel knowledge and information, and strong relationships within the enterprise innovation ecosystem can enable member companies to obtain more novel knowledge and information without investment. The enterprise innovation ecosystem provides a platform for the expansion of original achievements and the reorganization of existing knowledge elements, and also provides support for the development of new fields and the creation of new knowledge. Enterprises can quickly understand the potential needs of the market in the innovation ecosystem, and can quickly improve the ability to acquire new knowledge, which is conducive to the rapid development of new products. Based on the above analysis, this article makes the following assumptions.

Hypothesis 1: The corporate innovation ecosystem has a significant positive impact on dual innovation.

Hypothesis 1a: The corporate innovation ecosystem has a significant positive impact on exploratory innovation.

Hypothesis 1b: The corporate innovation ecosystem has a significant positive impact on exploitative innovation.

As a symbiotic, open and dynamic self-organizing system, the enterprise innovation ecosystem can provide technical cooperation, knowledge sharing, channel sharing, service coordination and other support to meet the diverse and complicated needs of users. Enterprise innovation ecosystems can often guide investment directions and technical standards, and can also achieve system change and stability evolution through integrated innovation. Enterprise innovation performance is the increase in enterprise value after the company implements and adopts new technologies. There are many factors that affect innovation performance in the enterprise innovation ecosystem. The level of innovation performance at different development stages of the enterprise's innovation ecosystem is also constantly changing. Members of the innovation ecosystem promote dynamic capabilities and collaborative innovation in order to meet customer needs, and promote members to quickly enter new markets and create new value. Members of the corporate innovation ecosystem continue to create new value through common evolution in a common business environment. Dynamic capabilities in the innovation ecosystem can transform resources into value.

Productivity, health, and creativity in the corporate innovation ecosystem affect innovation performance. In the enterprise innovation ecosystem, the innovation niche is affected by multiple innovation subjects. The innovation niche further affects the innovation model. Innovation consciousness, talent supply, technical support, and financial support also affect the innovation model. The innovation model further affects innovation performance. The trust of members in the enterprise's innovation ecosystem can increase the possibility of resource exchange and reduce transaction costs. Trust also reduces the cost of knowledge transfer, increases the possibility of absorption and retention of new knowledge, and affects the level of innovation performance. Utilization and integration of innovation resources within the enterprise innovation ecosystem can reduce market uncertainty and risk, and system specifications can reduce enterprise research and development costs, thereby improving innovation performance. Based on the above analysis, this article makes the following assumptions.

Hypothesis 2: The corporate innovation ecosystem has a positive impact on innovation performance.

Dual innovation refers to the simultaneous development of utilization innovation and exploratory innovation. The purpose of exploratory innovation is to enter new markets or launch new technological activities, usually more radical innovation activities. The purpose of utilization innovation is to consolidate the competitiveness of existing markets or to improve existing products. Generally, it is gradual

innovation by integrating existing knowledge, existing technology, existing research or experiments. The absorption of external knowledge and the use of existing knowledge and resources can improve the level of knowledge utilization and help improve the efficiency of exploratory innovation. Exploratory innovation can explore the applicability of existing products and technologies. Exploitative innovation can provide better services to target customers by expanding the functions of existing products or integrating the existing knowledge of the enterprise. Exploitative innovation can improve existing products, expand existing product functions, and enhance the competitive advantage of the enterprise market by better meeting user needs. Exploratory innovation enables companies to have deep insights into new technology applications, new market dynamics, and the needs of potential markets, and develop new products or services to meet new needs, thereby gaining a competitive advantage for the company in the future. Exploratory innovation can provide new opportunities and open new markets. Exploratory innovation Targeting new markets and new products often has a high degree of uncertainty. The innovative effects of exploratory innovation cannot be released in the short term. The results of exploratory innovation can be a way to take advantage of it. Enterprises can conduct exploratory innovation on the basis of exploitative innovation. The virtuous circle of exploratory and exploitative innovation helps to improve the level of innovation performance. Exploratory innovation can develop new products, generate new patents, adopt new technologies and new business processes, thereby creating new market segments and expanding market share. Exploratory innovation takes the future needs of customers and the market as the innovation goal, and uses new technology and new knowledge as the innovation foundation to make high-risk investments in externalities. The long-term performance brought by large-scale radical innovation is highly uncertain. Exploitative innovation to improve products by utilizing and reconstructing existing knowledge can meet the current needs of users and achieve rapid sales of products in the market, thereby improving innovation performance at a low risk in the short term. Dual innovation is a key driver of innovation performance. Based on the above analysis, the following hypotheses are proposed.

Hypothesis 3: dual innovation has a significant positive impact on enterprise innovation performance.

Hypothesis 3a: exploratory innovation has a significant positive impact on enterprise innovation performance.

Hypothesis 3b: utilized innovation has a significant positive impact on enterprise innovation performance.

The corporate innovation ecosystem provides a variety of partnerships for product and service innovation. The members of the enterprise innovation ecosystem are interdependent and co-evolving. Member companies in the enterprise innovation ecosystem can transform information into information available for dual innovation through a common understanding. It is relatively easy for companies in the enterprise innovation ecosystem to acquire more new

knowledge and technologies. Other members of the innovation ecosystem have a higher degree of recognition of corporate innovation. Members in the innovation ecosystem can enhance the ability of enterprises to innovate and speed up innovation. By sharing knowledge and communicating with other member companies in the system, companies can increase the possibility of exploratory innovation. Exploratory innovation can rely on the enterprise innovation ecosystem to obtain non-redundant knowledge resources. Cooperation and exchanges among members in the innovation ecosystem promote knowledge acquisition and innovation, and use external resources and knowledge to promote innovation activities. Members within the innovation ecosystem can use the knowledge or ideas inside and outside the innovation ecosystem to expand innovation resources and assist companies to improve innovation performance.

The knowledge of suppliers and users in the enterprise innovation ecosystem can improve the ability of enterprises to meet users and the speed of new product launches. Suppliers and users have different effects on improving the interactive effect and exploratory nature of dual innovation. Enterprises in the innovation ecosystem can improve the relative exploratory nature of dual innovation by acquiring technologies and knowledge that are significantly different from the current resource base. Enterprises use various connections in the system to continuously acquire new knowledge, and the more the enterprise knowledge portfolio expands. The ratio between exploratory innovation and exploitative innovation in binary innovation is a variable that changes rapidly as the environment changes. Exploitative innovation can provide a guarantee for enterprises to gain value in a short-term in a dynamically changing environment. Exploitative innovation cannot meet the needs of new technologies and new markets; exploratory innovation promotes the development of new technologies and new products, can improve enterprises' adaptation to changes in technology structure and changes in market demand, and also helps companies seize new technology opportunities in a timely manner. And new market opportunities. The innovation ecosystem of a company promotes innovation performance. Dual innovation plays a moderating role between the corporate innovation ecosystem and innovation performance. Exploratory innovation and utilization innovation in binary innovation are based on a large amount of knowledge, technology and skills to iteratively upgrade products or create new products. Dual innovation requires enterprises to have the latest technical and product information in a timely manner.

In the corporate innovation ecosystem, members can transfer and collaborate with each other through tacit cooperation knowledge, thereby strengthening the impact of exploratory and exploitative innovation on innovation performance. The relationship learning activities among members in the enterprise innovation ecosystem can obtain or control more effective resources, thereby improving the level of exploratory innovation and exploitative innovation. The relationship learning between enterprises can also

enhance the dual innovation ability and further increase the residual value of enterprises. Dual innovation has improved the existing resources and capabilities of the enterprise and the enterprise can obtain more innovation performance. Cooperative enterprises in the enterprise innovation ecosystem can enable both parties to obtain knowledge resources and innovation information that are conducive to innovation based on ordinary information exchange and sharing. These information and knowledge resources are conducive to balanced utilization innovation and exploration innovation. The quality of information sharing between the cooperative companies has improved the level of knowledge, which in turn has improved the level of knowledge of dual innovation. Enterprises can also enhance their dual innovation capabilities by seizing the opportunities of new knowledge and new technologies. Dual innovation has optimized the company's thinking mode and improved its innovation performance.

Enterprises in the enterprise innovation ecosystem can use the resources and cooperation relationships in the system to develop new products and new technologies, so as to obtain higher innovation performance, which in turn promotes the implementation of dual innovation based on the system. The improvement of dual innovation capabilities provides a solid guarantee for the improvement of innovation performance. Dual innovation also promotes enterprises to gain a competitive advantage. At the same time, the cooperative enterprises in the system have further improved the level of exploitative innovation and exploration innovation through knowledge sharing and interaction. The improvement of the level of exploitative innovation and exploratory innovation has laid a good foundation for the improvement of innovation performance. Based on the above analysis, this article makes the following assumptions.

Hypothesis 4: Dual innovation has a significant positive regulatory effect on the role of the corporate innovation ecosystem in corporate innovation performance.

Hypothesis 4a: Exploratory innovation has a significant positive regulatory effect on the role of the corporate innovation ecosystem in corporate innovation performance.

Hypothesis 4b: Utilization innovation has significant positive regulation in the process of the role of the corporate innovation ecosystem in corporate innovation performance.

IV. RESEARCH DESIGN

A. Data collection

This article selects the electronic information industry enterprises as the research object and data collection object. This article selects Guangdong, Fujian, Zhejiang, Jiangsu, Shanghai and other regions to conduct questionnaire surveys. The surveyed enterprises need to meet the following conditions. The company has built and operated an enterprise innovation ecosystem. The company has been operating for more than 5 years, has more than 30 employees, has an annual operating income of more than 30 million yuan, and an enterprise asset scale of more than 20 million yuan. The

questionnaire includes four parts: corporate innovation ecosystem, dual innovation, innovation performance, and basic corporate information. The respondents were middle and senior managers of the company. The questionnaires are issued and collected in the following ways. The research team went to the enterprise to conduct in-depth interviews, and instructed the respondents to fill in the questionnaire and retrieve it. The research team uses various channels to contact the target company, and sends an e-mail to the target company, and the respondent mails the completed questionnaire to the research team. From July to November 2018, the research team distributed nearly 294 questionnaires to enterprises in Guangdong, Fujian, Zhejiang, Jiangsu, Shanghai and other places for nearly 6 months. 264 questionnaires were eventually recovered, of which 252 were valid questionnaires and the effective recovery rate 85.7%, the data recovery is well representative. China's electronics and information industry data comes from the China Electronics and Information Industry Statistical Yearbook and China Statistics Yearbook. Relevant data were processed using Stata 15 software and SPSS 26.0 software.

B. Variable measurement

1) *Measurement of enterprise innovation ecosystem:* Based on the research results of enterprise innovation ecosystem evaluation of Zhang Gui et al. [20] (2018), this paper uses "Information System Integration Service Revenue", "Information Technology Consulting Service Revenue", "Data Processing and Storage Service Revenue", "Technology Transfer Project Revenue", "Technology Exchange and Promotion Revenue", "New Business Revenue", "New Product Revenue" and other 12 items measure the health of the enterprise's innovation ecosystem. This article uses the health of the enterprise's innovation ecosystem to replace it. Enterprise innovation ecosystem. Before the data analysis, the data was standardized. In this paper, the principal component analysis method is used, and the weight of the enterprise innovation ecosystem indicators is determined according to the variance contribution rate of the extracted principal components.

2) *Dual innovation measurement:* This paper draws on the research scales of Jansen et al. [8] (2006), Kollmann and Stockmann [21] (2014) to measure exploratory innovation and exploitative innovation. Among them, exploitable innovation uses 6 items to measure and exploratory innovation uses 7 Item measurement. Each measurement is measured on a Likert 7-level scale. This article considers that the use of calculation forms such as absolute difference or increment will lead to the loss of information for data analysis and is not conducive to interpretation. In this article, we will use the sum of the scores of exploitative innovation and exploratory innovation to measure binary innovation.

3) *Enterprise innovation performance measurement:* Corporate innovation performance refers to the contribution of process innovation and product innovation to corporate performance. This paper draws on the research of Qian

Xihong et al. [22] (2010) and Zheng Ye et al. [23] (2017), and adopts "new services and product development faster than their peers" and "process innovation compared with their peers 6 faster" and other 6 items to measure innovation performance. The above items are measured with Likert 7-level scale.

The test results of the reliability and validity of related items meet the requirements of statistical analysis.

4) *Controlling variable*: This article selects the company age and company size as the control variables. The age of the company uses the difference between the year of the questionnaire recovery and the year the company was founded as the age of the company, and the size of the

company is measured using the natural logarithm of the number of employees.

V. EMPIRICAL RESULTS AND ANALYSIS

A. Empirical results and analysis

This paper uses SPSS 26.0 software to analyze the variables involved. "Table I" shows the descriptive statistics and correlation coefficients of each variable in the regression model. From "Table I", it can be seen that the correlation coefficient between the variables is below 0.7. For multicollinearity threats, there is a significant correlation between the explanatory variables and the explanatory variables.

TABLE I. MEANS, STANDARD DEVIATIONS AND CORRELATIONS

| | Mean | Standard deviation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|------|--------------------|--------|--------|--------|--------|--------|------|------|
| 1 | 5.71 | 1.178 | 0.89 | | | | | | |
| 2 | 5.26 | 1.153 | 0.74** | 0.86 | | | | | |
| 3 | 4.42 | 1.032 | 0.51** | 0.41** | 0.87 | | | | |
| 4 | 5.03 | 1.137 | 0.41** | 0.27** | 0.46* | 0.83 | | | |
| 5 | 4.97 | 1.026 | 0.28** | 0.34** | 0.51** | 0.47** | 0.89 | | |
| 6 | 6.76 | 2.384 | 0.31 | 0.52 | 0.41 | 0.32 | 0.58** | 1.00 | |
| 7 | 2.97 | 0.837 | 0.11 | 0.43 | 0.52 | 0.37 | 0.46* | 0.37 | 1.00 |

^a ** and * indicate significant at 1% and 5% levels, respectively. The diagonal value is the square root of AVE. 1 represents the enterprise innovation ecosystem. 2 stands for dual innovation. 3 represents exploratory innovation. 4 represents utilization innovation. 5 represents the innovation performance of the company. 6 represents the scale of the enterprise. 7 represents the age of the business.

B. Analysis of statistical results and hypothesis testing

A regression model was established with the corporate innovation ecosystem as the explanatory variables, dual innovation, exploratory innovation, utilization innovation, and corporate innovation performance as the explanatory variables, and controlling the impact of enterprise size and age. The results of regression analysis are shown in "Table II".

In model (1), with binary innovation as the dependent variable and the enterprise innovation ecosystem as the independent variable, the regression coefficient of the enterprise innovation ecosystem is 0.236, which is significant at the 5% level. This shows that the corporate innovation ecosystem has a significant positive impact on dual innovation. Hypothesis 1 is supported by empirical data.

In model (2), with exploratory innovation as the dependent variable, and the enterprise innovation ecosystem as the independent variable, the regression coefficient of the enterprise innovation ecosystem is 0.008, which is not significant. This shows that the impact of the enterprise innovation ecosystem on exploratory innovation is not significant. Assumption 1a is not supported by empirical data.

In model (3), the utilization innovation is the dependent variable, and the enterprise innovation ecosystem is the independent variable. The regression coefficient of the enterprise innovation ecosystem is 0.448, which is significant at the 1% level. This shows that the corporate

innovation ecosystem is positively related to utilization innovation. Hypothesis 1b is verified.

In model (4), with the innovation performance of the enterprise as the dependent variable and the innovation ecosystem of the enterprise as the independent variable, the regression coefficient of the enterprise innovation ecosystem is 0.371, which is significant at the level of 1%. This shows that the corporate innovation ecosystem is significantly positively related to corporate innovation performance. Hypothesis 2 is supported by empirical data.

TABLE II. EMPIRICAL TEST RESULTS OF CORPORATE INNOVATION ECOSYSTEM AFFECTING DUAL INNOVATION AND CORPORATE INNOVATION PERFORMANCE

| Variable | Dual innovation | Exploratory innovation | Exploitative innovation | Innovation performance |
|---------------------------------|---------------------|------------------------|-------------------------|------------------------|
| | Model(1) | Model(2) | Model(3) | Model(4) |
| Enterprise Innovation Ecosystem | 0.236** (3.57) | 0.008 (1.81) | 0.448*** (4.47) | 0.371*** (3.46) |
| Enterprise size | 0.016* (2.98) | 0.002* (2.87) | 0.143** (3.01) | 0.152** (3.25) |
| Business age | -0.042* (-2.86) | -0.001* (-2.86) | -0.107** (-3.18) | -0.104* (-3.01) |
| Constant term | -0.361** (-4.23) | -0.452** (-4.47) | -0.573** (-5.12) | -0.477** (-5.03) |
| Adjusted R^2 value | 0.371 | 0.006 | 0.446 | 0.354 |
| F Value | 16.471*** | 1.976 | 27.487*** | 15.582*** |
| Number of samples | 252 | 252 | 252 | 252 |

a. ***, **, and * indicate that they are significant at the levels of 1%, 5%, and 10%, respectively; T values are in parentheses.

"Table III" is the regression results of multicollinearity. Models 5, 6, and 7 examine the impact of dual innovation on corporate innovation performance. In model (5), with the innovation performance of the enterprise as the dependent variable and the dual innovation as the independent variable, the regression coefficient of the dual innovation is 0.462, which is significant at the 1% level. This shows that dual innovation is significantly positively related to the corporate innovation ecosystem. Hypothesis 3 is supported by empirical data.

In the model (6), with the innovation performance of the enterprise as the dependent variable and exploratory innovation as the independent variable, the regression coefficient of exploratory innovation is 0.072, which is not significant. This shows that the impact of exploratory innovation on corporate innovation performance is not significant. Assumption 3a is not fully supported by empirical data.

In the model (7), the innovation performance of the enterprise is used as the dependent variable, and the exploitative innovation is used as the independent variable. The regression coefficient of the exploitative innovation is 0.532, and it is significant at the level of 1%. This shows that exploitative innovation is significantly positively related to corporate innovation performance. Hypothesis 3b is verified.

In this paper, in the verification of regulatory effects, regression analysis was performed after normalizing the explanatory variables and explanatory variables separately. Models 8, 9 and 10 examine the moderating effect of dual innovation in the process of the corporate innovation ecosystem affecting corporate innovation performance.

In the model (8), the innovation performance of the enterprise is taken as the dependent variable, and the product and control variables of the dual innovation, the dual innovation and the enterprise innovation ecosystem are put into the regression model. According to the data in Table 3, the regression coefficient of the product term of the enterprise innovation ecosystem is 0.541, and it is significant at the 1% level. This shows that dual innovation has a significant positive regulatory effect in the process of the

corporate innovation ecosystem affecting corporate innovation performance. Hypothesis 4 is supported by empirical data.

In model (9), take enterprise innovation performance as the dependent variable, and put the product term and control variable of exploratory innovation and enterprise innovation ecosystem into the regression model. According to the data in "Table III", exploratory innovation and enterprise innovation ecosystem and the regression coefficient of the product term is 0.091 and is not significant. This shows that exploratory innovation does not play a regulating role in the process of the corporate innovation ecosystem affecting corporate innovation performance. Assumption 4a is not supported by empirical data.

In model (10), the enterprise innovation performance is taken as the dependent variable, and the product term and control variables of exploitative innovation and enterprise innovation ecosystem are put into the regression model. According to the data in Table 3, exploitative innovation and enterprise innovation ecosystem, the regression coefficient of the product term of is 0.681 and is significant at the 1% level. This shows that exploitative innovation has a significant positive regulatory effect in the process of corporate innovation ecosystem affecting corporate innovation performance. Suppose 4b is supported.

TABLE III. EMPIRICAL TEST RESULTS OF CORPORATE INNOVATION ECOSYSTEM AND DUAL INNOVATION AFFECTING CORPORATE INNOVATION PERFORMANCE

| Variable | Enterprise innovation performance | | | | | |
|--|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| | Model(5) | Model(6) | Model(7) | Model(8) | Model(9) | Model(10) |
| Dual innovation | 0.462 ^{***} (4.73) | | | 0.471 ^{***} (4.84) | | |
| Exploratory innovation | | 0.072 (1.71) | | | 0.081 (1.84) | |
| Exploitative innovation | | | 0.532 ^{***} (7.59) | | | 0.547 ^{***} (7.98) |
| Enterprise innovation ecosystem × dual innovation | | | | 0.541 ^{***} (6.16) | | |
| Enterprise innovation ecosystem × exploratory innovation | | | | | 0.091 (1.87) | |
| Enterprise innovation ecosystem × utilization innovation | | | | | | 0.681 ^{***} (7.19) |
| Enterprise size | 0.215 ^{**} (3.14) | 0.165 [*] (3.01) | 0.395 ^{**} (4.21) | 0.241 ^{**} (3.23) | 0.174 [*] (3.11) | 0.451 ^{**} (5.21) |
| Business age | -0.102 [*] (-3.01) | -0.092 [*] (-2.91) | -0.112 [*] (-3.14) | -0.131 [*] (-3.11) | -0.101 [*] (-3.01) | -0.212 [*] (-4.16) |
| Enterprise innovation ecosystem | | | | 0.246 ^{**} (3.85) | 0.261 ^{**} (3.91) | 0.295 ^{**} (4.16) |
| Constant term | -0.471 ^{***} (-4.82) | -0.364 ^{***} (-4.15) | -0.667 ^{***} (-7.95) | -0.471 ^{***} (-4.82) | -0.468 ^{***} (-4.75) | -0.718 ^{***} (-8.06) |
| Adjusted R ² value | 0.448 | 0.003 | 0.534 | 0.514 | 0.002 | 0.552 |
| F Value | 25.407 ^{***} | 1.701 | 43.611 ^{***} | 41.076 ^{***} | 2.031 | 51.213 ^{***} |
| Number of samples | 252 | 252 | 252 | 252 | 252 | 252 |

^{a.} ***, **, and * indicate that they are significant at the levels of 1%, 5%, and 10%, respectively; T values are in parentheses.

C. Robustness test

In order to test the reliability of the above research conclusions, this paper uses Hagedoom and Bloodt [24] (2003), Yan Yang et al. [25] (2012) to measure the innovation performance of enterprises. This paper uses

March [11] (1991), He and Wong [26] (2004), Cao et al. [12] (2009) scales measure exploratory innovation and utilization innovation, and perform a series of robustness tests on the above results. The test results are shown in "Table IV" and "Table V".

TABLE IV. ROBUSTNESS TEST RESULTS OF CORPORATE INNOVATION ECOSYSTEM AFFECTING DUAL INNOVATION AND CORPORATE INNOVATION PERFORMANCE

| Variable | Dual innovation | Exploratory innovation | Exploitative innovation | Innovation performance |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | Model(1) | Model(2) | Model(3) | Model(4) |
| Enterprise Innovation Ecosystem | 0.103 ^{**} (3.23) | 0.003 (2.01) | 0.183 ^{***} (3.71) | 0.173 ^{**} (3.13) |
| Enterprise size | 0.021 [*] (2.91) | 0.001 [*] (2.89) | 0.033 ^{**} (2.91) | 0.053 ^{**} (3.03) |
| Business age | -0.031 [*] (-2.92) | -0.001 [*] (-2.82) | -0.097 ^{**} (-3.01) | -0.064 [*] (-2.91) |
| Constant term | -0.217 ^{**} (-3.31) | -0.152 ^{**} (-4.16) | -0.433 ^{**} (-4.11) | -0.077 ^{**} (-4.01) |
| Adjusted R ² value | 0.322 | 0.002 | 0.364 | 0.311 |
| F Value | 19.771 ^{***} | 1.676 | 29.871 ^{***} | 19.892 ^{***} |
| Number of samples | 252 | 252 | 252 | 252 |

^{a.} ***, **, and * indicate that they are significant at the levels of 1%, 5%, and 10%, respectively; T values are in parentheses.

TABLE V. ROBUSTNESS TEST RESULTS OF CORPORATE INNOVATION ECOSYSTEM AND DUAL INNOVATION AFFECTING CORPORATE INNOVATION PERFORMANCE

| Variable | Enterprise innovation performance | | | | | |
|--|-----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Model(5) | Model(6) | Model(7) | Model(8) | Model(9) | Model(10) |
| Dual innovation | 0.362*** (3.77) | | | 0.151*** (3.81) | | |
| Exploratory innovation | | 0.022 (1.71) | | | 0.011 (1.44) | |
| Exploitative innovation | | | 0.113*** (4.91) | | | 0.374*** (4.18) |
| Enterprise innovation ecosystem × dual innovation | | | | 0.343*** (4.63) | | |
| Enterprise innovation ecosystem × exploratory innovation | | | | | 0.021 (1.66) | |
| Enterprise innovation ecosystem × utilization innovation | | | | | | 0.371*** (4.79) |
| Enterprise size | 0.015** (3.03) | 0.075* (2.91) | 0.193** (3.11) | 0.041** (3.01) | 0.074* (2.91) | 0.051** (3.27) |
| Business age | -0.082* (-2.91) | -0.042* (-2.96) | -0.012* (-3.04) | -0.037* (-2.91) | -0.001* (-2.91) | -0.012* (-2.96) |
| Enterprise Innovation Ecosystem | | | | 0.041** (3.05) | 0.011** (3.11) | 0.095** (3.36) |
| Constant term | -0.374*** (-3.81) | -0.041*** (-3.55) | -0.167*** (-3.51) | -0.171*** (-4.02) | -0.068*** (-3.35) | -0.218*** (-4.16) |
| Adjusted R ² value | 0.382 | 0.001 | 0.331 | 0.416 | 0.001 | 0.442 |
| F Value | 24.103*** | 1.401 | 38.141*** | 40.378*** | 1.831 | 49.013*** |
| Number of samples | 252 | 252 | 252 | 252 | 252 | 252 |

a. ***, **, and * indicate that they are significant at the levels of 1%, 5%, and 10%, respectively; T values are in parentheses.

VI. CONCLUSION

This article takes the electronics and information industry enterprises as the research object, and selects 252 enterprises as the research sample, and empirically analyzes the effect of corporate innovation ecosystem and dual innovation on corporate innovation performance. The empirical results are shown below. First, the enterprise innovation ecosystem is positively related to dual innovation. The enterprise innovation ecosystem has a significant promotion effect on exploitative innovation, but has no significant effect on exploratory innovation. Second, the corporate innovation ecosystem has a promoting effect on corporate innovation performance. Third, dual innovation has a boosting effect on corporate innovation performance, exploratory innovation has no significant impact on corporate innovation performance, and exploitative innovation has an incentive effect on corporate innovation performance. Fourth, dual innovation has a positive regulatory effect on the role of the corporate innovation ecosystem on corporate innovation performance. Exploratory innovation has a modest regulatory effect on the role of the corporate innovation ecosystem on corporate innovation performance. The moderating effect of innovation in the process of corporate innovation ecosystem's impact on corporate innovation performance is significant.

This research has achieved certain results, but still has the following limitations. First, the research sample size is not large. In the future, when exploring the relationship between

the corporate innovation ecosystem, dual innovation and corporate innovation performance, the sample size and industry size will need to be further expanded. Secondly, it only explores the impact of the health of the corporate innovation ecosystem on dual innovation and corporate innovation performance. In the future, it is necessary to further explore the impact of the growth and suitability of the corporate innovation ecosystem on dual innovation and corporate innovation performance. Finally, it only explains the micro-mechanisms and effects of the corporate innovation ecosystem affecting dual innovation and corporate innovation performance. The future impact of the corporate innovation ecosystem on service innovation performance, product innovation performance, technology innovation performance, and collaborative innovation performance needs to be further explored mechanism and effect.

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