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Article

Customer Concentration and Strategic Knowledge Disclosure of Enterprise: Evidence from China

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Abstract

Strategic knowledge disclosure is becoming more and more common and important in enterprise innovation management. Nowadays enterprises are in the global open innovation network with many strategic alliances and supply chain partners. The behavior and relationship factors of external important stakeholders are of great significance to strategic knowledge disclosure. Based on transaction cost economics theory and the circular model of strategic knowledge disclosure process, this study takes manufacturing listed enterprises from 2010 to 2019 as the research object, and uses their published papers in scientific journals to represent strategic knowledge disclosure behavior. Finally, this study empirically examines the influence of supplier's dependence on major customers (i.e. customer concentration) on supplier's strategic knowledge disclosure. The customer concentration of suppliers has a significant negative impact on the implementation of strategic knowledge disclosure. High customer concentration will inhibit the total amount of strategic knowledge disclosure by suppliers. When the internal R&D expenditure of suppliers is further taken into account in the model, high customer concentration has a more obvious inhibitory effect on the intensity of suppliers' strategic knowledge disclosure. In order to analyze the selection mechanism of strategic knowledge disclosure based on the perspective of external important stakeholders, and provide a feasible path for the strategic management innovation knowledge of enterprises under the specific relationship network.

Keywords: strategic knowledge disclosure; customer concentration; model of strategic knowledge disclosure process; information transaction cost

1. Introduction

In the era of knowledge economy and open innovation paradigm, strategic knowledge disclosure has evolved into an effective competitive strategy[1] that can not only obtain external knowledge, but also prevent excessive leakage of core technology. On the one hand, strategic knowledge disclosure has become increasingly common and important in corporate practice, such as IBM's disclosure of patented software[2], BGI's publication of scientific papers[3] in scientific journals, etc. These behaviors bring new development opportunities for enterprises in the long run. On the other hand, enterprises are increasingly embedded in the global open innovation network, connecting and interacting with a large number of suppliers, strategic alliances and supply chain partners. This gradually increasing interaction or cooperation will inevitably increase the risk of enterprises leaking their core knowledge to potential competitors. Therefore, how to effectively implement strategic knowledge disclosure without increasing the possibility of external competition is one of the core challenges facing academia and industry.

Strategic knowledge disclosure refers to the behavior[4] that an enterprise voluntarily discloses the innovation knowledge that could have been proprietary to the outside world without direct reward, nor can it prevent an enterprise from obtaining the knowledge. It is regarded as a strategic mechanism[2] to reshape the collaborative behavior of other participants in the enterprise innovation ecosystem. As a strategic means, knowledge disclosure is not applicable to any situation. When to implement strategic knowledge disclosure is an important issue faced by enterprises. The existing literature mainly examines the strategic knowledge disclosure behavior[1,2,4–6] of enterprises under the interaction of internal and external environment from the perspective of "disclosure enterprise standard", but the research on how to adjust the strategic knowledge disclosure strategy in response to the actions of external important stakeholders from the perspective of "external enterprise behavior" is insufficient. In particular, when the enterprise is embedded in the close connection and cooperation with the external actors in the innovation collaboration network, the relationship between the organization and the external important stakeholders may have a greater[2] impact on the knowledge disclosure decision and its optimization. Enterprises need to make a trade-off[7] between protecting the leakage or spillover of knowledge assets and endangering their own development, and disclosing knowledge to important external partners to form collaborative innovation. Considering that customers are important external stakeholders of enterprises, Chinese listed companies are highly dependent on customers and have prominent[8] relational transactions, it is of great significance to examine enterprises' strategic knowledge disclosure from the perspective of "core enterprise-external important stakeholders" based on specific types of inter-enterprise relationship factors.

Based on the literature gap and practical needs, this paper introduces the perspective of "behavior and relationship of external important stakeholders," focusing on whether the dependence degree of supplier enterprises on major customers (namely, customer concentration degree) affects their strategic knowledge disclosure strategy. Among them, the dependence degree of suppliers on major customers is mainly studied by the dependence degree of the top five customers and the dependence degree of the largest customer respectively. The strategic knowledge disclosure strategy is empirically tested from two aspects: ① the total amount of knowledge disclosure behavior ② and the intensity of knowledge disclosure behavior, so as to answer how the dependence degree of suppliers on different customer groups affects their strategic knowledge disclosure strategy choice.

Based on the transaction cost economics theory and the cycle model of strategic knowledge disclosure process, this paper takes the A-share listed manufacturing companies in Shanghai and Shenzhen from 2010 to 2019 as the research object, and uses the papers published in scientific journals to represent the strategic knowledge disclosure behavior. To empirically test whether the degree of dependence on major customers (namely, customer concentration) affects the strategic knowledge disclosure strategy of supplier enterprises. The research contribution lies in the unique perspective of customer relationship in the supply chain from the perspective of the important external stakeholders of the enterprise, and the in-depth analysis of the information disclosure needs of the important external stakeholders of the customer for the core enterprise and how the information acquisition channels affect the strategic knowledge disclosure motivation and behavior strategy of the core enterprise. And expand the research perspective of corporate strategic knowledge disclosure behavior mechanism for external stakeholders.

2. Theoretical Analysis and Research Hypotheses

2.1. Cycle Model of Strategic Knowledge Disclosure Process for Customers

Based on Rotolo et al. 's theoretical model[9] of corporate strategic knowledge disclosure motivation for external stakeholders (academia, industry, investors, customers and institutional institutions), and Yu Yiyong and Yang Zhong's theory[10] of strategic knowledge disclosure process cycle, this paper attempts to build a customer-oriented corporate strategic knowledge disclosure process cycle model.

Customers, as business partners of enterprises in supply chain, are direct consumers of enterprises' products and services, and can provide valuable information such as product demand and market preference in the process of new product development. When facing customers as an important external stakeholder, enterprises' strategic knowledge disclosure behavior has direct or indirect benefits. From the perspective of direct effect, public knowledge disclosure may increase customers' demand for the innovation, thus providing enterprises with the effectiveness[11] of directly benefiting from the innovation; From the perspective of reputation effect, because customers usually associate the image of a company being at the forefront of technology with the high quality of products, public knowledge disclosure can often increase the sales [12]of the products applied in the innovation. Secondly, strategic knowledge disclosure can obtain user feedback and improve subsequent innovation. Knowledge disclosure can trigger feedback from downstream users, especially in user-driven R&D activities. Companies can improve existing products and processes based on knowledge interaction with users, or further develop new products [11]based on user feedback.

First, knowledge disclosure is a complementary logic of knowledge heterogeneity in the context of open innovation. Through its own active knowledge disclosure behavior, enterprises aim to acquire external knowledge and resources or some complementary capabilities. Secondly, knowledge disclosure is the market logic to find potential partners. Knowledge disclosure can be used as a signal to show the innovation progress and R&D trajectory to external enterprises at a lower search cost, thus attracting potential partners in the market to participate in[2] the R&D innovation process of enterprises. Finally, knowledge disclosure is an effective means for enterprises to establish integrity/reputation. Public knowledge disclosure demonstrates a company's scientific capabilities, makes subsequent strategic spillovers more likely, and helps enterprise improve corporate reputation to diffuse product innovation[13].

Enterprises may face different levels of strategic knowledge disclosure choices. At the level of disclosure content, there are theoretically two types of knowledge related to innovation activities that can be disclosed: (1) knowledge related to current or future market needs or problems, that is, enterprises strategically disclose current or expected future technical problems to the external environment in order to improve technology and seek support from others. The disclosure of problem-oriented knowledge may affect the spillover effect generated by external factors in the future, because it indicates the company's needs for its environment. Thus, such issue-related strategic knowledge disclosure reduces the preexisting information asymmetry of the external environment about what knowledge the firm is looking for. (2) Solution-related knowledge required to develop technologies and products. When companies voluntarily and strategically disclose knowledge about how to solve specific problems to the external environment, solution-based knowledge disclosure (such as papers that reflect solving specific needs) occurs, and this kind of knowledge disclosure aims to obtain market. It provides information to existing partners about which solutions are needed. It can also be seen as a powerful signal of what complementary capabilities or resources are needed by potential future partners. It is also an effective way for competitors or end users to deal with them. As a result, this strategic knowledge disclosure related to solutions reduces the adverse selection problem that companies may have when looking for potential partners in the future. At the level of disclosure scope, corporate strategic knowledge disclosure will involve disclosure intensity and disclosure breadth.[14]

2.2. Customer Concentration and Supplier's Strategic Knowledge Disclosure Strategy

2.2.1. Suppliers' Willingness to Disclose Strategic Knowledge: One-to-One Relationship VS. One-to-Many Relationship

Customer concentration can affect suppliers' willingness to disclose strategic knowledge. As a structural attribute of the supplier-customer relationship, customer concentration reflects the degree to which suppliers are committed to doing business[15] with their major customers, and can affect

the ability[16] of suppliers to use the information and knowledge obtained from customers to innovate. A high degree of customer concentration means that there is a strong bilateral relationship between suppliers and customers. This one-to-one relationship is an effective channel for information sharing and knowledge exchange between suppliers and customers, and can even cross geographical boundaries to share[17] knowledge, and promote inter-organizational cooperation and joint problem[18] solving. Because the customers are closer to the customers in the supply chain, the higher the customer concentration is, the easier it is for the suppliers to timely learn the market information such as consumer demand from the main customers, which reduces the search cost[19] of new product demand and the willingness to disclose knowledge publicly. In addition, from the customer perspective, because can through private channels to better alleviate the information asymmetry, the main customers will reduce the development prospects for those who are able to infer the suppliers information dependence, public disclosure of knowledge will reduce the suppliers. This is consistent[20] with Crawford et al. 's finding that there is a negative correlation between customer concentration and the public disclosure of information such as supplier management revenue and sales forecast. However, low customer concentration indicates that enterprise customers are dispersed, suppliers trade with multiple customers, and the two sides show weak ties[21]. Because knowledge disclosure is conducive to promoting information flow and knowledge sharing between suppliers and geographically distant and geographically dispersed customers, suppliers with low customer concentration are more willing to disclose strategic knowledge. Moreover, due to its inherent structural advantages (i.e., Bridges), weak supplier-customer relationships (i.e., low customer concentration) can increase suppliers' access to new resources and the potential[22] for value creation after knowledge disclosure.

2.2.2. Disclosure Motivation of Suppliers to Acquire External Knowledge and Resources: Customers' "Collective Blindness" VS. "Diversified Openness" of Customers

Customer concentration can affect suppliers' knowledge disclosure motivation to acquire external knowledge and resources. This knowledge public disclosure mechanism is particularly strategically important when the supplier firm has limited knowledge and resources to investigate specific issues, as it can enable the supplier to benefit[23] from lower R&D costs, or when the issue may be deemed too risky to warrant investigation[24].

A high degree of customer concentration means that the supplier business partners are unitary and easily "locked in" by large customers and organizational inertia. This may lead to "collective blindness" among partners, limiting suppliers' openness to new information and jeopardizing their acquisition efficiency[25], thus weakening suppliers' access to external knowledge and resources. Moreover, when suppliers focus too much on key customers, the scope of enterprise technology often becomes too narrow, which prevents suppliers from accessing different opportunities and even misses new external innovation opportunities[26]. Suppliers with higher customer concentration may become complacent with their existing partners, which will weaken their motivation[15] to continue learning or expand their search scope, further hindering strategic knowledge disclosure and knowledge transfer between closely related entities. On the contrary, suppliers with low customer concentration may have more autonomy and opportunities to cooperate with different customers to obtain heterogeneous knowledge for innovation, and their openness to external knowledge and resources and acquisition motivation are stronger, so as to ensure diversified information sources[26]. In addition, the ecosystem around the enterprise, the number of participants and the level of diversity determine the knowledge that the enterprise may acquire. Low customer concentration of suppliers open its customers more diverse, the diversification market could also increase the supplier disclosed knowledge will be used and reward opportunities.

2.2.3. Disclosure Motivation of Suppliers to Attract Cooperation and Expand Market: Retention of Existing Customers VS. Developing New Customers

Customer concentration can affect the supplier's knowledge disclosure motivation to attract cooperation and expand the market. When strategic knowledge disclosure is implemented in the form of public publication, the openness of the paper sends a "certification signal" [27] to potential customers about the quality of new products and services, and the journal peer review process it follows provides credibility[28] for the company's claims about its products and services. Intentional strategic disclosure can be used as an initiating mechanism[2] to activate collaboration and improve the likelihood of success for suppliers seeking suitable partners.

Transaction cost economics theory holds that there are high switching costs in supply chain relationships, and high customer integration will bring high switching costs to suppliers. Under the high degree of customer concentration, the strong relationship between the supplier and the main customer will encourage the supplier to participate more in the investment of specific relationship, which will reduce the value of the supplier to the external parties, and lead to high switching cost if the supplier seeks new customers. High customer concentration also means that suppliers have high dependence on major customers and low[29] bargaining power. Major customers can effectively exercise their high bargaining power to influence suppliers' decision-making behavior. Therefore, suppliers will maintain the cooperative relationship with major customers, try their best to meet the product demand and user feedback of major customers, and reduce the motivation of knowledge disclosure to actively explore new markets and find potential partners. However, low customer concentration indicates that the enterprise customer base is fragmented, and the company needs to allocate its limited capacity to a large number of customers, which leads to a reduction in the allocation amount of each customer and a high[30] possibility of customer churn. Suppliers need to make efforts to attract potential customers or explore new market Spaces in the future. Implementing strategic knowledge disclosure can disseminate corporate scientific or technical standards (such as clinical trials, product and service protocols) to the wider academic and industrial[31] communities, which is particularly important for attracting complex and specialized potential customers. At the same time, the public disclosure of knowledge can better promote the products of dispersed suppliers and improve the reputation of the company, which is conducive to the commercialization of innovation and even open new markets[32] for the company.

Based on the above analysis of suppliers' strategic knowledge disclosure willingness and motivation, this paper puts forward the following research hypotheses:

H1: There is a negative correlation between customer concentration and strategic knowledge disclosure.

3. Research Design

3.1. Sample Selection and Data Source

This paper selects A-share listed manufacturing companies in Shanghai and Shenzhen from 2010 to 2019 as the initial research sample. The selection of research objects and sample observation period is based on the following two aspects: (1) Listed companies in the manufacturing industry have greater R&D investment, higher R&D density, higher openness of R&D cooperation environment, and more common behaviors such as publicly publishing scientific and technological papers and implementing strategic knowledge disclosure; [11]② The sample selection ends in 2019 to ensure that there are three or more consecutive years of historical observation data of enterprises' strategic knowledge disclosure behavior in the empirical measurement stage. In the process of sample selection, samples with ST, financial data or corporate governance data missing were eliminated; At the same time, the samples with zero patent applications are excluded, mainly considering that listed companies without patent applications are less innovative and less likely to publish scientific papers with partial basic research. Finally, this paper constructs an unbalanced panel data with a total of 12658 firm-year observations. In this paper, the continuous variables are winsorized by 1% and the robust standard errors are used.

The types of data in this paper mainly include strategic knowledge disclosure paper data, customer concentration data, firm-level financial and innovation activity data, and provincial intellectual property and economic development indicators data. Among them, the data of strategic knowledge disclosure papers are from CNKI database (<https://www.cnki.net/>), which is one of the main Chinese academic full-text databases and represents the most comprehensive total database of Chinese knowledge resources available. The data collection steps of publicly published scientific and technological papers of listed companies are as follows: (1) Obtain the list of A-share manufacturing listed companies in Shanghai and Shenzhen from 2010 to 2019, review and manually search the relevant names of listed companies, including the full name, abbreviation and former name (if there is any name change) of sample listed companies; (2) Obtain the list of listed companies in Shanghai and Shenzhen from 2010 to 2019. ② Set the search conditions for the data of publicly published scientific and technological papers of listed companies, that is, query the "Advanced Search" - "Literature classification catalogue" on the home page of CNKI database (to ensure the consistency of statistical caliber, that is, the papers published by the company are all scientific and technological papers, The four options of "Philosophy and Humanities", "Social Sciences Series I", "Social Sciences Series II" and "Economics and Management Science" were removed from the literature classification catalogue when the search conditions were set, and the search conditions were entered successively, including the author's unit (full name/abbreviation/former name were searched separately; Precise query), publication time (from 2010 to 2022), update time (unlimited); (3) Extract the annual publication data of scientific and technological papers of listed companies according to the year of publication, that is, based on the results of all papers in the observation period of sample "Listed company A" retrieved in step 2, after retrieving the condition of "group browsing - publication year", extract the total number of scientific and technological papers published by "listed company A" in each year successively; (4) The annual publication data of all sample listed companies from 2010 to 2022 were summarized and sorted out in EXCEL document year by year. The data of customer concentration and the control variables at the company level and regional level are from the CSMAR Economic and Financial Research Database.

3.2. Variable Measurement

3.2.1. Explained Variable

Strategic knowledge disclosure: Referring to the research methods of Simeth and Lhuillery[32] and Li et al., this paper constructs two indicators of strategic knowledge disclosure strategy in different dimensions, which are ① total amount of knowledge disclosure (the number of scientific and technological papers published by the enterprise in the next period); [13] And ② the intensity of knowledge disclosure (the ratio of the number of scientific papers published in the next period to the R&D expenditure). Since R&D investment plays an important role in the scientific papers published by enterprises, it is appropriate to use the knowledge disclosure intensity index to measure the explained variable.

3.2.2. Explanatory Variable

Customer concentration: The existing literature mainly measures the degree of customer concentration faced by suppliers based on the proportion of major customers in the company's sales. Since December 2007, China Securities Regulatory Commission has required companies to disclose the proportion of total sales of the top five customers. Considering the integrity of sample data and the principle of comparability, referring to Zhao et al., this paper uses[30] the proportion of sales of the top five customers disclosed in the annual report of listed companies to the total annual sales as a measurement indicator of customer concentration. The higher the value of this index is, the greater the proportion of the supplier company's sales goes to its main customers, so the higher the customer concentration is.

3.2.3. Control Variable

In order to control firm-level heterogeneity, this paper refers to the studies of Simeth and Lhuillery[32], Li et al., Lampe and Ihl[13,14], and Yu Yiyong and Yang Zhong et al., and selects a series[10] of control variables, including R&D intensity (the ratio of total R&D expenditure to operating income) and enterprise size (the natural logarithm of total assets at the end of the period). Because these two indicators reflect the overall research output potential, scale effect and the relative importance of research activities; R&d expenditure (the logarithm of a firm's R&D investment) and R&D output (the logarithm of a firm's number of patent applications, indicating the realized R&D results) are used to control the output of a firm's research activities, because greater R&D expenditure and higher research productivity are expected to help increase the likelihood of strategic knowledge disclosure as well as the amount of knowledge disclosure; Firm age (years of establishment). In addition, companies need to have some specific capabilities to implement strategic knowledge disclosure, such as extensive knowledge accumulation (total number of invention patents granted during the observation period) and scientifically educated R&D personnel (the proportion of technical employees and the proportion of postgraduate employees can measure the company's R&D process). Finally, the institutional construction at the regional level, such as the intellectual property system and the level of economic development, will affect the strategic knowledge disclosure behavior of enterprises by influencing regional knowledge spillover and diffusion. Therefore, this paper also controls the level of provincial IPR protection (the IPR protection index disclosed in the National IPR Development Report issued by the State Intellectual Property Office and divides it by 100) and the level of regional economic development (the natural logarithm of provincial GDP).

3.3. Model Setting

Firstly, the explained variable index ① the total amount of knowledge disclosure, that is, the number of scientific and technological papers published by enterprises, is a counting variable. The results obtained by the general least square estimation method for counting data are inconsistent and biased, and Poisson estimation and negative binomial estimation are ideal. The descriptive statistics of the total amount of knowledge disclosure show that the data show the characteristics of over-dispersion, which cannot meet the assumption that the mean of Poisson estimation is equal to the variance. Therefore, the negative binomial regression model is used. For the choice between the fixed effect and the random effect, the Hausman test results show that the fixed effect is more appropriate. Secondly, the explained variable indicator ② the intensity of knowledge disclosure is generally distributed in a large range of positive numbers, including the observed value of zero, which is a restricted dependent variable. All the statistical analysis results in this paper are calculated by Stata 16.

4. Empirical Analysis

4.1. Descriptive Statistics and Correlation Analysis

4.1.1. Descriptive Statistics

Table 1 reports the descriptive statistics of the main research variables. The sample number of scientific papers published to an average of 22, a maximum of 4250; Science and technology strength of 2 published papers on average, a maximum of 500 articles, these Numbers show that although the sample company strategic knowledge between disclosure level there is a certain difference, but the Chinese manufacturing industry listed companies are actively involved in strategic knowledge, contribute to scientific knowledge reserves. For the customer concentration, the average (median) ratio of the top five customers in the sample companies is 0.276 (0.226), [30]respectively. In the aspect of control variables, the statistical data and basic researches in Table 1.

Table 1. Descriptive statistics of variables.

Variables	Observations	Mean	Median	Standard deviation	Minimum	Maximum
Total amount of knowledge disclosed	12658	22.461	3.000	128.806	0.000	4250.000
Intensity of knowledge disclosure	12658	2.273	0.316	13.814	0.000	500.143
Customer concentration	12658	0.276	0.226	19.455	0.000	0.889
R&d intensity	12658	4.450	3.693	3.770	0.000	22.280
Enterprise size	12658	12.987	12.824	1.257	8.952	18.337
R&d expenditure	12658	8.763	8.852	1.930	0.000	14.538
R&d output	12658	3.214	3.296	1.672	0.000	9.659
Age of enterprise	12658	18.995	18.600	5.848	0.915	64.041
Accumulation of knowledge	12658	1.725	1.609	1.629	0.000	6.105
Technical staff	12658	19.142	15.378	13.257	2.552	68.394
Highly educated employees	12658	3.175	1.354	5.156	0.000	52.079
Intellectual property protection	12658	0.745	0.768	0.138	0.404	0.938
Level of economic development	12658	10.491	10.564	0.782	6.240	11.731

4.1.2. Correlation Analysis

Table 2 reports the main research of Pearson and Spearman correlation between variables. The explained variable index ① The relationship between the total amount of knowledge disclosure and the customer concentration index is significantly negative, which provides preliminary evidence that the customer concentration is negatively correlated with the enterprise strategic knowledge disclosure. Among the control variables, enterprise size, R&D expenditure, R&D output, knowledge accumulation, skilled employees and highly educated employees are positively correlated with the total amount of strategic knowledge disclosure, while R&D intensity, enterprise age, intellectual property protection and economic development level are negatively correlated with the total amount of knowledge disclosure. The maximum variance inflation factor of all independent variables is 2.54, which alleviates the concern of multicollinearity.

Table 2. Variable Pearson and Spearman correlation coefficient.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. The total disclosure of knowledge	1.000	-	-	0.392***	0.323*	0.241*	0.045***	0.233*	0.021*	0.159*	-	-
		0.153***	0.064***		**	**		**	*	**	0.119*	0.110*
											**	**
2. Customer concentration	-	1.000	0.165***	-	-	-	-	-	0.136*	0.044*	0.023*	0.089*
	0.033*			0.191***	0.109*	0.034*	0.039***	0.065*	**	**	**	**
	**				**	**		*				
3. The research and development strength	-	0.129***	1.000	-	0.323*	0.231*	-	0.199*	0.534*	0.437*	0.181*	0.262*
	0.028*			0.218***	**	**	0.068***	**	**	**	**	**
	**											
4. Enterprise size	0.143*	-	-	1.000	0.713*	0.481*	0.232***	0.288*	-	0.087*	-	0.001
	**	0.165***	0.190***		**	**		**	0.092*	**	0.112*	
									**		**	
5. R&d spending	0.099*	-	0.292***	0.597***	1.000	0.628*	0.171***	0.402*	0.191*	0.315*	0.066*	0.191*
	**	0.077***				**		**	**	**	**	**
6. R&d output	0.094*	-0.030**	0.166***	0.514***	0.629*	1.000	0.102***	0.327*	0.183*	0.242*	0.064*	0.177*
	**				**			**	**	**	**	**
7. Enterprise age	-	-	-	0.202***	0.106*	0.093*	1.000	0.163*	-	0.053*	-	0.202*
	0.036*	0.038***	0.081***		**	**		**	0.041*	**	0.099*	**
	**								**		**	
8. Knowledge accumulation	0.050*	-	0.148***	0.345***	0.413*	0.380*	0.163***	1.000	0.160*	0.228*	0.020*	0.118*
	**	0.073***			**	**			**	**	*	**
9. Technical staff	0.044*	0.125***	0.496***	-	0.163*	0.152*	-	0.137*	1.000	0.470*	0.087*	0.108*
	**			0.078***	**	**	0.047***	**		**	**	**
10. Highly educated employees	0.031*	0.105***	0.507***	0.060***	0.237*	0.196*	0.0003	0.198*	0.548*	1.000	0.002	0.080*
	**				**	**		**	**			**
11. The protection of intellectual property rights	-	0.009	0.130***	-	0.114*	0.090*	-	0.032*	0.077*	0.008	1.000	0.671*
	0.026*			0.104***	**	**	0.067***	**	**			**
	**											
12. The level of economic development	-	0.074***	0.187***	-0.003	0.214*	0.194*	0.194***	0.135*	0.083*	0.047*	0.722*	1.000
	0.017*				**	**		**	**	**	**	

Note:***** denotes significance at the levels of 1%, 5% and 10%, respectively.

4.2. Hypothesis Testing

Table 3 reports customer concentration and strategic knowledge to disclose the return of the hypothesis testing results. Among them, the model 1 and model 3 is the benchmark model includes only the control variable, the model 2 and 4 are including explanation variable customer concentration model the whole samples. First, the model 1 and model 2 main inspection customer relationship of the total concentration and strategic knowledge to disclose. The regression coefficient of customer concentration is – 0.002 and significant at the level of 10%, which supports Hypothesis 1. Shows that high customer concentration can inhibit enterprise strategic knowledge disclosures, supplier enterprises higher customer concentration is associated with lower total strategic knowledge disclosure. In the aspect of control variables, r&d strength, enterprise scale, r&d output and knowledge accumulation significantly positive impact on strategic knowledge total disclosure, this is consistent with the results of existing basic. Secondly, model 3 and model 4 main test concentration, and the intensity of strategic knowledge disclosure relationship. Customer concentration of regression coefficient is 0.033, and a significant at 5% level, the results support the hypothesis 1. Shows that high customer concentration can inhibit enterprise strategic knowledge levels of disclosure, supplier enterprises higher customer concentration is associated with lower intensity of strategic knowledge of disclosure, and disclosure than knowledge, total customer concentration for knowledge revealed the strength of the negative influence is greater. In the aspect of control variables, the enterprise scale, r&d and technical staff strength of strategic knowledge disclosure have a significant positive effect, but the research and development strength and negatively correlated with age, partly verified the young companies to invest more in terms of strategic knowledge of disclosure.

Table 3. Customer concentration and strategic knowledge to disclose the regression results.

variable	Model 1	Model 2	Model 3	Model 4
	The dependent variable = total disclosure of knowledge		Dependent variable = intensity of knowledge disclosure	
Customer concentration		-0.002* (-1.77)		-0.033** (2.06)
R&d intensity	0.011* (1.70)	0.011* (1.66)	-0.339*** (-2.71)	-0.333*** (2.70)
Enterprise scale	0.168** (3.76)	0.164** (3.67)	1.384** (4.02)	1.320** (3.84)
R&d spending	0.005 (0.34)	0.005 (0.35)	0.911** (2.17)	0.892** (2.15)
Research and development production	0.040** (2.42)	0.040** (2.40)	0.072 (0.26)	0.090 (0.32)
Enterprise age	-0.013 (-1.35)	-0.012 (1.32)	-0.212** (-2.10)	-0.217** (-2.11)
Accumulation of knowledge	0.046** (3.71)	0.045** (3.65)	0.174 (0.95)	0.151 (0.79)
Technical staff	-0.003 (1.37)	-0.003 (1.30)	0.086** (2.12)	0.089** (2.18)
Highly educated employees	0.002	0.003	0.047	0.055

	(0.30)	(0.46)	(0.59)	(0.69)
The protection of intellectual property rights	0.275	0.270	-5.233	-5.900
	(1.53)	(1.50)	(0.89)	(-0.98)
Level of economic development	0.061	0.068	0.130	0.278
	(0.77)	(0.86)	(0.16)	(0.32)
Constant term	-2.030***	-2.000***	-21.261***	-20.448***
	(2.76)	(2.72)	(2.82)	(-2.79)
Sample observations	12658	12658	12658	12658
Prob>chi2	0.000	0.000	0.007	0.007
Log Pseudolikelihood	-26821.282	-26816.535	-42086.468	-42077.882

Note:***, **, * , respectively in 1%, 5% and 10% significance level, brackets said t - test values, the same below.

4.3. Robustness Test

4.3.1. Changing the Measurement Method of Strategic Knowledge Disclosure of Explained Variable (Using the Paper Data of the Next Two Issues)

To sample companies lag for two years and published scientific papers published total strength by the empirical test is as explained variable, regression results are consistent with the original model, research conclusion remains robust.

Table 4. replacement robustness test of the measuring methods of strategic knowledge of disclosure.

variable	Model 1	Model 2	Model 3	Model 4
	The dependent variable amount = publishing		The dependent variable = paper strength	
Customer concentration		-0.002* (1.72)		-0.035** (2.14)
R&d intensity	0.003 (0.47)	0.003 (0.44)	-0.360*** (-2.78)	-0.354*** (2.76)
Enterprise scale	0.188*** (4.59)	0.183*** (4.54)	1.515*** (4.16)	1.442*** (4.00)
R&d spending	0.009 (0.46)	0.009 (0.47)	0.876** (2.02)	0.859** (2.00)
Research and development production	0.021 (1.29)	0.021 (1.28)	0.080 (0.25)	0.099 (0.31)
Enterprise age	-0.015 (1.55)	-0.015 (1.52)	-0.235** (-2.16)	-0.239** (2.18)
Accumulation of knowledge	0.027* (1.77)	0.025 (1.63)	0.105 (0.50)	0.079 (0.36)
Technical staff	-0.002 (0.89)	-0.002 (0.82)	0.090** (2.24)	0.094** (2.30)

Highly educated employees	0.001 (0.18)	0.002 (0.34)	0.054 (0.66)	0.063 (0.76)
The protection of intellectual property rights	0.330* (1.69)	0.325* (1.67)	-5.441 (0.85)	-6.118 (0.93)
Level of economic development	0.054 (0.67)	0.061 (0.77)	0.124 (0.14)	0.272 (0.30)
Constant term	-2.042** (-2.38)	-2.016** (-2.35)	-21.832*** (-2.77)	-20.867*** (2.73)
The sample observations	11354	11354	11354	11354
Prob>chi2	0.000	0.000	0.007	0.007
Log Pseudolikelihood	-23785.697	-23780.765	-38209.335	-38200.945

4.3.2. Change the Variable Customer Concentration Measurement Method (Using the Index of the First Big Customer Sales Accounted)

In the existing literature is usually the first big customer sales accounted for as indicators for customer concentration. Although the China Securities Regulatory Commission requires listed companies to disclose the proportion of sales related to the top five customers, companies can voluntarily disclose the detailed proportion of sales to the top five customers. Therefore, there are a lot of detailed disclosure of listed companies accounted for the largest customer sales, robustness test customer concentration can be replaced with the first big customer sales proportion index. Table 5 reports the regression results, which show that the research conclusion is still robust after replacing the measurement method of customer concentration index.

Table 5. Robustness tests of alternative measures of customer concentration.

Variables	Model 1	Model 2	Model 3	Model 4
	Dependent variable = total number of papers published		Dependent variable = intensity of publication	
Client concentration _ No. 1		-0.004** (-1.98)		-0.074*** (-2.95)
R&d intensity	0.011* (1.70)	0.011* (1.67)	-0.339*** (-2.71)	-0.331*** (-2.69)
Size of enterprise	0.168*** (3.76)	0.164*** (3.75)	1.384*** (4.02)	1.332*** (3.91)
Research and development expenditures	0.005 (0.34)	0.005 (0.35)	0.911** (2.17)	0.870** (2.12)
R&d output	0.040** (2.42)	0.040** (2.45)	0.072 (0.26)	0.083 (0.30)

Age of business	-0.013	-0.013	-0.212**	-0.218**
	(-1.35)	(-1.45)	(-2.10)	(-2.13)
Accumulation of knowledge	0.046***	0.045***	0.174	0.161
	(3.71)	(3.77)	(0.95)	(0.87)
Technical staff	-0.003	-0.003	0.086**	0.090**
	(-1.37)	(-1.30)	(2.12)	(2.19)
Highly educated employees	0.002	0.003	0.047	0.050
	(0.30)	(0.38)	(0.59)	(0.64)
Intellectual property protection	0.275	0.273	-5.233	-5.652
	(1.53)	(1.51)	(-0.89)	(-0.95)
Level of economic development	0.061	0.067	0.130	0.230
	(0.77)	(0.85)	(0.16)	(0.28)
Constant term	-2.030***	-1.994***	-21.261***	-20.237***
	(-2.76)	(-2.74)	(-2.82)	(-2.77)
Sample observations	12658	12658	12658	12658
Prob>chi2	0.000	0.000	0.007	0.007
Log Pseudolikelihood	-26821.282	-26811.885	-42086.468	-42069.184

5. Conclusions and Implications

5.1. Research Conclusions

In this paper, the research conclusion is as follows: first of all, based on the theory of transaction cost economics, customer concentration affects supplier innovation of enterprise knowledge management strategy. Specifically, when facing customers, an important external stakeholder, suppliers with high customer concentration will avoid choosing strategic knowledge disclosure to manage innovation knowledge, that is, to publicly disclose internal innovation achievements in the form of scientific papers. On the contrary, they will choose to exchange knowledge and share information with major customers (especially big customers) through private channels. In this case, the information feedback and knowledge spillover from major customers on product R&D are direct and efficient for suppliers. In contrast, suppliers with low customer concentration prefer strategic knowledge disclosure to manage innovation knowledge. They will disclose the internal knowledge related to product R&D problems or solutions to the diversified and highly dispersed external customer groups through public channels by publishing scientific and technological papers. In this case, the cost of information sharing and knowledge exchange between supply chain business partners is low, and the efficiency of obtaining user feedback in the future is high.

Secondly, based on the customer-oriented strategic knowledge disclosure process cycle model, the supplier's customer concentration has a significantly negative impact on the implementation of strategic knowledge disclosure strategy. High customer concentration not only inhibits the total amount of strategic knowledge disclosure behavior, but also inhibits the intensity of strategic knowledge disclosure, and the inhibition effect on the intensity of knowledge disclosure is stronger. In addition, consider two different customer concentration measure, compared with the top five customer impact on strategic knowledge to disclose supplier strategy, of strategic knowledge of concentration of suppliers' enterprise's biggest client disclosure policy stronger inhibitory effect. Specifically, when the supplier enterprise has the characteristics of low customer concentration, due to the diversity and openness of the customer group, the supplier enterprise will have a stronger

motivation to acquire external knowledge and resources. In addition, when the customers are scattered and easy to lose, the supplier enterprises will have stronger knowledge disclosure motivation to attract cooperation and expand the market. Under the combination of strong knowledge disclosure motivation and favorable knowledge disclosure conditions, the supplier enterprises with low customer concentration will prefer to implement strategic knowledge disclosure strategy, and are more likely to obtain the future benefits generated by knowledge public disclosure.

5.2. Research Contribution

This paper mainly makes the following two contributions: First of all, this article obtains from the enterprise external important stakeholders, choose customer relationship in the supply chain a unique Angle of view, analyze and validate the external important stakeholders of core enterprise information disclosure requirements and access to information channels will affect how the core enterprise's strategic knowledge disclosure strategy, Important stakeholders behavior and the relationship between "from the" external perspective to expand strategic knowledge disclosure mechanism research. Existing literature mainly based on the perspective of disclosure of enterprise standard enterprise strategic knowledge disclosures, under internal and external environment interaction from the external enterprise behavior perspective in dealing with the external important stakeholders how to adjust the strategic knowledge disclosure strategy under the action of research. This paper theoretically proposes and empirically tests the mechanism of customer concentration on corporate strategic knowledge disclosure, which provides a new research perspective for enterprises to coordinate the innovation activities and collaboration of important external actors in the innovation chain and promote knowledge sharing and interaction.

Secondly, based on the enterprise strategic knowledge disclosure process cycle model, depth of deconstruction customer oriented supplier disclosure of enterprise strategic knowledge circulation mechanism, not only carefully distinguish between the top five suppliers under the customer's concentration and the first big customer concentration enterprise strategic knowledge disclosure strategy choice, also focuses on supplier corporate disclosures intensity of strategic knowledge, To echo of theory and empirical added Lampe and Ihl[14] based on enterprise strategic knowledge disclosure intensity (focusing on homogeneity) in the field of knowledge and knowledge disclosure scope (focus in the field of knowledge heterogeneity), and geared to the needs of external stakeholders such[9] as Rotolo (academia, industry, investors, customers, and institutions) of the enterprise strategic knowledge disclosure motivation theory model And other related research.

5.3. Management Implications

First, in the context of open innovation, it provides a reference for core enterprises in different degrees of cooperation with the upstream and downstream of the innovation chain to implement strategic knowledge disclosure. In an external partners and supply chain upstream and downstream cooperation interaction in the real world, unconscious knowledge leakage is inevitable, enterprises need to find an appropriate balance, can protect the core knowledge assets disclosure or overflow, and can selectively voluntarily disclose some information to the partner to facilitate collaborative innovation. When the core enterprise and supply chain upstream and downstream enterprises to participate in collaborative innovation, if the core enterprise has formed with upstream and downstream enterprise is highly dependent on relations of cooperation, at this point, the strategic knowledge disclosure can reduce appropriately; Core enterprise if not close cooperative relationship with upstream and downstream enterprises to establish strong, at this point, the core enterprise can actively research and development of public disclosure of some knowledge, to speed up the upstream and downstream of complementary and the development and commercialization of innovation, and promote the building of the whole innovation chain and synergistic effect. For example, the core enterprise can publicly disclose information about future innovation, in order to attract the downstream customers to enter their innovation ecosystem[33].

Secondly, it provides ideas for knowledge intensive enterprises to trade off knowledge protection and knowledge disclosure strategies under different innovation profitability. In open innovation networks, formal and informal intellectual property protection mechanisms and strategic knowledge disclosure are both feasible strategies[10]. In the face of different knowledge combinations and innovation profitability, enterprises should carefully weigh the degree and method of strategic knowledge disclosure. The knowledge disclosure should be avoided or minimized when the internal knowledge portfolio is biased towards the authorized patents, if the patents are weak and undefendable. However, if it is a strong and defensible patent portfolio, limited knowledge disclosure is feasible. When the enterprise knowledge portfolio is biased towards trade secrets, because the disclosure of trade secrets will cause great harm to the enterprise, strategic knowledge disclosure should be avoided as much as possible. In addition, there is also a tension between strategic knowledge disclosure through publishing scientific papers and patent application activities. Publishing papers as a form of knowledge disclosure increases the prior art, but it will limit the possibility of obtaining patents. Therefore, the choice of various means of knowledge disclosure should be carefully considered.

In summary, from a management perspective, companies must make prudent choices between whether to disclose their R&D achievements (or keep them as trade secrets), how to disclose them (i.e. publish papers or apply for patents), and disclosure strategies to maximize the strategic benefits from their internal R&D achievements.

5.4. Limitations and Prospects

First, from the perspective of supply chain, the relationship between upstream and downstream enterprises involves the degree of business dependence, geographical distance, direct or indirect network effects, and the concentration degree of the whole supply chain. These factors will affect the strategic knowledge disclosure behavior of core enterprises to varying degrees, which needs further exploration in the future. This paper also cannot directly test the impact of inter-organizational relationship quality indicators, such as trust and power imbalance, on supplier enterprises' strategic knowledge disclosure strategy. Secondly, in addition to specific types of inter-enterprise relationships and relationship strength characteristics, core enterprises will also be in the position of the supply network. Finally, future research can comprehensively measure the concept of enterprise strategic knowledge disclosure, such as "breadth of strategic knowledge disclosure", which is defined as the number[14] of knowledge disclosure channels. Organizations that use a wider range of knowledge disclosure may have a wider scope of knowledge disclosure.

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