

Enterprise Internationalization and Enterprise Innovation Performance: The Regulating Effect of Equity Incentive

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Abstract: Against the backdrop of globalization in today's era, Chinese enterprises are experiencing a flourishing trend of internationalization. With the rise of the Chinese economy and the continuous advancement of reform and opening up, an increasing number of Chinese enterprises are actively integrating into the global market, seeking the resources needed for their own development on a global scale, enhancing innovation capabilities, and striving to improve their position and influence in the global value chain. This article takes 647 manufacturing enterprises as the research objects, subdivides the measurement of internationalization into depth and breadth, quantitatively explores the impact of the depth and breadth of enterprise internationalization on innovation performance, and investigates the moderating effect of equity incentives. The results show that: the depth of internationalization significantly promotes innovation performance of enterprises, and equity incentives positively moderate the relationship between them; the breadth of internationalization significantly promotes innovation performance of enterprises, and equity incentives positively moderate the relationship between them.

Keywords: Internationalization depth; internationalization breadth; innovation performance; equity incentives.

1. Introduction

In the context of globalization, the internationalization of Chinese enterprises shows a momentum of vigorous development. With the rise of China's economy and the continuous promotion of reform and opening up, more and more Chinese enterprises actively integrate into the global market, trying to find the resources needed for their own development on a global scale, strengthen their innovation capacity, and strive to enhance their position and influence in the global value chain. In 2022, China's OFDI flow exceeded US \$160 billion, ranking second in the world and the top three in the world for 11 consecutive years. By the end of 2022, China's OFDI stock reached US \$2.75 trillion, ranking the top three in the world for six consecutive years. Chinese enterprises have set up 47,000 overseas enterprises in 190 countries and regions. Thus it can be seen that China's outbound investment capacity is at the forefront of the world. In the context of economic globalization, Chinese enterprises actively enter the international market. Does it improve the innovation ability of enterprises? For Chinese enterprises participating in international markets, is the higher their participation, the better their innovation performance?

At present, the research has analyzed the relationship between enterprise internationalization and enterprise innovation performance, but it has not reached a unified conclusion. Some scholars believe that promoting the internationalization strategy plays a role in promoting the innovation performance of enterprises. Mario et al. (2008) concluded from empirical research on enterprises that when the enterprise internationalization reaches a certain degree, it can penetrate into many overseas markets, successfully obtain more innovation output and improve business performance [1]. Filippetti et al. (2017) conducted empirical research on the country as an individual, and found that when the national absorption capacity of innovation resources is strong enough, internationalization promoted the improvement of national

innovation performance through the efficient flow of innovation resources [2]. Based on Zhao Chuanwen (2020) and organizational learning theory, the data of listed companies in China's high-tech industry confirmed that the degree of internationalization has a significant positive impact on enterprise innovation performance [3]. Zhai Xiaorong et al. (2023) show that the new energy vehicle enterprises above the scale mainly focus on the expansion strategy of overseas subsidiaries, and improve their innovation performance by integrating the government or various market resources [4]. There are also some scholars believe that internationalization will inhibit effect on enterprise innovation performance, Yao pengpeng (2018) based on organizational learning theory of enterprise internationalization and innovation performance relationship, think enterprise internationalization will test enterprise absorption ability, bring challenges to enterprise innovation performance, and through empirical research verified the internationalization negative influence enterprise innovation performance conclusion [5]. Luo Xinyi (2021) proposed that the improvement of internationalization depth will lead to resource mismatch, and cause operational risks to hit the enterprise innovation ability of the [6].

Scholars have not reached a unified conclusion on the research of the relationship between two and others. Existing studies mostly analyze the adjustment factors between internationalization and innovation performance from the perspectives of external environment and enterprise nature, and few studies mention the regulating role of equity incentive on the relationship between the two on the road of enterprise internationalization [7][8][9]. China belongs to a developing country, and the manufacturing industry is an important factor to distinguish developing countries from developed countries. Focusing on the study of China's manufacturing industry can better explore their own internationalization path for Chinese enterprises.

2. Theoretical Analysis and Research Hypothesis

2.1. Depth of enterprise internationalization and enterprise innovation performance

This paper subdivides the internationalization of enterprises into the depth and breadth of internationalization. The depth of internationalization refers to the intensity of enterprises' participation in international operation and their dependence on overseas markets. On the one hand, the internationalization depth of higher enterprise and overseas market higher degree of integration, the local cultural differences, market demand, competitive environment and human resources will have a deeper understanding, which enables them to get more complementary resources in different countries, still have the opportunity from relatively backward countries for cheaper raw materials and labor, reduce production costs, for product international cooperation research and development to provide more sufficient financial support [10]. Further internationalization can continuously expand the channels for enterprises to acquire overseas knowledge, provide enterprises with richer and more valuable knowledge resources, and create more opportunities for interaction and communication, which will help stimulate the innovation ability of enterprises and promote the improvement of innovation performance of [11]. On the other hand, enterprises with higher international depth can have access to more cutting-edge scientific and technological knowledge, and improve their innovation performance through technology transfer and knowledge sharing [12]. With the internationalization of enterprises, they have a wider range of learning opportunities and stronger innovation motivation, thus promoting the improvement of research and development efficiency, promoting the output of scientific and technological achievements, and improving the innovation performance [13]. Therefore, this paper proposes the hypothesis that:

H1: The depth of enterprise internationalization can promote the innovation performance of enterprises

2.2. Breadth of enterprise internationalization and enterprise innovation performance

Internationalization breadth is the size of the scope of international business. The larger the scope of participation, the more international market it will be involved in, and the more resources and learning opportunities it will be exposed. On the one hand, in the process of internationalization of enterprises, the increase of the breadth of internationalization not only expands the way for enterprises to obtain resources, but also injects the diversity and complementary resources into the enterprise. These resources include technology, talent, market information and so on. They realize the horizontal flow within the enterprise, and promote the exchange and complementary of resources between different regions and countries [14]. By setting up overseas subsidiaries, enterprises can cooperate with local suppliers, R & D institutions, and allocate R & D resources and carry out R & D layout globally, so as to further improve the innovation performance of enterprises [15]. On the other hand, internationalization breadth provides enterprises with learning opportunities across regional and cultural boundaries. Through communication with innovation subjects in different regions, enterprises can enrich their knowledge reserve and

improve their ability of exploratory learning, so as to promote the improvement of innovation performance. Internationalization breadth increase will also stimulate enterprise internal innovation power, different countries market diversity and the difference of business environment will force enterprises to constantly adjust the products, services and even organization structure, to meet the needs of the local market, the challenging environment forced enterprise continuous innovation, constantly explore, improve the flexibility and adaptability of enterprise [16]. Therefore, this paper proposes the hypothesis that:

H2: The breadth of enterprise internationalization promotes the innovation performance of enterprises

2.3. Adjustment effect of equity incentive

Compared with local enterprises, international enterprises bear more agency costs, and the uncertainty brought by international operation is more prominent. Enterprises operating in different countries are affected by the economy, culture and policies of the host country, which increases the uncertainty of operation. To alleviate the principal-agent problem, shareholders usually take steps to provide management with incentives closely related to the long-term development of the company, such as stocks or options, to strengthen the management incentives and supervision of [17]. Through equity incentive, from the role of shareholders, realize the identity conversion, makes the managers and the interests of the owner of the bundled, so that managers will consider the future long-term development of the enterprise to make decisions, this practice helps to improve enterprise innovation ability and increase innovation output [18]. Senior managers tend to pay more attention to the short-term interest goals in the tenure cycle, and tend to choose in the investment areas with low risk and high certainty [19]. Equity incentive improves managers' willingness to take risks, and can share the high returns of innovation success. At the same time, considering personal interests and reputation demands, managers are more willing to provide more resources to innovative projects that can increase the competitive advantage of the company, and promote the performance level of technological innovation to improve [20]. Therefore, this paper proposes the hypothesis that:

H3: Equity incentive has a positive regulating effect on the relationship between the enterprise internationalization depth and enterprise innovation performance

H4: Equity incentive has a positive regulating effect on the relationship between enterprise internationalization breadth and enterprise innovation performance

3. Research Design

3.1. Sample Selection

This paper mainly explores the influence of the internationalization degree on the innovation performance of enterprises. Manufacturing is usually an important part of a country's economy, especially for developing countries and emerging economies, manufacturing is often an important pillar of supporting the national economy, manufacturing is usually an important part of a national economy, China and the global industrial chain and supply chain is inseparable, in the internationalization strategy of Chinese enterprises is manufacturing, manufacturing is also an important field of technology innovation and competition [21]. At the same time, with the decline of China's demographic dividend, the

increase of labor costs, the cost of land and capital has also increased significantly, the domestic development of manufacturing enterprises is limited, and it is urgent for enterprises to go out [22]. Therefore, the manufacturing industry is selected as a sample to study the basic situation of the internationalization and innovation of Chinese enterprises.

In this paper, the data of A-share listed companies from 2015 of Chinese manufacturing industry to 2022 are selected as observation samples, and the data are processed in the following way; (1) excluding enterprise samples without overseas business; (2) excluding listed companies with transaction status of ST and * ST; (3) excluding observation samples with missing data and abnormal observed values. The international data and financial data used in this paper are from the CSMAR database and Wind database, and the enterprise patent data are from the CNRDS database. In the end, this paper obtained 5,176 observations from 647 listed manufacturing companies.

3.2. Definition and measurement of variables

(1) Dependent Variable: The number of patents is directly correlated with a company's level of technological innovation, serving as an indicator of its innovation capability. With increasing awareness of intellectual property rights, patent applications have become a crucial means for companies to safeguard their intellectual property. Moreover, considering that there is typically a time lag in patent grants, we adopt the approach of Peng Songlin (2017) and Li Xuesong (2022) by utilizing the number of patent applications to gauge a

company's innovation capability, we logarithmically transform the number of patent applications and add one for calculation [23][24].

(2) Independent Variables: Concerning internationalization depth, we follow established research methodologies while taking into account data accessibility. We opt for the ratio of overseas business revenue to total operating revenue to assess this dimension [25][26]. An escalation in this ratio signifies a deepening level of internationalization, with a higher proportion of overseas business revenue indicating greater internationalization depth.

Regarding internationalization breadth, we similarly rely on previous research methodologies and data availability. We employ the number of overseas subsidiaries to measure this dimension [27][28]. An increase in the value of this indicator denotes an expansion of internationalization, with a larger number of overseas subsidiaries signifying greater internationalization breadth.

(3) Moderator Variable: With equity ownership, as stock prices ascend, managers also stand to gain higher returns. This mechanism can mitigate managerial myopia and incentivize long-term investments such as research and development (R&D) innovation. Consequently, we utilize the ratio of total executive shareholdings to total shares outstanding as a metric for the level of executive equity incentives [29].

(4) Control Variables: We incorporate company size, financial leverage, return on total assets, growth rate, and years since establishment as control variables [30][31]. The primary variables are delineated in Table 1.

Table 1. Primary variable definitions

Variable Type	Variable Name Measurement Method	Variable Symbol	Measurement Method
Dependent Variable	Innovation Performance	Patent	Ln(Number of patents applied for in the current year + 1)
Independent Variables	Enterprise Internationalization Depth	Doic1	Overseas business revenue/Total operating revenue
	Enterprise Internationalization Breadth	Doic2	Ln(Number of overseas subsidiaries + 1)
Moderator Variable	Equity Incentives	MSH	Number of shares held by management/Total number of shares
	Company Size	Size	Ln(Total assets)
Control Variables	Financial Leverage	Lev	Total liabilities/Total assets
	Return on Total Assets	ROA	Net profit/Total assets at the end of the period
	Growth	Growth	(Current year's operating revenue - Previous year's operating revenue)/Previous year's operating revenue
	Years Since Establishment	Age	Ln(Current year - Year of establishment)

3.3. Model Specification

In order to test the influence effect of enterprise internationalization on enterprise innovation performance, referring to the model design of Zhang Jie (2017) and Yu Yihua (2018) [32][33], the total regression model of this study is as follows:

$$Patent_{it} = \alpha_0 + \alpha_1 \times Doic1_{it} + \alpha_2 \times Size_{it} + \alpha_3 \times Lev_{it} + \alpha_4 \times ROA_{it} + \alpha_5 \times Growth_{it} + \alpha_6 \times Age_{it} + year + ind + \varepsilon_{it} \quad (1)$$

$$Patent_{it} = \alpha_0 + \alpha_1 \times Doic2_{it} + \alpha_2 \times Size_{it} + \alpha_3 \times Lev_{it} + \alpha_4 \times ROA_{it} + \alpha_5 \times Growth_{it} + \alpha_6 \times Age_{it} + year + ind + \varepsilon_{it} \quad (2)$$

To examine the moderating effect of equity incentives on the relationship between enterprise internationalization and innovation performance, an interaction term is added to the regression model:

$$\begin{aligned}
Patent_{it} = & \beta_0 + \beta_1 \times Doic1_{it} + \beta_2 \times MSH_{it} + \\
& \beta_3 \times Doic_{it} \times MSH_{it} + \beta_4 \times Size_{it} + \beta_5 \times Lev_{it} + \\
& \beta_6 \times ROA_{it} + \beta_7 \times Growth_{it} + \beta_8 \times Age_{it} + year + \\
& ind + \varepsilon_{it} \tag{3}
\end{aligned}$$

$$\begin{aligned}
Patent_{it} = & \beta_0 + \beta_1 \times Doic2_{it} + \beta_2 \times MSH_{it} + \\
& \beta_3 \times Doic_{it} \times MSH_{it} + \beta_4 \times Size_{it} + \beta_5 \times Lev_{it} + \\
& \beta_6 \times ROA_{it} + \beta_7 \times Growth_{it} + \beta_8 \times Age_{it} + year + \\
& ind + \varepsilon_{it} \tag{4}
\end{aligned}$$

Patent_{it} represent the innovation performance of company i in year t, Doic1_{it} represents the internationalization depth of company i in year t, Doic2_{it} represents the internationalization breadth of company i in year t, MSH_{it} represents the equity incentives of company i in year t, Doic1_{it} × MSH_{it} is the interaction term between internationalization depth and equity incentives of company i in year t, used to measure the moderating effect, Doic2_{it} × MSH_{it} is the interaction term between internationalization breadth and equity incentives of company i in year t, used to measure the moderating effect, Size_{it} is company size, Lev_{it} is financial leverage, ROA_{it} is return on total assets, Growth_{it} is growth, Age_{it} is years since establishment, year and ind respectively represent year and industry fixed effects, ε_{it} is the error term. To ensure the accuracy of the regression results, decentralization is performed before constructing the interaction terms between enterprise internationalization and equity incentives, to avoid potential multicollinearity.

4. Empirical Results and Analysis

4.1. Descriptive analysis

First, descriptive statistics were made on the main variables of the sample of 647 listed manufacturing companies involved in the institute. Descriptive statistics of this paper include the total sample, mean, median, standard deviation,

maximum and minimum. To avoid the effect of extreme values on the empirical results, the continuous variables involved were treated at 1% Winsorize. Table 2 is the descriptive statistical results, in which the mean value of the innovation performance of the explained variable enterprise Patent is 3.533, the minimum value is 0, the maximum value is 6.518, and the standard deviation is 1.243, indicating that the innovation performance of the sample enterprises is quite different, and the sample enterprises have some diversity. The average value of the enterprise internationalization depth of Doic 1 is 0.196, the minimum value is 0.002, and the maximum value is 0.763, indicating that the proportion of overseas income of the sample enterprises is different, and the depth of internationalization is different. Interpretive variable internationalization breadth Doic 2 average of 0.74, the median of 0.693, the minimum of 0, the maximum of 3.367, the standard deviation of 0.856, that the sample enterprise overseas subsidiaries of large difference, from the mean and median, about 50% of enterprises overseas only a subsidiary, that the country of manufacturing enterprise internationalization breadth is in the primary stage. The average value of the adjustment variable equity incentive MSH is 0.132, the minimum value is 0, the maximum value is 0.634, and the standard deviation is 0.172, indicating that the total shareholding ratio of senior executives of the sample enterprises is not high, and the equity incentive level of different enterprises varies greatly. In addition to the main variables mentioned above, the mean ROGA ROA in the control variables in the selected sample was 0.04, which varied between -0.187 and 0.189, indicating a large difference in yield among enterprises. The mean value of growth Growth was 0.156, varying between -0.398 and 1.571, showing significant variability. The mean value of enterprise size Size is 22.33, which varies between 20.21 and 25.39, indicating that there are some differences between enterprise sizes. The mean value of financial leverage Lev is 0.400, varying between 0.069 and 0.77, indicating that there are still differences in the asset-liability ratio between enterprises. The mean enterprise age of Age was 2.991, varying between 2.197 and 3.526, indicating some differences in the year of enterprise establishment. Considering the above, it shows that the sample companies selected in this survey are differentiated and diversified, which can reflect the operating conditions of Chinese manufacturing companies.

Table 2. Descriptive statistics

Variables	N	Mean	Median	Std. Dev	Minimum	Maximum
Patent	5176	3.533	3.638	1.243	0	6.518
Doic1	5176	0.196	0.140	0.181	0.002	0.763
Doic2	5176	0.740	0.693	0.856	0	3.367
MSH	5176	0.132	0.028	0.172	0	0.634
ROA	5176	0.040	0.038	0.056	-0.187	0.189
Growth	5176	0.156	0.114	0.292	-0.398	1.571
Size	5176	22.33	22.22	1.048	20.21	25.39
Lev	5176	0.400	0.399	0.168	0.069	0.770
Age	5176	2.991	2.996	0.264	2.197	3.526

4.2. Correlation analysis

In Table 3, which reports the correlation coefficient among the variables in this study, we found that the coefficient between internationalization depth and innovation performance is 0.118 and significantly positive correlation at

1%; the correlation coefficient between internationalization breadth and innovation performance is 0.431 and significantly positive correlation at 1%, preliminarily indicating that enterprise internationalization improves enterprise innovation performance. The correlation coefficient between return on total assets and innovation performance was 0.043 and

significantly positive at 1%; growth and innovation performance was 0.067 and 1%; enterprise size and innovation performance was 0.427 and 1%; financial leverage and innovation performance was 0.244 and at 1%. Therefore,

the selection of control variables in this paper is more reasonable. Moreover, the correlation coefficient between the variables is not greater than 0.5, and the maximum VIF value is 1.83, indicating that there is no multicollinearity effect.

Table 3. Correlation analysis

	Patent	Doic1	Doic2	MSH	Size	Lev	ROA	Growth	Age
Patent	1								
Doic1	0.118***	1							
Doic2	0.431***	0.331***	1						
MSH	0.005	0.120***	0.011	1					
ROA	0.043***	0.019	0.012	0.096***	1				
Growth	0.067***	0.026*	0.053***	0.086***	0.304***	1			
Size	0.427***	-0.001	0.463***	-0.265***	0.098***	0.081***	1		
Lev	0.244***	0.046***	0.277***	-0.213***	-0.365***	0.034**	0.455***	1	
Age	-0.0110	-0.048***	0.025*	-0.239***	-0.033**	-0.108***	0.194***	0.099***	1

4.3. Multiple regression analysis

We further conducted an empirical test on the relationship

between enterprise internationalization and enterprise innovation performance and the adjustment effect of equity incentive. The empirical results are shown in Table 4:

Table 4. The regression results

	(1) Patent	(2) Patent	(3) Patent	(4) Patent	(5) Patent
Doic1		0.417*** (0.080)		0.324*** (0.081)	
Doic2			0.264*** (0.019)		0.257*** (0.019)
MSH				0.470*** (0.088)	0.418*** (0.086)
Doic1×MSH				1.294*** (0.415)	
Doic2×MSH					0.577*** (0.094)
ROA	1.182*** (0.297)	1.091*** (0.297)	1.150*** (0.292)	0.970*** (0.296)	1.065*** (0.291)
Growth	-0.064 (0.052)	-0.063 (0.052)	-0.063 (0.051)	-0.080 (0.052)	-0.083 (0.051)
Size	0.610*** (0.017)	0.608*** (0.017)	0.501*** (0.018)	0.621*** (0.017)	0.520*** (0.018)
Lev	0.193* (0.108)	0.161 (0.108)	0.132 (0.106)	0.210* (0.108)	0.143 (0.106)
Age	-0.241*** (0.060)	-0.230*** (0.060)	-0.182*** (0.060)	-0.188*** (0.061)	-0.156*** (0.060)
Constant	-10.256*** (0.396)	-10.271*** (0.395)	-8.152*** (0.416)	-10.732*** (0.405)	-8.666*** (0.428)
Year	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes
N	5176	5176	5176	5176	5176
ADJ-R2	0.374	0.377	0.397	0.382	0.404

Model (1) Only the control variables of this study are added, showing that most of the control variables selected in this paper are significantly related to the explained variables, and have a certain control effect on the model.

Model (2) The depth of internationalization is added on the basis of model (1). The regression results show that the adjusted R2 of the model is increased from 0.374 to 0.377, indicating that the model has stronger explanatory power after adding the depth of internationalization. The correlation coefficient between the depth of enterprise internationalization and enterprise innovation performance is 0.417, which is significant at the level of 1%, indicating that the improvement of enterprise internationalization depth will

significantly promote the improvement of enterprise innovation performance, which is in line with the H1 proposed in this paper.

Model (3) adds the internationalization breadth of explanatory variables on the basis of model (1). The regression results show that the adjusted R2 of the model has increased from 0.374 to 0.397, indicating that the model has stronger explanatory power after adding the internationalization breadth. The correlation coefficient of enterprise internationalization breadth and enterprise innovation performance is 0.264, and it is significant at the level of 1% respectively, indicating that the improvement of enterprise internationalization breadth will significantly

promote the improvement of enterprise innovation performance, which is in line with the H2 proposed in this paper.

In the model (4), on the basis of the model (2), the interaction term of the adjustment variable equity incentive and equity incentive and enterprise internationalization depth is added. After the adjustment of the model, the R² is increased from 0.377 to 0.382, indicating that the model is stronger. From the perspective of the regression results, the regression coefficient of the interaction between equity incentive and the depth of enterprise internationalization is 1.150, which is significant at the level of 1%, indicating that equity incentive enhances the relationship between the depth of enterprise internationalization and enterprise innovation performance, and equity incentive is a positive adjustment between the two, which is in line with the H3 proposed in this paper.

Model (5) On the basis of model (3), the interaction term of adjusting variable equity incentive and equity incentive and the breadth of enterprise internationalization was added. The adjusted R² of the model increased from 0.397 to 0.404, indicating that the model was stronger. From the perspective of the regression results, the regression coefficient of the interaction between equity incentive and the breadth of enterprise internationalization is 0.577, and it is significant at the level of 1%, indicating that equity incentive enhances the relationship between the breadth of enterprise internationalization and enterprise innovation performance, and equity incentive is a positive adjustment between the two, which is in line with the H4 proposed in this paper.

4.4. Robustness test

In order to ensure the robustness of the above regression analysis, we further use the patents obtained by the enterprise in the current year as the surrogate variable for the explained variables. From the regression results, the results after replacing the explanatory variables were basically consistent with those of the benchmark regression, and the results of the original model were verified, indicating that the results of this study are robust.

5. Research Conclusions and Implications

This paper studies China's listed manufacturing enterprises from 2015 to 2022, and verifies the positive correlation between the depth and breadth of internationalization and enterprise innovation performance, and the adjustment relationship between equity incentive. The main conclusions are: the depth of internationalization will significantly promote the innovation performance, equity incentive will positively regulate the relationship between the two; internationalization breadth will significantly promote the innovation performance, and equity incentive will positively regulate the relationship between the two.

Enterprises should unswervingly implement the internationalization strategy and seize the innovation resources of overseas markets to enhance their innovation ability. In the face of the limited domestic market, enterprises should put their long-term goals, dare to acquire overseas high-quality technology and knowledge through internationalization, strengthen industry-university-research cooperation, deepen the internationalization strategy, so as to ensure the steady improvement of the innovation ability of

Chinese enterprises. At the same time, we should also strengthen the protection of intellectual property rights, and establish a sound intellectual property management system, to ensure that our own innovation achievements are not subject to infringement and theft. Enterprises to their own present situation and future planning and situation has a clear judgment, reasonable planning enterprise internationalization strategy, fully understand the advantages and disadvantages of enterprise, the internationalization strategy in combination with their own conditions, to optimize overseas resources reasonable screening, in the further internationalization strategy, can consider adjusting the internationalization layout, expanding enterprise overseas business scope. Equity incentive in regulating the relationship between enterprise internationalization and innovation performance play a good effect, so enterprises should actively implement equity incentive, appropriate promotion executives holdings, makes the management and enterprise interests integration, promote the internationalization of enterprise innovation performance, boost enterprise innovation performance.

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