Changes in RMB Exchange Rate and Innovation of (Listed) Enterprises

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Abstract: China proposed that innovation plays an important role in the prosperity and development of a country, highlighting the key position of innovation in the overall modernization construction and emphasizing the necessity for enterprises to participate in innovative development and master key core technologies. Since entering the 21st century, globalization has accelerated, and Chinese enterprises have become increasingly involved in economic globalization, constantly relying on their strong technology to secure a place in the global division of labor. China implemented a managed floating exchange rate system based on market supply and demand after the exchange rate reform, adjusted with reference to a basket of currencies, which increased exchange rate uncertainty. The article adopts an empirical analysis method from the perspective of changes in the RMB exchange rate, and establishes a panel data regression model to examine the impact of the rise and fall of the RMB exchange rate on the innovation capability of enterprises. The results indicate that the appreciation of the Renminbi can enhance the innovation capability of enterprises. This conclusion is beneficial for policy makers to formulate corresponding exchange rate policies to empower the construction of innovative countries.

Keywords: RMB Exchange Rate; Enterprise Innovation; Innovation Capability

1. Introduction

The 2024 Central Economic Work Conference emphasized the need to develop new quality productive forces through technological innovation and build a modern industrial system. The 2024 government work report clearly points out the key position of innovation in the overall modernization construction of China. Enterprises are the most active subject of technological innovation and the main carrier of new quality productivity, playing a very important role in the national innovation system. The 14th Five Year Plan for Economic and Social Development of the People's Republic of China and the Long Range Objectives Through the Year 2035 emphasize the need to improve enterprises' capability in technological innovation and strengthen their key position in technological innovation, which helps to promote the aggregation of various innovation factors to enterprises. This shows that promoting the improvement of enterprise technological innovation level is a necessary guarantee for implementing the innovation driven development strategy and forming new sources of growth momentum. The technological innovation of enterprises continuously promotes the transformation and upgrading of domestic consumption structure and industrial structure, and promotes high-quality economic development. At present, Chinese enterprises are more willing to focus on innovative development, investing more and more in technological innovation research and development, and achieving more and more remarkable results. The supporting role of technology in development is constantly increasing. From 2001 to 2022, the proportion of R&D investment in China's GDP increased from 1.1% to 2.54%. According to the World Intellectual Property Organization's 2022 report, China's international patent application volume reached 700015 in 2022, an average annual growth rate of 0.6%, ranking the highest in the world for four consecutive years. However, Chinese enterprises also face challenges such as weak innovation foundations, insufficient competitiveness, and external environmental impacts. The impact of the external environment is mainly reflected in exchange rate fluctuations. The fluctuation of exchange rates will affect the relative competitiveness of imported products and domestic products, and affect the import and

export trade situation of enterprises, thereby affecting their decisions to strengthen technological research and development to improve their own production efficiency. Therefore, it is important to study the effect of the RMB exchange rate on corporate innovation from the perspective of its exchange rate. Especially in recent years, Chinese enterprises have become increasingly involved in economic globalization, while the world is undergoing unprecedented changes characterized by instability, uncertainty, and insecurity. The rise of the anti-globalization trend advocated by Trump, as well as the Russo Ukrainian war, the Israeli Palestinian conflict, and other significant impacts on international trade, have placed international exchange rates in a highly uncertain environment. In this situation, the choice of innovative technology development by enterprises has become an important issue of concern for policy makers. This article aims to study the relationship between the RMB exchange rate and corporate innovation, and provide suggestions for the government to formulate economic policies in the face of changes in the international macro environment.

2. Literature Review and Theoretical Mechanism

2.1 Literature Review

Many literatures have studied the factors that affect enterprises. From the perspectives of information and supervision effects, some have found that the reform of the registration system has a significant promoting effect on the quantity of R&D innovation investment and the number of R&D innovation personnel in enterprises, but has no significant promoting impact on the intensity of R&D innovation in enterprises [1]. From the perspective of digital finance, some have found that digital finance can enhance environmental technology innovation in enterprises. According to industry university research alliances, it is proposed that participating in industry university research strategic alliances can significantly improve corporate performance, with the key mechanisms being the enhancement of innovation capabilities and external attention [3]. However, literature on corporate innovation from the perspective of exchange rates is very scarce and has a long-time interval. There are two opinions on the impact of the RMB exchange rate on corporate innovation: one is the promotion theory, and the other is the inhibition theory. The main viewpoint of the promotion theory is that exchange rate appreciation leads to lower relative pricing of foreign producers' products, thus giving companies more motivation to innovate to increase profits and avoid a decrease in market share. A large number of scholars have selected domestic enterprise data to study the relationship between exchange rate fluctuations and enterprise technological innovation, and have pointed out that the appreciation of the RMB exchange rate can increase the quantity of patents of enterprises and promote research and development innovation [4]. The theory of inhibition holds that exchange rate appreciation could lead to a decrease in exports and output of enterprises, resulting in a reduction in innovation and research and development investment. Based on this viewpoint, many scholars have conducted relevant research. Some scholars have found that when companies face significant financing constraints, exchange rates have a greater inhibitory effect on their R&D investment [5]. Both the promotion theory and the inhibition theory have great reference function for studying the impact of RMB exchange rate on corporate innovation. However, it is worth noting that most of these studies are relatively old, and it is debatable whether they could correctly reflect the impact of the RMB exchange rate on corporate innovation in the context of significant changes in the international and domestic environment currently. Therefore, this article pays attention to the latest data and information, striving to draw conclusions that are in line with current trends and provide suggestions for policy-making and innovative national construction.

2.2 Theoretical Mechanism

Research has shown that the export contraction caused by the appreciation of the currency in China will also affect the innovation output of export enterprises, mainly through the competitive effect channel. Enterprises promote product differentiation and quality upgrades through innovative behavior to maintain an advantage in industry competition. In addition, the fierce competition faced by enterprises is not only reflected in the product market, but also in the technology field. When one or more enterprises in the same field have stronger

technology, the others will improve their own research and innovation level to maintain their advantage. The competitive effect within this industry provides incentives for corporate innovation. More competition may directly force companies to increase innovation to maintain their competitiveness in the export marketplace [6].

As a result, the main hypothesis of this article is: the appreciation of the RMB exchange rate is beneficial for technological innovation of Chinese enterprises.

3. Data Description and Model Construction

3.1 Data Description

The corresponding indicators for the operating information of listed companies and the number of patent applications in this article are from the Guotai An database, CNRDS database, and the website which called the China Patent Office, respectively. The data period is from 2018 to 2021, and the relevant data has been processed. Among them, the annual number of patent applications of listed enterprises comes from the China Intellectual Property Administration. First, list all the patent application data of listed companies for each year, and then merge the data belonging to the same group according to the same stock code, while removing duplicate sample data to obtain the final data. To ensure the accuracy of the data, all continuous variables were truncated by 1% each to obtain the data required for this study.

3.2 Indicator Selection and Calculation

3.2.1. Real effective exchange rate of RMB

The actual effective exchange rate of the Chinese yuan selected in the article refers to the data on the BIS official website. The BIS effective exchange rate dataset covers long time series of nominal and effective exchange rates, which can serve as a measure of international competitiveness, a component of financial condition indices, and a measure of external shock transmission. The nominal effective exchange rate index (NEER) is calculated based on the geometric trade weighted average of bilateral exchange rates, while the actual effective exchange rate index is obtained by adjusting NEER based on relative consumer prices. This article calculates the annual real effective exchange rate index of the Chinese yuan by weighted averaging the obtained real effective exchange rate indices for different months (with 2020 as the base year).

3.2.2. Enterprise Innovation Capability

Enterprise innovation capability refers to the ability of enterprises to meet or create market demand and enhance competitiveness by applying knowledge and human intelligence through various methods and means. Existing literature indicates that patent data is widely used to evaluate a company's innovation capability [6]. Previous studies have shown that the number of patent applications is the most intuitive indicator of a company's innovation capability. In addition, other innovation indicators, such as research and development efficiency, lack unified calculation standards. Therefore, in terms of innovation evaluation indicators, this paper uses network crawling to obtain specific data on patent rights of listed companies in China from 2018 to 2021. Using the newly crawled dataset, a company innovation quantity indicator is constructed. Among them, the indicators for measuring the number of enterprise patents include: the number of invention patents, the amount of utility model and design patents. The annual number of patent applications introduced in this article refers to the total number of invention patents, utility model patents, and patents in design independently applied for by all listed companies in that year.

3.2.3. Other control variables

After referring to previous relevant research [7], this article has decided to control for the following variables. (1) The proportion of R&D expenditure to operating revenue, which is the ratio of the investment in technological innovation and R&D by a company in a certain year to its operating revenue for that year. (2) The total value of enterprise assets, which refers to the total assets of the enterprise's balance sheet. (3) The net profit margin of total assets refers to the net profit of an enterprise from a certain year divided by the assets of the enterprise. (4) Financial debt ratio. Obtained by calculating the ratio of financial liabilities to assets.

3.3 Model Construction

The main objective of this article is to explore the impact of changes on the RMB exchange rate on corporate innovation. Drawing on the approach of Jiang Ting [8], this article chooses a fixed effects model to analyze the impact of the

RMB exchange rate on corporate innovation.

$$Y_{it}=\alpha_0+\alpha_1 X_t+\alpha_2 A_{it}+\alpha_3 B_{it}+\alpha_4 C_{it}+\alpha_5 D_{it}+\mu_i+\theta_t+\varepsilon_{it} \quad (1)$$

Among them, Y_{it} is the innovation activity of company i in year t. X_t is the actual effective exchange rate of the Chinese yuan in year t. A_{it} is the proportion of R&D investment to operating revenue of company i in year t. B_{it} is the asset value of company i in year t. C_{it} is the net profit margin of total assets of company i in year t. D_{it} is the financial debt ratio of company i in year t. μ_i and θ_t are individual and time fixed effects, respectively, and ε_{it} is the error term, as shown in Table 1.

Table 1. Descriptive Statistics of Variables

Variable type	Variable	Observations	mean value	standard deviation	minimum value	Maximum value
Explained variable	Number of independent patent applications	15146	97.88908	374.9903	0	12155
explanatory variable	Real Effective Exchange Rate Index of Renminbi	15146	99.51428	2.219617	97.03	103.06
control variable	R&D investment to revenue ratio	15146	.527184	.1181238	0	11.35893
control variable	Total asset value (RMB 100 million/100 million)	15146	195.21	968.88	0.63	18892
control variable	Net profit margin of total assets	15146	.0348963	.0778276	-.5284809	.2228917
control variable	Financial debt ratio	15146	.395153	.0778276	-.5284809	.2228917

4. Result Analysis and Testing

4.1. Benchmark Regression

Table 2 shows the baseline regression results. The results show that RMB appreciation can significantly increase the amount of patent applications of Chinese (listed) enterprises, that is, it can promote the technological innovation of Chinese companies, which is consistent with the analysis results of the theoretical model in this paper. Besides, the coefficient results of the control variables show that the proportion of technological innovation and R&D investment in operating income, total asset value and net profit margin of total assets of Chinese (listed) enterprises are positively correlated, and negatively correlated with the financial debt ratio of enterprises, but not significant.

The control variables show that the proportion of technological innovation and R&D investment in operating income, total asset value and net profit margin of total assets of Chinese (listed) enterprises are positively correlated, and negatively correlated with the financial debt ratio of enterprises, but not significant. results show that the appreciation of the RMB can significantly increase the amount of patent applications of Chinese listed enterprises, which can promote technological innovation of Chinese companies. This is consistent with the theoretical model analysis results in this article. Additionally, the coefficient results of controlling variables indicate that the proportion of technological innovation and R&D investment to operating income, total asset value, and total asset net profit margin of Chinese (listed) enterprises are positively correlated, and negatively correlated with the financial debt ratio of enterprises, but not significantly, as shown in Table 2.

Table 2. Regression Results

	(1)	(2)	(3)	(4)	(5)
	Y	Y	Y	Y	Y
X	4.212***	4.215***	2.219***	2.201***	2.211***
	(0.541)	(0.541)	(0.541)	(0.543)	(0.544)
A		3.464	1.860	2.329	2.315
		(20.006)	(19.650)	(19.701)	(19.701)
B			0.000***	0.000***	0.000***
			(0.000)	(0.000)	(0.000)
C				6.883	7.504
				(20.599)	(20.719)

D					-3.242
					(11.579)
_cons	-321.289***	-321.360***	-154.392***	-152.393***	-152.043***
	(53.866)	(53.870)	(53.543)	(53.878)	(53.895)
N	15146.000	15146.000	15146.000	15146.000	15146.000
r2	0.005	0.005	0.041	0.041	0.041
year	Yes	Yes	Yes	Yes	Yes
id	Yes	Yes	Yes	Yes	Yes

4.2. Robustness Test

This article chooses the method of replacing variables for robustness testing: replacing the variable total asset value with the total asset growth rate. The calculation method for the growth rate of total assets is to divide the increase in assets by the total assets of the previous period, and express it as variable E. Because considering that the total asset value is a stock for a certain period of time, a variable that can reflect numerical changes is introduced for testing. These analyses consistently confirm the promoting effect of RMB appreciation on innovation of Chinese (listed) enterprises, thus verifying the robustness of the empirical results, as shown in Table 3.

Table 3. Results of Robustness Test

	(1)	(2)	(3)	(4)	(5)
	Y	Y	Y	Y	Y
X	4.212***	4.215***	4.249***	4.242***	4.255***
	(0.541)	(0.541)	(0.543)	(0.544)	(0.546)
A		3.464	3.643	3.895	3.882
		(20.006)	(20.007)	(20.068)	(20.069)
E			4.650	4.894	4.953
			(5.132)	(5.348)	(5.350)
C				3.552	4.476
				(21.850)	(21.987)
D					-4.472
					(11.794)
_cons	-321.289***	-321.360***	-325.433***	-324.646***	-324.183***
	(53.866)	(53.870)	(54.057)	(54.276)	(54.292)
N	15146.000	15146.000	15146.000	15146.000	15146.000
r2	0.005	0.005	0.005	0.005	0.005
year	Yes	Yes	Yes	Yes	Yes
id	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5. Conclusion and Policy Recommendations

This article empirically tests the impact of the real effective exchange rate of the Chinese yuan and the trend of technological innovation in enterprises based on its characteristics. The results indicate that overall, the appreciation of the Chinese yuan can effectively promote innovation in enterprises, mainly in terms of the increase in the amount of patent applications. In addition, the growth in the proportion of R&D investment to operating revenue, total asset value, and total asset net profit margin also has a certain promoting effect on the innovation of enterprises.

This article proposes the following policy recommendations based on the above research: Firstly, from the perspective of the number of patent applications, there are significant differences in innovation capabilities among Chinese enterprises. Therefore, when formulating innovation incentive policies, it is necessary to consider the innovation capabilities of different enterprises. The government can provide subsidies and tax incentives to industries with relatively weak innovation capabilities, encouraging them to increase innovation investment and enhance their innovation capabilities. Secondly, as the saying goes, "forging iron requires one's own strength." Enterprises should recognize the importance of innovation, adjust the pace and rhythm of

innovation, continuously increase the number of patents, and optimize investment in technological innovation in a timely manner according to changes in the macro environment. They should seek breakthroughs in processes, techniques, and actively participate in various market competitions to achieve high-quality development of foreign trade of China. Additionally, it is necessary for the government to constantly keep up with the times, focus on promoting the improvement of the foreign exchange management system and enhancing the innovation capability of enterprises in macro policies, thereby strengthening the international competitiveness of Chinese enterprises.

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