A Study On The Impact Of Financialization Of Manufacturing On Firms' Technological Innovation: Based On Data From Chinese A-Share Listed Companies

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Abstract:

Enterprise technological innovation is of great importance for China to enhance its innovation competitiveness and promote sustainable and stable national economic growth under the new normal. There have been some literatures on the effect of financialization of real estate enterprises on enterprise technological innovation, but no unified conclusion has been reached. Few researches have conducted any analysis on the mechanism between those two, and there are many problems with the research methodology used. Based on the data of Chinese listed manufacturing enterprises from 2010 to 2020, this research accurately esti[@]mated and tested the technological innovation effect of financialisation of manufacturing enterprises and its effect mechanism with a mixed panel OLS, the Tobit model and the mediating effects model. The results demonstrated that the financialisation of manufacturing enterprises significantly constrains technological innovation, and that such effect acts through the channels of exogenous financing, liquidity supply, earnings driven and R&D resource plundering. Finally, based on the findings above, corresponding recommendations were made to the authorities and manufacturing enterprises.

Keywords: manufacturing; financialisation; technological innovation; listed enterprises

1. Introduction

As China's economy has entered a new normal, the main industries in China have gradually shifted from the traditional crude resource input driven model to a green, efficient and intensive innovation driven model. Therefore, the main and key way to drive the rapid development of China's national economy for now and in the future is to enhance the independent innovation capacity of China and Chinese enterprises and to build an independent innovation network.

According to the World Development Indicators (WDI) database of the World Bank, China's R&D expenditure, as a share of GDP, rose rapidly, from 1.09% in 2001 to 2.24% in 2019. However, compared with developed countries, China's R&D expenditure, as a share of GDP, was 2.05% in 2018, lower than the world average of 2.31% and far below the average of 2.68% of high-income countries in 2018. In terms of innovation performance and output of enterprises, as the main driving force of China's innovation capacity enhancement, even though the share of China's R&D expenditure continues to rise, the level of innovation performance and output of Chinese enterprises is significantly lower than those of enterprises in developed Western countries.

Due to high risks, high investment and long lead time of innovation, enterprises face various constraints and obstacles, of which the most significant is financial constraint (Hall &

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Lerner, 2010). The financialisation of enterprises can influence the internal financial constraints of enterprises through profitable asset investment, increased liquidity and crowding out of resources, which in turn acts on enterprise technological innovation. Therefore, it is important to focus on and study the financialisation of manufacturing enterprises and enterprise technological innovation to optimize the allocation of innovation resources within manufacturing enterprises and enhance the innovation drive and competitiveness of China.

Financialisation is the process of a country's rising status of financial markets, financial agents and financial institutions in the process of economic development, while the financialisation of manufacturing refers to the phenomenon of enterprises gradually moving away from production operations to investment in the financial sector (Du et al., 2017).As the financialisation of the economy accelerates, business operations are increasingly influenced by the financial market (Krippner, 2005).According to the Csmar enterprise database, the total scale of financial assets allocated by non-financial listed enterprises has grown rapidly since 2007, and by the end of 2020, as shown in Figure 1, the total scale of non-monetary financial assets held by non-financial listed enterprises in China reached $5,224.8 billion, of which long-term equity investments accounted for the highest share, and the proportion of non-monetary financial assets in the total assets of enterprises reached 23% on average. Since December 2012, when CSRC issued the Supervisory Guidelines for Listed Enterprises No. 2 - Supervisory Requirements for the Executive and Use of Funds Raised by Listed Enterprises which allows listed enterprises to use idle funds raised to purchase investment products with high safety and liquidity and securities trading financial assets such as stocks and bonds, and shadow banking assets began to rise rapidly. During the economic transition period in particular, there is a strong desire for non-financial enterprises to allocate more assets to financial assets for the purpose of increasing returns and hedging risks when profitability in the real sector as a whole is declining (Foster, 2007).

Figure 1：Total size of non-monetary financial assets held by non-financial listed enterprises
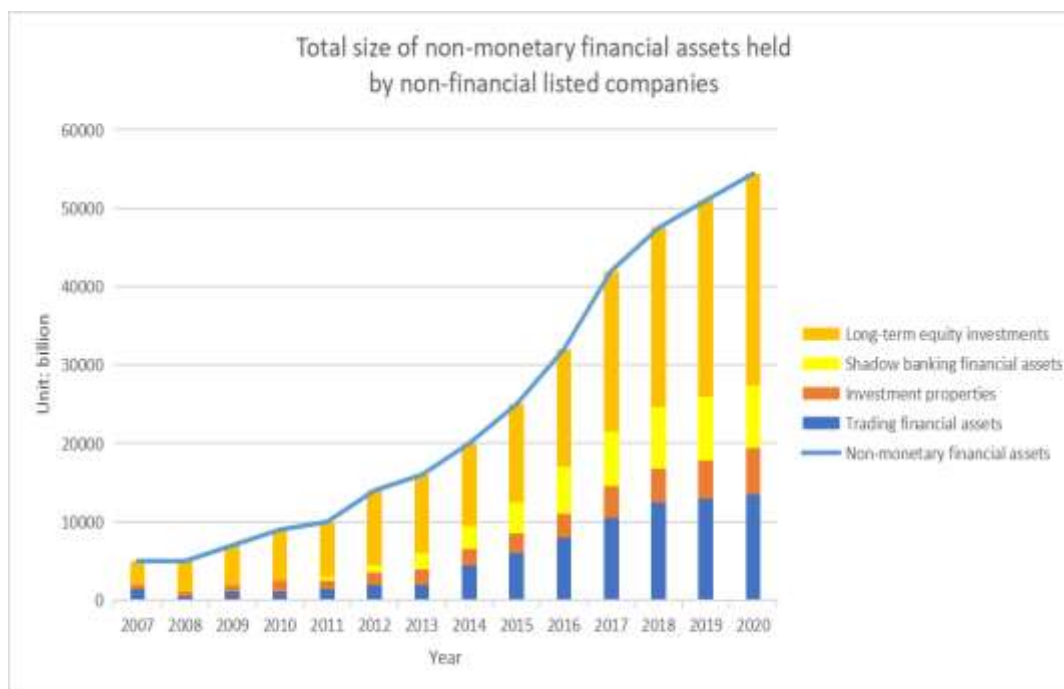
As scholars have explored the effect of financialisation on economic development (Barane and Hake, 2018), some researches have focused on the effects of the financialisation process of enterprises in non-financial sectors on enterprise technological innovation, but few researches have systematically analyzed the mechanisms of the effects. Some scholars

have debated the "reservoir effect" (Gehringer, 2013) and the "crowding out effect" (Cupertino et al., 2019) of the financial investment behavior on enterprise technological innovation.

In addition, most researches have ignore issues such as truncation (or imputation), reverse causality and omission of variable bias in econometric models, leading to serious endogeneity problems, which ultimately result in ineffective identification of the technological innovation effect of enterprise financialisation. In addition, no researches have been conducted to systematically analyze the mechanisms, effects and mechanisms of financialisation of manufacturing enterprises on enterprise technological innovation. Therefore, considering the theoretical researches and practical problems above, the main question of this research was to analyze the mechanism, effect and mechanism of the financialisation of manufacturing enterprises on enterprise technological innovation.

2. Literature Review

2.1 Effect analysis of the financialisation of manufacturing enterprises on enterprise technological innovation

The effect of financialisation on technological innovation of manufacturing enterprises is still uncertain, and scholars have debated on the direction of the effect, which is mainly divided into the "crowding out effect" and the "reservoir effect".

On one hand, the financialisation of manufacturing enterprises can constrain the level of technological innovation (Cupertino et al., 2019; Liu et al., 2021), and the financialisation of manufacturing enterprises has a "crowding-out effect" on technological innovation. In imperfectly competitive markets, enterprises with monopoly power use a large amount of surplus funds generated by monopoly profits for financial investment, and use their monopoly position to restrict the expansion of production capacity of other enterprises following their suits in the industry, constraining the technological progress of the industry as a whole. The high returns from financialisation can induce "short-sighted" behavior on executives, and the relatively low risks of investment in financial assets resulted from external causes such as market fluctuations if the investment fails make executives more tolerant of investment failure in financial assets than in technological innovation, and give executives an incentive to invest in financial assets rather than in technological innovation (Jayadev 2019; Epsyein, 2019). When the profitability of the main business declines, enterprises will devote more resources to financial asset investment, which not only undermines the foundation for enterprises to make technological innovation, but also squeezes out innovation investment and reduces enterprises innovation capacity (Wang et al., 2017;). In summary, enterprise executives tend to curtail enterprise R&D investment and allocate more financial assets in the short-term operation of the enterprise.

On the other hand, the financialization of manufacturing enterprises has a positive contribution effect on the level of technological innovation of enterprises (Liu, 2017). Xu and Liu (2019) argued that the financialisation of enterprises has a positive effect on both innovation investment and innovation performance, and the positive effect is more significant on non-state enterprises. As technological innovation requires continuous and large-scale capital investment, manufacturing enterprises convert a portion of their idle assets into highly liquid financial assets with financialisation strategies, using the converted financial assets as a "reservoir" to meet the immediate financial needs of long-cycle R&D activities (Gehringer. 2013).In addition, some financing-constrained enterprises (e.g. small, medium-sized and start-up enterprises) have difficulties in accessing external finance, which leads them to engage in financial investment activities in order to generate more profits and invest in internal R&D activities, and such financialisation indirectly contributes to the technological innovation of manufacturing enterprises. As a result, manufacturing enterprises are able to obtain higher returns on their assets in the financial markets through financial asset allocation and use the "incremental" profits to invest in

R&D and innovation, thus contributing to higher levels of technological innovation.

Based on the analysis above, the direction of effect of financialisation of manufacturing enterprises on enterprise technological innovation is uncertain and is currently under debate among scholars. This research believed that the direction of effect is a combination of "crowding out effect" and "reservoir effect". Therefore, the following hypotheses were proposed.

H1a: Financialisation of manufacturing enterprises has a negative effect on the input and performance of technological innovation, and the "crowding out effect" is more significant than the "reservoir effect".

H1b: Financialisation of manufacturing enterprises has a positive effect on the input and performance of technological innovation, and the "crowding out effect" is less significant than the "reservoir effect".

2.2 Mechanistic analysis of the effect of financialisation of manufacturing enterprises on enterprise technological innovation

Considering the "crowding out" and "reservoir effect" mechanisms of the financialization of manufacturing enterprises on enterprise technological innovation, this research analyzed the mechanism of the financialization of manufacturing enterprises on enterprise technological innovation through the four paths of exogenous financing, liquidity supply, revenue support and R&D resource plundering.

The "reservoir effect" mechanism is mainly manifested by manufacturing enterprises converting idle assets and profits into financial assets to meet their funding needs for technological R&D and to reduce the uncertainty risks of innovation in the long run. Firstly, the liquidity supply path is the most direct manifestation of the "reservoir effect" mechanism (Soener, 2015). In order to achieve rapid breakthroughs in production technology, enterprises must invest large amounts of R&D capital. By investing idle capital in financial assets, enterprises can improve the efficiency of capital use, accelerate the liquidity of capital and enable them to achieve higher profits for a long-term development, helping them to improve the sustainability of their surpluses and provide continuous financial support for their technological innovation investments (Li, 2019). Therefore, when the financial support of manufacturing enterprises for technological innovation is manifested as a "reservoir effect", the most direct manifestation within the enterprise is a significant increase in the liquidity of the enterprise assets and the expansion of the scale of cash flow. Secondly, the earnings driven path is an indirect expression of the "reservoir effect" mechanism. As a general rule of thumb, the rate of return on financial assets is higher than the rate of return on fixed assets, so manufacturing enterprises can obtain a higher rate of return by allocating financial assets compared to investments in fixed assets (Sen & Dasgupta, 2018).The excess profits from financialisation of manufacturing enterprises can be used as an innovation development fund and generate a reservoir of capital, which in turn supports the enterprise technological R&D expenditure. In addition, higher returns on enterprise assets (improved enterprise performance) imply that the size of funds available for R&D and innovation will expand further, although the expansion of R&D expenditure may not be able to catch up with the rate of enterprise financialisation. Taken together, the analysis above suggests that manufacturing enterprises can influence enterprise technological innovation through the liquidity supply path and earnings driven path.

The "crowding-out effect" mechanism is mainly manifested in the scale and structure adjustment of external financing and the crowding out of R&D investment. Firstly, the financialisation of manufacturing enterprises will lead to the adjustment of the scale and structure of their external financing. Through the process of financialisation, the liquidity of internal assets of manufacturing enterprises has increased significantly, resulting in changes in the demand for external financing. On one hand, due to the higher return on financial assets compared to fixed assets and the high financing constraint and small scale of credit financing, enterprises will pursue higher profits from financial investments by

raising more equity financing and reducing credit financing, thus allocating more financial assets in the short term for the purpose of obtaining excessive profits. However, due to the risk aversion and profit inclination of financiers, the expansion of equity financing has resulted in enterprise operation and innovative R&D being constrained by financiers, resulting in the constraint of enterprise technological innovation activities. On the other hand, the financialisation of manufacturing enterprises has increased the supply of liquidity and reduced the demand for small-scale credit financing, which is subject to the constraints of the underlying, thereby indirectly reducing the scale of enterprise R&D investment. Secondly, the "crowding out effect" of the financialisation of manufacturing enterprises on technological innovation is directly manifested in the reduction of the scale of R&D investment by enterprises, i.e. the crowding out of innovation resources (Zhong, 2021).

In order to maximize the short-term profits, the executives of enterprises will squeeze out R&D investment funds and use them to allocate more financial assets, which directly constrain the development of innovation capability of enterprises. Based on the analysis above, this research further proposed the following hypothesis.

H2: Financialisation of manufacturing enterprises is driven by exogenous financing, liquidity supply, earnings driven and R&D resource plundering, and this effect is the result of the "reservoir effect" and the "crowding out effect".

3. Samples

3.1 Data sources

This research used data on Chinese A-share listed enterprises in CSMAR database from 2010 to 2020. As the research object of this research was manufacturing enterprises, non-manufacturing enterprises were excluded. Based on the principles of accuracy and availability of this research, the following data with missing values and extreme values were further removed: ST and *ST enterprises, i.e., delisted or soon to be delisted enterprises; enterprises with either a total assets less than or equal to 0, or an operating income less than or equal to 0; enterprises with a gearing ratio greater than 100%, i.e., listed enterprises that do not conform to actual operations; enterprises with missing data on some variable. In order to reduce the bias of the effect of extreme values on the empirical estimation results, this research performed a 1% and a 99% Winsorize tail shrinkage on all continuous variables on the samples. Finally, this research obtained a total of 7,768 samples for the main regression estimation, which contained a total of 2,070 listed manufacturing enterprises.

3.2 Variable selection

According to the research question of this research, explanatory variables were selected as the amount of R&D expenditures (rd) and the number of valid invention patents granted (inv) of manufacturing enterprises, which measures the R&D input and output performance of enterprise technological innovation respectively. Considering the potential issues resulted from heteroskedasticity and outliers, this research took the inverse hyperbolic sine function for R&D expenditure (in billion yuan) and the number of effective patents (in units) respectively, and obtained arsinh_rd and arsinh_inv. Meanwhile, the core explanatory variable was selected as the degree of financialization of enterprises (including the degree of financialization with a lag of one period). In this research, Zhang and Zheng (2018) and Duan and Zhuang (2021) were referred to select enterprise financial asset categories including the following components: monetary funds, financial assets for trading, net available-for-sale financial assets, net held-to-maturity investments, net investment properties, net dividends receivable and net dividends receivable, Peng and Huang (2018) were referred to define the degree of enterprise financialization (fin) as the proportion of total financial assets of the enterprise to its total assets.

In this research, the following variables were selected as control variables for the regression estimation with reference to Görg (2007) and Huang et al. (2021): the ratio of total liabilities to owner's weight; growth rate of operating income, i.e. the current growth rate of total operating income compared to the previous period; independent directors' ratio (board), i.e. the proportion of the number of independent directors to the total number of directors in the board of directors; compensation incentives (ip), i.e. the proportion of directors, supervisors and senior directors in the board of directors; and the proportion of independent directors to the total number of directors; CEO shareholding (ceohr), i.e. the shareholding of the CEO as a percentage of the total shareholding of the enterprise.

The following variables were selected as mediating variables in the subsequent effect mechanism test. Exogenous financing, with reference to researches by such as Hai et al. (2021), credit financing and equity financing was processed as follows. Firstly, credit financing (debt) was defined as the ratio of the sum of short-term borrowing and long-term borrowing to the total assets of the enterprise. Secondly, equity financing (equity) was defined as the ratio of the sum of paid-in capital and capital surplus to enterprise total assets. Liquidity supply (ocf), drawing on the choice of variables by Duan and Zhuang (2021), this research used the ratio of net operating cash flow to total enterprise assets to measure enterprise liquidity supply as a way to characterize the ability of enterprises to enhance liquidity in the production and operation process. Profitability of net assets (roe), referring to the research conclusions reached by such as Chen and Zeng (2012), this research used the return on net assets as a variable to explore the earnings driven path, and the variable took the value of the proportion of net profit to net assets of the enterprise. R&D investment intensity (rda), to further investigate the "crowding-out effect" of financialization of manufacturing enterprises on enterprise technological innovation, this research considered whether the financialization of manufacturing enterprises achieved the purpose of robbing R&D resources by lowering R&D investment intensity. Therefore, this research used the R&D investment intensity index to investigate this path, and the value of R&D investment intensity index was the ratio of R&D expenditure to total operating cost of the enterprise. Foreign investment (efi), given that the financialization of manufacturing enterprises may constrain the technological cooperation and knowledge exchange between enterprises and external innovation agents, this research examined the path of technological cooperation abatement from the perspective of foreign investment of manufacturing enterprises. Referring to the study of Ming et al. (2019) and others, this research used the total amount of foreign investment (the inverse hyperbolic sine function) to examine the technical cooperation abatement path.

4. Research Design

4.1 Baseline model

The main research question of this research was how the financialization of manufacturing enterprises influences the level of enterprise technological innovation. One of the explanatory variables of interest is R&D investment in enterprise technological innovation, which was a continuous variable, so this research chose a mixed panel data model (OLS) to estimate the effect of financialization of manufacturing enterprises on R&D investment in enterprise technological innovation, with reference to the research methods used by Du et al. (2017) and Zhang et al. (2019). The benchmark OLS model (1) is as follows.

$$arsinh(rd_{it}) = \beta_0 + \beta_1 \cdot fin_{it} + X_{it}\gamma + \tau_t + \lambda_i + \mu_{it} \qquad (1)$$

where $arsinh(rd_{it})$ is the expenditure enterprises i pays in item t; and takes the inverse hyperbolic sine function; fin_{it} is to what degree enterprise i is financialized in item t; X_{it} is n-matrixn of $n \times k$ (the gross number of sample observations is $n = i \times t$)

which enterprise i's k; control variables are included in item t; τ_t is the time fixed effect; λ_i is the individual fixed effect; μ_{it} is the random disturbance term for supporting the zero condition mean assumption and random perturbation term that follows normal distribution; β_0 is the intercept term coefficient; γ is the control variable coefficient matrix of order $k \times 1$; β_1 is the explanatory variable solve-for parameter this research mainly focused on.

Another explanatory variable of interest in this research was the number of effective patents for enterprise technological innovation output, but the number of effective patents variable was of more than half of the sample values of zero. This indicated that some manufacturing enterprises did not obtain valid patents granted for their innovation activities in past years, resulting in a large number of valid patents with a large number of zero values. If the model was estimated directly using OLS, the random disturbance term would violate the assumption of normality distribution, resulting in large bias in the estimation of the model parameters. Such phenomenon is collectively called data truncation or imputation in econometric researches. Cameron & Trivedi (2005) and Wooldridge (2010) recommended the use of Tobit models to alleviate such problem. Therefore, this research used the Tobit model to estimate the effect of financialization of manufacturing enterprises on the output performance of enterprise technological innovation, and the benchmark Tobit model (2) and (3) were as follows.

$$arsinh(inv_{it}) = \begin{cases} R_{it}^* & if \ R_{it}^* > 0 \\ 0 & if \ R_{it}^* \leq 0 \end{cases} \ \text{Or} \ arsinh(inv_{it}) = \max\{0, R_{it}^*\} \qquad (2)$$

$$R_{it}^* = \varphi_0 + \varphi_1 \cdot fin_{it} + X_{it}\xi + \theta_t + v_i + \varepsilon_{it} \qquad (3)$$

where $arsinh(inv_{it})$ is the number of patent licensing by enterprise i in item t and takes the inverse hyperbolic sine function; R_{it}^* is the latent variable; fin_{it} is to what degree enterprise i is financialized in item t; X_{it} is n-matrixn of $n \times k$ (the gross number of sample observations is $n = i \times t$) which enterprise i's k; control variables are included in item of t; θ_t is the time fixed effect; v_i is the individual fixed effect; ε_{it} is the random disturbance term for meeting the zero condition mean assumption and random perturbation term that follows normal distribution; φ_0 is the intercept term coefficient; ξ is the control variable coefficient matrix of order $k \times 1$; φ_1 is the explanatory variable solve-for parameter this research mainly focused on. Different from the benchmark OLS model estimation method, as there is left truncation in the distribution of valid patents while in the latent variable estimation model the random perturbation term supports the normality assumption, the Tobit nonlinear model generally assumes MLE (Maximum Likelihood Estimation) to estimate model solve-for parameters, which was explained and deduced in detail in the book by Wooldridge (2010).

4.2 Intermediary effects model

In order to examine the mechanism of the effect of financialization of manufacturing enterprises on enterprise technological innovation and to test the five paths of action proposed by the hypotheses, this research drew on Baron & Kenny's (1986) stepwise regression method to test the mediating effects, which allowed the construction of the following models (4), (5), and (6).

$$y_{it} = a_0 + a_1 \cdot x_{it} + X_{it}A + \tau_{1t} + \lambda_{1i} + \varepsilon_{1it} \qquad (4)$$

$$m_{it} = b_0 + b_1 \cdot x_{it} + X_{it} B + \tau_{2t} + \lambda_{2i} + \varepsilon_{2it} \qquad (5)$$

$$y_{it} = c_0 + c_1 \cdot x_{it} + c_2 \cdot m_{it} + X_{it} C + \tau_{3t} + \lambda_{3i} + \varepsilon_{3it} \qquad (6)$$

where y_{it} is the explanatory variable, and the Tobit model is used in models (4) and (6) when the explanatory variable is the effective number of patents; x_{it} is the core explanatory variable; m_{it} is the mediating variable, and credit financing (debt), equity financing (equity), liquidity supply (ocf), net asset margin (roe), R&D investment intensity (rda), and foreign investment (efi) were selected as mediating variables in this research; X_{it} is the $n \times k$ -order matrix consisting of k control variables for enterprises i in the t period.

According to the method and process used by Wen and Ye (2014) on the analysis of the mediating effects model, this research conducted a stepwise regression of the three models (4) (5) (6) above to estimate their corresponding parameters, where a_1, b_1, c_1 and c_2 were the main parameters to be estimated in the mechanism test of this research. When a_1, b_1, c_2 are significant, it indicates that there is an indirect effect between the financialization of manufacturing enterprises and the technological innovation of enterprises. When a_1, b_1, c_2 are significant and c_1 is significant, the same sign of $b_1 c_2$ and c_1 indicates that there is a partial mediating effect between the two, and the different sign of $b_1 c_2$ and c_1 indicates that there is a masking between the two. When a_1, b_1, c_2 are significant and c_1 is not, it indicates that there is a full mediating effect.

5. Research Results

This part examined whether the financialization of manufacturing enterprises influences the R&D input and output performance of enterprise technological innovation and what the direction of the effect is. The estimation result of the baseline OLS and Tobit model on the effect of financialization of manufacturing enterprises on enterprise technological innovation is shown in Table 1, where Columns (1)(2) are the estimation results of the effect of financialization of manufacturing enterprises on enterprise R&D investment, and columns (3)(4) are the estimation results of the effect of financialization of manufacturing enterprises on the number of effective patents granted by enterprises. In addition, column (1)(3) control individual fixed effects only, and column (2)(4) control double fixed effects.

Table 1 Baseline OLS and Tobit model estimation results

Variables	(1) arsinh_rd	(2) arsinh_rd	(3) arsinh_inv	(4) arsinh_inv
fin	-0.166***	-0.119***	-1.249***	-1.571***
	(0.04)	(0.04)	(0.12)	(0.13)
size	0.302***	0.248***	0.087***	0.112***
	(0.02)	(0.02)	(0.01)	(0.01)
lev	-0.002	0.003	-0.154***	-0.171***
	(0.01)	(0.01)	(0.02)	(0.02)
grow	-0.041***	-0.026*	-0.408***	-0.495***
	(0.01)	(0.01)	(0.03)	(0.03)
board	0.075	0.033	-0.413***	-0.202
	(0.05)	(0.05)	(0.12)	(0.12)

ip	0.019***	0.017***	0.018***	0.022***
	(0.00)	(0.00)	(0.00)	(0.00)
shsr1	-0.002	-0.000	0.005***	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)
ceohr	0.084*	0.118**	-0.684***	-0.636***
	(0.05)	(0.05)	(0.11)	(0.11)
Adjusted R^2	0.2148	0.2255	-	-
Pseudo R^2	-	-	0.0473	0.0495
Ind_FE	YES	YES	YES	YES
Year_FE	NO	YES	NO	YES
Obs	7768	7768	7768	7768

Note: (1) In round brackets are robust standard errors；(2)* $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$.

This research combined the test estimation results and reached the following conclusions.

The financialization of manufacturing enterprises has a significant negative effect on the R&D investment and effective patents of enterprise technology innovation, indicating that the financialization of manufacturing enterprises will constrain the R&D investment and output performance of enterprise technology innovation, and the "crowding out effect" is more significant than the "reservoir effect" (see columns (2)(4) in Table 1). Therefore, it can be seen that hypothesis 1a is supported, and this result is basically consistent with the estimation results of the researches by Liu et al. (2021) and Duan and Zhuang (2021). Based on this result, the following theoretical explanations can be made. Firstly, based on the speculative arbitrage theory, due to the resource constraint of manufacturing enterprises and the higher return on financial assets than on fixed assets, executives of manufacturing enterprises continuously reduce enterprise innovation R&D investment based on the profit maximization principle and use the funds saved to allocate more financial assets. In this case, the motives and behaviors of manufacturing enterprises to allocate financial assets directly "crowd out" the R&D capital investment of enterprises. Secondly, based on the principal-agent theory, the goal of enterprise executives is to maximize their own reputation and income conflict with uncertainties and high risks of innovative R&D activities, resulting in rational executives becoming "short-sighted". At the same time, the potential rewards for executives in the process of financialization of manufacturing enterprises may cause enterprises to further reduce spending on innovation and R&D activities and continue to allocate large amounts of capital to financial assets. Thirdly, in the framework of incomplete market analysis, there are a few manufacturing enterprises with monopoly power in industries, and these enterprises can obtain high monopoly profits and their behavior can guide the subsequent behavior of other enterprises in industries. As a result, the monopolistic manufacturing enterprises in the industry generate a large amount of idle and surplus profits in the process of production and operation, and these idle surplus funds are used by the monopolistic enterprises to allocate more financial assets and restrict other enterprises from expanding their production scale, resulting in other enterprises in the industry following the monopolistic enterprise financialization behavior, which eventually constrains the technological progress of the whole industry in key areas. Of course, the financialization of manufacturing enterprises can lead to higher profits and improved performance, which may be reinvested into their R&D and innovation activities, manifested as a "reservoir effect". In the current case, the "crowding out effect" of financialization of manufacturing enterprises is much more significant than the "reservoir effect".

In summary, the financialization of manufacturing enterprises has a significant

constraint effect on the R&D input and output performance of enterprise technology innovation and this constraint effect is generated by the "crowding out" effect over the "reservoir effect". In other words, the "crowding out" effect of financialization of manufacturing enterprises on R&D expenditures is much more significant than the innovation promotion effect generated by the increase of return on assets, which demonstrated that hypothesis 1a is supported.

6. Analysis of Effect Mechanisms

6.1 The "reservoir effect" mechanism

6.1.1 Liquidity supply path

The liquidity supply path is financialization of manufacturing enterprises - liquidity supply - enterprise R&D investment. This research used liquidity supply as an instrumental variable to test such effect. The estimation results of the mediating effects model based on the liquidity supply path is shown in Table 2. The results demonstrated that the financialization of manufacturing enterprises significantly increases the liquidity of enterprise assets ($b_1 > 0$), and the increase in the liquidity of enterprise assets significantly promotes the expansion of the scale of enterprise R&D expenditures ($c_2 > 0$), while the effect of financialization of manufacturing enterprises on enterprise R&D investment remains a negative effect on performance ($c_1 < 0$). At this point, $b_1 c_2 > 0$ and $c_1 < 0$ are different, the effect of financialization of manufacturing enterprises on enterprise R&D investment through liquidity supply channels is shown as a masking effect, and it can be seen that the "reservoir effect" is less significant than the "crowding out effect".

Table 2 Estimation results of the mediating effects model based on the liquidity supply path

Variables	(1)	(2)	(3)
	arsinh_rd	ocf	arsinh_rd
fin	-0.119***	0.071***	-0.104**
	(0.04)	(0.01)	(0.04)
ocf			0.259***
			(0.10)
Adjusted R^2	0.2255	0.0176	0.4683
Ind_FE	YES	YES	YES
Year_FE	YES	YES	YES
Obs	7768	7768	7768

Note: (1) In round brackets are robust standard errors；(2)* p < 0.1, ** p < 0.01, *** p < 0.001.

6.1.2 Revenue driven path

The revenue driven path is financialization of manufacturing enterprises - return on net assets - enterprise R&D investment. This research used return on net assets as a mediating variable to validate such path. The estimation results of the mediating effects model based on the earnings driven path is shown in Table 3. The financialization of manufacturing enterprises significantly increases the return on net assets of enterprises ($b_1 > 0$), and the increase in the return on assets of enterprises significantly expands the scale of R&D

expenditures of enterprises ($c_2 > 0$), while the effect of financialization of manufacturing enterprises on R&D investment of enterprises remains a negative effect of performance ($c_1 < 0$).At this point, $b_1 c_2 > 0$ and $c_1 < 0$ are different, and the effect of financialization of manufacturing enterprises on enterprise R&D investment through revenue driven channels is a masking effect, and it can be concluded that the "reservoir effect" is less significant than the "crowding out effect".

Table 3 Estimation results of the mediating effects model based on the return driven path

Variables	(1)	(2)	(3)
	arsinh_rd	roe	arsinh_rd
fin	-0.119***	0.407**	-0.118***
	(0.04)	(0.18)	(0.04)
roe			0.008**
			(0.00)
Adjusted R²	0.2255	0.0129	0.2255
Ind_FE	YES	YES	YES
Year_FE	YES	YES	YES
Obs	7768	7768	7768

Note: (1) In round brackets are robust standard errors；(2)* p < 0.1, ** p < 0.01, *** p < 0.001.

6.2 The "crowding out" mechanism

6.2.1 Exogenous financing path

The exogenous financing paths are financialization of manufacturing enterprises - credit financing - enterprise technology innovation and financialization of manufacturing enterprises - equity financing - enterprise technology innovation. This research used the degree of credit financing and equity financing as mediating variables to verify such effect path. The estimation results of the mediating effect model based on the exogenous financing path is shown in Table 4. On one hand, the financialization of manufacturing enterprises significantly reduces the scale of enterprise credit financing ($b_1^d < 0$) and expands the scale of equity financing ($b_1^e > 0$), and the expansion of enterprise credit financing significantly increases enterprise R&D investment ($c_2^{d,rd} > 0$) and promotes higher levels of innovation output performance ($c_2^{d,inv} > 0$). The expansion of enterprise equity financing has no significant effect on enterprise R&D investment ($c_2^{e,rd} = 0$), but suppresses the level of enterprise innovation output performance ($c_2^{d,inv} < 0$). On the other hand, there is a significant negative effect of financialization of manufacturing enterprises on both R&D input and output performance of enterprise technology innovation ($c_1^{rd} < 0$ and $c_1^{inv} < 0$). At this point, with the same sign as $b_1^d c_2^{d,rd} < 0$ and $c_1^{rd} < 0$ (or $b_1^d c_2^{d,inv} < 0$ and $c_1^{inv} < 0$), the effect of financialization of manufacturing enterprises on enterprise technological innovation through credit financing channels demonstrates a partial mediating effect. In addition, $b_1^e c_2^{e,inv} < 0$ and $c_1^{inv} < 0$ have the same sign, and the effect of financialization of manufacturing enterprises through equity financing channels on the

innovation output performance of enterprises demonstrates a partial mediation effect. Based on the analysis above, it can be concluded that the "crowding out effect" is more significant than the "pooling effect".

Table 4 Estimation results of the mediating effects model based on the exogenous financing path

Variables	(1) arsinh_rd	(2) arsinh_inv	(3) debt	(4) equity	(5) arsinh_rd	(6) arsinh_inv
fin	-0.119***	-1.571***	-0.130***	0.211***	-0.113**	-1.738***
	(0.04)	(0.13)	(0.01)	(0.06)	(0.05)	(0.13)
debt					0.965***	1.310***
					(0.09)	(0.17)
equity					-0.053	-0.446***
					(0.04)	(0.08)
Adjusted R^2	0.2255	-	0.1604	0.1404	0.4828	-
Pseudo R^2	-	0.0495	-	-	-	0.0499
Ind_FE	YES	YES	YES	YES	YES	YES
Year_FE	YES	YES	YES	YES	YES	YES
Obs	7768	7768	7768	7765	7765	7765

Note: (1) In round brackets are robust standard errors；(2)* $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$.

6.2.2 R&D resource plundering path

The R&D resource predation path is financialization of manufacturing enterprises - R&D input intensity - enterprise innovation output performance. This research used R&D input intensity as a mediating variable to test such path. The estimation results of the mediating effect model based on the R&D resource predation path is shown in Table 5. The results demonstrated that the financialization of manufacturing enterprises significantly attenuates R&D input intensity ($b_1 < 0$), and an increase in R&D input intensity can enhance the level of enterprise innovation output performance ($c_2 > 0$), while the effect of financialization of manufacturing enterprises on enterprise innovation output performance remains a negative effect of performance ($c_1 < 0$). At this point, $b_1 c_2 < 0$ and $c_1 < 0$ are of the same sign, and the effect of financialization of manufacturing enterprises on the innovation output performance of enterprises through R&D resource plundering channels demonstrates a partial mediating effect. Based on the intermediary effect analysis above, the "crowding out effect" is more significant than the "pooling effect".

Table 5 Estimation results of the mediating effects model based on the path of R&D resource plundering path

Variables	(1) arsinh_inv	(2) rda	(3) arsinh_inv
fin	-1.571***	-0.035**	-1.645***
	(0.13)	(0.01)	(0.13)
rda			0.674***
			(0.24)

Adjusted R^2	-	0.0169	-
Pseudo R^2	0.0495	-	0.0495
Ind_FE	YES	YES	YES
Year_FE	YES	YES	YES
Obs	7768	7768	7768

Note: (1) In round brackets are robust standard errors；(2)* p < 0.1, ** p < 0.01, *** p < 0.001.

7. Conclusion

Some researches believed that the degree of financialisation of manufacturing enterprises influences the level of technological innovation, but there has not been a consensus on the direction of the effect, and there are some limitations in existing researches in terms of the research strategy used and the mechanism analysis conducted (Liu, 2017; Duan and Zhuang, 2021). Is there any effect of financialisation of manufacturing enterprises on the level of technological innovation of enterprises? Is the effect positive or negative? Is there any significant heterogeneity in such effect? What are the mechanisms of the effect? Therefore, based on the data of Chinese A-share manufacturing enterprises listed in the CSMAR database from 2010-2018, this research applied a series of appropriate research methods to argue that the following conclusions could be reached. Firstly, the financialisation of manufacturing enterprises significantly curtails enterprise R&D investment and constrains the level of enterprise innovation output performance. Secondly, the financialisation of manufacturing enterprises has a "reservoir effect" (masking effect) on the innovation of enterprise technology through liquidity supply and revenue driven paths and a "crowding out effect" (partial intermediation effect) on the innovation of enterprise technology through exogenous financing and innovation resource plundering (partial intermediation effect). Therefore, the technological innovation effect of the financialisation of manufacturing enterprises is a combination of the "reservoir effect" and the "crowding out effect", and the "crowding out effect" is much more significant than the "reservoir effect".

Based on the research findings above, combined with the current situation of manufacturing development and current practical experience, this research offers the following suggestions. Authorities should firstly adhere to the innovation driven orientation of manufacturing industry, establish and improve the innovation risk compensation mechanism, effectively restrain the degree of financialization of enterprises, and comprehensively stimulate the R&D and innovation vitality of real enterprises, secondly accelerate the reform of the financial market, crack the problem of "difficult financing" for manufacturing enterprises, improve the proportion of credit financing for enterprises, and enhance financial inclusion and inclusiveness, thirdly increase the financial market supervision and governance, promote full and orderly competition in the financial industry, optimize the business environment of the real economy, and effectively narrow the gap between the return on assets of the manufacturing industry and the financial industry, and fourthly actively build an open, harmonious, inclusive and efficient innovation network system, improve the cooperation mechanism of "authorities, industry, academia, research and application", and promote the strengthening of scientific and technological exchanges and cooperation among innovation subjects. The manufacturing enterprises should firstly give higher weight to technological innovation performance in the annual performance assessment of manufacturing enterprises, improve the incentive mechanism for technological innovation of enterprises, and strictly regulate the use of innovative R&D funds, secondly establish and improve the modern enterprise management system with clear property rights, clear authority and responsibility, separation of authorities and enterprises, and scientific management, so as to effectively restrain the "short-sighted" behavior of enterprise executives, and thirdly improve the enterprise risk warning and response system mechanism, set up a "reservoir" of enterprise strategic funds, and avoid

unnecessary equity financing as much as possible.

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