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Research article

Financial asset allocation and green innovation

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Abstract: Sustainable development is a key issue of global concern, and countries around the world are striving to promote green development. From the perspective of financial asset allocation motivation, this paper explores the impact of financial asset allocation on green innovation based on the data of A-share listed non-financial companies from 2011 to 2021. First, there is an inverted U-shaped relationship between the proportion of financial asset allocation and the green innovation of physical enterprises, that is, as the proportion of financial asset allocation increases, the green innovation output of enterprises first increases and then decreases. After robustness testing, the conclusion still holds. Second, further testing of the intermediary mechanism shows that the moderate holding of short-term financial assets by real enterprises can increase the output of green innovation by alleviating financing constraints, which is manifested as the "reservoir" effect. The "crowding out" effect plays a leading role when overallocation of financial assets reduces liquidity supply and capital expenditure, which in turn reduces green innovation output. Third, in the test of financial asset allocation preference, it is found that the short-term financial assets held by enterprises mainly play a "reservoir" effect, that is, they tend to be "preventive" motives. Holding long-term financial assets mainly exerts a "crowding out" effect, that is, tends to "seek profits" motives. Finally, there are differences in the impact of financial asset allocation on green innovation output among enterprises with different property rights, different monetary policies and different social responsibilities.

Keywords: financial asset allocation; green innovation; preventive motivation; profit-seeking motives

JEL Codes: Q56

1. Introduction

In recent years, green innovation (GreInva) behaviors have attracted more and more attention in academia. Different from general traditional innovation, there is a clear "dual externality" in green technology innovation. (Rennings, 2000), which is reflected in the positive and external nature of knowledge technology, that is, enterprises bear the cost of GreInva, but cannot enjoy the corresponding income; on the other hand, the negative externalities brought by environmental pollution, that is, the cost of pollution emissions are not included in the production costs, and the motivation of enterprises to carry out green technology innovation is insufficient. In the past, the research on green innovation in the industry was mainly divided into the following two parts: on the one hand, existing research started from the enterprise, mainly to explore the impact of financing policies (Huang and Cha, 2022), corporate social responsibilities (Ran et al., 2023) and heterogeneity of senior management teams (Qi et al., 2023) on green innovation; on the other hand, from the perspective of institutional factors, the research themes mainly include environmental regulation (Yang and Cheng, 2021) and environmental policy (Huang and Cha, 2022). In recent years, researchers have begun to follow with interest GreInva under the market-oriented mechanism, but there are relatively few such studies. Continuous and stable financial support is an indispensable factor when allocating production factors for GreInva, and it is clear that financial asset allocation (FAA) behavior will affect GreInva (Chen et al., 2022).

FAA refers to the tendency of real enterprises to invest in financial assets (FA) with the increase of investment income of FA (Krippner, 2005), and there is a tendency to gradually separate from the real industry. On the one hand, most scholars believe that FAA has a "reservoir effect" on the main business of real enterprises, which is manifested in the fact that entity enterprises can give certain financial support to the main business such as innovation through the allocation of FA, and encourage enterprises to increase investment in the main business, thereby having a positive impact on the main business investment. Kliman and Williams (2015) used US data to demonstrate the increase in financial asset allocation at the expense of productive investment. They explained theoretically why, accompanied by the growth of dividend payment and the growth of corporate portfolios, productive investment did not decrease. Hu et al. (2017) studied the relationship between financial asset allocation and GDP cycle variables, broad variable M2 cycle variables, statutory reserve rates and stock index growth rates, indicating that the company's allocation of financial assets is based on the "preventive" motivation. On the other hand, most studies have found that FAA behavior has a "crowding-out effect" on main business investment, which is manifested in the high return on capital asset investment causing physical enterprises to transfer funds originally used for main business development into financial projects, thereby having a negative effect on innovation and other main businesses. Tori and Onaran (2017), based on the panel data of the balance sheets of non-financial companies in Western European countries, finds that financial payments have an adverse impact on fixed assets investment. Wang et al. (2017) conducted empirical research under the framework of market arbitrage analysis, and the research results showed that the opportunities for financial arbitrage in physical enterprises significantly inhibit the innovation drive of enterprises.

The above research is mainly based on the simple linear relationship between FAA and main business investment, and does not reveal the more complex relationship between the two. In the past two years, research has found that there may be a nonlinear relationship between FAA and related decision-making. For example, Tan et al. (2022) found that moderate corporate financialization inhibits financial risks, while excessive corporate financialization deepens financial risks. Inspired by such

research, we argue that FAA may have the superposition of the above two utilities, resulting in a nonlinear relationship, so we focus on whether there is a U-shaped (inverted U-shaped) relationship between the two. The results show that there is an inverted U-shaped relationship, that is, there is a critical value in the proportion of financial asset allocation (Fin), and when the Fin is on the left side of the critical value, with the increase of the Fin, the degree of GreInva development of enterprises gradually increases. When the Fin is on the right side of the critical value, the degree of GreInva of enterprises gradually decreases with the increase of the Fin. The results show that the positive and negative effects of FAA behavior exist at the same time, but the degree of influence is different, and the sum results of the two effects are different under different Fin, so that the overall nonlinearity is presented.

Although some scholars have explored the FAA behavior from the perspective of motivation, which means that in addition to the allocation of financial assets (FA) for preventive motivation, there are also FAA behaviors for the purpose of pursuing profit (Liu et al., 2022), but the above research does not distinguish the types of FAA from the perspective of motivation. In fact, real enterprises may allocate different types of financial assets for different motives (Du et al., 2021), and it is precisely because of this difference that the utilization of financial assets is bound to be different, which in turn has different impacts on their investment decisions. This article verifies the preventive and profit driven motives of FAA based on financing constraints, liquidity supply and capital expenditures. Based on this, it explores the impact of different types of financial assets on GreInva from the perspective of FAA motives. The results show that enterprises holding short-term financial assets mainly exert the "reservoir" effect, that is, they tend to be "preventive motivation". The holding of long-term financial assets mainly exerts the "crowding out" effect, that is, the tendency to a "profit-seeking motive", which indicates that the FAA under different motives will have different economic consequences.

Different internal and external environmental governance factors affecting the economic consequences of FAA may also be an important reason for the above research conflicts. Therefore, it is particularly important to explore and verify which internal and external factors affect the economic consequences of FAA behavior, and then explore the role of property rights, monetary policy and social responsibility in Fin and GreInva. The study finds that there are differences in the impact of Fin on GreInva under different property rights, different monetary policies and enterprises with different social responsibilities, which indicates that different internal and external governance factors may have different impacts on the economic consequences of FAA.

In summary, the research contributions of this paper are: First, this paper focuses on analyzing the nonlinear impact of Fin on GreInva. From the perspective of preventive motivation and profit-seeking motivation, based on the trade-off between the pros and cons of allocating financial assets and investing in GreInva, the strength and weakness of the two motivations under different proportions of financial assets are analyzed, so as to explore the nonlinear impact between them. Second, this article not only examines the overall relationship between Fin and GreInva, but also divides financial assets into short-term and long-term categories based on their liquidity. It is found that holding short-term FA mainly plays a reservoir effect, while holding long-term FA mainly plays a crowding out effect, which helps to test the impact of allocating FA on GreInva under different financialization preferences. Third, it emphasizes the importance of appropriate FAA, and by measuring the optimal value of the Fin of Chinese listed companies, it is conducive to exploring the existence of the optimal level of allocation of FA, and then standardizing the investment behavior of FA of entity enterprises and preventing the hidden dangers of excessive financialization, which has significance for promoting the development of the real industry.

2. Research assumptions and methods

2.1. Research assumptions

With the increase in investment returns on financial assets, physical enterprises are increasingly inclined to invest in FA (Krippner, 2005), showing a tendency to gradually detach from the physical industry. It has been found that there are two motivations for enterprises to allocate financial assets. The first is preventive motivation: In order to prevent the shortage of funds and ensure the normal operation of enterprises, enterprises will tend to use idle funds to invest in FA to revitalize funds and increase the liquidity of assets. At this time, the FAA is equivalent to a "reservoir" (Gehringer, 2013). Andrew (2015) used US firm data for empirical testing and found that financialized investment by non-financial firms does not lead to a decline in productive investment. The second is the profit-seeking motive: FA have the dual characteristics of high risk and high return. The rate of return is higher than other productive industries, and in order to pursue short-term excess interests, enterprises tend to invest financial assets. Because enterprise funds are limited, it will inevitably crowd out the funds for production research and development, innovation investment and other main businesses, specifically manifested as the "crowding out effect". Peng et al. (2018) show that the main motivation of Chinese non-financial enterprises in allocating financial assets is to pursue profits, rather than precautionary savings. Shi et al. (2021) found through research that the purpose of allocating FA is mainly based on profit seeking motivation. These two motivations are not contradictory in themselves and are likely to emerge simultaneously, and one of them may dominate, or the two motivations may alternate as the allocation of financial assets deepens. Tan et al. (2022) studied the mechanism of corporate financialization affecting financial risk and found that based on the "preventive" motivation, the appropriate Fin reduces financial risk, which is specifically manifested as the "reservoir" effect. Based on the "profit-seeking" motive, excessive FAA will increase financial risks, which is manifested as a "crowding out" effect.

Through the motivation analysis above, it is found that the impact of FAA on the level of GreInva has both positive and negative effects, and the magnitude of these two effects may vary under different circumstances, depending on the relative size of the two motivations for enterprises to allocate financial assets. Entities need to make trade-offs between short-term returns on financial assets and their main business in order to make economic decisions that maximize economic benefits. This means that the Fin and GreInva relationship is not simply linear, but there may be a tipping point. Specifically, there may be two scenarios between Fin and GreInva, as shown in Table 1.

Table 1. The relationship between financial asset allocation and green innovation.

Hypothesis	Left of the critical point	Right of the critical point	Relationship
1a	The "preventive" motivation is greater than the "profit-seeking" motivation: increasing the output of green innovation	The "profit-seeking" motivation is greater than the "preventive" motivation: reducing the output of green innovation	Inverted U-shaped relationship
1b	The "profit-seeking" motivation is greater than the "preventive" motivation: reducing the output of green innovation	The "preventive" motivation is greater than the "profit-seeking" motivation: increasing the output of green innovation	U-shaped relationship

Based on the situation that the proportion of financial assets allocated by enterprises is low, the green innovation level of real enterprises is low.

Under the circumstance that the level of GreInva of real enterprises is low, on the one hand, when real enterprises hold FA moderately, as the Fin increases, the preventive motivation of real enterprises to smooth the capital demand for GreInva through the allocation of FA is enhanced. First of all, unlike general innovation, green innovation involves the green transformation of enterprises and the change of production and operation models and concepts, which has high costs and resource constraints, and often faces more serious financing constraints. FA have the characteristics of short purchase period, strong profitability and liquidit, and enterprises will produce surplus funds to invest in financial assets, which can reduce idle funds within the enterprise and improve the efficiency of capital utilization. The financial benefits can also prevent the risk of cash flow shortage that may occur when green innovation continues to invest, and alleviate the dilemma of insufficient financing for enterprises (Yang, 2019). At this time, enterprises allocate more financial assets, which helps to provide sufficient capital supply for GreInva activities, and good liquidity reserves also make enterprises more confident to engage in GreInva activities. Second, based on the risk transmission effect, the financial field has the characteristics of high income uncertainty and greater loss risk, and this risk is easily transmitted to real enterprises, and the larger the total FA held by enterprises, the higher the financial risk (Huang et al., 2018). When enterprises hold FA moderately, even if the Fin is increased, it will not cause greater financial risks due to the excessive proportion of financial assets, making enterprises more active in GreInva activities. Finally, based on the "portfolio theory", green innovation has high risks, and real enterprises can hedge and avoid risks to a certain extent by allocating diversified financial assets, so as to have the ability to take more risks in GreInva and R&D activities, achieve technological upgrading and promote the development of GreInva. Moreover, due to the strong liquidity of financial assets, the appropriate allocation of FA can improve the capital turnover of enterprises, reduce the risk of default and disperse the risks of green innovation to a certain extent, so that enterprises can more actively engage in green innovation activities. Therefore, when real enterprises hold financial assets moderately (to the left of the critical point), as the Fin increases, the degree of investment in GreInva by real enterprises may increase.

On the other hand, when an entity enterprise excessively holds FA, with the increase of the corporate Fin, the profit-seeking motivation of the entity enterprise to continue to invest in FA gradually increases. First, based on the dual externalities of GreInva, GreInva itself needs to bear high environmental governance costs, and it usually leads to enterprises taking risks higher than rewards (Cai et al., 2019). With the rapid growth of R&D costs and demand, innovation risks increase. In contrast, corporate management will be more willing to invest funds in FA with a short payback period (Xie, 2018), and the resources of GreInva are crowded out. Second, as the Fin gradually increases, to a certain extent, it means that the returns obtained by enterprises from FAA are likely to exceed the value increase brought by the main business such as innovation, thus ignoring the high risks associated with high returns, at which time the profit-seeking motivation gradually dominates. The accumulation of financial risks will lead to large fluctuations in the company's future cash flow, which in turn will have a crowding out impact on GreInva activities (Wang et al., 2021). Finally, based on the analysis of the operation system of real enterprises, excessive investment in financial assets by real enterprises will gradually make the financial sector more important than the real sector, and then change the investment strategy of enterprises, that is, from long-term development strategy to short-term profit strategy. While enterprises are chasing short-term excess profits, the profit of green innovation will be squeezed out, which will lead to damage to the welfare of employees. The growth of employees' labor

income may stagnate, resulting in a lack of enthusiasm of innovators and too little investment in human capital, which in turn hinders the development of GreInva.

Although the above two motivations exist in the process of allocating FA, in general, when the Fin is low, the preventive motivation of enterprises to allocate financial assets is stronger than that of profit-seeking, and the overall preventive motivation is superior. Therefore, when the Fin is low, with the increase of Fin, the green innovation output of enterprises will gradually increase. However, with the increase of the Fin, the preventive motivation to improve the liquidity reserve of enterprises through the Fin gradually weakens, while the profit-seeking motivation to obtain short-term returns through the Fin gradually increases. When the Fin increases to a certain proportion (at the critical point position), the two motivations are at the same level, at which time the GreInva willingness of real enterprises reaches the maximum. Then, with the continuous increase of the Fin, the profit-seeking opportunity of enterprises to allocate financial assets exceeds the preventive motivation, which is manifested in the fact that when the Fin is high (right of the critical point), as the Fin increases, the willingness for GreInva gradually decreases. From this, the following hypothesis 1a is proposed:

Hypothesis 1a: Under other conditions being equal, there is an inverted U-shaped relationship between the proportion of corporate financial assets allocated and green innovation.

Based on the situation that the proportion of financial assets allocated by enterprises is low, the green innovation level of real enterprises is high

When the Fin is low, first, although the lower level of FAA leads to a lower possibility of financial risk for real enterprises, excessive investment in GreInva by real enterprises will itself generate higher risks due to uncertainty about returns (Huang et al., 2018). At this time, entity enterprises pay more attention to the innovation risks brought to the company by a high proportion of GreInva investment, and once GreInva activities lose stable and durable cash flow, entity enterprises will tend to allocate FA to pursue short-term profits. Second, the investment of real enterprises in Fin itself also amplifies the level of financial risk (Guo et al., 2021), so real enterprises may reduce green innovation out of risk resistance. At this time, although the increase in the Fin can provide sufficient capital reserves for green innovation output, making real enterprises more motivated and able to invest resources in green innovation investment (Xu et al., 2019), on the whole, the "reservoir" effect of increasing FAA on the basis of a low Fin is not as good as the "crowding" effect of allocating financial assets in the face of high innovation risks. On the left side of the tipping point, since the willingness of real enterprises to reduce the risk of GreInva itself by reducing the proportion of GreInva exceeds the willingness to increase the proportion of GreInva investment under the "preventive motivation", the level of GreInva output of real enterprises gradually decreases as the Fin increases.

However, with the increase of the Fin, the degree of protection for green innovation R&D funds of real enterprises has gradually increased. At the same time, with the reduction of GreInva, the willingness of real enterprises to reduce the risk of GreInva itself by reducing the proportion of GreInva is gradually weakening. When the Fin increases to a certain level (just at the critical value position), the two willingnesses are at the same level. At this time, the GreInva of real enterprises is at the lowest level. Later, although the "crowding out" effect on GreInva still plays a role as the Fin continues to increase, because GreInva is at a low level, on the whole, the "preventive" motivation prevails. Therefore, when the Fin is high (on the critical right), with the increase of Fin, the level of GreInva of real enterprises gradually increases. From this, hypothesis 1b is proposed:

Hypothesis 1b: Under other conditions being equal, there is a U-shaped relationship between the proportion of corporate financial assets allocated and green innovation.

2.2. Sample selection and data processing

Considering the impact of the financial crisis, this paper excludes the data before 2008 as well as 2008, 2009 and 2010, and selects China's A-share listed companies from 2011 to 2021 as the original sample. The data on business green innovation output comes from the China Research Data Service Platform (CNRDS), and other relevant variables are mainly from the Guotai an Database (CSMAR). In this article, the sample data is processed according to the following standards: (1) financial enterprises among the sample enterprises are excluded; (2) enterprises that were ST during the period of rejection; (3) delisted enterprises are excluded; (4) enterprises with missing main variables are excluded; (5) the financial data in the sample were shrunk by 1% using the Stata software; and finally 24987 sample observations from 2011 to 2021 were obtained.

2.3. Definition of main variables

2.3.1. Financial asset allocation

Drawing on the practices of Duan and Zhuang (2021), this paper selects the proportion of corporate FA held, that is, the Fin of enterprises divided by the total assets at the end of the period. It should be pointed out that investment real estate is separated from the real economic sector and has the characteristics of independence and virtuality, so it is classified as a financial asset. In order to test whether there is a nonlinear relationship between the Fin and the GreInva, this paper also sets the square term of the Fin (Fin^2).

2.3.2. Green innovation

The number of innovation patent applications is an important indicator to measure technological innovation, which can reflect the innovation ability and level of entity enterprises. Drawing on the practice of Wu and You (2022), the patent information submitted by listed companies in the patent database of the State Intellectual Property Office of the People's Republic of China is integrated, and the number of green patent applications is used to measure the level of green innovation of enterprises. Specifically, the total number of green invention patents and utility model patent applications of listed companies in the current year is used as the proxy variable of green technology innovation index, and the natural logarithm of this variable is taken to solve the skewed distribution problem. In order to avoid the situation that the number of patent applications is 0 after logarithm, the natural logarithm of the green patent application data is added to 1 to measure the level of green innovation.

2.3.3. Control variables

Drawing on the practices of relevant literature (Zhang and Zhao, 2022; Wang and Li, 2023), this paper selects indicators that may affect GreInva from the enterprise level and sets them as the following control variables: (1) Size: based on the total asset data at the end of the observation sample, calculate the logarithm of total assets, that is, ln(total assets); (2) Financial lever (Lev): according to the data of total assets and total liabilities at the end of the observation of sample enterprises, calculate the ratio of total liabilities to total assets; (3) Top1: calculate the ratio between the number of shares held by the

top shareholder and the total number of shares based on the observed sample company's shareholding ratio; (4) Duality: according to the management position of the sample enterprise, if the president and the managing director are the same person, the value is 1, or else, the value is 0; (5) Indep: observe the data of the number of independent directors and the number of directors of the sample E): on the basis of the character of the enterprise, the value of state-owned enterprises is 1, and the value of non-state-owned enterprises is 0; (8) Age of establishment: according to the year of establishment of the sample enterprise, calculate the establishment time and take the natural logarithm, that is, ln(current year - establishment year + 1); (9) Cash proportion (cash): based on the annual cash and cash equivalents of the sample enterprises and the total assets data at the beginning and end of the period, the ratio of the two is calculated, that is, cash and cash equivalents/the average of assets at the beginning and end of the period. The role of control variables is to alleviate the problem of missing variable bias to a certain extent, and the finer the control, the more it can alleviate the problem of missing variable bias. Individual fixed effect refers to variables that only change with the individual but not with other factors, but because there are too many individuals, the loss of freedom is too large, and it is easy to appear insignificant, so drawing on the practices of Ran (2023), we only introduce annual virtual variables and industry virtual variables to control the annual fixed effect and industry fixed effect. Table 2 follows.

Table 2. Variable definitions and measures.

Variable type	Variable name	Variable symbol	Variable description
The variable being explained	Green innovation	GreInva	Ln (1+ Number of green patent applications)
Explanatory variables	The proportion of financial asset allocation	Fin	(Monetary funds + Tradable financial assets + Financial assets available for sale + Investment real estate + Hold-to-maturity investments + Dividends receivable + Dividends receivable)/Total assets
	The square of the proportion of financial funds allocated	Fin^2	The square of the proportion of financial asset allocation
Control variables	Enterprise size	Size	Ln (Enterprise assets)
	Financial leverage	Lev	liability/Total assets
	The shareholding ratio of the largest shareholder	Top1	It is expressed using the total shareholding of the top shareholder as a percentage of the company's total share capital
	Both positions are held concurrently	Duality	If the chairman and the general manager are the same person, take 1; otherwise take 0
	Proportion of independent directors	Indep	Use the number of independent directors as a percentage of the total number of board members
	Organizational performance	Roa	Net profit/Average balance of total assets
	Ownership structure	Soe	The value of state-owned enterprises is 1, and the value of non-state-owned enterprises is 0
	Age of establishment	Age	Ln (The year of the year - Year of establishment +1)
	Cash weighting	Cash	Cash and cash equivalents/Total assets

2.4. Model design

Based on the Hausman test results, this article selects a bidirectional fixed effect model for regression analysis, which controls the year and industry. In order to verify the impact of Fin on GreInva, according to the research hypothesis, a model 1 with GreInva as the explanatory variable and Fin and its square term Fin2 as the explanatory variables is constructed as follows:

$$GreInva_{it}=\alpha_0+\alpha_1 Fin_{it}+\alpha_2 Fin^2{}_{it}+\alpha_k Controls_{it}+\sum Year+\sum Ind+\varepsilon_{it}. \quad (1)$$

3. Empirical analysis

3.1. Descriptive statistical analysis

Table 3 reports the descriptive statistical results of each variable, where the average value of GreInva of real enterprises is 0.472, and the SD is 0.884, indicating that the green innovation level of listed companies in China is different, and the sample differentiation is good. The average value of Fin was 0.237, and the proportion of FA invested by sample enterprises in the total asset scale reached 23.7%, indicating that the financialization level of non-financial listed enterprises in China is relatively high overall (Duan et al., 2021), which also reflects the necessity and practical significance of studying the behavior of FAA.

Table 3. Descriptive statistics of variables.

Variable	N	Mean	p50	SD	Min	Max
GreInva	25971	0.472	0	0.884	0	6.900
Fin	34974	0.237	0.192	0.166	0	1
Size	34974	22.17	21.95	1.555	14.95	31.19
Lev	34974	0.444	0.413	1.113	−0.200	184.6
Top1	34305	0.343	0.320	0.152	0	1
Dual	33810	0.293	0	0.455	0	1
Indep	34298	0.376	0.364	0.0560	0	1
Roa	34971	0.0350	0.0390	0.729	−46.88	110
soe	33399	0.351	0	0.477	0	1
Age	34898	3.160	3.178	0.259	1.792	7.612
Cash	34971	0.169	0.128	0.139	−0.00400	1.028

3.2. Basic regression analysis

Table 4 reports the regression results of Fin and GreInva of real enterprises. According to column (1), the regression coefficient (Rc) of Fin is 0.306, and the Rc of Fin^2 is −0.422. Both are significant at the level of 1%, which is in line with the characteristics of the inverted U-shaped curve, assuming that hypothesis 1a is verified. In order to further explain the trend of GreInva, the total sample was divided into two groups according to the critical value of Fin (the critical value calculated according to column (1) was 0.363)[1], and group regression was carried out separately. Column (2) is the regression result

[1] There are two ways to calculate the critical value. Based on the data of A-share listed non-financial companies from 2011 to 2021, the following steps are carried out to test the inverted U-shaped relationship: Step 1: An inverted U-shaped curve

of the left side of the critical value (Fin < 0.363), and the Rc of the Fin is 0.224, which is significant at the level of 5%. Column (3) is the regression result to the right of the critical value (Fin > 0.363), and the Rc of the Fin is −0.240 and is significant at the level of 5%. This shows that in the case of low Fin, it is mainly manifested as the "reservoir" effect, that is, by increasing internal financing channels, making up for the lack of investment in green innovation, and then playing the role of feeding back to real industries such as green innovation (Du et al., 2017). When the Fin is high, it is mainly manifested as the "crowding out effect", that is, in the case of limited resources, it will undoubtedly crowd out real investment, thereby inhibiting the development of green innovation (Soe et al., 2012). Again, it is not rigorous to judge the inverted U-shaped relationship between the two based on the statistical significance of the quadratic term coefficient, referring to Lind and Mehlum (2010). Using the utest command for accurate testing, the calculated extreme value point is 0.36, and the value range of Fin is (0, 0.99).

Table 4. Financial asset allocation and green innovation: benchmark regression.

Variable	Full-sample regression	Subsample regression	
		Fin < 0.363	Fin > 0.363
	(1)	(2)	(3)
	GreInva	GreInva	GreInva
Fin	0.306***	0.224**	−0.240**
	(0.111)	(0.113)	(0.102)
Fin^2	−0.422***		
	(0.137)		
Size	0.153***	0.158***	0.131***
	(0.004)	(0.005)	(0.011)
Lev	0.062***	0.060***	0.061**
	(0.014)	(0.016)	(0.029)
Top1	−0.045	−0.018	−0.200***
	(0.035)	(0.039)	(0.077)
Dual	0.046***	0.050***	0.032
	(0.011)	(0.013)	(0.024)
Indep	−0.378***	−0.291***	−0.804***
	(0.089)	(0.099)	(0.200)
Roa	0.063***	0.058***	0.149*
	(0.019)	(0.021)	(0.087)
SOE	0.039***	0.028**	0.092***
	(0.012)	(0.014)	(0.029)
Age	−0.129***	−0.133***	−0.108**
	(0.022)	(0.025)	(0.049)
Cash	0.276***	0.284**	0.347***
	(0.063)	(0.122)	(0.075)

Continued on next page

is fitted according to the original data; Step 2: Perform quadratic term regression, and judge that the coefficient of the primary term is 0.306 and the coefficient of the quadratic term is -0.422 and both are significant; Step 3: Find the breakpoint, where because the test method is based on quadratic regression, the critical value = −b/2a = 0.363. Alternatively, it can be tested with the utest command, and the extreme point calculated is 0.36, which is consistent with the previous method.

Variable	Full-sample regression	Subsample regression	
		Fin < 0.363	Fin>0.363
	(1)	(2)	(3)
	GreInva	GreInva	GreInva
_cons	−2.512***	−2.635***	−1.799***
	(0.125)	(0.138)	(0.302)
year	Yes	Yes	Yes
industry	Yes	Yes	Yes
N	24987.000	20529.000	4451.000
R2	0.234	0.230	0.277

Note: The values in parentheses are the heteroscedasticity robust standard error of the regression coefficient; ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively, the same as below

3.3. Robustness analysis

3.3.1 Endogenous test

(1) Propensity score matching method (PSM)

The Fin will be affected by certain characteristics, which may cause specimen self-selecting problems, and this article uses PSM for endogeneity testing. The basic idea of matching is as follows: taking the Fin as the matching standard, this paper sets the dumb variable (PSM), because the critical point of the inverted U-shaped curve is about 36.3%, when the Fin is greater than 36.35%, it is set to 1; otherwise, set to 0. The basic idea of matching is as follows: taking the Fin as the matching standard, this paper sets the dumb variable (PSM). Since the critical point of the inverted U-shaped curve is about 36.3%, when the Fin is greater than 36.35%, it is set to 1; otherwise, set to 0. At the same time, whether the Fin exceeds the critical value is taken as the treatment variable, the variable that affects both Fin and GreInva is selected as the covariate, and GreInva is selected as the result variable. When matching, enterprises with a Fin exceeding 36.3% of the critical value were set as the experimental group, and a 1:1 ratio was used to match companies with Fin not exceeding the critical value of 36.3%. The results of this matching method showed that the estimated ATT value was −0.06, which was significant at the 5% level. The regression results are shown in column (1) of Table 5. The Rc of the Fin and its square term Fin^2 are 0.34 and −0.584, respectively, and both are significant.

(2) PSM+ Fixed effect

Fin and GreInva may face issues caused by missing variables. Based on PSM, this article adopts an FEM (fixed-effect model) to control fixed effects at the company level. Based on the matched sample, the regression results are shown in column (2) of Table 5. The Rc of the Fin and its square term Fin^2 are 0.345 and −0.575, respectively, which are significant to a certain extent, and the results are consistent with the previous text.

Table 5. PSM test results.

Variable	PSM	PSM + Fixed effect
	(1)	(2)
	GreInva	GreInva
Fin	0.340**	0.345*
	(0.164)	(0.193)
Fin^2	−0.584***	−0.575***
	(0.189)	(0.212)
_cons	−2.299***	−0.281
	(0.217)	(0.427)
year	Yes	Yes
industry	Yes	Yes
enterprise		Yes
N	7669.000	6608.000
R2	0.264	0.764

(3) Tool variable method

Table 6. 2SLS tool variable method.

	(1)	(2)	(3)
variable	first		two
	Fin	Fin^2	GreInva
Fin			3.612**
			(2.22)
Fin^2			−5.282**
			(−2.08)
IV1	−20.570***	−14.030***	
	(−34.33)	(−28.61)	
IV2	0.213***	0.094***	
	(16.82)	(9.09)	
_cons	4.515***	3.072***	−2.953***
	(34.42)	(28.61)	(−19.88)
year	Yes	Yes	Yes
industry	Yes	Yes	Yes
Observations	24,981	24,981	24,981
R-squared	0.722	0.632	0.195

Considering the endogenous impact of Fin on GreInva, the instrumental variable method is used to reduce the selectivity bias of samples. Referring to the research of Hu Haifeng et al. (2020), this paper selects the average of the financialization level (IV1) of the same industry and year (excluding the company) and the average financialization level (IV2) of the same city and year (excluding the company) as instrumental variables, which will not have an effect on the GreInva, but the investment decisions of corporate FA will refer to the investment of other companies in the same industry and

region. The regression results are shown in Table 6. Column (1) reports the regression results of the first stage, and the Rc of instrumental variables for Fin are all significant at the level of 1%. The Rc of the instrumental variables for Fin^2 were significantly positive, indicating that the two instrumental variables had good explanatory power for endogenous explanatory variables. Among them, the F statistic is 741, 455 (more than 10), and the p-value is 0.0000, which can reject the assumption that the instrumental variable is weak recognition. Column (3) reports the regression results of the second stage, the Rc of Fin and Fin^2 for GreInva are still significant. The results are consistent with the previous text.

3.3.3. Other robustness tests

(1) From the above descriptive statistical analysis, it can be seen that some enterprises have not applied for green patents or have not allocated financial assets, which makes the data of financial asset allocation and green innovation biased. We use the following methods to test robustness:

① Since the green innovation index of listed companies has the characteristics of truncated data with a lower bound of 0, drawing on the research of Faleye et al. (2014), the Tobit model is used instead of the fixed-effect model to further examine the effect of Fin on GreInva. The model results are shown in Table 8, in column (1), the Rc of Fin for GreInva is 1.0950, and the Rc of the square term (Fin^2) for GreInva is −1.9620, and both are significant at the level of 1%.

② Set the green innovation dumb variable (Dum GreInva): when the green innovation index is not 0, the value is 1; otherwise, the value is 0. In this paper, the Dum GreInva is used as the explanatory variable for logit regression, and the regression results are shown in column (2) of Table 8. The Rc of Fin and Fin^2 are 0.9722 and −1.8619, respectively, and both are significant at the level of 1%. The results are consistent with Table 4, which once again proves the robustness of the above results.

③ Rescreen the sample. By analyzing the characteristics of the sample data, the explanatory variables in the selected sample in this paper have more 0 values. This paper draws on the practices of Du and Xin (2021), deletes the samples with a green innovation (GreInva) of 0, and performs OLS regression according to the screened samples. The regression results are shown in column (3) of Table 8. The Rc for Fin and Fin^2 are 0.711 and −0.680, which are significant at the 1% and 5% levels, respectively, and the results are consistent with the previous text.

Table 8. Other robustness tests I.

Variable	(1) GreInva	(2) Dum_GreInva	(3) GreInva
Fin	1.0950***	0.9722***	0.711***
	(3.6416)	(2.8321)	(0.235)
Fin^2	−1.9620***	−1.8619***	−0.680**
	(−4.7509)	(−3.9622)	(0.299)
_cons			−4.191***
			(0.244)
year	Yes	Yes	Yes
industry	Yes	Yes	Yes
N	24989	24989	7529.000
R^2	0.1431	0.2136	0.252

(2) Replace the measurement indicators

① Replace the measurement indicators

In order to eliminate the impact of industry factors on the GreInva, this paper measures green innovation (MGreInva) by subtracting the average number of green patent applications from the number of green patent applications in the industry by referring to the practice of Lu and Li (2022). Column (1) of Table 9 reports the regression results using the recalculated green innovation index as the explanatory variable. The Rc of Fin is significantly positive, and the Rc of the square term Fin^2 is significant and consistent with the previous results.

② Replace explanatory variables

This paper draws on Hu and Dou (2020) to measure the proportion of financial asset allocation (Fin2), considering that investment real estate may be the main business for real estate companies, and re-evaluates the proportion of FA to total assets after excluding investment real estate (Fin2). Column (2) of Table 9 reports the regression results using the remeasured financial asset allocation index as the explanatory variable, and the Rc of Fin2 is 0.437, which is significant at the level of 1%. The Rc of the square term of the financial asset allocation ratio ($Fin2^2$) is −0.569, which is significant at the level of 1% and is consistent with the previous results. At the same time, drawing on the practice of Duan and Zhuang (2021), the proportion of monetary funds and transactional GreInva to total assets was selected to measure the proportion of financial asset allocation (Fin3), and the estimated results are shown in column (3) of Table 9: the Rc of Fin3 is significantly positive, and the Rc of the square term of the financial asset allocation ratio ($Fin3^2$) is significantly negative, which is consistent with the previous results.

Table 9. Robustness analysis of replacement metrics.

Variable	(1)	(2)	(3)
	MGreInva	GreInva	GreInva
Fin	0.306***		
	(0.111)		
Fin^2	−0.422***		
	(0.137)		
Fin2		0.437***	
		(0.114)	
$Fin2^2$		−0.569***	
		(0.144)	
Fin3			0.622***
			(0.125)
$Fin3^2$			−0.644***
			(0.149)
_cons	−2.981***	−2.520***	−2.535***
	(0.125)	(0.124)	(0.124)
year	Yes	Yes	Yes
industry	Yes	Yes	Yes
N	24987.000	24987.000	24987.000
R^2	0.104	0.234	0.235

4. Mechanism of action test

4.1. Mediation test

4.1.1. Reservoir effect mechanism

Moderate allocation of financial assets by enterprises can promote GreInva, which may be related to the "reservoir effect" of financial asset allocation behavior. When the Fin is too high, the financial asset allocation behavior will reduce the GreInva, and the "reservoir effect" may not play a leading role. From the perspective of the reservoir effect, financial assets have the characteristics of short purchase terms. Enterprises invest their remaining production funds in financial assets appropriately, which helps to provide sufficient funding supply for enterprises and alleviate internal financing constraints of physical enterprises. At the same time, sufficient cash flow makes external financing institutions more willing to invest funds in the enterprise, thereby alleviating external financing constraints. A good financing environment makes enterprises more confident in engaging in green innovation activities, thereby promoting green innovation output. On the contrary, if a physical enterprise invests excessively in financial assets, due to the characteristics of high risk and high uncertainty in financial assets, external investors will be more cautious when investing funds in the production activities of the enterprise, and the financing constraints faced by the enterprise may increase, which is likely not conducive to the development of green innovation activities. Therefore, this paper introduces financing constraints (KZ) as an intermediary variable to explore the influence mechanism of Fin and GreInva from the perspective of the reservoir effect, and uses Baron and Kenny's (1986) Mesomeric effect test procedure to establish the following model:

$$GreInva_{it}=\alpha_0+\alpha_1 Fin\_S_{it}+\alpha_k Controls_{it}+\eta_t+\delta_j+\varepsilon_{it}, \quad (2)$$

$$KZ_{it}=\beta_0+\beta_1 Fin\_S_{it}+\beta_k Controls_{it}+\eta_t+\delta_j+\varepsilon_{it}, \quad (3)$$

$$GreInva_{it}=\lambda_0+\lambda_1 Fin\_S_{it}+\lambda_2 KZ_{it}+\lambda_3 Controls_{it}+\eta_t+\delta_j+\varepsilon_{it}. \quad (4)$$

Among them, KZ is the proxy variable of the financing constraint of the entity enterprise (Ju et al., 2013), and the higher the value, the stronger the financing constraint faced by the entity. Since the "reservoir effect" of financial asset allocation is mainly manifested by short-term trading of FA, the proportion of short-term trading of FA (Fin_S) is selected as the explanatory variable. Considering the relationship between Fin and GreInva, the intermediary test is carried out according to the samples on the left and right of the inverted point value of the inverted U-shaped curve, and the results are shown in Table 10.

According to Table 10, on the left side of the inflection point, Fin_S has a negative correlation with KZ, indicating that holding moderate short-term trading financial assets can ease financing constraints. Since there is an insignificance between β_1 and λ_2, the significance of the mediation effect is further tested by the bootstrap method. Among the indirect effects, the 95% confidence interval was [0.0788579, 0.1968498] and the 95% bias correction confidence interval was [0.0788242, 0.1967579]. In the direct effect, the 95% confidence interval is [2.109553, 2.973716], and the 95% deviation correction confidence interval is [2.127198, 2.996102], none of which contain 0. In column (6) of Table 10, to the right of the inflection point, the Rc of Fin_S and KZ were not significant, indicating that when the Fin is high, the impact of the reservoir effect of Fin on GreInva is not obvious.

Table 10. Financial asset allocation, financing constraints and green innovation.

Variable	Left of the inflection point			Right of the inflection point		
	(1)	(2)	(3)	(4)	(5)	(6)
	GreInva	KZ	GreInva	GreInva	KZ	GreInva
Fin_S	1.261***	−9.200***	1.047***	−0.266*	−5.396***	−0.259
	(0.348)	(0.391)	(0.368)	(0.136)	(0.249)	(0.173)
KZ			−0.006			−0.002
			(0.005)			(0.007)
_cons	−2.689***	8.639***	−2.594***	−1.946***	10.096***	−1.912***
	(0.144)	(0.229)	(0.165)	(0.255)	(0.581)	(0.320)
year	Yes	Yes	Yes	Yes	Yes	Yes
industry	Yes	Yes	Yes	Yes	Yes	Yes
N	18637.000	21373.000	16799.000	6345.000	6582.000	4835.000
R^2	0.230	0.631	0.233	0.269	0.622	0.270

4.1.2. Mechanism of crowding out effect

Excessive FAA by enterprises can hinder GreInva, which may be related to the "crowding out effect" of financial asset allocation behavior. When the Fin is at a moderate level, FAA behavior will promote GreInva, and the "crowding out effect" may not play a leading role. From the perspective of the crowding out effect, when the return on financial investment is maintained at a high level, physical enterprises are more willing to replace the funds used for main investment with financial investment compared to high-risk and long-term innovation investment. Overinvestment in financial assets by enterprises may encroach on the resources originally used for innovation, thereby suppressing green innovation output. Therefore, this article introduces liquidity supply (Ocf) and capital expenditure (Exp) as intermediary variables to examine whether financial asset allocation affects green innovation by squeezing out liquidity supply and capital expenditure. At the same time, the variables Fin_S and KZ in equations (2)–(4) are replaced by Fin and Ocf (or Exp), where Ocf is measured by the proportion of net operating cash flow to total assets, which reflects the liquidity level of enterprise assets (Hu et al., 2013). Exp is measured by the proportion of cash paid for the construction of fixed and intangible assets and other long-term assets to total assets at the end of the period, which reflects the level of investment in the main business assets of enterprises (Hu et al., 2020).

As shown in Table 11, the coefficient β_1 of Fin in column (2) and the coefficient λ_2 of liquidity supply (Ocf) in column (3) are not significant, indicating that the intermediary effect is not significant. The coefficient β_1 of Fin in column (5) and the coefficient λ_2 of liquidity supply (Ocf) in column (6) are only one insignificant, and the significance of the intermediary effect is further tested by the bootstrap method. Among the indirect effects, the 95% confidence interval was [0.0788579, 0.1968498] and the 95% bias correction confidence interval was [0.0788242, 0.1967579]. In the direct effect, the 95% confidence interval was [2.109553, 2.973716] and the 95% bias correction interval was [2.127198, 2.996102], neither of which contained 0. It shows that overallocation of GreInva will inhibit corporate green innovation by crowding out liquidity supply.

Table 11. Financial asset allocation, liquidity supply and green innovation.

Variable	Left of the inflection point			Right of the inflection point		
	(1)	(2)	(3)	(4)	(5)	(6)
	GreInva	Ocf	GreInva	GreInva	Ocf	GreInva
Fin	0.224**	−0.002	0.209*	−0.240**	−0.022	−0.198*
	(0.113)	(0.009)	(0.115)	(0.102)	(0.014)	(0.109)
Ocf			0.097			0.262**
			(0.073)			(0.107)
_cons	−2.635***	−0.161***	−2.613***	−1.799***	−0.256***	−1.777***
	(0.138)	(0.012)	(0.143)	(0.302)	(0.040)	(0.327)
year	Yes	Yes	Yes	Yes	Yes	Yes
industry	Yes	Yes	Yes	Yes	Yes	Yes
N	20529.000	25207.000	19670.000	4451.000	5184.000	3772.000
R^2	0.230	0.131	0.231	0.277	0.168	0.278

As shown in Table 12, the coefficient β_1 of the explanatory variable Fin for capital expenditure (Exp) in column (2) is significantly negative, indicating that moderate FAA can significantly reduce capital expenditure, and at the same time, the coefficients λ_1 and λ_2 of the regression of Fin and Exp on the explanatory variable (GreInva) in column (3) are significant, and $\beta_1\lambda_2$ and λ_1 are different. It shows that the reduction of capital expenditure has a veiled effect between Fin and green innovation, that is, when the Fin is low, the crowding out effect of real enterprises' allocation of financial assets cannot offset its promotion effect on green innovation through other paths (reservoir effect). On the right side of the inflection point, the coefficient β_1 of Fin on Exp in column (2) is significantly negative, and the coefficients λ_1 and λ_2 of the regression of Fin and Exp on the explanatory variable (GreInva) in column (5) are significant, and $\beta_1\lambda_2$ is the same as λ_1, indicating that the reduction of capital expenditure plays a partial mediating effect in the reverse impact of Fin on GreInva, indicating that overallocation of financial assets will squeeze out liquidity supply. In turn, it inhibits corporate green innovation.

Table 12. Financial asset allocation, capital expenditure and green innovation.

Variable	Left of the inflection point			Right of the inflection point		
	(1)	(2)	(3)	(4)	(5)	(6)
	GreInva	Exp	GreInva	GreInva	Exp	GreInva
Fin	0.224**	−0.069***	0.268**	−0.240**	−0.067***	−0.178*
	(0.113)	(0.006)	(0.113)	(0.102)	(0.004)	(0.104)
Exp			0.529***			0.836***
			(0.115)			(0.296)
_cons	−2.635***	0.089***	−2.677***	−1.799***	0.144***	−1.929***
	(0.138)	(0.007)	(0.139)	(0.302)	(0.012)	(0.306)
year	Yes	Yes	Yes	Yes	Yes	Yes
industry	Yes	Yes	Yes	Yes	Yes	Yes
N	20529.000	26590.000	20517.000	4451.000	6297.000	4444.000
R^2	0.230	0.175	0.231	0.277	0.245	0.279

4.2. Financialization preferences

Entity enterprises may have financialization preferences in the process of FAA, that is, entity enterprises may allocate different types of financial assets for different motives. Duan (2021) found that the impact of FAA behavior on technological innovation under different motivations is heterogeneous. Du (2021) further examines the preference of entity enterprises to invest in financial assets based on the background of pledge of controlling shareholders, and confirms that the controlling shareholders' allocation of financial assets is related to their motives. So, do real enterprises holding financial assets with different maturity and different degrees of flexibility affect the level of GreInva through the "reservoir effect" or "crowding out effect"? Studies have found that enterprises tend to hold some financial assets with short maturity and low switching costs as preventive assets, exerting the "reservoir effect" to cope with risks such as cash flow shortage and financing constraints (Liu et al., 2018). Conversely, if enterprises excessively hold long-term financial assets with poor liquidity and high switching costs, when enterprises face risks such as financing constraints, they have to squeeze out industrial assets because they cannot be realized quickly (Tori and Onaran, 2017). This paper explores this issue based on existing research and establishes the following models to clarify the relationship between Fin and GreInva at different maturity levels:

$$GreInva_{it}=\alpha_0+\alpha_1 SFin_{it}+\alpha_2 Sfin^2{}_{it}+\alpha_k Controls_{it-1}+\sum Year+\sum Ind+\varepsilon_{it}, \quad (5)$$

$$GreInva_{it}=\beta_0+\beta_1 SFin_{it}+\beta_k Controls_{it-1}+\sum Year+\sum Ind+\varepsilon_{it}, \quad (6)$$

$$GreInva_{it}=\alpha_0+\alpha_1 LFin_{it}+\alpha_2 LFin2_{it}+\alpha k Controls_{it-1}+\sum Year+\sum Ind+\varepsilon_{it}, \quad (7)$$

$$GreInva_{it}=\beta_0+\beta_1 LFin_{it}+\beta_k Controls_{it-1}+\sum Year+\sum Ind+\varepsilon_{it}. \quad (8)$$

Among them, $SFin_{it}$ represents the proportion of short-term transactional FA held by enterprises, drawing on the practice of Tan (2022) and measuring by the proportion of transactional FA/total assets. $LFin_{it}$ represents the proportion of long-term stable FA held by enterprises, referring to the research of Wan et al. (2020), measured by the proportion of FA available for sale, investment real estate and investment held to maturity to total assets. The regression results are shown in Table 13 below. In short-term trading financial assets, column (1) indicates the regression results of its nonlinear relationship with green innovation, the Rc of SFin is significantly positive, and the Rc of $SFin^2$ is significantly negative. That is, the relationship between SFin and GreInva is inverted U-shaped. According to the critical value of financial asset allocation (the critical value calculated from column (1) is 0.226), the total sample is divided into two groups and grouped regression is carried out separately. Column (2) is the regression result to the left of the critical value (SFin < 0.226), and the Rc of SFin is 2.065, which is significant at the level of 1%. Column (3) is the regression to the right of the critical value (SFin > 0.226), and the coefficient of SFin is −0.158, but it is not significant. When enterprises hold moderate short-term transactional financial assets, they can fund green innovation through the reservoir effect and promote the development of green innovation, and the conclusion is consistent with existing research. However, when the short-term transactional FA held by enterprises are excessive, the crowding out effect of short-term transactional financial assets cannot play a restraining effect on GreInva, so it is not significant. In long-term stable financial assets, column (4) indicates the regression result of its nonlinear relationship with green innovation, the Rc of LFin is significantly negative, and the coefficient of $LFin^2$ is significantly positive, that is, the long-term stable

financial asset allocation (LFin) and green innovation (GreInva) has a U-shaped relationship. According to the critical value of financial asset allocation (the critical value calculated from column (4) is 0.391), the total sample is divided into two groups and grouped regression is carried out separately. Columns (5) and (6) were the regression results to the left of the critical value (LFin < 0.391) and the right of the critical value (LFin > 0.391), respectively, and the regression results were significantly negative, indicating that the data were biased to the left. The conclusion that holding long-term stable financial assets by enterprises inhibits green innovation through the crowding out effect, while the reservoir effect does not play a role, is consistent with existing studies.

Table 13. Impact of holding long-term and short-term financial assets on green innovation.

Variable	Short-term trading financial assets			Long-term stable financial assets		
	(1) GreInva	(2) GreInva	(3) GreInva	(4) GreInva	(5) GreInva	(6) GreInva
SFin	0.917***	2.065***	−0.158			
	(0.243)	(0.534)	(0.128)			
$SFin^2$	−2.027***					
	(0.560)					
LFin				−0.429***	−0.373**	−0.304***
				(0.152)	(0.150)	(0.114)
$LFin^2$				0.548*		
				(0.290)		
_cons	−2.506***	−2.517***	−2.340***	−2.501***	−2.632***	−1.785***
	(0.125)	(0.159)	(0.205)	(0.124)	(0.136)	(0.319)
year	Yes	Yes	Yes	Yes	Yes	Yes
industry	Yes	Yes	Yes	Yes	Yes	Yes
N	24987.000	15212.000	9772.000	24987.000	21186.000	3794.000
R^2	0.234	0.227	0.266	0.234	0.232	0.274

5. Further analysis

In the previous research, we verified the inverted U-shaped relationship between Fin and GreInva, and overallocation of FA is not conducive to the development of GreInva of real enterprises, so it is important to seek a way to improve this negative impact. Referring to relevant research, this paper explores the role of property rights, monetary policy and social responsibility in the relationship between Fin and GreInva, and provides theoretical guidance for promoting the development of GreInva for enterprises and further understanding the interaction between financial asset allocation, internal and external governance and green innovation.

5.1. Financial asset allocation, nature of property rights and green innovation

Under the background of China's special system, the nature of property rights has a significant impact on the financing ability and financial decision-making of listed companies, so that the impact of Fin on GreInva may be different among enterprises with different property rights, which is manifested in the unique political advantages of state-owned enterprises and traditional credit

discrimination that will reduce the risk of investing in green innovation (Wan, 2020). From the perspective of political advantages, state-owned enterprises are an important subject of national strategic investment, which can receive more financial support from the government, and state-owned enterprises pay more attention to the harmonious development of the whole society, rather than the private interests of individual enterprises, ensuring that state-owned enterprises still have sufficient funds to invest in green innovation while allocating financial assets. Second, the government's support for SOEs in terms of taxation, resource allocation, etc. is actually an implicit guarantee for SOEs (Xu and Wu, 2018), reducing the risk of investing in green innovation. From the perspective of credit, because SOEs have strong political endorsement and natural political ties with the government, commercial banks are more willing to provide credit resources to SOEs, which have lower costs for obtaining credit resources and face less financing constraints than non-SOEs (Yang et al., 2017). Non-state-owned enterprises face greater financing constraints, and driven by a strong market-driven profit-seeking motive, they will tend to allocate FA and squeeze out green innovation investment.

Based on the nature of property rights, this paper divides the sample into two groups of state-owned enterprises and non-state-owned enterprises for regression and tests the linear or nonlinear relationship between Fin and GreInva. The regression results are shown in Table 14. It can be seen that in the group of non-state-owned enterprises, the inverted U-shaped nonlinear relationship between Fin and GreInva is still inverted, with the critical point at about 28% and an overall shift to the left, indicating that non-state-owned enterprises are more likely to reduce green innovation investment in advance. In the group of state-owned enterprises, there is a monotonically increasing linear relationship between Fin and GreInva, and state-owned enterprises have not reduced their investment in GreInva due to the increase in Fin.

Table 14. Financial asset allocation, property rights and green innovation.

Variable	State-owned enterprises		Non-state-owned enterprises	
	(1)	(2)	(3)	(4)
	GreInva	GreInva	GreInva	GreInva
Fin	0.126	0.222**	0.270**	−0.079
	(0.205)	(0.101)	(0.133)	(0.065)
Fin^2	0.148		−0.478***	
	(0.273)		(0.159)	
_cons	−3.267***	−3.269***	−2.184***	−2.179***
	(0.207)	(0.207)	(0.164)	(0.164)
year	Yes	Yes	Yes	Yes
industry	Yes	Yes	Yes	Yes
N	9172.000	9172.000	15811.000	15811.000
R^2	0.305	0.305	0.218	0.218

5.2. Financial asset allocation, monetary policy and green innovation

The previous research results support the "reservoir" effect hypothesis of FAA, that is, the appropriate FAA based on the reservoir effect will ease financing constraints, thereby increasing the output of green innovation. To further support this logic in this article, let's start with monetary policy.

Depending on credit channels, monetary policy can have a significant impact on the economic policy of real enterprises, and changes in monetary policy can also increase the volatility of economic consequences, manifested in the financial accelerator effect (Bernanke and Gertler, 1995). Under the tightening monetary policy, the price of financial assets is not high, and enterprises are more inclined to hold cash than to invest in financial assets (Cai et al., 2015). On the contrary, in the context of corporate financialization, loose monetary policy will prompt real enterprises to invest funds in high-return financial investment activities, while ignoring the bubble risk brought by virtual assets, further weakening the "reservoir" motivation of real enterprises to allocate financial assets.

Based on the above analysis, loose monetary policy will inhibit the "reservoir" motivation of real enterprises to invest in FA, so the text uses monetary policy to test whether there is a "reservoir" effect when Fin is moderate.

Referring to the research of Zou et al. (2011), this paper takes the M2 growth rate as a proxy variable of monetary policy, and arranges them from high to low, selects the upper and lower quartiles as the monetary policy easing group and monetary policy tightening group and then selects the lower proportion of financial asset investment (Fin < 36.6%) for group testing. The regression results are shown in columns (1) and (2) of Table 15. The Rc of Fin in the monetary policy tightening group is 0.313 when the Fin is low, and it is significant at the level of 10%. However, the Rc in the monetary policy easing group was not significant, and the results showed that loose monetary policy inhibited the "reservoir" motivation of real enterprises and did not significantly promote the output of green innovation. At the same time, using the whole sample for regression, as shown in columns (3) and (4) of Table 14, there is still an inverted U-shaped relationship in the monetary policy tightening group, and the critical value is about 42%, moving to the right, indicating that in the case of monetary policy tightening, real enterprises have more motivation to increase financial asset allocation. In the monetary policy easing group, the inverted U-shaped relationship is not significant. The results of grouping regression using monetary policy once again show that the "reservoir" effect of real enterprises is different among enterprises under monetary policy easing/tightening when the Fin is low.

Table 15. Financial asset allocation, monetary policy and green innovation.

Variable	Subsample regression（Fin < 36.6%）		Full-sample regression	
	Monetary Policy Easing Group	Monetary Policy Tightening Group	Monetary Policy Easing Group	Monetary Policy Tightening Group
	(1)	(2)	(3)	(4)
	GreInva	GreInva	GreInva	GreInva
Fin	0.147	0.313*	0.066	0.561***
	(0.156)	(0.160)	(0.140)	(0.174)
Fin^2			−0.157	−0.662***
			(0.167)	(0.220)
_cons	−2.766***	−2.538***	−2.528***	−2.471***
	(0.198)	(0.199)	(0.175)	(0.182)
year	Yes	Yes	Yes	Yes
industry	Yes	Yes	Yes	Yes
N	9402.000	11127.000	11690.000	13297.000
R^2	0.199	0.229	0.194	0.235

5.3. Financial asset allocation, social responsibility and green innovation

The above research results support the "profit-seeking" motivation hypothesis of financial asset investment, that is, excessive financial asset investment by real enterprises will reduce liquidity supply and capital expenditure based on the crowding out effect, thereby reducing the output of green innovation. To further support this logic in this article, let's start with the social responsibility aspect.

Under the economic background of the intensification of financialization of real enterprises in China, the social responsibility of real enterprises has a significant impact on financial and entity investment decisions, which is embodied in the fact that the value orientation of social responsibility based on "shareholder first" consolidates the development of real industries, and it is inevitably accompanied by a decrease in financial asset investment (Liu et al., 2019). If non-financial enterprises influence their investment decisions to reduce green innovation investment due to the "profit-seeking" motive, then social responsibility based on shareholder values can inhibit the "profit-seeking" motivation of real enterprises. Zhang (2013) pointed out that some enterprises are forced by external pressure or stakeholders' moral expectations to assume a low degree of social responsibility, and they have a weak incentive to inhibit financial asset investment.

Table 16. Financial asset allocation, social responsibility and green innovation.

Variable	Subsample regression（Fin>36.6%）		Full-sample regression	
	High Group	Low group	High Group	Low group
	(1)	(2)	(3)	(4)
	GreInva	GreInva	GreInva	GreInva
Fin	0.038	−0.435***	0.176	0.438***
	(0.148)	(0.136)	(0.160)	(0.162)
Fin^2			−0.184	−0.625***
			(0.203)	(0.194)
_cons	−2.606***	−1.056**	−2.548***	−2.884***
	(0.425)	(0.434)	(0.183)	(0.190)
year	Yes	Yes	Yes	Yes
industry	Yes	Yes	Yes	Yes
N	2464	2283	12118	11523
R^2	0.310	0.264	0.243	0.246

Based on the above analysis, corporate social responsibility is conducive to inhibiting the "profit-seeking" motivation of entity enterprises to invest in FA, so this text uses social responsibility to re-examine whether entity enterprises have the "profit-seeking" motivation when the proportion of financial asset investment is too high. This paper arranges the social responsibility index of Hexun.com from high to low, selects the upper and lower quartiles as the high corporate social responsibility group and the low social responsibility group, and then tests in groups. The regression results are shown in columns (1) and (2) of Table 15, and the coefficient of Fin in the low social responsibility group is −0.435% when the Fin is high, and it is significant at the level of 1%. The results show that high social responsibility inhibits the "profit-seeking" motivation of real enterprises and does not significantly reduce the output of green innovation. At the same time, the regression was carried out using the whole

sample, and the results showed that there was still an inverted U-shaped relationship in the low social responsibility group as shown in columns (3) and (4) in Table 14. The inverted U-shaped relationship was not significant in the high social responsibility group. The results of group regression using social responsibility in this paper once again show that when Fin is high, the "profit-seeking" motivation of real enterprises is different among enterprises with different degrees of social responsibility.

6. Conclusions

This article found that: First, there is an inverted U-shaped relationship between Fin and GreInva, that is, there exists a critical value. When the Fin is on the left of the critical value, real enterprises may promote the GreInva out of "preventive motivation"; when the Fin is on the right side of the critical value, real enterprises may squeeze out green innovation output out of "profit-seeking motive". After the robustness test, this conclusion still holds. Second, by exploring the mechanism by which Fin affects GreInva, it is found that the moderate holding of short-term FA by real enterprises can increase the GreInva by alleviating financing constraints, which is manifested as a "reservoir" effect. The "crowding out" effect plays a leading role, while the overallocation of GreInva reduces liquidity supply and capital expenditure, which in turn affects the output of green innovation. Third, in the test of financial asset allocation preference, it is found that the allocation of short-term FA by real enterprises plays a "reservoir" effect, and mainly tends to the "reservoir" motivation. The allocation of long-term FA plays a "crowding out" effect, mainly tending to the "profit-seeking" motive. Finally, in the heterogeneity analysis, it is found that there are differences in the impact of Fin on GreInva of enterprises with different property rights, different monetary policies and different degrees of social responsibility. The research conclusion of this paper deepens the research results on the influencing factors of GreInva, and also provides a new perspective for the research of Fin and green innovation activities of real enterprises and a useful reference for China's financial supervision and policy formulation.

First, in the context of corporate financialization, real enterprises increase or decrease investment in green innovation by influencing their investment decisions out of "preventive" motives and "profit-seeking" motives. For regulatory authorities, they should do a good job in managing and supervising the proportion of FA allocated by entity enterprises. In particular, corresponding restrictive measures should be taken for entity enterprises with a high Fin. Second, the entity enterprise will adjust the investment in green innovation according to the Fin, so as to maximize the interests of the enterprise, and for decision-makers, they should focus on the long-term development of the company itself, rationally use the remaining funds obtained from the allocation of FA, develop innovative business and enhance the core competitiveness of enterprises. Third, real enterprises should not rely too much on investment in financial assets but focus on real investment, conform to the country's transformation trend from high-speed growth to high-quality growth, increase innovation and improve independent innovation capabilities.

Use of AI tools declaration

All authors declare that we have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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