

Chain Shareholders and Green Transformation of Enterprises

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Abstract: Enterprises are the micro subjects to promote the green development of the economy. It is very realistic for China to deeply explore how the shareholder relationship network affects the green transformation of enterprises to build and upgrade the green development model. This paper takes the A-share listed companies in Shanghai and Shenzhen in China from 2010 to 2021 as samples to empirically test the impact of chain shareholders on the green transformation of enterprises. The study found that: chain shareholders can promote the green transformation of enterprises, and financing constraints and the first type of agency costs play a partial intermediary role. The research conclusion of this paper provides an important reference for chain shareholders to exert the resource governance effect, for optimizing the corporate governance mechanism and regulating shareholder behavior to help the green and high-quality economic development.

Keywords: chain shareholders; green transformation of enterprises; financing constraints; the first type of agency costs

1. Introduction

Although the previous extensive development model has promoted the high-quality economic development, it has also caused the continuous deterioration of the ecological environment. Taking the green development path has become the need of The Times. Based on the “double carbon” goal, the 14th Five-Year Plan further emphasizes the concept of green transformation, and points out that we should vigorously advocate green technology innovation, and promote green transformation in key industries and fields, so as to comply with the general trend of green development. Enterprises are the most direct source of creating economic value and discharging pollutants, as well as an important micro subject to realize green transformation. In order to effectively improve the current situation of environmental pollution and resource shortage to achieve long-term and stable development, it is necessary to stimulate enterprises’ green innovation awareness, enhance green transformation ability, and then activate the micro basis of green and high-quality economic development.

Most of the existing literature on driving the green transformation of enterprises is based on the perspective of macro policy and micro system, and few are analyzed from the perspective of corporate governance mechanism or equity structure. Moreover, many documents regard shareholders as completely rational individuals in isolation and ignore the impact of shareholder connection on the green transformation. It is common for enterprises to establish economic links through chain shareholders in the global capital market. There are currently two completely different views on the influence of chain shareholders on enterprise behavior. One is that chain shareholders encourage enterprises to innovate^[1], improve risk taking level^[2] and promote cooperation and win-win results among enterprises by giving full play to the resource governance effect. Another view is that chain shareholders aim to maximize the overall portfolio return, intensify the tendency of collusion and fraud, weaken the degree of market competition and reduce the investment efficiency^[3]. The green transformation cycle of enterprises is long, with great uncertainty and high investment risk, which requires not only the management to actively carry out innovation activities, but also the lasting and stable cash flow to guarantee^[4]. As a network link, chain shareholders may have an important impact on the green transformation of enterprises. On the one hand, chain shareholders may rely on resource governance advantages to alleviate financing constraints and agency conflicts and then promote green transformation of enterprises. On the other hand, chain shareholders may also have the willingness to manipulate collusion to worsen the agency conflict and thus inhibit the green transformation of enterprises. In short, there is no agreement on the discussion of chain shareholders on the green transformation of enterprises, and more research results are needed to provide evidence support.

Therefore, this paper takes the A-share listed companies in Shanghai and Shenzhen in China from 2010 to 2021 as the research sample to empirically test the impact of chain shareholders on the green transformation of enterprises, and tries to clarify the mechanism of the effect.

The possible contributions of this paper are as follows: (1) It expands the understanding of the economic consequences of chain shareholders. The existing research conclusions on chain shareholders have not yet been unified. Some scholars believe that chain shareholders play a role of collaborative governance, while others believe that chain shareholders have a motive of collusion and manipulation. Based on the micro perspective, this paper analyzes the impact of chain shareholders on the green transformation of enterprises, and supplements relevant literature. (2) It expands the research perspective of enterprises green transformation. The existing literature mainly examines the impact of environmental regulation, technological innovation and equity structure on the green transformation of enterprises. This paper takes chain shareholders as the entry point to provide a new perspective for the study of the influencing factors of the green transformation of enterprises. (3) It also discusses the role of chain shareholders in the green transformation of enterprises. This paper analyzes the internal mechanism of chain shareholders' influence on the green transformation of enterprises from the aspects of financing constraints and the first type of agency costs, so as to provide reference for enterprises to rationally allocate resources, restrain and supervise the management, and optimize green innovation decision-making.

2. Theoretical Analysis and Hypothesis Proposal

2.1. *The role of chain shareholders in promoting the green transformation of enterprises*

The green transformation of enterprises requires continuous and stable resource investment, and the company's performance cannot be improved in the short term, so the transformation process has great uncertainty^[5]. As a shareholder relationship network, chain shareholders can play a certain resource supervision effect to promote the green transformation of enterprises.

On the one hand, chain shareholders can give full play to the advantages of information resources to solve the financing problems, so as to promote the green transformation of enterprises. The long green transformation cycle and low probability of success require enterprises to invest a lot of resources. In the short term, they may occupy the financial capital and social capital of enterprises, making enterprises into a tight situation of funds, thus they actively reduce the investment in green technology innovation with high risk^[6], and hinder the transformation and upgrading of enterprises. Chain shareholders can timely and accurately obtain key operational information such as cash flow, investment and financing opportunities of relevant enterprises in the industry by holding shares of different enterprises in the same industry^[7], accelerate information transmission and communication^[8], help enterprises in the same industry establish stable strategic cooperation, and promote resource exchange between enterprises^[9]. Chain shareholders can also effectively exert the resource agglomeration effect to provide more sufficient and lower cost financial support for the company^[10], seek more cooperation opportunities and better partners^[11], accumulate broad contacts and high reputation, so as to effectively alleviate financing constraints, and then enhance enterprise green transformation will.

On the other hand, chain shareholders rely on their natural governance advantages to alleviate the first type of agency conflict, so as to stimulate the green transformation of enterprises. The risk of green transformation of enterprises is high, and the management usually only focuses on short-term operating income and personal reputation, which leads to frequent opportunistic behaviors, reduces the efficiency of asset utilization, and exerts crowding-out effect on the green innovation activities of enterprises^[12]. While chain shareholders have accumulated a lot of corporate governance experience, investment experience and industry expertise in the long-term market practice. They can effectively supervise the management's operational decision-making behavior by voting against the proposal that the shareholders and the management have differences^[13], dismissing the incompetent CEO^[14] and other methods^[15], and reduce the opportunistic behavior and the subjectivity of decision-making of senior executives, so as to avoid inefficient or even inefficient use of funds as much as possible, alleviate the first type of agency conflict, and provide guarantee for the green transformation of enterprises. Based on the above analysis, H1a is proposed:

H1a: When other conditions are fixed, chain shareholders can promote the green transformation of enterprises.

2.2. *The inhibitory effect of chain shareholders on the green transformation of enterprises*

The benefits of green transformation of enterprises are lagging behind and the risk of failure is high, while the goal of chain shareholders is often to maximize the overall value of the investment portfolio^[3], which easily leads to collusion and is not conducive to the green transformation of enterprises.

On the one hand, in order to reduce the overall risk of the investment portfolio, chain shareholders usually change the previous investment strategy or increase the necessary return rate to increase the cost of green innovation of enterprises^[16], so that the transformation and upgrading of enterprises lack the necessary capital basis, increase financing constraints, so as to reduce the green transformation ability of enterprises. At the same time, in order to maximize the value of the investment portfolio, chain shareholders may have strong motivation to urge enterprises in the same industry to conspire, improve their bargaining power to obtain excess returns, give up capturing promising investment opportunities^[3], weaken the innovation impetus, and then inhibit the green transformation of enterprises.

On the other hand, due to the fact that holding the equity of multiple enterprises is very easy to distract, and there may be friction between shareholders, the supervision of chain shareholders on the management of the enterprise may be weakened, and then it leads to the slackening of the management, results in more short-sighted behavior^[17], aggravates the ineffective allocation and use of assets, increases the first type of agency costs, and reduces enterprise green transformation will. Based on the above analysis, H1b is proposed:

H1b: When other conditions are fixed, chain shareholders have an inhibitory effect on the green transformation of enterprises.

3. Research Design

3.1. *Sample selection and data source*

This paper takes the A-share listed companies in Shanghai and Shenzhen of China from 2010 to 2021 as the original samples and screens them according to the following principles: (1) It excludes financial and insurance listed enterprises; (2) It removes enterprise data with asset-liability ratio greater than 1; (3) It eliminates ST enterprises; (4) It deletes samples with missing financial data, and finally obtains 19483 observed values. In order to avoid the interference of extreme values on the research conclusion, this paper implements tail reduction on all continuous variables at the level of 1%. The green patent data in this paper is from Chinese Research Data Service (CNRDS), and the rest of the data are from China Stock Market Accounting Research (CSMAR).

3.2. *Variable definition*

Green transformation of enterprises (GT). At present, the academic circle mainly uses the comprehensive indicator method and the alternative indicator method to measure the green transformation of enterprises. In view of the strong subjectivity and limitations of the comprehensive indicator method, this paper uses the research results of Yang Bo and Li Bo^[18] and Lu Huizhong^[5] for reference, and measures the green transformation of enterprises from both quality and quantity based on the perspective of green innovation. Compared with utility model patents, the invention patent can better reflect the innovation ability of enterprises, so as to better reflect the effect of green transformation of enterprises. Therefore, the quality of green innovation of enterprises (Gi) is measured by the number of green invention patent applications, and the number of all green patent applications is used as the proxy variable of green innovation quantity (Gp).

Chain shareholders (LSnum). According to the research of He and Huang^[19] and Pan Yue et al.^[3], chain shareholders metric is constructed: At the quarterly level, the major shareholders with a shareholding ratio of no less than 5% shall be retained, and then the number of major shareholders of each company who are also major shareholders in other companies in the industry shall be counted, and then the annual average value shall be calculated, and then add one to the annual average, and finally take the logarithm.

Control variables. According to the research of Wang Xiaoqi and Ning Jinhui^[20], Yang Bo and Li Bo^[18], Xiao Jing and Zeng Ping^[21], this paper selects control variables such as enterprise size and age. The specific variable definitions are shown in Table 1.

Table 1: Variable definitions

Variable type	Variable symbol	Calculation method
Explained variable	Gi	Ln(number of green invention patent applications+1)
	Gp	Ln(total number of green patent applications+1)
Explanatory variable	LSnum	Ln(annual average of the number of chain shareholders at the quarterly level+1)
Control variable	Size	Natural logarithm of total assets
	Age	Observation year-establishment year
	Lev	Total liabilities/total assets
	Roa	Net profit/total assets
	Growth	Operating revenue growth rate
	Cash	Monetary capital/total assets
	Top1	Shareholding ratio of the largest shareholder
	Dual	If the chairman concurrently serves as the general manager, the value will be assigned to 1, otherwise the value will be assigned to 0.
	Bsize	Ln(total number of directors)
	Indep	Number of independent directors/number of directors
	Ind	Dummy variable
Year	Dummy variable	

3.3. Model setting

In order to test the impact of chain shareholders on the green transformation of enterprises, this paper uses the following models:

$$GT_{i,t} = \alpha_0 + \alpha_1 LSnum_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 Age_{i,t} + \alpha_4 Lev_{i,t} + \alpha_5 Roa_{i,t} + \alpha_6 Growth_{i,t} + \alpha_7 Cash_{i,t} + \alpha_8 Top1_{i,t} + \alpha_9 Dual_{i,t} + \alpha_{10} Bsize_{i,t} + \alpha_{11} Indep_{i,t} + \Sigma Ind + \Sigma Year + \epsilon_{i,t} \quad (1)$$

Among them, the explained variable is enterprise green transformation (GT), which is measured by green innovation quality (Gi) and green innovation quantity (Gp), i and t represent the enterprise and year respectively, and $\epsilon_{i,t}$ is the random disturbance term of the model.

4. Empirical Results and Analysis

4.1. Descriptive statistics

Table 2: Descriptive statistics

Variable	N	Mean	Sd	Median	Min	Max
Gi	19483	0.700	1.027	0.000	0.000	4.394
Gp	19483	1.036	1.230	0.693	0.000	4.890
LSnum	19483	0.110	0.261	0.000	0.000	1.099
Size	19483	22.390	1.359	22.210	19.780	26.500
Age	19483	17.740	5.725	18.000	5.000	32.000
Lev	19483	0.443	0.205	0.439	0.057	0.899
Roa	19483	0.036	0.062	0.036	-0.264	0.197
Growth	19483	0.201	0.480	0.119	-0.559	3.317
Cash	19483	0.176	0.122	0.143	0.017	0.614
Top1	19483	0.341	0.149	0.319	0.087	0.737
Dual	19483	0.280	0.449	0.000	0.000	1.000
Bsize	19483	2.130	0.199	2.197	1.609	2.708
Indep	19483	0.376	0.054	0.364	0.333	0.571

Table 2 presents the descriptive statistical results for the main variables in this article. For the explained variables, the maximum value of green innovation quality (Gi) is 4.394, the minimum is 0, the average is 0.700, the median is 0, and the standard deviation is 1.027; The maximum value of green innovation quantity (Gp) is 4.890, the minimum is 0, and the mean, median and standard deviation are 1.036, 0.693 and 1.230 respectively. It can be seen from the quality and quantity of green innovation that the gap between the maximum and minimum value is large; The average is higher than the median, but lower than the standard deviation, which indicates that some enterprises in the sample have achieved certain results in green transformation and upgrading, but the transformation level is generally low, and there are great differences in the degree of green transformation between different enterprises. In terms of explanatory variables, the maximum value of chain shareholders (LSnum) is 1.099, indicating that the enterprise has at most three chain shareholders; The minimum value is 0, which indicates that there is no chain shareholders in some enterprises; The average and median value are 0.110 and 0 respectively, indicating that the number of chain shareholders in the selected sample range is generally not high, but many enterprises still hope to introduce some chain shareholders; The standard deviation is 0.261, which indicates the obvious difference in the number of chain shareholders

between different enterprises. There are no exceptions to other variables, so we will not repeat them here.

4.2. Correlation analysis

Table 3 shows the test results of Pearson correlation coefficient of the main variables. It isn't difficult to find that the correlation coefficient between green innovation quality (Gi) and green innovation quantity (Gp) is 0.924, and the significant positive correlation is at the level of 1%, reflecting the high similarity between the two in measuring the green transformation of enterprises. The correlation coefficient between the chain shareholders (LSnum) and the quality of green innovation of enterprises (Gi) is 0.190, and the correlation coefficient between LSnum and the quantity of green innovation (Gp) is 0.192, and both are significantly positively correlated at the level of 1% respectively. This preliminarily shows that chain shareholders can promote the green transformation of enterprises and support H1a. In addition, except that the correlation coefficient between the two measurement methods of green transformation is 0.924, the correlation coefficient between each variable is not more than 0.6, indicating that there is no significant multicollinearity problem and the regression results are highly reliable.

Table 3: Pearson's correlation coefficient test

Variable	Gi	Gp	LSnum	Size	Age	Lev	Roa	Growth	Cash	Top1	Dual	Bsize	Indep
Gi	1												
Gp	0.924***	1											
LSnum	0.190***	0.192***	1										
Size	0.409***	0.424***	0.326***	1									
Age	0.059***	0.066***	0.077***	0.207***	1								
Lev	0.171***	0.197***	0.123***	0.492***	0.194***	1							
Roa	0.009	0.004	0.016**	0.018**	-0.077***	-0.337***	1						
Growth	0.005	0.003	-0.030***	0.019***	-0.026***	0.021***	0.198***	1					
Cash	-0.021***	-0.060***	-0.044***	-0.220***	-0.134***	-0.351***	0.223***	0.006	1				
Top1	0.015**	0.020***	0.059***	0.205***	-0.105***	0.043***	0.140***	-0.006	0.037***	1			
Dual	-0.005	-0.018**	-0.085***	-0.164***	-0.110***	-0.121***	0.027***	0.032***	0.076***	-0.040***	1		
Bsize	0.065***	0.070***	0.162***	0.249***	0.050***	0.133***	0.015**	-0.036***	-0.046***	0.008	-0.168***	1	
Indep	0.038***	0.025***	-0.019***	0.036***	-0.030***	0.008	-0.020***	-0.004	-0.004	0.056***	0.096***	-0.529***	1

Note: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

4.3. Benchmark regression results

Table 4: Regression results

Variable	(1)	(2)
	Gi	Gp
LSnum	0.167*** (5.90)	0.152*** (4.83)
Size	0.333*** (45.44)	0.388*** (48.39)
Age	-0.006*** (-4.31)	-0.009*** (-5.97)
Lev	0.147*** (3.77)	0.320*** (7.02)
Roa	0.228** (2.13)	0.488*** (3.95)
Growth	-0.006 (-0.45)	-0.007 (-0.45)
Cash	0.540*** (9.79)	0.425*** (6.81)
Top1	-0.003*** (-5.73)	-0.003*** (-5.27)
Dual	0.050*** (3.52)	0.026 (1.60)
Bsize	-0.002 (-0.04)	-0.011 (-0.24)
Indep	0.118 (0.81)	-0.184 (-1.12)
Constant	-7.189*** (-38.63)	-8.193*** (-39.91)
Ind	Control	Control
Year	Control	Control
N	19483	19483
R ²	0.311	0.367

Notes: ***, **, and * represent significance levels of 1%, 5% and 10% respectively; the t value of corresponding coefficient is in brackets, the same below.

Table 4 reports the regression results of chain shareholders and green transformation of enterprises. According to column (1) in Table 4, the regression coefficient between chain shareholders (LSnum) and enterprise green innovation quality (Gi) is 0.167, which is significant at the level of 1%; It can be

seen from column (2) that there is a significant positive correlation between chain shareholders (LSnum) and enterprise green innovation quantity (Gp) at the level of 1%, that is, under certain other conditions, the more the number of chain shareholders, the higher the green transformation level of enterprises, which verifies H1a. The introduction of chain shareholders can help enterprises obtain sufficient information resources and governance experience to some extent, promote the sharing of key resources, reduce financing costs, and alleviate the first type of agent conflict, so as to promote the green transformation of enterprises.

4.4. Robustness test

4.4.1. Propensity score matching method (PSM)

Given the possible self-selection problem of chain shareholders, this paper uses the propensity score matching method (PSM) to verify. With reference to the methods of Yu Zhimai^[22], Du Shanzhong and Li Zhuo^[23], the enterprises with chain shareholders are designated as the processing group, while the control group is the enterprises without chain shareholders, and the enterprise size, enterprise age, asset-liability ratio, enterprise growth, equity concentration, duality, board size and the proportion of independent directors are selected as the matching variables to carry out 1:1 nearest neighbor matching. After excluding the unsuccessfully matched sample enterprises, the remaining samples are regressed, and the results show that the coefficient of chain shareholders (LSnum) is still significantly positive, that is, the research conclusion remains unchanged.

4.4.2. Explanatory variables and control variables lag for one period

Chain shareholders can effectively promote the green transformation of enterprises, but it may also be that the higher level of green transformation of enterprises attracts multiple major shareholders to invest, thus forming a network connection of chain shareholders. In order to solve the possible reverse causal problem between the chain shareholders and enterprises green transformation, this paper lags the explanatory variables and all control variables for one period and make a regression again. The empirical results obtained are consistent with the benchmark regression, that is, chain shareholders are significantly and positively correlated with the green transformation of enterprises, and the research conclusion of this paper is still valid.

4.4.3. Change the explained variable

In order to ensure the reliability and preciseness of the research conclusion, this paper uses the method of Yang Bo and Li Bo^[18] for reference to measure the green transformation of enterprises by adding one to the number of green invention patents authorizations and taking the logarithm, and by adding one to the number of all green patents authorizations and taking the logarithm. The re-regression result shows that the coefficient of chain shareholders (LSnum) is still significantly positive at the level of 1%, which is consistent with the benchmark regression conclusion.

4.4.4. Replace the explanatory variables

Referring to the practice of Pan Yue et al.^[3], the dummy variable LSdum is set: if the enterprise has chain shareholders in the current year, the value is 1, otherwise it is 0, and the coefficient of LSdum is still significantly positive when the model (1) is regressed. According to the research of Chen et al.^[15], the shareholding ratio of chain shareholders (LSshare) is used to measure the chain shareholders. Specifically, the sum of the share ratio of each enterprise held by chain shareholders is calculated at the quarterly level, and the annual average value is calculated. The coefficient of LSshare is significantly positive at the 1% level, indicating that the research conclusion is still robust after using different measures for the variables.

4.4.5. Change the definition threshold of chain shareholders

Referring to the research of Du Shanzhong and Ma Lianfu^[2], this paper adjusts the shareholding ratio to 10%, redefines the chain shareholders, and calculates the new chain shareholder index, which is regressed with enterprise green innovation quality (Gi) and green innovation quantity (Gp). The coefficients of chain shareholders are significantly positive, indicating that under the new measurement method, chain shareholders still can play a governance synergy role, enhance the enthusiasm of enterprises to carry out green innovation activities, so as to promote enterprises to achieve green transformation, that is, H1a is still established.

The robustness test results are consistent with the benchmark results, which are not listed here due to space limitation.

5. Analysis of Action Mechanism

According to the above theoretical analysis, chain shareholders can alleviate the financing constraints, reduce the first type of agency conflict and lay the foundation for the green transformation of enterprises by relying on their advantages in information resources and rich governance experience. Therefore, this paper discusses the role of chain shareholders in the green transformation of enterprises from the two dimensions of financing constraints and the first type of agency costs. Referring to the method of Wen Zhonglin et al.^[24], the following intermediary effect model is constructed:

$$Med_{i,t} = \beta_0 + \beta_1 LSnum_{i,t} + \beta_2 Size_{i,t} + \beta_3 Age_{i,t} + \beta_4 Lev_{i,t} + \beta_5 Roa_{i,t} + \beta_6 Growth_{i,t} + \beta_7 Cash_{i,t} + \beta_8 Top1_{i,t} + \beta_9 Dual_{i,t} + \beta_{10} Bsize_{i,t} + \beta_{11} Indep_{i,t} + \Sigma Ind + \Sigma Year + \delta_{i,t} \quad (2)$$

$$GT_{i,t} = \gamma_0 + \gamma_1 LSnum_{i,t} + \gamma_2 Med_{i,t} + \gamma_3 Size_{i,t} + \gamma_4 Age_{i,t} + \gamma_5 Lev_{i,t} + \gamma_6 Roa_{i,t} + \gamma_7 Growth_{i,t} + \gamma_8 Cash_{i,t} + \gamma_9 Top1_{i,t} + \gamma_{10} Dual_{i,t} + \gamma_{11} Bsize_{i,t} + \gamma_{12} Indep_{i,t} + \Sigma Ind + \Sigma Year + \sigma_{i,t} \quad (3)$$

5.1. Financing constraints

The green transformation of enterprises is often limited by their limited resources and cash flow^[4]. The experience resources accumulated by chain shareholders are conducive to attracting external investment for enterprises, reducing financing costs, and promoting the green transformation of enterprises. This paper refers to the method of Dong Xiaohong et al.^[25], and uses the absolute value of the SA index to reflect the size of enterprise financing constraints, specifically: $FC = |-0.737 * Size + 0.043 * Size^2 - 0.04 * Age|$, where Size is in millions of yuan. The larger the FC value, the stronger the financing constraints the enterprise faces. The test results are shown in columns (1), (2) and (3) of Table 5. From the comprehensive results, chain shareholders can effectively give full play to the resource effect, help enterprises to accumulate broad contacts and social relations, broaden financing channels, and ease the financing constraints faced by enterprises, so as to accelerate green transformation of enterprises.

5.2. The first type of agency costs

Table 5: Regression results of mechanism test

Variable	Intermediary variable: financing constraints			Intermediary variable: the first type of agency costs		
	(1) FC	(2) Gi	(3) Gp	(4) Turnover	(5) Gi	(6) Gp
LSnum	-0.071*** (-16.57)	0.114*** (3.99)	0.106*** (3.36)	0.064*** (5.68)	0.165*** (5.80)	0.149*** (4.73)
FC		-0.754*** (-11.87)	-0.636*** (-9.72)			
Turnover					0.040** (2.45)	0.050*** (2.69)
Size	-0.033*** (-20.86)	0.308*** (45.71)	0.367*** (47.67)	-0.015*** (-4.92)	0.333*** (45.50)	0.389*** (48.48)
Age	0.040*** (254.43)	0.024*** (8.66)	0.017*** (5.54)	0.002*** (2.98)	-0.006*** (-4.36)	-0.009*** (-6.03)
Lev	0.013 (1.61)	0.156*** (4.03)	0.328*** (7.20)	0.592*** (27.20)	0.123*** (3.09)	0.290*** (6.23)
Roa	0.146*** (7.79)	0.338*** (3.17)	0.582*** (4.70)	1.261*** (20.50)	0.177 (1.64)	0.425*** (3.39)
Growth	-0.001 (-0.41)	-0.007 (-0.51)	-0.008 (-0.49)	0.038*** (4.94)	-0.007 (-0.56)	-0.009 (-0.57)
Cash	-0.097*** (-9.98)	0.467*** (8.47)	0.364*** (5.81)	0.099*** (3.68)	0.536*** (9.73)	0.420*** (6.73)
Top1	-0.000*** (-3.70)	-0.003*** (-6.18)	-0.003*** (-5.59)	0.002*** (12.93)	-0.003*** (-5.96)	-0.003*** (-5.51)
Dual	-0.014*** (-7.41)	0.039*** (2.78)	0.017 (1.04)	-0.038*** (-6.39)	0.052*** (3.62)	0.028* (1.72)
Bsize	-0.019*** (-3.30)	-0.016 (-0.37)	-0.023 (-0.49)	-0.031* (-1.82)	-0.000 (-0.01)	-0.010 (-0.20)
Indep	-0.193*** (-10.14)	-0.028 (-0.19)	-0.307* (-1.88)	-0.183*** (-3.19)	0.125 (0.86)	-0.175 (-1.07)
Constant	3.935*** (114.23)	-4.223*** (-16.53)	-5.691*** (-19.87)	0.697*** (9.60)	-7.217*** (-38.67)	-8.229*** (-40.03)
Ind	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
N	19483	19483	19483	19483	19483	19483
R ²	0.803	0.318	0.370	0.263	0.311	0.367

Chain shareholders have rich governance experience and natural profit-seeking motivation. By strengthening the supervision of the management, they can improve the speed of capital turnover, make the goals of shareholders and management compatible, ease the first type of agency conflict, and enhance the willingness of enterprises to green transformation. This paper uses the research method of Qin Hailin and Qi Jianshuang^[26] to measure the agency cost of an enterprise by using the total asset turnover rate (Turnover). The higher the value, the lower the first type of agency costs of enterprises. The regression results are shown in columns (4), (5) and (6) of Table 5. Column (4) of Table 5 shows that when the dependent variable is total asset turnover rate (Turnover), the coefficient of LSnum is significantly positive at the level of 1%, that is, chain shareholders improve the asset turnover rate and reduce the first type of agency costs. Columns (5) and (6) of Table 5 reflect the significant positive correlation between the total asset turnover rate and the green transformation of enterprises, indicating that the higher the total asset turnover rate, the lower the agency cost, and then the stronger the willingness of enterprises to achieve green transformation. Finally, it is concluded that reducing the first type of agency costs is one of the ways to improve the green transformation ability of enterprises.

6. Conclusion and Enlightenment

The green transformation of enterprises driven by green innovation is of great practical significance to accelerate the construction of ecological civilization and promote green and high-quality economic development. This paper empirically tests the influence and mechanism of chain shareholders on the green transformation of enterprises by taking the A-share listed companies in Shanghai and Shenzhen of China from 2010 to 2021 as samples. The results show that: (1) The introduction of chain shareholders can effectively promote the green transformation of enterprises, and the conclusion remains unchanged after the robustness test; (2) The mechanism test shows that chain shareholders can stimulate the green transformation of enterprises by alleviating financing constraints and reducing the first type of agency costs.

Based on the above research conclusions, this paper obtains the following enlightenment:

(1) Enterprises should make full use of the resource governance advantages owned by chain shareholders to strengthen their awareness of green transformation. The existence of chain shareholders can help enterprises obtain relatively concentrated heterogeneous industry information, improve cooperation efficiency, reduce financing constraints, improve governance structure, alleviate agency conflicts, and promote green transformation of enterprises. Therefore, enterprises need to introduce a certain number of chain shareholders. The smooth realization of enterprise transformation and upgrading can not only meet the requirements of environmental supervision, but also obtain long-term core competitive advantages for enterprises. Company managers need to establish green development awareness, build and improve green innovation culture, actively carry out technology research and development activities, and then promote the green transformation of enterprises. (2) The government departments should give certain policy support to build a good market competition environment. Relevant government departments can appropriately increase green R&D subsidies for enterprises, increase preferential tax support, provide more financing channels for enterprises, increase capital sources, reduce the cost of fund-raising, improve the ability of small- and medium-sized enterprises to deal with risks, and thus enhance the overall willingness of enterprises to make green transformation. At the same time, the government should also establish a sound mechanism to regulate the behavior of chain shareholders, strengthen the supervision of the daily business activities of the market, avoid the collusion of enterprises in the same industry, and create a free market environment for the green transformation and upgrading of enterprises. (3) Regulatory authorities should improve relevant policies and regulations to improve the degree of chain shareholders' participation in the green transformation of enterprises. Regulatory authorities should pay more attention to and reasonably guide chain shareholders to actively participate in the transformation and upgrading of enterprises. They should strengthen the supervision of monopoly behavior, standardize the market order, give full play to the advantages of chain shareholders, obtain sufficient information resources and governance experience, and drive enterprise transformation with green innovation.

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