

# An Empirical Study of Corporate Green Innovation, Surplus Management and Financing Constraints

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**Abstract.** This paper studies the relationship between green innovation, financing constraints and financial performance of listed companies on the Shanghai-Shenzhen Exchange 2010-2019. The research found that the financing constraints of listed companies are significantly negatively correlated with green innovation, that is, the stronger the green innovation capacity a listed company has, the less financing constraint it faces. Further research found that both accrual surplus management and real surplus management positively moderate the relationship between financing constraints and green innovation. Compared with the lower level of surplus management, green innovation of enterprises with higher degree of surplus management has a more remarkable effect on financing constraints. Therefore, enterprises should strengthen green innovation, ease financing constraints; reasonably and moderately conduct surplus management, and improve accounting information disclosure mechanism.

**Keywords:** green innovation, accrued surplus management, real surplus management, financing constraints

## 1 INTRODUCTION

The climate issue has become the focus of attention for countries around the world. China has put forward the carbon peaking and carbon neutral strategy, which is the necessary path for China's high-quality economic development. In this context, China has formulated a series of green industrial development policies and continuously established and improved green financial policy system, including green credit policy, green bond policy, green equity financing policy, etc. These policies are effectively promoting the green transformation of enterprises and accelerating investments in clean energy, energy conservation and emission reduction, circular economy, ecological economy projects, etc. The research on corporate green innovation is also a hot research topic in the theoretical circles, firstly, the research on the influencing factors of corporate green innovation, such as the impact of accounting information quality, executive compensation, environmental regulation, and property rights

nature on green innovation; The second is to study the economic consequences of corporate green innovation, such as the effects of green innovation on environmental performance, economic performance, corporate competitiveness, employee employment, financing constraints, etc. In terms of research methods, there is a lack of existing studies on the empirical research of green innovation in listed companies, and due to the difficulty of obtaining objective data such as green patents and green R&D, few studies have used these objective methods to measure green innovation, and most of them use questionnaire survey measures, which are weak in objectivity and cannot accurately reveal the reality of green innovation (Wu Dejun, 2019). This paper adopts green patents to measure green innovation, and adopts an empirical method to study the impact of corporate green innovation on financing constraints and the moderating effect of surplus management, which is somewhat innovative.

## **2 RESEARCH HYPOTHESIS**

### **2.1 Green innovation and financing constraints in public companies**

Green innovation is the driving force to promote the green transformation of enterprises<sup>[1]</sup>. Enterprises carry out green R&D investment activities, facing the risk of large investment amount, long period and high risk, which may bring pressure to the short-term performance of enterprises, but in the long term, green innovation is beneficial to the sustainable development of enterprises<sup>[2]</sup>. First, it can help enterprises to save energy and reduce emissions, reduce energy consumption per unit of output value, and improve the efficiency of resource and energy utilization<sup>[3]</sup>, thus reducing costs and improving performance; second, green innovation helps to develop and utilize clean energy and renewable energy, develop ecological economy and circular economy, and promote the development of new industries, which is in line with the national green industrial policy<sup>[4]</sup>; third, green innovation helps enterprises to develop green products, meet consumer green needs, improve the core competitiveness of enterprises, and establish competitive advantages<sup>[5]</sup>. Therefore, corporate green innovation helps to obtain financing<sup>[6]</sup>. In the context of increasingly improved green financial policies, debt financing, and equity financing are all tilted toward green enterprises, and only by continuously strengthening green innovation and assuming green responsibility can enterprises obtain more and lower-cost financing and ease financing constraints<sup>[7]</sup>. Wu Hongjun argues that the environmental risks of polluting industries significantly affect the financing of enterprises, and the disclosure related to green environment can be a strategic behavior to support the external financing of enterprises with high environmental risks<sup>[8]</sup>. Corporate green innovation is in line with the requirements of national industrial policy and environmental protection policy, which is conducive to achieving the realization of harmonious development of environment and people, conducive to obtaining continuous support from stakeholders, and conducive to obtaining various policy support from government departments, thus conducive to alleviating financing constraints. Based on the above analysis, the following hypotheses are proposed.

H1: The financing constraint of listed companies shows a negative correlation with green innovation. The stronger the green innovation ability is, the stronger its financing ability is and the smaller the financing constraint is.

## **2.2 Green innovation, surplus management and financing constraints in public companies**

Information economics argues that the fundamental reason why financing is expensive and difficult for enterprises lies in the information asymmetry between external investors, creditors and enterprises<sup>[9]</sup>, when investors and creditors do not have sufficient information about the enterprise's operation, they are not willing to finance the enterprise, or consider it more risky, they will raise the financing cost. Good financial performance is an important condition for a company to obtain financing. High-quality financial performance conveys good news to the market about the company's operating conditions<sup>[10]</sup>, The company's operating income, profits and asset scale have grown rapidly, the profitability has maintained a high level, and strong debt servicing capacity. Good performance is conducive to raising share prices, bringing good expectations to investors, reducing the cost of equity financing, increasing the scale of equity financing, and thus easing financing constraints. Good performance improves creditors' evaluation of the company's solvency and facilitates access to larger amounts of lower-cost bank loans and bond financing, thus easing financing constraints. Management can disguise the company's performance through accrual surplus management and real surplus management. Accrual surplus management is the act of choosing the right accounting policies and accounting estimates to whitewash the company's financial performance within the space of subjective judgment allowed by the current accounting standards and accounting system. Accrual surplus management does not change the real business activities of the company. Real surplus management is the intervention of a company's management in accounting information by timely and deliberate construction, adjustment or alteration of the company's actual operating, investment and financing activities, etc.<sup>[11]</sup> Real surplus management can manipulate accounting profits upward through a large number of related party transactions, expansion of production, reduction of expenses and other manipulation methods that affect cash flow. A large number of studies have shown that both accrual surplus management and real surplus Management can help ease corporate financing constraints. Based on the above analysis, the following hypotheses are proposed.

H2: Accrual surplus management of listed companies has a positive moderating effect on the relationship between financing constraints and green innovation.

H3: Real surplus management of listed companies has a positive moderating effect on the relationship between financing constraints and green innovation.

## **3 STUDY DESIGN**

### **3.1 Sample data**

This paper takes A-share listed companies in Shanghai and Shenzhen exchanges from 2010-2019 as the research sample, excluding financial companies, ST and \*ST companies and samples of listed companies with missing relevant variables, and finally 9250 observations are obtained after finishing. Python software is used to capture the green patent data of listed companies from the website of the State Intellectual Property Office, and other data are obtained from the Guotaian database.

### 3.2 Variable definition

#### 3.2.1 Explained variable

The explained variable is the financing constraint of listed companies, and drawing on the practice of scholars such as Yang Le, the financing constraint is measured using the ratio of total cash assets<sup>[12]</sup>, i.e., the increase in cash and cash equivalents/average total assets, and the smaller the ratio of total cash assets indicates the larger the financing constrain.

#### 3.2.2 Explain variables

The explanatory variable is green innovation of listed companies, Use the natural logarithm of the sum of the number of green patent applications of listed companies and 1 as the metric, drawing on the approach of Zhang Junmin et al<sup>[13]</sup>.

#### 3.2.3 Regulate variables

The adjusting variable is surplus management, including accrual surplus management and real surplus management. Accrued surplus management is calculated based on the absolute value of residuals according to the modified Jones model, and real surplus management is calculated based on the Roychowdhury (2006) method, with data from the Guotaian database.

#### 3.2.4 Control variables

On the basis of the existing studies, the control variables are selected as asset-liability ratio, cash asset ratio, fixed asset ratio, operating income growth rate, equity concentration and industry competition. The specific definitions of each variable are shown in Table 1.

**Table 1.** Variable definition table

Variable property	Variable name	Variable symbols	Variable Definitions
Explained variable	Financing Constraint	FCZ	Increase in cash and cash equivalents/average total assets
Explanatory variables	Green Innovation	GI	The natural logarithm of the sum of the number of green patent applications of listed companies and 1
Regulated variables	Accrued surplus management	AEM	Calculate the absolute value of the residuals according to the modified Jones model
	Real surplus Management	REM	Calculated according to Roychowdhury (2006) method
Control variable	Asset-liability ratio	ALR	Total liabilities/total assets at the end of the period
	Cash Asset Ratio	CASH	Cash and equivalents/total assets at end of period
	Fixed assets ratio	TP	End of period fixed assets/total assets
	Operating income growth rate	GROR	(Operating income of the current period - operating income of the previous period)/operating income of the previous period

	Shareholding Concentration	SRTT	Shareholding ratio of top ten shareholders
	Industry Concentration	HHI	The sum of squares of the percentage of total industry revenue of each market competitor in an industry.

### 3.3 Model design

In order to test Hypothesis 1, examine the impact of green innovation on financial performance of listed companies, models (1) and (2) are developed.

$$FCZ=\alpha+\beta1GI \quad (1)$$

$$FCZ=\alpha+\beta1GI+\beta2control+\varepsilon \quad (2)$$

In order to test Hypothesis 2 and 3, examine the moderating effect of listed companies' surplus management on the relationship between green innovation and financing constraints, model (3) is established.

$$FCZ=\alpha+\beta1GI+\beta2AEM(REM)+\beta3GI*AEM(REM)+\beta4control+\varepsilon \quad (3)$$

## 4 EMPIRICAL RESULTS AND ANALYSIS

### 4.1 Descriptive statistics

As seen from Table 2, the mean value of cash total assets ratio of listed companies is 1.9135, the minimum value is -516.0900 and the maximum value is 584.6900; the mean value of green innovation is 0.3793, the minimum value is 0 and the maximum value is 6.7708; the mean value of accrued surplus management is -0.0007, the minimum value is -2.4327 and the maximum value is 1.4078; the real surplus The mean value of management is -0.0089, the minimum value is -5.7819, and the maximum value is 3.1574.

**Table 2.** Descriptive statistics of main variables

	Sample number	Average/ mean value	Standard deviation	Minimum	Median	Maximum
FCZ	9250	1.9135	20.9525	-516.0900	0.1687	584.6900
GI	9250	0.3793	0.8285	0.0000	0.0000	6.7708
AEM	9250	-0.0007	0.0963	-2.4327	0.0001	1.4078
REM	9250	-0.0089	0.2179	-5.7819	0.0037	3.1574
ALR	9250	0.4627	0.2064	0.0103	0.4614	1.7584

CASH	9250	0.1430	0.1100	-0.0233	0.1135	0.8165
TP	9250	0.2357	0.1746	0.0001	0.1995	0.9542
GROR	9250	0.1820	1.6230	-1.3092	0.0865	84.9920
SRTT	9250	55.1789	15.3861	1.3200	55.2200	100.9700
HHI	9250	0.1228	0.1237	0.0184	0.0859	1.0000

#### 4.2 Regression analysis

In order to test the impact of green innovation on financing constraints of listed companies, regression tests are conducted according to model (1) and (2), and the results are shown in columns (1) and (2) in Table 3. The regression result of model (1) shows that the correlation coefficient between the ratio of listed companies' total cash assets and green innovation is 1.4939, and is significant at the 1% level. The regression result of model (2) shows that the correlation coefficient between the ratio of listed companies' total cash assets and green innovation is 1.3326 and is significant at the 1% level. Therefore, financing constraints are significantly and negatively related to green innovation. The stronger the innovation ability of listed companies, the higher the ratio of total cash assets and the smaller the financing constraint. Therefore, listed companies strengthen green innovation, which helps to alleviate financing constraints. As for the control variables, the ratio of cash total assets is significantly and positively related to return on net assets, asset-liability ratio, cash assets ratio, equity concentration and industry concentration; it is significantly and negatively related to fixed assets ratio.

**Table 3.** Correlation analysis results

	(1)	(2)	(3)	(4)
	FCZ	FCZ	FCZ	FCZ
GI	1.4939*** (5.6664)	1.3326*** (5.0914)	1.2855*** 4.9131	0.9652*** (3.6439)
AEM			-2.9748 -1.2069	
REM				0.8809 0.8261
GI*AEM			11.4313*** -3.9373	
GI*REM				12.9733*** -7.8400
ROE		5.1369*** (4.8027)	5.6438*** 5.1983	4.6806*** (4.3627)
ALR		11.7756 *** (10.4067)	11.4864*** 10.1074	12.2359*** (10.7893)
CASH		25.8348*** 11.8887	25.3400*** 11.6180	25.4693*** 11.6312
TP		-2.7923** (-2.1545 )	-3.0394** -2.3431	-2.6480** (-2.0418)
GROR		0.1912	0.1822	0.2022

		(1.4435)	1.3759	(1.5280)
SRTT		0.0575*** 4.0476	0.0581*** 4.0867	0.0527*** 3.7071
HHI		9.3359*** (5.3490)	9.2344*** 5.2964	8.9397*** (5.1346)

Note: \* \* \*, \* \* and \* mean that the correlation coefficient is significant at 1%, 5% and 10% respectively. Under the coefficients in columns (1)- (3) are T values.

### 4.3 Moderating effect analysis

In order to test the moderating effect of listed companies' surplus management on the relationship between financing constraints and green innovation, regression tests are conducted according to model (3), and the results are shown in columns (3) and (4) in Table 3. The regression results show that the coefficient of the cross product term between accrual surplus management and green innovation is 11.4313 and is significant at the 1% level. The coefficient of the cross product term between real surplus management and green innovation is 12.9733 and is significant at the 1% level. Therefore, both accrual surplus management and real surplus management have a significant positive moderating effect on the negative relationship between financing constraints and green innovation. The mitigation effect of green innovation on financing constraints is more significant for firms with higher degree of surplus management compared to those with lower degree of surplus management. Both accrual surplus management and real surplus management strengthen the mitigating effect of green innovation on financing constraints.

## 5 RESEARCH CONCLUSION AND SUGGESTION

### 5.1 Research conclusions

Through the research on green innovation, financing constraints, and earnings management, this paper draws the following conclusions:

First, the financing constraint of listed companies is significantly and negatively related to green innovation. The stronger the green innovation capability of listed companies, the higher the ratio of cash to total assets and the smaller the financing constraint. The possible reason is that the development of green innovation technology, process and products is conducive to enterprises to reduce the consumption of resources and energy, reduce pollution emission, improve the efficiency of resource and energy utilization, promote the development and utilization of new energy and renewable energy, and promote the development of circular economy, which is in line with the national green industrial policy, green credit policy, green bond policy and green equity financing policy, and is more likely to obtain financing support.

Second, surplus management positively regulates the relationship between financing constraints and green innovation. Accrual earnings management is mainly adjusted by changing accounting policies, accounting estimates, related party transactions, etc., such as changing the depreciation period and method of fixed assets, the amortization period and method of intangible assets, the accrual method of asset impairment reserves, and the

valuation method of ending inventory. Accounting data, and then manipulate accounting information. Real earnings management is mainly through the adjustment of production costs, expenses and cash flow of operating activities, such as reducing depreciation expenses and increasing profits by disposing of fixed assets. Earnings management improves corporate financial performance, alleviates information asymmetry, and is conducive to corporate financing activities, thereby strengthening the inhibitory effect of green innovation on financing constraints.

## **5.2 Policy recommendations**

Based on the above research, the following policy recommendations are made:

First, enterprises should strengthen green innovation and alleviate financing constraints. China's high-quality economic development must strengthen green transformation, vigorously develop new energy, renewable energy, circular economy and ecological economy, use green technology to transform traditional industries, reduce energy and resource consumption, reduce pollution emissions, improve energy and resource utilization efficiency, and transform the mode of economic development. Strictly implement green financial policies, issue green credit, green bonds, and develop green equity financing. Create a good financing environment for enterprises with strong green innovation ability, increase financial support and ease financing constraints.

Second, moderate and reasonable surplus management and improve accounting information disclosure mechanism. Accounting information is a bridge between external investors, bondholders and enterprises, and is an important way to alleviate information asymmetry. Enterprises should make reasonable use of surplus management tools within the scope allowed by accounting standards and their related systems to improve the quality of information disclosure, alleviate information asymmetry between enterprises and creditors and investors, and alleviate corporate financing constraints.

Future research suggestions: Different types of green innovation activities, such as green process innovation, green technology innovation, green product innovation, green organization innovation, etc., will have the impact of corporate credit financing, bond financing, and equity financing, which need further research.

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