

# Research on the impact of green innovation on stock returns of listed companies

Rong Zhuang

Nanjing University of Science and Technology, Nanjing, China

**Abstract.** This study examines all listed companies over the past decade, using green patent grants as a proxy for corporate green innovation and annual stock returns with reinvested cash dividends as a measure of stock performance. The empirical analysis demonstrates that green innovation initiatives are recognized by market participants and generate higher stock returns. The positive correlation between green innovation and corporate stock performance indicates that such practices can achieve a win-win outcome in both economic and social benefits.

**Keywords:** Green innovation, Stock income, Listed company.

## 1. Research Background

With global warming and the continuous deterioration of the natural environment, as well as the increasing environmental awareness among people worldwide, low-carbon development and green development have become the demands of the times. How to ensure economic development while improving environmental quality has become an important issue of concern for countries. As the world's second-largest economy, China's rapid economic growth has also brought some environmental problems, such as increased carbon emissions, energy consumption, and climate change. Innovation, coordination, green development, openness, and sharing, as China's five major development concepts, clarify the important role of innovation-driven and green development in promoting China's economic and social development. Green innovation, as the intersection of these two, has become a key means to balance economic development and environmental protection, achieving green economic transformation, under the current context of slowing economic growth and increasingly severe resource and environmental constraints.

Enterprises are regarded as important sources of technological innovation and also major entities in patent applications. By the end of 2022, China's total number of granted invention patents reached 4,220,155, accounting for 65.92% of all invention patents granted. Meanwhile, stock market fluctuations not only reflect the direction of macroeconomic changes but also indicate shifts in corporate operating conditions and development prospects. According to the efficient market theory, a company's economic behavior should be reflected in its stock price, further influencing its stock returns. Therefore, studying whether green innovation by listed companies can lead to better stock market performance is of great significance for enhancing corporate enthusiasm for green innovation and increasing societal attention to it. As one of the ways for enterprises to actively fulfill social responsibilities, green innovation helps improve the reputation of listed companies and shape their positive image.

## 2. Literature Review

### 2.1. Definition and measurement criteria of green innovation

In recent years, scholars both domestically and internationally have proposed varying definitions of green innovation. The concept was first introduced in the book *\*Green Innovation Drive: A Disciplinary Breakthrough for Innovation and Sustainable Development\**, where Fussler and James defined it in 1996 as new products or production processes that deliver value to consumers and businesses while significantly reducing environmental impacts. Borghesi et al. (2015) further defined it as environmentally friendly innovation that promotes social and economic sustainability, helps enterprises gain unique competitive advantages, and reduces pollution and resource overuse. With

continuous updates to green innovation measurement standards, most scholars now use the number of green patents as a proxy variable. Fang Xianming and Na Jinling (2020) noted that green patents, being officially recognized, represent the primary form of green innovation demonstrated by listed companies, enabling more accurate measurement of their green innovation levels.

## **2.2. Factors affecting enterprise stock returns**

Lin Jianhao and Wang Meijin (2011), based on a general equilibrium model, demonstrated that under pro-cyclical monetary policies, there exists a certain correlation between money supply and stock returns, with monetary quantity growth showing a positive correlation with stock returns. Dong Xiuliang (2013) analyzed the relationship between China's inflation rate and stock returns using the present value discount model, with empirical results revealing a negative correlation. Guo Baiying and Zhou Renyuan (2019) proposed that when investors cannot freely short sell stocks, the disclosure of positive corporate information helps increase stock prices and generate higher returns, a phenomenon more pronounced during bull markets. Fama and French (1992) found through empirical research that changes in price-to-earnings ratio, total corporate assets, and book-to-market ratio all influence corporate stock returns, with the book-to-market ratio showing the most significant impact among these three factors.

## **2.3. Relationship between green innovation and corporate stock returns**

Empirical studies by Liu Bai and Wang Xinzhu (2021) demonstrate that corporate green innovation enhances stock returns, as companies can obtain risk compensation through such innovations. However, some scholars hold opposing views. Giuli and Kostovetsky (2014) argue that green innovation reflects corporate social responsibility (CSR), which may increase investment and consequently reduce both operating profits and stock returns.

# **3. Theoretical basis and research hypothesis**

## **3.1. Theoretical Basis**

### **3.1.1. Effective Market Theory**

In 1970, building on previous research, Fama further developed and proposed the efficient market theory. He acknowledged that stock price movements are random, but these random fluctuations arise from the market's continuous absorption of new information, which causes stock prices to fluctuate to varying degrees.

According to existing research, China's stock market is currently in the stage of weak-form efficiency. After enterprises engage in green innovation and obtain authorization, they will disclose the information on the official website of the National Intellectual Property Administration. Enterprises will also use the patent for related production to seek excess profits. Meanwhile, due to the application of new patents, the current stock prices of enterprises are often lower than their normal prices. According to the efficient market theory, the stock prices of such companies should return to the normal price range within a certain period. Rational investors often adjust the valuation of the stock based on the positive or negative information after acquiring the information about the enterprise's green innovation activities, and then buy or sell the corresponding stocks to bring the price back to a reasonable range.

### **3.1.2. Signal Transmission Theory**

Michael Spence proposed the theory of signal transmission in 1973. Both the efficient market theory and traditional economic research assume that information dissemination is timely. However, in reality, there are obvious problems of "information asymmetry" and "adverse selection" in the market. Ordinary investors cannot have the same level of information acquisition as enterprise managers.

When disclosing information about listed companies' operational development, major shareholder activities, and related matters, investors' decision-making is significantly influenced. Obtaining green patent authorization serves as a market disclosure of corporate green innovation initiatives, demonstrating proactive social responsibility. This may also be perceived by external observers as a strategy to reduce production costs through advanced technological capabilities, thereby achieving above-average market returns. Such developments accelerate corporate growth, elevate external investors' expectations, enhance corporate reputation and performance metrics, ultimately boosting enterprise value and increasing stock market returns.

### 3.2. Research Hypotheses

Green innovation can not only enhance corporate image and attract more investment from governments and investors, but also boost product sales and profits. Both factors will positively contribute to higher stock returns. Based on this, the paper proposes the following hypotheses:

H1: Green innovation promotes stock returns.

### 3.3. Research Design

#### 3.3.1. Data Sources and Sample Processing

Based on the reliability, scientific nature, and universality of the data, this paper selects the data of China's listed companies from 2012 to 2022 as the sample, referencing the research of other scholars. The stock returns of listed companies obtained from green innovation often have a time lag, so all independent variables are lagged by one period. The time interval of explanatory variables and control variables is 2013-2022, while the time interval of the dependent variable, stock returns, is 2012-2022. Financial companies, ST and PT companies, and samples with missing data are excluded. The main variables in this paper undergo a 1% trimming treatment, resulting in 26,514 observations. Data processing is performed using Stata 17.0.

**Table 1.** Variable Definitions and Measurement Criteria

class	variable	Variable explanation
explained variable	Return	Consider the annual return on individual stocks reinvested in cash dividends
explanatory variable	GI	The natural logarithm of the total number of green patent applications in the current year plus one
controlled variable	Firmsize	Enterprise size, natural logarithm of total assets
	Lev	Debt-to-asset ratio: total liabilities/total assets
	Roa	Return on assets: Net profit/Total assets
	Compensation	Natural logarithm of total compensation of top three directors
	Dual	The value 0 indicates that the chairman and general manager are not concurrently held, while 1 indicates that they are.
	Share 1	Majority shareholder shareholding ratio
	Share 10	The shareholding ratio of the second to the tenth largest shareholders
	Inderatio	Independent directors' proportion
class	variable	Variable explanation

#### 3.3.2. Model Settings

To analyze whether green innovation by listed companies can generate stock returns, we construct the following benchmark regression model:

$$Return_{i,t} = C + \beta_1 GI_{i,t-1} + \beta_2 Control_{t-1} + u_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

If the regression  $\beta_1$  parameter is significantly positive, it means that the listed company carries out green, which can bring higher stock returns to the company. That is, the stock returns of companies with stronger green innovation ability are better.

## 4. Empirical analysis

### 4.1. Descriptive and correlation statistics

The table below shows that all sample variables have mean values greater than or equal to their medians, indicating a right-skewed distribution. The skewness of Return and GI is particularly pronounced, suggesting the presence of high-return stocks with strong green innovation capabilities in the market. The green innovation level of enterprises ranges from 0 to 4.317, with a variance of 1.056, revealing significant differences in corporate attitudes toward green innovation. Some companies still need to improve their green innovation capabilities. Firm size has a variance of 1.254, higher than other variables, indicating substantial size differences among enterprises in the market.

**Table 2.** Descriptive statistics of variables

variable	sample number	mean	median	variance	least value	crest value
Return	26514	0.150	0.035	0.512	-0.579	2.241
GI	26514	0.759	0.000	1056	0.000	4.317
Firmsize	26514	22.06	21.89	1.254	19.69	25.95
Lev	26514	0.411	0.398	0.209	0.0502	0.944
Roa	26514	0.0425	0.042	0.0696	-0.278	0.227
Compensation	26514	14.21	14.21	0.769	12.05	16.20
Dual	26514	0.293	0.000	0.455	0.000	1.000
Share 1	26514	0.342	0.321	0.147	0.0874	0.737
Share 10	26514	0.248	0.240	0.0131	0.0243	0.561

### 4.2. Benchmark Regression and Analysis

**Table 3.** Results of Corporate Green Innovation and Stock Returns

VARIABLES	(1)	(2)	(3)
	Return	Return	Return
GI	0.0135***	0.00828*	0.0258*** (0.00508)
Firmsize		s	-0.116*** (0.00705)
Lev			-0.00126 (0.00746)
Roa			0.00435 (0.0165)
Compensation			-0.0235*** (0.00657)
Dual			-0.00430 (0.00995)
Share1			0.338*** (0.0532)
Share10			0.0550 (0.0435)
Inderatio			0.0791 (0.0832)
Constant	0.140*** (0.00387)	0.00868 (0.0101)	2.645*** (0.161)
Observations	26,514	26,514	26,514
R-squared	0.001	0.323	0.334
Year FE	NO	YES	YES
Individual FE	NO	YES	YES

The estimation results in column (3) reveal that the coefficient of corporate green innovation is 0.0258, which passes the 1% significance level test. This indicates that green innovation significantly enhances corporate stock returns, meaning higher green innovation levels lead to greater stock market performance. These empirical findings demonstrate that green innovation can boost corporate stock returns, thereby validating Hypothesis H1.

### 4.3. Robustness Test

The first-stage regression results indicate that the selected instrumental variable (L.GI) shows a significant correlation with the endogenous variable (GI) at the 1% significance level, with a regression coefficient of 0.277, demonstrating no weak instrument problem. The regression results after adding the instrumental variable are presented in Column (2), revealing that corporate green innovation and stock returns maintain a positive correlation with a coefficient of 0.101. This coefficient demonstrates an improvement over the benchmark regression and remains statistically significant at the 1% level, indicating that endogeneity issues have minimal impact on the study's findings.

**Table 4.** Robustness Test of Two-Stage Least Squares Method for Green Innovation and Stock Returns

VARIABLES	2SLS Phase 1	2SLS Phase 2	VARIABLES
	GI	Return	
GI		0.101*** (0.0250)	GI
L.GI	0.277*** (0.00734)		L.GI
Firmsize	0.313*** (0.00931)	-0.236*** (0.0132)	Firmsize
Lev	0.0169 (0.0143)	0.0106 (0.0135)	Lev
Roa	-0.0322 (0.0471)	0.0125 (0.0444)	Roa
Compensation	0.0691*** (0.00907)	0.00361 (0.00880)	Compensation
Dual	-0.0122 (0.0142)	-0.00343 (0.0134)	Dual
Share1	-0.468*** (0.0744)	0.662*** (0.0720)	Share1
Share10	-0.308*** (0.0642)	0.0174 (0.0616)	Share10
Inderatio	0.266** (0.118)	0.0451 (0.112)	Inderatio
Constant	-7.182*** (0.204)	5.030*** (0.295)	Constant
Observations	22,392	22,392	Observations
Year FE	YES	YES	Year FE
Individual FE	YES	YES	Individual FE

## 5. Conclusions and policy recommendations

Enterprises are recognized as fundamental sources of innovation and knowledge creation. The stock market, functioning as both a barometer and a gauge of economic trends, reflects societal and economic development to some extent, thereby influencing the actual interests of listed companies. Given the rising prominence of environmental factors in today's context, studying whether corporate green innovation activities can enhance stock market returns holds significant importance for both

enterprises and society as a whole. This paper examines the impact of corporate green innovation on stock returns using all listed companies from 2012 to 2022 as a sample. Overall, implementing green innovation enables listed companies to achieve higher stock market returns. As sustainable green development becomes a global priority, enterprises with more green patents gain greater investor recognition, leading to higher capital market returns. Notably, the acquisition of green utility model patents demonstrates particularly significant positive effects on corporate stock performance.

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