УДК 330.3:336.027:502.12

Shao Ziyu[1], I. P. Dzeraviaha[1], D. G. Malashevich[2]
[1]Belarusian State University
[2]Belarusian State Technological University

GREEN INVESTMENT, GREEN INNOVATION AND ECONOMIC GROWTH QUALITY

This paper examines the internal mechanism of green investment affecting economic growth quality from the perspective of green innovation. Solving this problem requires studying a number of new economic categories, including the concepts of green investment and innovation. In addition, an important aspect is the development of a consistent approach to assessing the quality of economic growth. This concept can be interpreted in different ways. In the context of this article, special attention is given to the influence of green innovation and investment on the quality of economic growth. A serious obstacle to solving the problems posed in the article is the lack of statistics necessary to build quantitative models. Therefore, it is important to search for parameters and indicators that can fully characterize investment and innovation processes in the green economy. To examine this issue, mediation effect test models are established based on the logic of the causal steps approach. Then, this paper empirically tests the mediation effect by using the causal steps approach, the Sobel test and the Bootstrap method with panel data from 30 provinces in China from 2010 to 2020. The results show that green investment has a favorable effect on economic growth quality, with approximately 30% of the total effect is mediated by green innovation. The conclusion remains valid after a series of robustness checks. In order to improve economic growth quality, it is recommended that green financial policies, innovation policies and economic growth policies work in unison.

Keywords: Green investment, economic growth quality, green innovation, People's Republic of China, mediation effect.

For citation: Shao Ziyu, Dzeraviaha I. P., Malashevich D. G. Green investment, green innovation and economic growth quality. *Proceedings of BSTU*, *issue 5*, *Economics and Management*, 2024, no. 1 (280), pp. 58–66 (In Russian).
DOI: 10.52065/2520-6877-2024-280-7.

Шао Цзыюй[1], И. П. Деревяго[1], Д. Г. Малашевич[2]
[1] Белорусский государственный университет
[2]Белорусский государственный технологический университет

ЗЕЛЕНЫЕ ИНВЕСТИЦИИ, ЗЕЛЕНАЯ ИННОВАЦИЯ И КАЧЕСТВО ЭКОНОМИЧЕСКОГО РОСТА

В статье рассматривается внутренний механизм влияния зеленых инвестиций на качество экономического роста с точки зрения зеленых инноваций. Решение данной проблемы требует изучения ряда новых экономических категорий, включая понятия зеленых инвестиций и инноваций. Кроме того, важным аспектом является выработка последовательного подхода к оценке качества экономического роста. Это понятие может трактоваться по-разному. В контексте данной статьи особое место отводится влиянию зеленых инноваций и инвестиций на качество экономического роста. Серьезным препятствием для решения поставленных задач является нехватка статистики, необходимой для построения количественных моделей. Поэтому важное значение имеет поиск параметров и показателей, которые могут в полной мере характеризовать инвестиционные и инновационные процессы в зеленой экономике. Для изучения поставленного вопроса были созданы тестовые модели эффекта посредничества, основанные на логике подхода причинно-следственных шагов. После данный эффект эмпирически проверяется с использованием подхода причинно-следственных шагов, теста Собела и метода начальной загрузки на панельных данных из 30 провинций Китая за 2010–2020 гг. Результаты показывают, что зеленые инвестиции оказывают благоприятное влияние на качество экономического роста, причем около 30% общего эффекта опосредовано зелеными инновациями.

После ряда проверок на устойчивость вывод остается в силе. Для повышения качества экономического роста рекомендуется, чтобы политика зеленого финансирования, инновационная политика и политика экономического роста работали в унисон.

Ключевые слова: зеленые инвестиции, качество экономического роста, зеленая инновация, Китайская народная республика, эффект посредничества.

Для цитирования: Шао Цзыюй, Деревяго И. П., Малашевич Д. Г. Зеленые инвестиции, зеленая инновация и качество экономического роста // Труды БГТУ. Сер. 5, Экономика и управление. 2024. № 1 (280). С. 58–66 9 (На англ.).
DOI: 10.52065/2520-6877-2024-280-7.

Introduction. The promotion of sustainable economic development has become a goal shared by nations worldwide with the emergence of various environmental issues, such as global warming and the tightening of supply constraints for fossil energy. In order to achieve this goal, countries develop their strategies related to green transformation of economy. This paper considers the example of China that has clearly proposed the implementation of an innovation-driven green development strategy against the backdrop of its rising economic volume and declining growth rate.

Literature Review. Endogenous growth theory holds that technological innovation is at the core of economic growth [1]. Most of the existing studies affirm the view that technological innovation is a driving force for economic development [2] and the basis for sustainable economic development [3]. Technological innovations have positive effects on enhancing resource allocation efficiency, increasing production efficiency, upgrading product and labor quality, etc. This is able to affect the demand- and supply-side, overcoming diminishing returns to scale and saving costs of all kinds, thereby transforming the way of economic growth and improving its quality.

Green innovation is the integration of technological innovation and the concept of green development. Besides the positive effect of possessing technological innovation, green innovation can further reduce environmental pollution, promote the development of renewable energy industries and raise energy use efficiency [4], so as to improve the environment while saving environment-related costs to drive high-quality economic growth.

However, projects for green innovation are characterized by long-run, high-risk and dual externalities (technological and environmental externalities). It brings problems such as increased financing costs, constrained amounts of financing and reduced willingness to innovate, which leads to insufficient investment in the field of green innovation [5]. Therefore, it will be necessary to divert investments from carbon- and resource-intensive investments toward sustainable investments in order to promote green innovation.

Green investment, which is born out of the notion of sustainable development, makes investment decisions based on the goal of realizing the triple effect related to economy, society and environment. It focuses on economic growth and environmental protection, which is compatible with green innovation and high-quality economic growth in terms of development dynamics and advantages. The existing literature has found that green investment is an important initiative to promote green innovation as well as one of the key means to improve economic growth quality [6].

On the one hand, green investment can not only directly finance green innovation but also reduce the risk of green innovation and raise the expectation of green innovation returns through expenditures on environmental infrastructure construction, environmental protection management affairs, environmental monitoring and supervision, etc. Moreover, green investment at the government level, which can reflect the intensity of environmental policies, is able to perform a strong demonstration function through the signaling effect. This enhances the environmental protection awareness of various economic agents, increases the willingness of firms to undertake the risk of green innovation, as well as attracts capital and talent to the field of green innovation.

On the other hand, green investment, particularly productive green investment, has a long-run positive impact on the economy [7]. Furthermore, green investments have strong unproductive investment purposes, including improvement of energy efficiency, reduction of emissions, generation of clean and renewable energy, environmental protection and so on. Therefore, it is capable of giving a strong impetus to the improvement of the environment, energy conservation and emission reduction, as well as the enhancement of the living quality of residents and improvement of economic growth quality from both the environmental and social perspectives.

In summary, there is a lot of literature that has studied the relationship between green investment and green innovation, green innovation and economic growth quality, as well as green investment and economic growth quality, respectively. Many scholars have shown that green investment and green innovation are essential factors in improving economic growth quality [8]. And it is worth noting that green investment is crucial to driving green innovation, taking into account market failure caused by the long-run, high-risk and double externalities of green innovation. As can be seen, it is possible for green innovation to mediate the effect of green investment on economic growth quality.

Green investment can enhance the level of green innovation through resource injection and signaling, which is favorable to the improvement of the efficiency of production and resource allocation, the enhancement of the quality of products and labor, as well as energy savings and emission reduction, and thus improves economic growth quality from the perspectives of economic aggregate, environment and society.

In addition, in recent years, the public demand for high environmental quality has been increasing, and environmental protection policies have been gradually tightening. In this context, the increase in green investment and the improvement in green innovation driven by it are conducive to the construction of sustainable competitive advantages for firms, making them more capable of meeting the requirements and expectations of today's market and government. This will enable enhanced operational and environmental performance for firms, thereby promoting high-quality economic growth.

Furthermore, the increase in green innovation driven by green investment is possible to relatively alleviate the problem of productive capital crowd-out caused by the unproductive investment purposes of green investment, through channels such as saving costs in production and environmental management [9], boosting efficiency and increasing the commercial value of the products [10], thereby promoting the development of the economy.

However, there is limited literature that has examined the relationship between green investment, green innovation, and economic growth quality in an integrated framework. To date, no empirical literature has explored whether green innovation plays an effective role as a mediator in the impact of green investment on economic growth quality.

Given that, this paper aims to explore the intrinsic mechanism of green investment affecting economic growth quality, with a particular focus on green innovation as a mediator variable. To empirically examine this question, we uses panel data from 30 provincial units in China from 2010 to 2020. The findings of the study using China as a sample can be appropriately extrapolated to other developing countries with full consideration of the development characteristics of any particular country.

Methodology and Data. Methods for testing mediation effects can be broadly classified into three categories: the causal steps approach, the difference in coefficients method, and the product of coefficients method [11]. Among them, the difference in coefficients method is infrequently employed in the existing papers because of its high Type I error rate. The causal steps approach, proposed by Baron et al. [12], is one of the most widely used methods in the previous studies. Nevertheless, the method has low statistical power and may somewhat underestimate the probability of a Type I error [11]. In this regard, Wen et al. [13] proposed a test procedure for the mediation effect based on the causal steps approach combined with the product of coefficients method (Sobel test). The test procedure has low rates of Type I or Type II errors and is now widely adopted in academia. However, the Sobel test has the assumption that the product of coefficients has a normal distribution, which is difficult to achieve in a small sample.

In recent years, the Bootstrap method, which is one of the product of coefficients methods, has been used in an increasing number of papers. This method is able to directly estimate the mediation effect without restricting its sampling distribution. Moreover, some scholars have found that the Bootstrap method, especially the bias-corrected Bootstrap method, is one of the methods with the highest statistical power through simulation studies [14]. But this method may have the potential to overestimate the Type I error rate.

As can be seen, there are both advantages and disadvantages to the test methods for the mediation effect available today. Based on this, this paper mainly adopts the test procedure proposed by Wen et al. [13] to examine the mediation effect of green innovation. Additionally, the bias-corrected Bootstrap method is employed for robustness checks in order to ensure the reliability of the findings.

Referring to the test procedure proposed by Wen et al. [13], the constructed model and the test steps carried out in this paper are as follows:

Step 1. Verify the total effect of green investment on economic growth quality through a regression without considering the influence of the green innovation factor. The following model is established:

$$EGQ_{it} = a_0 + a_1 GI_{it} + \\ + \sum_{j=2}^{8} a_j CV_{it} + \eta_i + \gamma_t + \varepsilon 1_{it}, \qquad (1)$$

where i is the province and t is the year; EGQ_{it} is the economic growth quality and GI_{it} is the green investment; CV_{it} are the control variables, including human resources, industrial structure, level of nationalization, government expenditure, level of technological progress, level of actual utilization of foreign investment, and level of urbanization; η_i is the individual fixed effect and γ_t is the time fixed effect; $\varepsilon 1_{it}$ is the random error term; a_0 is a constant term; a_1 and a_j are the estimated coefficients of the corresponding terms.

The regression coefficient a_1 and its significance need to be focused on. The coefficient a_1 represents the total effect of the green investment on economic growth quality. If a_1 is significant, it indicates that green investment has a significant impact on economic growth quality. In this case, the next step of the test can be performed. On the contrary, put an end to the test.

Step 2. Test the effect of green investment on the mediator variable, green innovation, through regression. The specific regression model is as follows:

$$GTI_{it} = \beta_0 + \beta_1 GI_{it} + \\ + \sum_{j=2}^{6} \beta_j CV2_{it} + \eta_i + \gamma_t + \varepsilon 2_{it}, \qquad (2)$$

where the meaning of i, t, GI_{it}, η_i and γ_t are the same as in equation (1); GTI_{it} refers to green innovation; $CV2_{it}$ are the control variables, including human resources, industrial structure, level of technological

progress, level of actual utilization of foreign investment, and level of urbanization; $\varepsilon 2_{it}$ is the random error term; β_0 is a constant term; β_1 and β_j are the estimated coefficients of the corresponding terms.

Here, it is important to pay attention to the regression coefficient β_1, which shows the effect of green investment on green innovation. But the next step can be carried out regardless of whether β_1 is significant or not.

Step 3. Combining the results of Step 2, the direct and mediation effects are tested by regression in this step. The following is the specific model:

$$EGQ_{it} = \delta_0 + \delta_1 GI_{it} + \delta_2 GTI_{it} + \\ + \sum_{j=3}^{9} \delta_j CV_{it} + \eta_i + \gamma_t + \varepsilon 3_{it}, \quad (3)$$

where the meaning of i, t, EGQ_{it}, GI_{it}, CV_{it}, η_i and γ_t are the same as in equation (1); and the meaning of GTI_{it} is the same as in equation (2); $\varepsilon 3_{it}$ is the random error term; δ_0 is a constant term; δ_1, δ_2 and δ_j are the estimated coefficients of the corresponding terms.

The regression coefficient δ_1 reflects the direct effect of green investment on economic growth quality while controlling for the green innovation variable. The regression coefficient δ_2 shows the effect of green innovation on economic growth quality while controlling for the green investment variable. The multiplication item $\beta_1 \cdot \delta_2$ of the coefficients is the estimated value of the mediation effect, as can be seen from the argument of Mackinnon et al. [15]. Moreover, it has the following relationship with the estimated value of the total effect (coefficient α_1) and the estimated value of the direct effect (coefficient δ_1).

$$\alpha_1 = \delta_1 + \beta_1 \cdot \delta_2. \quad (4)$$

The key concern here is the regression coefficients β_1 and δ_2. If β_1 of equation (2) and δ_2 of equation (3) are both significant, it means that the mediation effect is significant, and step 4 can be skipped to proceed directly to step 5. If one of them is not significant or neither of them is significant, step 4 should be carried out.

Step 4. Test the significance of the mediation effect by the Sobel Z-statistic. Based on the test method for the mediation effect proposed by Sobel [16], the Sobel Z-statistic can be calculated using the following formula:

$$z = \frac{\beta_1 \cdot \delta_2}{\sqrt{\delta_2^2 \cdot S_{\beta_1}^2 + \beta_1^2 \cdot S_{\delta_2}^2}}, \quad (5)$$

where S_{β_1} and S_{δ_2} are the standard errors of the estimated coefficients β_1 and δ_2, correspondingly; β_1, S_{β_1}, δ_2 and S_{δ_2} are respectively derived from equations (2) and (3).

If the Z-statistic passes the test of significance level, then it indicates that there is a mediation effect, and step 5 should be followed. Otherwise, stop the test. Besides, when green investment can indirectly promote economic growth quality by raising the level of green innovation, the absolute value of coefficient δ_1 should be smaller than the absolute value of coefficient α_1.

Step 5. Determine the type of mediation effect (complete mediation or partial mediation).

If the coefficient δ_1 of equation (3) is significant, it indicates that there is a direct effect of green investment on economic growth quality. Green innovation has a partial mediation effect. Green innovation has a complete mediation effect if the coefficient δ_1 is not significant.

In addition, the Bootstrap method, which is used for robustness checks in this paper, is a repeated sampling method. The basic logic of the nonparametric Bootstrap method is to take the original sample as the "statistical population", obtain a large number of different Bootstrap resamples by repeatedly random sampling with replacement, and then calculate relevant confidence intervals. Statistical software commonly used (SPSS, Stata, etc.) is currently capable of performing calculations of the Bootstrap method directly.

Taking into account the study purpose, the Bootstrap test steps in this paper are as follows:

First of all, as there have been previous studies that the number of Bootstrap resamples should be no less than 1000 and recommended to be 5000 [17], this paper is based on the original sample (data from 30 provinces in China) for 5000 repeatedly random sampling with replacement. As a result, the corresponding estimated values $\widehat{\beta_{1k}} \cdot \widehat{\beta_{2k}}$ (k = 1, 2,..., 5000) of the mediation effect can be calculated for the Bootstrap resamples obtained from each sampling. Among them, $\widehat{\beta_{1k}}$ are the estimated values of the coefficient obtained from the regression on the Bootstrap resamples based on equation (2); $\widehat{\beta_{2k}}$ are the estimated values of the coefficient obtained from the regression on the Bootstrap resamples based on equation (3).

Next, sort these estimated values of the mediation effect by numerical magnitude to obtain the sequence C. Its distribution approximates the actual distribution obtained from the original population. Then calculate confidence intervals based on this distribution. Since detailed calculation formulas are introduced and derived in much existing literature [17, 18], we do not repeat them here. And in this paper, we use Stata to perform 5000 repeated random samplings with replacement and compute confidence intervals. If the confidence interval of the mediation effect obtained does not include 0 between the upper and lower values, it indicates that green innovation has the mediation effect. Conversely, it shows that there is no evidence that the mediation effect exists.

To test the model, dependent, independent, mediator and control variables are used. The dependent variable is economic growth quality (*EGQ*). In order to comprehensively examine economic growth quality in the current Chinese context, this paper constructs an evaluation indicator system based on existing literature and China's "new concept for development". The indicator system comprises five dimensions: innovation development, coordination development, green development, openness development and sharing development.

The independent variable is green investment (*EI*). In recent years, most relevant empirical papers at the regional level have measured green investment using expenditures for energy conservation and environment protection, investment in environmental protection, or investment in environmental pollution control [19]. However, these measurement methods have a relatively narrow coverage scope since they ignore productive green investment, which has a significant impact on economic growth quality. Therefore, this paper measures green investment by including productive green investment in addition to expenditures for energy conservation and environment protection based on official statistics data availability and existing literature [20].

The mediator variable is green innovation (*GTI*). Technical innovation is commonly measured in the relevant literature using indicators such as the number of patents or research and experimental development investments. The Patent Law of the People's Republic of China categorizes patents into invention patents, utility model patents, and design patents. Of these, invention patents are considered the most innovative. Therefore, this paper uses the number of green invention patents obtained in the region during the year (from the CNRDS database) to measure green innovation.

The control variables in this paper include human resources, industrial structure, level of nationalization, government expenditure, level of technological progress, level of actual utilization of foreign investment, and level of urbanization based on previous studies and data availability. Specific methods of measurement and data sources are listed below.

Referring to Barro's method [21], human resources (*HR*) are measured using average years of schooling. The specific calculation formula is as follows:

$$HR_i = \frac{0P_{i1} + 6P_{i2} + 9P_{i3} + 12P_{i4} + 16P_{i5}}{Total\ namber\ of\ person}, \quad (6)$$

where i is the province; P_{i1} is the number of people in each province who are not attending school; P_{i2}, P_{i3}, P_{i4} and P_{i5}, respectively, are the numbers of persons in each province who finished primary, junior high school, senior high school, as well as post-secondary and above. The data are from the "China Statistical Yearbook" and the "China Population & Employment Statistical Yearbook".

Industrial structure (*IS*) is measured using the share of value added of the tertiary industry in *GDP*, with data from the "China Statistical Yearbook". The level of nationalization (*NAT*) is measured by the proportion of the number of urban employment in state-owned units at year-end to the total number of urban employment at year-end. The data is from the "China Statistical Yearbook" and the "China Labour Statistical Yearbook". Government expenditure (*GE*) is measured using general public budget expenditure as a share of *GDP*, with data from the "China Statistical Yearbook". The level of technological progress (*TEP*) is measured by the number of research and experimental development personnel, with data obtained from the "China Statistical Yearbook". The level of actual utilization of foreign investment (*FI*) is measured by the proportion value of actual utilization of foreign investment to *GDP*, and the data is from the "China Commerce Yearbook". The level of urbanization (*URB*) is expressed in terms of the urbanization rate, which is derived from the "China Population & Employment Statistical Yearbook".

The model was tested on the research sample of 30 provinces in China (excluding Tibet) from 2010 to 2020. The missing values in the control variables were filled by the interpolation method. And all value variables were deflated using 2010 as the base period. The results of the descriptive statistics for the variables are shown in Table 1.

Table 1

Descriptive statistics

Variable (Unit)	Observations	Mean value	Standard deviation	Min value	Max value
EGQ	330	0.18	0.12	0.05	0.76
EI (billion yuan)	330	41.50	24.11	3.22	145.03
GTI (piece)	330	879.17	1251.14	1.00	6936
HR (year)	330	9.13	0.88	7.16	12.68
IS (%)	330	43.08	9.70	27.94	89.37
NAT (%)	330	21.63	9.74	6.74	52.51
GE (%)	330	24.75	10.31	10.58	64.30
TEP (person)	330	127272	145479	4008	872238
FI (%)	330	2.02	1.73	0.01	10.09
URB (%)	330	57.75	12.44	33.81	89.60

Source. Calculated by authors.

As can be seen from Table 1, the level of economic growth quality in China is not very high, with a mean value of 0.18. Green investment and green innovation are relatively weak, with significant differences across different years and regions.

Result and Discussion. This paper uses the econometric software Stata 14.0 for empirical tests. Table 2 shows the results of the benchmark regression and the corresponding bias-corrected Bootstrap test.

At the 1% significance level and keeping other variables constant, each trillion yuan increase in green investment is able to increase the index of economic growth quality by 0.2 units (2nd column of Table 2), which is about one times the mean value of the current index. Moreover, green investment can significantly influence green innovation (3rd column of Table 2). Holding all other conditions the same, each trillion yuan increase in green investment is in a position to adding about 6031 patents for green inventions. Furthermore, the results in the 4th column of Table 2 indicate that the regression coefficients corresponding to the green investment and green innovation variables are significant.

Therefore, green innovation can play a partial mediation role in the process of green investment affecting the economic growth quality. Moreover, the estimated value of the mediation effect is 0.00006, which accounts for about 30.15% of the total effect.

Additionally, the results of the bias-corrected Bootstrap test reveal that both direct and mediation effects exist (the results in Table 2 show that the confidence intervals for both the direct and mediation effects do not contain 0), thus the above conclusions are robust.

Then, in order to further enhance the credibility of conclusions, this paper conducts robustness checks by replacing the core independent variable and the mediator variable, respectively. The details are as following.

On the one hand, with reference to the frequently used measurement methods in previous papers, expenditures for energy conservation and environment protection are used to measure green investment here. On the other hand, this paper uses the application number of green invention patents in the region during the year to measure green innovation from the perspective of innovation vitality for robustness checks. The results of robustness checks are presented in Table 3.

It can be observed from Table 3 that, whether replacing the core independent variable or the mediator variable, the results of the mediation effect test procedure and Bootstrap test indicate that green investment can affect economic growth quality both directly and by promoting green innovation. Accordingly, the benchmark regression conclusions are deemed to be highly robust.

Table 2

Benchmark regression and robustness check (bias-corrected Bootstrap test)

Variables/Pathway	Equation (1)	Equation (2)	Equation (3)
	GI → EGQ	*GI → GTI*	*GI + GTI → EGQ*
GI_{it}	0.0002^{***} (3.52)	6.0306^{***} (2.98)	0.00016^{***} (2.86)
GTI_{it}	–	–	0.00001^{***} (4.02)
Constant	0.1755^{***} (3.48)	2144.9040 (1.39)	0.1636^{***} (3.26)
Control variables	YES	YES	YES
Time fixed effect	YES	YES	YES
Individual fixed effect	YES	YES	YES
R^2	94.73	70.09	95.01
Number of samples	330	330	330
Sobel Z-statistic	2.382^{**}		
Bootstrap test result-mediation effect	[0.00000766, 0.0000901]		
Bootstrap test result-direct effect	[0.000000759, 0.0003634]		

Notes: 1. In the 2nd–4th rows of the table, numbers are regression coefficients and numbers in parentheses are their corresponding t-statistics.

2. *** stands for $p < 0.01$, ** stands for $p < 0.05$, and * stands for $p < 0.1$.

3. "YES" means that all control variables, time fixed effects, or individual fixed effects are included in this regression.

4. In the 11th–12th rows of the table, numbers in parentheses "[]" are the lower and upper values of the 95% confidence intervals for the bias-corrected Bootstrap test.

Source. Calculated by authors.

Table 3

Robustness checks (replacement of core independent variable and mediator variable)

Variables/ Pathway	Replacement of core independent variable			Replacement of mediator variable		
	GI → *EGQ* Equation(1)	*GI* → *GTI* Equation(2)	*GI* + *GTI* → *EGQ* Equation(3)	*GI* → *EGQ* Equation(1)	*GI* → *GTI* Equation(2)	*GI* + *GTI* → *EGQ* Equation(3)
GI_{it}	0.0006^{***} (3.96)	24.9299^{***} (4.56)	0.0005^{***} (2.93)	0.0002^{***} (3.52)	28.9337^{***} (3.09)	0.00017^{***} (2.98)
GTI_{it}	–	–	0.00001^{***} (3.64)	–	–	0.000001^{***} (2.93)
Constant	0.1797^{***} (3.58)	2026.1520 (1.34)	0.1670^{***} (3.39)	0.1755^{***} (3.48)	10520.0500 (1.48)	0.1642^{***} (3.29)
Control variables	YES	YES	YES	YES	YES	YES
Time fixed effect	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES
R^2	94.78	71.25	95.02	94.73	73.20	94.88
Number of samples	330	330	330	330	330	330
Sobel *Z*-statistic	2.864^{***}			2.125^{**}		
Bootstrap test result-mediation effect	[0.0000225, 0.0003731]			[0.00000723, 0.0000872]		
Bootstrap test result-direct effect	[0.0001359, 0.0008131]			[0.00000235, 0.0003665]		

Notes: 1. In the 2nd–4th rows of the table, numbers are the regression coefficients and numbers in parentheses are their corresponding t-statistics.

2. *** stands for $p < 0.01$, ** stands for $p < 0.05$, and * stands for $p < 0.1$.

3. "YES" means that all control variables, time fixed effects, or individual fixed effects are included in this regression.

4. In the 11th–12th rows of the table, numbers in parentheses "[]" are the lower and upper values of the 95% confidence intervals for the bias-corrected Bootstrap test.

Source. Calculated by authors.

Conclusion. This paper empirically examines the possibility that green innovation mediates the effect of green investment on economic growth quality using the test procedure for the mediation effect and the bias-corrected Bootstrap method, with panel data from 30 provinces in China for the period of 2010 to 2020.

The findings show that green innovation can play a partial mediation effect in the process by which green investment affects economic growth quality. The mediation effect accounts for approximately 30.15% of the total effect. While keeping all other variables the same, each trillion yuan increase in green investment is able to increase the index of economic growth quality by 0.2 units, which is about one times the mean value of the current index. Among these, 0.06 units are attributed to the mediation role played in it by green innovation.

Therefore, it is advisable to strengthen the coordination and cooperation among green financial policies, innovation policies and economic growth policies. This can improve the efficiency of green capital utilization and maximize the mediation role of green innovation, thus effectively enhancing the effect of policy implementation and promoting high-quality economic growth.

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Information about the authors

Shao Ziyu – PhD student, the Department of Corporate Finance. Belarussian State University (4, Nezavisimosti Ave, 220030, Minsk, Republic of Belarus). E-mail: 104959156@qq.com

Dzeraviaha Ihar Petrovich – PhD (Economics), Associate Professor, Professor, the Department of Corporate Finance. Belarusian State University (4, Nezavisimosti Ave, 220030, Minsk, Republic of Belarus). E-mail: Dzeraviaha@sbmt.by

Malashevich Diana Georgievna – Senior Lecturer, the Department of Management, Business Technology and Sustainable Development. Belarusian State Technological University (13a, Sverdlova str., 220006, Minsk, Republic of Belarus). E-mail: malashevich@belstu.by

Информация об авторах

Шао Цзыюй – аспирант кафедры корпоративных финансов. Белорусский государственный университет (220030, г. Минск, пр. Независимости, 4, Республика Беларусь) E-mail: 104959156@qq.com

Деревяго Игорь Петрович – кандидат экономических наук, доцент, профессор кафедры корпоративных финансов. Белорусский государственный университет (220030, г. Минск, пр. Независимости, 4, Республика Беларусь). E-mail: Dzeraviaha@sbmt.by

Малашевич Диана Георгиевна – старший преподаватель кафедры менеджмента, технологий бизнеса и устойчивого развития. Белорусский государственный технологический университет (220030, г. Минск, пр. Независимости, 4, Республика Беларусь). E-mail: malashevich@belstu.by

Received 15.02.2024