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ВЛИЯНИЕ ЗЕЛЕНЫХ ИНВЕСТИЦИЙ НА КАЧЕСТВО ЭКОНОМИЧЕСКОГО РОСТА

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Исследуется влияние зеленых инвестиций на качество экономического роста. Прежде всего для его измерения предлагается система оценки, включающая пять параметров (инновации, уровень координации, экологичность, уровень открытости и уровень совместного использования), с присвоением весов с применением метода взвешенной энтропии. Для эмпирического изучения влияния зеленых инвестиций на качество экономического роста исследуются панельные данные по 30 провинциям Китая за период с 2010 по 2020 г. с использованием двусторонней модели с фиксированными эффектами. Результаты показывают, что при сохранении других условий неизменными увеличение зеленых инвестиций на 1 трлн юаней может повысить индекс качества экономического роста на 0,3 ед., что в 1,6 раза превысит актуальное среднее значение этого показателя в Китае. Более того, такой положительный эффект имеет определенное запаздывание. Эти выводы остаются актуальными в случае учета проблемы эндогенности и проведения серии проверок надежности. Для повышения качества экономического роста предлагаются соответствующие меры экономической политики.

Ключевые слова: зеленые инвестиции; качество экономического роста; Китай; система показателей; метод взвешенной энтропии.

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THE IMPACT OF GREEN INVESTMENT ON THE ECONOMIC GROWTH QUALITY

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This paper studies the impact of green investment on the economic growth quality. First of all, in order to measure the economic growth quality, this paper proposes an indicator system based on five dimensions of innovation, coordination, green, openness and sharing, and utilises the entropy weighting method to assign weights. Then, based on panel data

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for 30 Chinese provinces from 2010 to 2020, a two-way fixed effects model is used to empirically examine the impact of green investment on the economic growth quality. The results show that while keeping other conditions unchanged, an increase of 1 trln yuan in green investment can increase the quality index of economic growth by 0.3 units, which is 1.6 times the current average value of the index in China. Moreover, this positive effect has a certain lag. These conclusions remain valid on the basis of taking into account the endogeneity issue and a series of robustness checks. Finally, with a view to effectively improving the economic growth quality, appropriate measures of economic policy are proposed.

Keywords: green investment; economic growth quality; China; indicator system; entropy weight method.

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Introduction

Improving the economic growth quality (EGQ), especially promoting sustainable economic development, has become a common goal for all countries in the world as the prominence of problems such as overcapacity, environmental pollution and economic structural imbalance. The 2030 Agenda for sustainable development and the Paris agreement were launched successively. To achieve these goals, investments have to shift from carbon- and resource-intensive investments to sustainable investments. Green investment, as an investment derived from the concept of sustainable development, has received wide attention from all sectors of society. It makes investment decisions based on the criteria of achieving the triple effect – economic, social and environmental. It can be seen that green investment is closely related to the EGQ.

Nowadays, a growing number of scholars are focusing on the factors influencing the EGQ, including green finance [1, p. 31954], environmental regulation [2, p. 299], technological innovation, and so on. However, there is relatively little existing literature that focuses on the topic of the impact of green investments on the EGQ. Moreover, the available empirical evidence doesn’t reach consensus on the direction of the impact of green investment on the EGQ due to variations in research samples, methods, and other aspects [3, p. 98; 4, p. 82].

Given that, this paper uses panel data from 30 provincies in China from 2010 to 2020 to study the impact of green investment on the EGQ. There are two main reasons for using China as the study subject. On the one hand, the quality of China’s economic growth is a critical factor affecting global environmental, resource and social conditions. China is not only a major country in terms of primary energy consumption and CO_2 emissions, but also the world’s most populous country. And China is the second-largest economy in the world. On the other hand, the study findings related to the quality of China’s economic growth can provide a reference for other countries, especially developing countries. And it can be appropriately extrapolated to developing countries with full consideration of the development characteristics of any particular country.

Literature review and theoretical analysis

With the emergence of a series of negative impacts caused by economic growth at a high speed, such as over-investment of resources and overcapacity [5, p. 26], academics have begun to turn their attention to the study of the EGQ [6, p. 61]. Moreover, with the depth of research, more and more scholars believe that the EGQ has a multidimensional character, including economic, social and environmental dimensions [7, p. 135].

In order to find effective engines for high-quality economic growth, green investment has become a hot topic in academia. Green investment, especially productive green investment, as a form of investment, is bound to have the long-term benefits of driving the economy [4, p. 70]. Moreover, the increase in green investment can play the role of capital injection, resource guidance and signal transmission, which is helpful to promote green innovation [8], to improve industrial structure [9], etc. Improvements in green innovation and other aspects are able to effectively enhance resource utilisation and production efficiency, optimise resource allocation, so as to save environment-related costs and promote high-quality economic growth.

At present, many studies have separately confirmed the positive effects of green investment on economic volume, total factor productivity, employment rate [10, p. 274], industrial structure [9], environmental quality [4, p. 69], and happiness [11], which are all single dimensions of the EGQ. A few studies have examined the relationship between green investment and the EGQ on the basis of measuring the EGQ from a multidimensional perspective. The analysis of Zhang Minglong [3, p. 89] shows that green investment can not only promote economic growth through the investment multiplier effect, but also boost high-quality economic development.

However, it should be noted that the positive benefits of investment on economic development may not be realised, especially in the short run. Based on empirical tests of data from 1961 to 2008 in China, Du Liyong found that in different stages of economic development or different frontier technologies, there is a significant growth effect of investment on long run economic growth, while there are differences in its short run effect [12, p. 35]. Furthermore, green investment, especially governmental green investment, has a strong non-productive investment purpose, such as reducing environmental pollution. This would crowd out productive capital and increase the wealth burden, which would be detrimental to economic development. And the achievement of these environmental and social goals requires sustained and large investments. As a result, green investments that are short-term and small in amount not only crowd out productive capital, but also fail to effectively generate environmental and social benefits. The empirical research results of Zeng Sheng and his collegues indicate that low volumes of green investment are not beneficial to high-quality economic growth [4, p. 77].

In summary, some scholars have explored the impact of green investment on the EGQ, and the conclusions of the study are useful for the research of this paper. Nevertheless, related studies are relatively lacking in comprehensive consideration of the EGQ as well as channel analysis. And the findings of existing studies are not exactly the same. The positive effects of green investments on the EGQ may be constrained by conditions [4, p. 70] and need to take into account the current background, including economic, social, technology, the scale of investment and so on.

Nowadays, with the deterioration of the ecological environment and the frequent occurrence of natural disasters, people's awareness of environmental protection is increasing and environmental regulations are becoming ever more stringent. In response, countries have begun to vigorously develop the green economy. In 2022, the total amount of global environmental, social, and governance (ESG) funds reached 2.5 trln US dollars, and the total amount of China's ESG funds amounted to about 400 bln yan. Investments in clean energy amounted to 1.1 trln US dollars globally, with China accounting for nearly half of the total global investment. Moreover, China International Capital Corporation estimated that total value of green investment in China is expected to increase to 163 thsd US dollars in the next 5 years. In general, green investments in China are currently large with a trend towards sustained inputs.

And with this background, the increase in green investment allows firms to better adapt to market demand and gain consumer value identification, thus improving environmental and economic benefits. Therefore, this paper argues that the benefits and saved costs from green investments will outweigh the amount of capital that is crowded out, resulting in high-quality economic development. Furthermore, long-term sustained green investment are capable of optimising the environment, saving energy, reducing emissions, and improving the quality of life of residents, thus enhancing the EGQ from an environmental and social perspective.

The construction of indicator system of economic growth quality and measurement methodology

The construction of indicator system of economic growth quality. Although there is currently no consensus among scholars on methods to measure the EGQ, existing studies can be divided into two categories broadly. For the first category, a single indicator is used to measure the EGQ. However, with the depth of research, more and more scholars believe that this method has certain limitations [13, p. 11]. The second category explores the EGQ in a multidimensional perspective. In this type of empirical literature, the most widely used method to measure the EGQ is the establishment of a hierarchical indicator system. Most of these indicator systems take into account the coordinated development of the economy, society and environment [4, p. 73]. However, the specific indicators chosen by scholars are diverse, influenced by factors such as viewpoints, national circumstances and data availability.

Based on this, referring to existing literature and combining with China's new concept for development, this paper constructs an evaluation indicator system of economic growth quality that contains five secondary indicators of innovation development, coordination development, green development, openness development and sharing development (table 1). The specific reasons for establishing the indicator system based on the new concept for development are as follows.

Firstly, in order to promote high-quality economic development, the new concept for development of innovation, coordination, green, openness and sharing was put forward in China in 2015 and subsequently widely implemented. Among these, innovation development focuses on the issue of the dynamics of economic development. Coordination development pays attention to the balanced problems of economic development. Green development is concerned with the environment and the sustainability of the economy. Openness development places emphasis on the breadth and depth of opening up to the outside world. Sharing development emphasises issues of social equity. General Secretary Xi Jinping has repeatedly emphasised that the five aspects of the new concept for development are aggregates that have intrinsic linkages which need to be synergised in order to effectively improve the quality of economic development.

In this context, some studies have begun to measure the EGQ in China based on the new development concept. Furthermore, some scholars have pointed out that the new concept for development can be used as the theoretical foundation for constructing an indicator system for high-quality economic development [14, p. 6]. It can be seen that measuring the EGQ based on the new concept for development is not only of practical significance, but also has certain theoretical and methodological support.

Secondly, economic development is a process of upward spiral. Economic development in different periods has its own unique characteristics. Moreover the new concept for development, which is introduced as a strategic direction for the new features of the economy after entering a new era in China, has a distinctive epochal character. Hence, exploring the quality of China's economic growth from the perspective of the new concept for development can better study the state of China's economy in the current context and depict the characteristics of China's economic development in the new era.

Thirdly, the index of economic growth quality should reflect the economic sustainability of the research subjects. The new concept for development, which explains the goals, motivation, approach and path of development, fundamentally determines the effectiveness and even the success or failure of China's development [15, p. 41]. Therefore, the indicator system based on the new concept for development can better reflect China's sustainable development capability.

The hierarchy and logic of this assessment system apply to other countries as well. Nevertheless, the specific indicators need to be adjusted accordingly to the development situation of the particular country.

Measurement methodology. In order to avoid the interference of subjective factors, this paper adopts the entropy weight method to assign weights to the indicators, and then uses the weighted sum approach to calculate the index. The specific steps are as follows.

Step 1. Data standardisation, which described by following equations:

- for benefit object

$$x'_{qij} = \frac{x_{qij} - x_{\min}}{x_{\max} - x_{\min}},$$

- for cost object

$$x'_{qij} = \frac{x_{\max} - x_{qij}}{x_{\max} - x_{\min}},$$

where $x_{\max}$ is the maximum value of the j-th index; $x_{\min}$ is the minimum value of the j-th index; x_{qij} is the value of the j-th indicator for province i in year q; x_{qij} is the index value obtained after standardisation. Moreover, the data that turns to zero after standardisation is appropriately shifted in order to avoid the impact of zero values. Its equation is

$$x''_{qij} = x'_{qij} + K, \text{ if } x'_{qij} = 0,$$

where x_{qij} is the index value after shifting and standardisation; K is the indicator shift magnitude ($K = 0.000\,000\,001$).

Step 2. Calculation of the entropy e_j, which is produced in the following way:

$$e_i = -\frac{1}{\ln(rn)} \sum_{q=1}^{r} \sum_{i=1}^{n} P_{qij} \ln P_{qij},$$

where r is the year; n is the province;

$$P_{qij} = \frac{x''_{qij}}{\sum_{q=1}^{r} \sum_{i=1}^{n} x''_{qij}}.$$

Step 3. Calculation of the weight w_j. It's equation is the following:

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{m} \left(1 - e_j\right)},$$

where m is the number of indicators.

Step 4. Calculation of the index of the EGQ by using the following equation:

$$\text{EGQ}_{qi} = \sum_{j=1}^{m} \left(w_j x''_{qij}\right),$$

where EGQ_{qi} is the index of EGQ of different provinces in different years.

Table 1

EGQ indicator system

Primary indicator	Secondary indicators	Tertiary indicators (unit)	Calculation method	Indicator attributes
EGQ	Innovation development	Research and experimental development investment intensity (mln yuan)	Internal expenditure on R & D	+
		Degree of technology transaction activity (mln yuan)	Transaction value of technical market	+
		Domestic patent output (piece)	Total number of three kinds of domestic patent granted	+
		Number of R & D personnel (people)	Full-time equivalent of (R & D) personnel	+
	Coordination development	Advanced level of industrial structure (%)	$\frac{\text{Value added of tertiary industry}}{\text{GDP}}$	+
		Urbanisation level (%)	$\frac{\text{Number of urban population}}{\text{Total population at year-end}}$	+
		Demand structure (%)	$\frac{\text{Total retail sales of consumer goods}}{\text{GDP}}$	+
		Urban-rural income gap (yuan)	Disposable income of urban households per capita – disposable income of rural households per capita	–
		Urban-rural consumption difference (%)	Engel's coefficient of urban households – Engel's coefficient of rural households	–
	Green development	Energy consumption per unit of GDP (yuans for tone)	$\frac{\text{Volume of energy consumption}}{\text{GDP}}$	–
		Waste gas per unit of GDP output (US dollars for tone)	$\frac{\text{Volume of } SO_2 \text{ emissions}}{\text{GDP}}$	–

Ending of the table 1

Primary indicator	Secondary indicators	Tertiary indicators (unit)	Calculation method	Indicator attributes
EGQ	Green development	Greening coverage of built-up area (%)	Greening coverage of built-up area	+
		General industrial solid waste generated per unit of GDP (yuans for tone)	$\frac{\text{Generation volume of general industrial solid waste}}{\text{GDP}}$	–
		Park green space per capita (m^3)	Park green space per capita	+
	Openness development	Degree of dependence upon foreign trade (%)	$\frac{\text{Total amount of import and export trade}}{\text{GDP}}$	+
		Level of actual utilisation of foreign investment (%)	$\frac{\text{Value of actual utilisation of foreign investment}}{\text{GDP}}$	+
		Number of foreign invested enterprises (unit)	Number of foreign invested enterprises	+
	Sharing development	Unemployment rate (%)	Registered unemployment rate in urban area	–
		Education spending per capita (yuans for person)	$\frac{\text{Educational expenditure}}{\text{Total population at year-end}}$	+
		Number of physicians per 10 000 people	$\frac{\text{Total number of licensed physicians \& physician assistants}}{\text{Total population at year-end}}$	+
		Basic social insurance coverage rate (%)	$\frac{\text{Participants of basic endowment insurance for urban workers at year-end}}{\text{Total population at year-end}}$	+
		Number of buses per 10 000 people (set)	Number of buses per 10 000 people	+

Model, variable and data

Variable description and data sources. EGQ is considered as an explained variable. Refer to the previous section for specific indicator selection (see table 1) and measurement method.

Explanatory variable is green investment (GI). Academics have measured green investment in a variety of ways in recent years. In studies at the regional level, most of the literature measures green investment using expenditure for energy conservation and environment protection, investment in environmental protection, or investment in environmental pollution control. However, these indicators cover a relatively narrow range. Based on this, combined with the principle of data availability, this paper uses the sum of the expenditure for energy conservation and environment protection as well as productive green investment (forestry investment and investment in water conservancy construction) to measure green investment, drawing on existing literature [4, p. 74].

In order to eliminate the influence of other factors on the explained variables, this paper selects human capital, degree of nationalisation, government expenditure, total population at year-end, industrial structure, and green innovation as control variables based on previous studies [3, p. 94; 4, p. 74] and data availability.

Of these, human capital (HC) is measured using average years of schooling. Referring to Barro's method [16], the formula for calculating human capital is established as follows:

$$\mathrm{HC}_i = \frac{0P_{i1} + 6P_{i2} + 9P_{i3} + 12P_{i4} + 16P_{i5}}{\text{Total number of persons aged 6 years and over}},$$

where i is the province; P_{i1} is the number of persons in each province who are not attending school; P_{i2}, P_{i3}, P_{i4}, 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 degree of nationalisation (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 government expenditure (GE) is measured using general public budget expenditure as a share of GDP. The total population (TP) at year-end is measured using the total population numbers at year-end. Industrial structure (IS) utilises the share of value added of the secondary industry in GDP as a measure. Green (technological) innovation (GTI) is measured using the number of patents for green inventions.

The research data were obtained mainly from the following sources: «China statistical yearbook», «China statistical yearbook on science and technology», «China statistical yearbook on environment», «China forestry statistical yearbook», «China water statistical yearbook», «Yearbook of China water resources», «China statistical yearbook for regional economy», «China statistical yearbook on high technology industry», «China population & employment statistical yearbook», «China energy statistical yearbook», «China health statistical yearbook», «China labour statistical yearbook», statistical yearbooks of each province, statistical communique of each province on the national economic and social development, EPS database, CNRDS database, etc.

Data processing and descriptive statistics. In this paper, 30 provinces (excluding Hong Kong, Macao, Taiwan and Tibet) in China from 2010 to 2020 are selected as the research sample. All value variables were deflated using 2010 as the base period. In addition, the missing values in the control variables were filled by the interpolation method. The results of descriptive statistics of the variables are shown in table 2.

Table 2

Descriptive statistics

Variable (unit)	Observations	Mean value	Standard deviation	Minimum value	Maximum value
EGQ	330	0.18	0.12	0.05	0.76
EI (bln yuan)	330	41.50	24.11	3.22	145.03
HC (people)	330	9.13	0.88	7.16	12.68
NAT (%)	330	21.63	9.74	6.74	52.51
GE (%)	330	24.75	10.31	10.58	64.30
TP (mln people)	330	45.62	27.47	5.63	126.24
IS (%)	330	43.58	8.84	15.83	59.05
GTI (piece)	330	879.17	1251.14	1.00	6936.00

According to table 2, it can be seen that the overall level of the quality of China's economic growth is relatively low (mean value is 0.18), and there are some differences in the quality index of economic growth among different provinces in different years. There is also a large gap between the amount of green investment in the sample. The overall degree of human capital is high and has been more evenly distributed across provinces over the years. China has relatively small levels of nationalisation, government expenditure and green innovation in the sample period. The secondary sector in China, dominated by industry and manufacturing, is more developed.

Model. Since the data is a balanced and short panel, this paper selects the model among the pooled regression model, the random effects model and the fixed effects model by using the econometric software *Stata 14.0*. The specific steps are as follows.

Step 1. Combining the previous analysis.

This paper firstly constructs the fundamental econometric model

$$\mathrm{EGQ}_{it} = \lambda + \lambda_1 \mathrm{GI}_{it} + \sum_{j=2}^{7} \lambda_j \mathrm{CV}_{it} + \varepsilon_{it}, \quad (1)$$

where *i* is the province, *t* is the year; EGQ_{it} is the quality of economic growth; GI_{it} is the green investment; CV_{it} is the control variables, including human capital, degree of nationalisation, government expenditure, total population at year-end, industrial structure, and green innovation; λ_0, λ_1 and λ_j are the parameters to be estimated. Among them, the value and the corresponding *p*-value of parameter λ_1 are at the core of this paper's concern; ε_{it} is a stochastic disturbance term.

Step 2. The least squares dummy variables test.

This paper tests whether the model should use pooled regression by method of least squares dummy variables regression. The null hypothesis of the method is that all of the individual dummy variables are zero.

The regression results show that 96.67 % of the individual dummy variables are significant ($P = 0$). Therefore, the null hypothesis should be rejected. That is, there is an individual effect in the equation (1) and pooled regression should not be used.

Step 3. The Hausman test.

The Hausman test is used to determine whether to use a random effects model or a fixed effects model. The null hypothesis of the Hausman test is that the random effects model is appropriate.

The test results show that the *p*-value corresponding to the Hausman statistic is 0 and the null hypothesis of the Hausman test should be rejected (table 3). Therefore, the fixed effects model should be chosen among the random effects model and the fixed effects model.

Table 3

Model selection

Type of test	Results
Hausman test	chi2(5) = 137.66
	p-Value = 0
Joint significance test of annual dummy variables	Years 2–11 are equal 0
	F-statistics (10.29) = 10.14
	p-Value = 0

Given that, the econometric model is further adjusted to a fixed effects model

$$\mathrm{EGQ}_{it} = \lambda_0 + \lambda_1 \mathrm{GI}_{it} + \sum_{j=2}^{7} \lambda_j \mathrm{CV}_{it} + \eta_i + \varepsilon_{it}, \quad (2)$$

where η_i is the individual fixed effect. The meanings of the other variables are the same as in equation (1).

Step 4. The joint significance test of annual dummy variables.

The joint significance test of annual dummy variables is used to explore the presence of time effects in the model (equation (2)). The null hypothesis of this test is that there is no time effect.

The test results show that the null hypothesis should be strongly rejected (see table 3). Hence, the model should add time fixed effects.

In summary, the two-way fixed effects model should be used. Moreover in order to eliminate the effect of heteroskedasticity on the model, this paper uses cluster-robust standard error. Therefore, the model is finally adjusted as follows:

$$\mathrm{EGQ}_{it} = \lambda_0 + \lambda_1 \mathrm{GI}_{it} + \sum_{j=2}^{7} \lambda_j \mathrm{CV}_{it} + \eta_i + \gamma_t + \varepsilon_{it}, \quad (3)$$

where γ_t is the time fixed effect. The meanings of the other variables are the same as in equation (2).

Results and discussion

Benchmark regression. The econometric software *Stata 14.0* is also used for the empirical test results of which are presented in table 4. Column 1 of table 4 presents the result of the benchmark regression (equation (3)).

Table 4

Benchmark regression and robustness checks

Variables	Benchmark regression	Robustness checks – replacement of core explanatory variables		Robustness checks – adjustment of sample period
	1	2	3	4
EI_{it}	0.000 3** (2.24)	–	0.001 3* (1.84)	0.000 5*** (2.85)
$EI_{i,t-1}$	–	0.000 2* (1.75)	–	–
Constant	–0.380 7** (–2.61)	–0.346 7** (–2.32)	–0.355 3** (–2.67)	–0.358 3** (–2.33)
Control variables	+	+	+	+
Time fixed effect	+	+	+	+
Individual fixed effect	+	+	+	+
R^2	0.88	0.86	0.87	0.83
N	330	300	330	240

Notes: 1. In $2^{nd}–4^{th}$ rows of the table numbers are regression coefficients and numbers in parentheses inolicate the corresponding *t*-values. 2. The *t*-values in parentheses are calculated using in clustering robust standard errors. 3. Symbol * stands for $p < 0.1$, symbol ** stands for $p < 0.05$, symbol *** stands for $p < 0.01$. 4. Sign + means that all control variebles are controlled for this regression.

It can be found that increased green investment is able to significantly improve the EGQ. With all other variables unchanged, for every billion yuan increase in green investment, the index of the EGQ can increase by 0.000 3 units.

Robustness checking. In order to verify the reliability and non-randomness of the above findings, this paper conducts robustness checks by replacing the core explanatory variables, adjusting the sample period, and changing the control variables, respectively. The details are as following.

To begin with, there may be problems of lag effects as well as contemporaneous endogeneity when green investment is driving the EGQ. Therefore, this paper uses green investment with a one-year lag in place of the core explanatory variables (column 2 of table 4). In addition, referring to the common method of measurement in the existing literature, green investment is changed to be measured by the expenditure for energy conservation and environment protection (column 3 of table 4).

Then, this paper changes the sample period to 2013–2020. In 2012, in order to promote sustainable economic development, China integrated the construction of ecological civilisation with economic, political, cultural and social construction into the overall five-in-one layout of socialism with Chinese characteristics. It means that China is beginning to emphasise environmental problems, focusing on the coordinated development of the economy, the environment and society. This is exactly what high-quality economic development requires. In the same year, the Notice on the issuance of green credit guidelines was launched. It marks a breakthrough in the construction of China's green financial system. Hence, considering the lag of policy implementation, this paper selects the panel data from 2013–2020 for robustness testing with a view to studying the problem without policy interference (column 4 of table 4).

Finally, one control variable is removed from the six control variables in turn, and the results are presented in table 5.

Table 5

Robustness checks (changing the control variables)

Variables	EGQ (excluding HC)	EGQ (excluding NAT)	EGQ (excluding GE)	EGQ (excluding TP)	EGQ (excluding IS)	EGQ (excluding GTI)
GI_{it}	0.000 3** (2.23)	0.000 3** (2.22)	0.000 3** (2.17)	0.000 5* (1.94)	0.000 3** (2.31)	0.000 4** (2.60)
Constant	–0.346 1*** (–2.79)	–0.372 3** (–2.70)	–0.377 8*** (–2.95)	0.151 3 (1.62)	–0.373 9** (–2.67)	–0.564 7*** (–3.47)

Ending of the table 5

Variables	EGQ (excluding HC)	EGQ (excluding NAT)	EGQ (excluding GE)	EGQ (excluding TP)	EGQ (excluding IS)	EGQ (excluding GTI)
Control variables	+	+	+	+	+	+
Time fixed effect	+	+	+	+	+	+
Individual fixed effect	+	+	+	+	+	+
R^2	0.88	0.88	0.88	0.8	0.88	0.84
N	330	330	330	330	330	330

N o t e s: 1. The *t*-values in parentheses are calculated using in clustering robust standard errors. 2. Symbol * stands for $p < 0.1$, symbol ** stands for $p < 0.05$ and symbol *** stands for $p < 0.01$. 3. Sign + means that all control variebles are controlled for this regression.

In summary, the results of the robustness checks change slightly compared to the results of the benchmark regression, but the change is small. This is shown in that the parameter estimates λ_1 are slightly different, but signs are identical and the significance remains essentially the same. Accordingly, the benchmark regression conclusions are deemed to be highly robust.

It is worth noting that green investment with a one-year lag contributes significantly to the EGQ (column 2 of table 4). It not only verifies the robustness of the benchmark regression, but also shows that the impact of green investment on the EGQ has the effect of lagging. Keeping all other variables constant, for every billion yuan increase in green investment, the index of the EGQ can increase by 0.000 2 units. As stated in the section on theoretical analysis, it takes time for both the realisation of the positive effects of investment as well as the improvement of the environment and society.

Conclusions

Taking 30 provinces in China from 2010 to 2020 as the research object, this paper empirically examined the effect of green investment on the EGQ using the two-way fixed effects model.

The study results find that increased green investment can significantly improve the EGQ. For every trillion yuan increase in green investment, the index of the EGQ is able to increase by 0.3 units, which is 1.6 times the current average value of the index. Moreover, there is a certain lag in this positive effect.

Based on the above conclusions, it is recommended that China take measures to allow green investment to increase in the long run and sustainable manner, so as to take advantage of its positive effect of improving the EGQ. The details are as follows.

The government should improve the market mechanism and mobilise the enthusiasm and creativity of firms in green investment, so as to continuously increase green investment to promote high-quality economic growth. It is advised that green financial products should be enriched and the application of sustainable financial instruments boosted in order to provide more funding sources to support sustainable projects. Moreover, it is suggested that strengthen the disclosure of information related to environmental risks, so that investors are better able to understand the value and risks of firms, thus promoting the effective allocation of green funds. The government ought to further reinforce the cultivation of talents in green finance and increase the relevant talent pool, so as to lay the foundation for the subsequent development of the green economy.

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