



Does Green Finance Drive Financial Performance? A Panel Data Analysis with GMM Estimation

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ARTICLE INFO	ABSTRACT
Article History: Received: January 27, 2025 Revised: March 03, 2025 Accepted: March 09, 2025 Available Online: March 12, 2025	<i>Green finance has emerged as a prominent topic of discussion as the present generation increasingly recognizes the significance of a sustainable environment. This study employed a local Green Finance Development Index to analyze the substantial impact of green financing on the financial performance of environmentally conscious firms in China. Green finance serves as a fundamental motivator, enhancing the economic insight of environmentally responsible enterprises by strategically consolidating capital and facilitating the continuous interchange of essential information. The study utilizes actual data from 2012 to 2023, concentrating on green listed firms, to examine the relationship relating financial performance and green financing with the GMM estimation Model. This empirical study strengthens the scientific foundation of the green finance paradigm and creates a robust framework for decision-making, fostering the sustainable growth of green industries and enterprises. This empirical study strengthens the systematic foundation of the green finance paradigm and creates a robust framework for decision-making, facilitating the sustainable growth of green industries and enterprises.</i>
Keywords: Green Finance, Sustainable Environment, Financial Performance, GMM.	
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Introduction

Green finance has emerged as a leading issue of discussion as the present generation increasingly recognises the significance of an environment sustainability, (Chae et al., 2021). Sustainable and Green finance pertains to the financial services provision aimed at environmental safety

initiatives., defined as “the collection of economic activities that revitalize the environment and optimise resource usage”, Pang & Zheng, (2021). This includes the support of sustainable energy, safe and clean energy, eco-emollient conveyance as well as green building project. The word "green" pertains to activities that reduce pollution, conserve resources of nature and promote sustainable development, Shann et al., (2018). The advancement of green finance encompasses the accessibility of loans to achieve a sustainable ecological environment, Xiaie et al., (2020). Green finance incorporates green securities, green sources of credit, green investments as well as carbon financing.

From a comprehensive viewpoint, it is posited that the progression of green finance facilitates the optimisation of an economy's overall structure through enhancements in Quality of supply side, increased awareness of demand-side and sustained growth Zheng et al., (2021). From a constrained perspective, the advancement of green finance can empower industrialists to transform eco-friendly products via sustainable production methods, reduce transaction costs, and market the products in a manner that directs consumer behaviour (Ussman et al., 2019).

Green money serves as a catalyst for environmental development transformation in two ways. Firstly, it promotes entrepreneurs to adopt environmentally safe practices and goods; secondly, it reduces pollution by substituting high-energy machinery with energy-efficient alternatives. The advancement of green financing is contributing to poverty alleviation by increasing farmers' understanding of green products. Farmers should be incentivised to cultivate green and organic crops devoid of any substances that contribute to environmental damage (Wang & Zheng, 2020).

The efficacy of green finance advancement is enhanced when all regions simultaneously implement the similar national policies, Zhang et al., (2022). Several economic sectors, incorporating industry, agriculture and services, must adhere to the same national agenda. To facilitate rural regeneration, green funding must be integrated into ecological and ecologically sustainable initiatives. Furthermore, governments have to prioritise superior environmental quality and incentivise other sectors via diverse financial instruments to accelerate green growth. The attributes of green finance development are deemed very significant (Bashir et al., 2020; Lee & Min, 2015).

The development of green finance has concentrated on a theoretical background, production purposes, also the technological role within the economy. The quality of Environment must be enhanced, since sustainable enhancement is a significant global problem today (Nisar et al., 2022; Nasim et al., 2022a). It is essential to preserve the ecosystem for upcoming generations. The condition of the environment influences the standard of living. The expenses associated with technological industry are escalating pollution in several ways, impacting all living organisms. The degradation of the environment is a significant issue that is perpetually escalating, necessitating a comprehensive approach to remediate this toxic milieu via an informed use of green financing. All these adverse environmental repercussions negatively impact health of human, which is the overarching objective of human life. The environment is a collective issue rather than an individual one, and it is evident that mankind now faces an environment that is antagonistic to its aspirations for an improved quality of life (Raffiq et al., 2022; Hanif et al., 2024).

The quality of Environment is a conventional economic commodity having two separate interpretations. The initial pertains to the notion that a pristine environment is a shared resource for which financial actors are willing to compensate, notwithstanding potential price declines. Given the simultaneous occurrence of economic growth and technical improvement, it is reasonable to infer that individuals in affluent countries possess access to technological innovations that

significantly reduce the cost of enhancing local air quality (Nisar et al., 2022; Asghar et al., 2024). Consequently, persons in prosperous countries use a greater percentage of air quality than those in less fortunate nations. The secondary interpretation pertains to the willingness of people to allocate more financial resources towards environmental initiatives as their income increases, irrespective of price stability. These two findings indicate a detrimental correlation relating per capita income and pollution. Due to the characteristics of outwardness, the environment cannot be purified by individual actions except society mutually organizes such efforts via governmental intervention, including taxes, regulations, and tradable emissions permits (Morelli, 2011). A more robust association between income and pollution may be demonstrated via induced policy response.

Human actions may significantly influence extreme temperatures and increasing CO₂ emissions. Opponents of globalisation contend that its environmental effects are dual in nature. Pollution havens arise when trade liberalisation changes permit the relocation of polluting companies to areas with less rigorous regulatory frameworks (Wang et al, 2021).

To achieve climate resilience and sustainable development objectives, central banks worldwide must strategically use green finance to enhance macro-financial stability. Simultaneously, at the business level, the integration of green finance may transform investment plans, easing financial limitations on green innovation projects and enhancing overall results. The legal framework governing green finance may inhibit the debt financing activities of ecologically harmful firms, therefore positively impacting the shift towards sustainable economic models. Thus, prioritising the reallocation of resources to renewable energy is essential for transforming existing energy consumption patterns reliant on fossil fuels and promoting sustainable economic development Ashraf et al. (2025).

This research significantly enhances the current information about the relationship between green finance and the financial performance of environmental sustainable firms, particularly within the Chinese setting through a thorough analysis of data from 2012 to 2023 using the Generalised Method of Moments (GMM). This advanced use of the GMM model permits a thorough study that tackles possible endogeneity and elucidates the dynamic link among green financing and business performance across time. Estimation results from this method demonstrate a strong optimistic association between green financing and the financial success of companies. The findings indicate that green finance significantly benefits hygienic energy corporations and those with reduced dependence on subsidies of government, highlighting the probability for customised financial tactics and rules that acknowledge the distinct requirements and contributions of different sectors in green economy.

The next parts of this academic work are systematically organised to thoroughly examine the theories and hypotheses in Section 2. The Section 3 precisely delineates the study technique, clarifying the variables measurement and the creation of the model. The Section 4 presents empirical data and analysis, accompanied by robustness testing. Section 5 examines the findings and limitations.

2. Review of Literature

Green transition and Environmental sustainability are intrinsically linked; a green transition devoid of energy and environmental sustainability is inherently incomplete and insufficient (Ji et al., 2021; Hall et al., 2018). Cross-border renewable energy trade is crucial for climate change mitigation and enduring environmental sustainability (Sun et al., 2020; Ferrat et al., 2022; Taghizadeh-Hesary et

al., 2021). Renewable substitutes for fossil fuels, including wind also solar energy, are regarded as an efficacious means of restoring global environmental equilibrium (Mushed et al., 2021).

Pakrooh et al. (2020) investigated the increasing consciousness of carbon release in Iran agriculture sector to elucidate the factors contributing to CO₂ emissions. Over the last decade, the agricultural industry has faced heightened carbon emissions, inadequate governmental restrictions, and escalating fossil fuel consumption rates. Saravia-Matus et al. (2019) undertook an analysis of the relationship concerning greenhouse gas emissions and agricultural productivity in the Caribbean and Latin America. This study introduced an evaluation performance ratio, calculated as emissions of greenhouse gas relative to agricultural output in 2015, to evaluate advancements in these two locations. Examining the differences in elasticities across land management systems may provide insights into the link between agricultural productivity and greenhouse gas emissions. The study revealed that only a limited number of countries might mitigate agricultural emissions using land-use carbon sequestration methods in these areas.

Zhanng et al. (2019) analysed data from China main grain-producing areas from 1996 to 2016 to investigate the relationship among carbon release, energy utilization, and economic growth within the agriculture sector. The Granger causality test and ARDL model used data from the China Rural Statistical Yearbook spanning 1996 to 2016. Projected carbon releases from the agricultural sector in main producing areas of grain were determined to be consistent with the Environmental Kuznets Curve hypothesis.

Fei and Lin (2017) investigated the CO₂ emission efficiency of China's agriculture industry from 2001 to 2012. The researchers established a proxy for environmental degradation, which was used with two additional critical elements: the gap of technology and managerial failure. Distinct regions of China, including the central, eastern as well as western sections, exhibited variations in the agriculture sector. Research by Sandström et al. (2014) examined inter and annual variabilities and long term developments in territory exigence for supply of food, comprising animal products, crops, and biomass-derived goods, from 1961 to 2007 (Chen et al., 2019). The task of locating the data and integrating the information, observed estimate coefficients, and parameters in the study was complicated by several uncertainties. A greater variety of techniques, including land discharges from deforestation, is required to assess the inter and annual fluctuations in land demand, supply and the environmental consequences of agricultural products.

Nevertheless, since the global population demands superior sustainable combinations of environment services, it has been recommended to improve systems of agriculture. Nassim et al. (2022b) did research to investigate the efficacy of environmental quality and commerce in conjunction with human capital, handling a sample of 63 nations and used a panel ARDL methodology. Wang et al. (2019) observed that OECD economies have adopted a green economic development strategy via the establishment and enforcement of environmental laws and regulations. This study focused on examining the effects of environmental legislation on sustainable manufacturing in a given locale. The strictness of anti-deprivation rules regarding the advancement of green production was investigated using a panel data collection. The Porter hypothesis demonstrated that environmental regulation positively impacts development in sustainable output within a limited scope of rigidity. Innovation efforts have been shown to sustain technological dynamism, perhaps surpassing the passive green expenditures resulting from environmental regulations aimed at fostering a sustainable Earth.

Utilising the global Bank global development indices, Wastti and Zaidi (2020) analysed the correlation among environmental de gradation, energy utilization, and economic growth of

Kuwait and trade liberalisation, employing annual data from 1970 to 2017. Wang et al. (2019) assert that carbon releases significantly impact contemporary global environmental challenges. Consequently, it is essential to explore innovative strategies for enhancing energy efficacy to mitigate environmental harm while concurrently facilitating China's instant economic expansion. Research and Development include initiatives to devise and introduce novel products and services. It is generally the preliminary phase in the process of development. The primary aim is to market new products and services, Karim et al., (2022). The quality of Environment improves due to advancements in energy technology. Policymakers need to contemplate augmenting public expenditure, particularly in the energy sector, to stimulate technological innovation and subsequently diminish CO₂ emissions (Ferrat et al., 2022). Fernández et al. (2018) examined the variations in CO₂ emissions from the United States, the European Union (EU), and China between 1994 and 2013. Research and development expenditures have positively impacted the reduction of CO₂ releases in the United States and the European Union. Capital spending in green finance has surged in current decades due to advantageous social and economic externalities and financial encouragements. It is noteworthy that renewable energy funds failed to surpass traditional energy reserves throughout the COVID-19 pandemic, highlighting the need for increased capital investments. However, contrary to common perception, most research indicates that the most efficient method for establishing an economy of carbon-neutral is to promote the advancement of carbon-neutral reserves. Research indicates that green funds have surpassed their non-green counterparts, Ji et al., (2021).

Research indicates that the volatility of green funds is inferior to that of high-emission funds. The utilization of renewable energy sources is believed to enhance environmental circumstances as an alternative to fossil fuels. Consequently, it is essential to identify methods to diminish global reliance on fossil fuels to ensure the interconnection of economic and environmental advancement (Murshed, 2020).

Research indicates that establishing a green financing mediation channel is crucial for achieving carbon-restricted countries. Umar et al. (2021) demonstrated that two separate credit risk indicators reveal an inverse relationship between carbon-neutral lending exposure and default probability. The results were consistent across all bank sizes, demonstrating that green financing influenced credit hazard uniformly, irrespective of the bank's size. Due to a decline in credit risk, financial organizations might lower their provisions for loan loss as well as capital requirements. This inducement is crucial for augmenting credits of carbon-neutral and advancing environmental goals.

This study, informed by a literature analysis, demonstrates a correlation among green financing and financial performance, underscoring the importance of public as well as private partnership investments in renewable and effectual energy schemes, economic development, and other pertinent factors. This inquiry incorporates many aspects not previously explored in other studies about the impact of green funding on financial performance. This study is based on the following hypotheses:

Hypothesis: The Green Finance index has a significant positive influence on the financial performance of enterprises.

3. Methodology

3.1 Data

This thorough research examines the financial performance of Chinese firms, using a rigorous approach and a large dataset from 2012 to 2023. The research examines publicly traded

environmentally sustainable companies listed on the Stock Exchanges of Shenzhen and Shanghai. The China Securities Regulatory Commission is instrumental in this investigation by precisely identifying listed companies engaged in environment protection, natural resource conservation, environmental policy management, and efficient waste resource utilisation according to industry classification. Stringent elimination procedures are used to discard inappropriate samples. The final data set consists of annual observations from 120 green-listed organisations, totalling 1,440 yearly observations, which provide a balanced panel data set for a comprehensive analysis of the financial aspects in China green sector.

3.2 Dependent Variable

The dependent variable in this study is precisely defined as the financial performance of firms. Consistent with the technique proposed by Jamal et al. (2021); Jamal et al. (2022) we use return on assets (ROA) as a proxy of dependent variable, recognized for assessing financial performance.

3.3 Independent Variables

This thorough research identifies the Green Finance Index (GF) as the main descriptive and independent variable, including various financial operations like securities, green loans, investments also insurance that prioritise ecologically friendly processes. While environmentally friendly financial services are a key element of green finance, the complex structure of green financial goods requires a more thorough assessment. Grounded on the findings of Liu et al. (2023), a complex three-tier indicator system is precisely designed. This approach integrates data from 28 territories and cities from 2012 to 2023 in China, using a careful weightage technique that includes both subjective and objective components.

3.4 Control Variables

In accordance with Waang et al. (2024), we control the following variables, firm size (Size), Growth rate (Growth), financial leverage (Lev) and firm age (Age).Table 1 delineates and computes the main variables.

Table 1: Explanation of Variables

Variable	Description	Symbol	Computation Method
Dependent Variable	Return on Assets	ROA	At the end of the period, net profit divided by total assets.
Independent variable	Green finance index	GF	Computed in accordance with the indicator system
Control Variables	Size of Company	SIZ	Natural logarithm of the book value of the company's asset at the conclusion of the current year.
	Age of company	AGE	The year enlisting on stock exchange.
	Growth rate of company revenue	GR	The ratio of the corporation's operational income at the conclusion of the current year to the operating income at the end of the preceding year.
	Firm Leverage	FL	Total Equity/Total Debt

4. Methodology

4.1 Descriptive Statistic

Descriptive statistics provide a varied representation of data. It comprises complete observations, mean, median, minimum, maximum, and standard deviation. The researchers employ descriptive statistics to encapsulate the data and articulate the principal themes succinctly.

Table 2 below presents the descriptive statistics for assessing the green finance influence on financial performance in China. Green finance is the independent variable. The regressed variables is financial performance. The firm size, firm age, growth rate and firm leverage are control variables.

Table 2: Descriptive Summary

Variable	N	Mean	Median	Maxi	Mini	S.D
ROA	1440	0.094	0.025	0.462	0.067	0.042
GF	1440	15.59	13.49	47.65	-44.65	10.61
SIZ	1440	8.85	6.26	9.95	6.073	0.523
AGE	1440	5.233	4.652	26.54	-13.76	4.754
GR	1440	0.0565	6.48	9.751	6.809	0.5134
FL	1440	0.425	0.34	2.33	0.000	0.427

The Table represents the descriptive statistics of China. GF is green finance, this is independent variable. ROA is dependent variable, while SIZ for firm size, AGE is for firm age, GR is for growth rate of company and LEV for leverage, representing the control variables.

4.2 Correlation Matrix

Researchers often propose that the correlation between variables should not above 70% (Greene, 2003; Gujarati, 2012). Any result beyond 70% should raise concerns about the presence of multicollinearity. Table 3 displays the correlation matrix for China.

Table 3: Correlation Matrix

Variable	1	2	3	4	5	6
ROA	1					
GF	0.189	1				
SIZ	0.143	0.375	1			
AGE	0.177	0.149	0.394	1		
GR	0.353	0.4809	0.427	0.293	1	
FL	0.198	0.077	-0.296	0.037	-0.158	1

This table displays the correlation coefficients between variables along with their significance levels. Table 2 delineates the variables.

4.3 Generalized Moments Method (GMM)

GMM is used to address the problem of endogeneity. Endogeneity refers to the situation when the regressors are associated with the error term. The primary sources of endogeneity incorporate

omitted variables, simultaneity, and measurement mistakes. Furthermore, the Durbin-Wu-Hausman test is used to detect the existence of endogeneity.

Consequently, GMM is used to address the endogeneity issue by including instruments. The instrument serves as supplementary descriptive variables that are associated with the model primary explanatory variables, however, are uncorrelated with the error term included. Additionally, the lagged regressed variable introduces the issue of auto-correlation. Similarly, the time-invariant characteristics of a company may be associated with the independent variables, sometimes referred to as fixed effects. The distinctive model of the research is as follows:

$$ROA_{i,t} = \alpha + \delta_0 ROA_{i,t-1} + \delta_1 GF_{i,t} + \delta_2 FSZ_{i,t} + \delta_3 AGE_{i,t} + \delta_4 GR_{i,t} + \delta_5 FL_{i,t} + \varepsilon_{i,t} \quad (1)$$

Equation (1) shows the association between green finance and ROA, β represents the slope (beta-coefficient), whereas $\varepsilon_{i,t}$ denotes the error term.

4.3.1 Estimation Outcomes for China

Table 4 presents the estimate results for China with the 2-step system GMM estimator. The GF serves as a proxy for green finance. The lagged dependent variable ROAt-1 is significant and positive, indicating the dynamic character of the employed model, which is influenced by green finance. In Model 1, GF and ROA are statistically significant and positively correlated. FSZ has a negligible correlation with ROA. Firm age and firm growth show significant association with ROA. Leverage has a negative correlation with ROA. It suggests that green finance improve the amount of financial performance in China. The firm's leverage has an inverse relationship with ROA.

Table 4: Estimation Outcomes for China

Variables	Coefficient	P-value
ROAt-1	0.6548***	0.000
GF	0.0023**	0.017
FSZ	0.71	0.482
AGE	0.00439***	0.000
GR	1.056***	0.005
LEV	-1.016***	0.000
Constant	808.48***	0.001
F-test	374.85***	0.000
AR-1	-2.78***	0.001
AR-2	-0.278	0.831
Hansen	26.81	0.428
Groups Numbers	120	-
Instruments Numbers	56	-
Observations	1440	-

*The Table illustrates the results of two-step system GMM for the green innovation of china. The significance levels are, *** significance at 1% level, ** significance at 5% level, * significance at 10% level.*

Table 4 shows illustrate the presence of negative first-order serial correlation (AR-1), whereas the second-order serial correlation (AR-2) indicates that no second-order serial correlation was identified throughout the research. Furthermore, the Hansen test findings for all models indicate that the valid instruments null hypothesis cannot be rejected, confirming that the instruments are

legitimate and there is no potential link between the error component and the instruments. The results indicate that there are 120 groups and 56 instruments.

4.4 Results and Discussion

Green finance is of paramount importance due to the global push for environmental sustainability. Green innovation is a transformative technology that has shown effective in assisting firms in transitioning to sustainable development within production and innovation contexts Zhang and Liu (2023); Jing and Zhang (2024).

This research study using multivariate analysis to assess the influence of green finance on the degree of ROA in China. The conclusions correspond with stakeholder theory, demonstrating that green finance stimulate green innovation, which subsequently improves corporate financial performance. Prior research (Jamal et al., 2024; Mohammad & Wasiuzaman, 2021; Jamal et al., 2023; Muslicheh, 2020; Ahmad et al., 2021) has shown an increasing correlation between financial performance and sustainability criteria. The institutional theory asserts that a business's external and internal environment, together with its corporate culture, is crucial for achieving comprehensive sustainability. For the sake of this notion, the organization may be compared to an institution with a shared objective. The research by Develle (2021) and Zhang et al. (2022) shown that the green finance component exhibits significant performance results. Broadstock et al. (2021) and Muslichah (2020) have investigated the sustainability influence on green innovation. An successful ESG rating bolsters investor trust, hence enhancing ESG performance and subsequently elevating the firm's worth, according to Arniati and Muslichah (2023).

The results highlight substantial differences in the effect of green finance determinants on financial performance, revealing complex linkages among company strategy, environmental activities, and financial support systems. In enterprises dedicated to control of pollution, the factor of governance demonstrates a negligible influence on ROA, indicating that governance practices may be less pivotal to these firms' financial performance than in hygienic energy corporations, where governance factors exert a more pronounced and significant positive effect. This disparity may suggest that the governance frameworks and observes inside hygienic energy companies, maybe owing to their advanced characteristics and regulatory oversight, have a additional significant impact on their worth.

The size of firm constantly has a beneficial influence on ROA across all enterprises. This suggests that bigger companies, regardless of their subsidy amounts, often attain superior financial success, perhaps owing to economies of scale and stronger market policies. The firm leverage has an inverse correlation with ROA, indicating that increased debt levels may adversely affect enterprises' profitability. This impact is consistently negative and strong, underscoring the potential problems linked to extreme borrowing in environmentally orientated firms. Growth and company age both positively influence ROA, highlighting the significance of corporate development and liquidity in improving financial performance.

Previous research illustrates a basis for comprehending these dynamics, elucidating the complex linkages seen across various firm types, containing those involved in pollution management, hygienic energy, and varying degrees of governmental subsidy dependence. Research, including Yun (2022), indicates that companies with strong environmental policies and governance frameworks often have higher financial success, owing to improved operational efficiency and market distinctiveness. Furthermore, research by Wu et al. (2023) highlights the detrimental effects

of excessive leverage on corporate performance, especially in sectors governed by rigorous environmental rules.

The findings indicate that the scale of a business positively affects the ROA of Chinese firms. Li et al. (2021) and Mohammad and Wasiuzzaman (2021) confirmed that company size is positively correlated with ROA. The correlation between company age and growth is positive, indicating that both firm age and growth rate contribute to improved financial performance. The firm's leverage had a significant association with ROA. The results indicate that firms with more leverage will achieve higher profitability, whereas smaller businesses are expected to exhibit improved productivity.

5. Conclusion

This research significantly insight the impact of green financing on the financial performance of firms in China, spanning from 2012 to 2023. This study has elucidated the complex association relating green finance and the economic sustainability of environmentally responsible companies via the development of a regional Green Finance Development Index. Employing the Generalised Method of Moments (GMM) to examine data from green listed businesses, our results indicate a significant and positive relationship among green financing and financial performance of corporation. This association is not only statistical but indicates a profound causal association in which green finance serves as a pivotal catalyst, enhancing the economic proficiency of firms via effective capital provision and the promotion of essential information interchange.

The research examines the variability of green finance's effects, revealing a greater propensity to advantage clean energy firms and those with less reliance on subsidies of government. This emphasises the intricate and specialised nature of green finance efficacy, highlighting its capacity to customise financial assistance according to the distinct requirements and attributes of various firms.

5.1. Policy Recommendations

Our results provide various policy suggestions to optimise the prospective of green financing for sustainable economic growth. Policymakers should prioritise the expansion and enhancement of the green finance industry, facilitating greater accessibility and diversification of financing instruments for environmentally sustainable firms. This may include the creation of specialised green bonds, loans, and grants designed to facilitate research and development as well as innovation in sustainable technology. Moreover, instituting more explicit norms and inducements for green investments might draw increased private money into this area, so amplifying its total effect.

Secondly, improving transparency and reporting requirements about green finance operations may substantially increase investor trust and enable more information for decision-making. Establishing stringent assessment and monitoring procedures to analyses the environmental influence of supported projects may guarantee that green financing effectively contributes to the objectives of sustainable development.

Ultimately, cultivating a conducive regulatory framework that promotes cooperation among financial organizations, governmental entities, and sustainable firms may augment the efficacy of green financing. This include promoting information exchange, technology relocation, and capability-building efforts that enable enterprises to transform and develop sustainably.

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