Scientific Annals of Economics and Business
73 (X), 2026, 1-21
DOI: 10.47743/saeb-2026-0016

Taxation and Sustainability: How does Green Innovation influence the impact of taxation on Firm performance in China and the U.S

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Abstract: This study examines the impact of corporate taxation on financial performance, with a focus on the moderating role of green innovation. Using panel data from 35 U.S. and 25 Chinese listed technology companies between 2010 and 2022, econometric models are employed to capture both direct and interaction effects, with robustness checks ensuring reliability. Findings indicate that high tax rates constrain firms' financial performance by limiting resources available for strategic investment, including sustainability initiatives. In the United States, tax incentives such as credits mitigate these effects, supporting green innovation and improving firms' ability to balance fiscal pressure with long-term growth. In contrast, Chinese firms benefit from green innovation in the long run, but the high upfront costs combined with less developed fiscal support systems intensify short-term financial pressures. These results highlight the crucial role of tax policy design in encouraging sustainable business practices without undermining competitiveness. Incentive-based fiscal measures can foster green innovation, strengthen firm performance, and contribute to a more sustainable economic model. The comparative U.S.–China perspective represents an important contribution of this research, while the inclusion of robustness tests, particularly during the COVID-19 period, enhances the empirical validity of the findings across different contexts.

Keywords: taxation; firm performance; green innovation; R&D investment; comparative analysis.

JEL classification: M41; H20; C23; L25.

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Article history: Received 9 September 2025 | Accepted 15 April 2026 | Published online 9 May 2026

To cite this article: Lajmi, A., Khiari, W., Ben Yahia, E. (2026). Taxation and Sustainability: How does Green Innovation influence the impact of taxation on Firm performance in China and the U.S. *Scientific Annals of Economics and Business*, 73(X), 1-21. https://doi.org/10.47743/saeb-2026-0016.

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1. INTRODUCTION

Taxation plays a crucial dual role in sustainable development and corporate finance. While well-designed tax policies drive economic growth and government revenue, supporting the achievement of Sustainable Development Goals (SDGs), they also reduce businesses' cash flow, limiting resources for reinvestment, innovation, and strategic growth. Companies must balance contributing to public revenue with maintaining profitability and competitiveness, particularly in capital-intensive sectors where taxation significantly influences investment decisions (Djankov *et al.*, 2010).

To adapt, firms are increasingly adopting tax optimization strategies, such as leveraging credits and incentives, lowering their tax burden, free up capital, and fund innovation projects. These strategies are critical in today's financial environment, where businesses are also expected to meet high environmental and social standards. Governments play a pivotal role by offering tax incentives to encourage sustainable practices, particularly green innovation. These incentives make eco-friendly investments more financially viable, enabling firms to align their financial and environmental objectives (Nguyen *et al.*, 2021). By incorporating green innovation into their strategies, companies not only enhance their environmental performance but also strengthen their competitive position and meet growing stakeholder demands for responsibility.

Corporate Social Responsibility (CSR) further expands companies' commitments to society and the environment. CSR practices build trust with stakeholders, including customers, investors, and regulators, while fostering customer loyalty, reducing reputational risks, and ensuring long-term financial stability (Freeman, 2010). Integrating green innovation within CSR strategies allows firms to meet societal expectations while maintaining profitability and competitiveness in an evolving market landscape.

This paper addresses the following question: *How does green innovation moderate the impact of taxation on firm performance in the American and Chinese contexts?*

While existing research has explored taxation's direct impact on profitability and the advantages of innovation, little attention has been given to their interaction, particularly involving green innovation. This study bridges this gap by examining the interplay between taxation, green innovation, and financial performance, providing insights into the moderating role of green innovation.

By incorporating this dimension, the study offers a more nuanced and realistic interpretation of contemporary financial dynamics. It provides insight into the conditions under which taxation can become a lever for performance rather than a simple cost, and how green innovation can amplify or moderate this effect. This perspective not only enriches the debate on taxation and performance, but also enlightens public decision-makers and managers on the importance of designing policies and strategies that simultaneously integrate fiscal imperatives, environmental requirements and financial objectives.

The comparative approach of this research focuses on two major economies: the United States and China. The choice of the U.S. and China is based on their global economic prominence and their growing influence on sustainability initiatives. The U.S. represents a mature financial market with well-established regulatory policies that have historically incentivized corporate engagement in CSR and sustainability practices, making it an ideal context to study how CSR strategies impact financial performance in a stable and advanced economy. Moreover, the U.S., a mature economy, offers competitive tax policies and well-established incentives such as research

and development (R&D) tax credits, supported by a strong legal framework that promotes sustainability. In contrast, China provides a compelling perspective as an emerging market characterized by rapid economic growth and evolving regulatory frameworks that are increasingly prioritizing environmental and social issues. China has implemented progressive tax reforms to encourage sustainability and industrial growth. However, Chinese firms often face challenges like uneven application of tax incentives and the high costs of green innovation.

By comparing these distinct regulatory and economic environments, this study sheds light on how green innovation moderate taxation's impact on financial performance, addressing a critical gap in the literature and providing practical insights for policymakers and business leaders. The comparison between these two distinct contexts is crucial, because it allows to investigate whether CSR strategies yield consistent financial benefits across different economic systems, or if their effectiveness is shaped by the maturity and regulatory environment of the market. This cross-contextual analysis provides a deeper understanding of how companies can tailor CSR initiatives to optimize financial performance under varying economic and regulatory conditions, offering practical insights for both global and local business strategies. The technology sector was chosen for our study because it plays a central role in both economies and is heavily impacted by challenges related to innovation and sustainability. In the United States, the technology ecosystem is characterized by a strong capacity for innovation, supported by the interaction between businesses, academic institutions, and financial players. In China, the sector benefits from public policies aimed at strengthening technological autonomy and accelerating the energy transition. In both cases, technology companies simultaneously face imperatives of rapid innovation, environmental sustainability, and operational efficiency. Thus, studying this sector in both countries allows us to understand how national strategies influence organizations' ability to reconcile performance, innovation, and sustainability, making the technology sector a particularly relevant area of analysis for understanding contemporary economic transformations.

The paper is structured as follows: Section 2 reviews the literature and hypotheses. Section 3 details the data and methodology. Section 4 presents empirical results and robustness tests, followed by conclusions and implications in Section 5.

2. LITERATURE REVIEW

2.1. Theoretical background

To understand the interactions between taxation, green innovation, and firm performance, it is essential to consider the theoretical frameworks that provide a foundation for these dynamics.

2.1.1. Taxation and firm performance

Taxation is a critical factor shaping financial performance. Stakeholder theory (Freeman, 2010) highlights that ethical and transparent tax practices build trust with stakeholders, enhancing corporate reputation and financial stability (Schoenmaker and Schramade, 2023). Similarly, legitimacy theory (Suchman, 1995) suggests that fulfilling tax obligations strengthens a company's social legitimacy, fostering customer loyalty and stakeholder confidence (Nguyen *et al.*, 2021). From a strategic perspective, transaction cost theory

(Williamson, 1985) considers taxes as operational expenses affecting financial flexibility. Efficient tax management allows firms to allocate resources to sustainability initiatives, achieving both financial and environmental goals. Meanwhile, tax avoidance theory emphasizes that minimizing tax burdens can enhance post-tax profits, enabling firms to invest in green innovation and drive long-term growth (Desai and Dharmapala, 2006). Li *et al.* (2021) show that when U.S. states implement addback statutes to limit tax avoidance, firms significantly reduce their patent activity. This suggests that restricting tax avoidance can hinder innovation, thereby reinforcing the theory.

2.1.2. Green innovation and firm performance

Green innovation is a crucial driver of financial performance. According to stakeholder theory, aligning with societal expectations for environmental sustainability improves corporate reputation, stakeholder loyalty, and profitability (Homayoun *et al.*, 2023). Supporting this theory, Liu *et al.* (2024) provide empirical evidence that green innovation guided by stakeholder expectations significantly enhances both environmental and financial performance. Their study reinforces the idea that stakeholder engagement plays a critical role in driving sustainable business success. The Natural Resource-Based View (Hart, 1995) emphasizes that firms can enhance their competitive advantage by developing environmental capabilities that are strategic and difficult to replicate. Green innovation, as part of these capabilities, strengthens firms' positioning in increasingly sustainability-driven markets. This theoretical perspective is reinforced by recent contributions such as Achmad and Wiratmadja (2025). Furthermore, CSR theory emphasizes that integrating green innovation within corporate strategies not only fulfills societal expectations but also enhances resource utilization and financial outcomes (Nguyen *et al.*, 2021; Nureen *et al.*, 2023).

2.1.3. Green innovation and taxation

Taxation influences the adoption of green innovation, which in turn shapes financial performance. Stakeholder theory highlights that tax incentives encourage eco-friendly practices, aligning companies with societal norms and improving their reputation (Homayoun *et al.*, 2023). Additionally, institutional theory (Dimaggio and Powell, 2021) explains how regulatory pressures, in the form of tax incentives, drive firms toward sustainable practices, enhancing legitimacy. The Natural Resource-Based View (Hart, 1995) highlights that environmental capabilities can drive sustainable competitive advantage.

2.2. Empirical background and hypotheses development

Empirical studies provide further evidence on the interactions between taxation, green innovation, and financial performance, revealing important insights that support the formulation of hypotheses.

2.2.1. Taxation and firm performance

Taxation has a profound effect on corporate financial performance, with its influence varying depending on tax policies and firms' strategies. Elevated tax rates often restrict

companies' capacity to invest and grow. Djankov *et al.* (2010) found that high tax burdens reduce investment, particularly for small and medium enterprises, by limiting resources available for long-term projects. Similarly, Gadzo *et al.* (2013) identified a negative relationship between tax rates and financial metrics such as ROA and ROE, underscoring how taxes can diminish shareholder returns and reinvestment opportunities.

Strategic tax planning can mitigate these constraints. Zimmerman (1983) showed that firms leverage techniques such as intra-group debt structuring and transfer pricing to optimize their tax burden and improve financial outcomes. Tax incentives, including reduced corporate tax rates and credits, further enhance firms' ability to allocate resources effectively. For example, Chen and Frank (2022) demonstrated that lower tax rates encourage investment, particularly in capital-intensive sectors, by freeing up cash flow for innovation and expansion. Fang *et al.* (2022) provided compelling evidence from China's 2002 tax reform, where a 1% reduction in the effective tax rate increased ROA by 1.7%, driven by greater investments in fixed assets and reduced financial constraints.

In addition to direct effects, taxation shapes firms' financial structures, Nwaorgu and Abiahu (2020) observed that firms facing higher tax liabilities often resort to debt financing, altering their debt-to-equity ratios. Alkurdi *et al.* (2023) further explored the moderating role of governance mechanisms, finding that board gender diversity helps mitigate the negative impacts of elevated tax rates, illustrating how internal governance can influence firms' responses to taxation.

2.2.2. Green innovation and firm performance

The relationship between green innovation and financial performance is complex, shaped by regulatory contexts and firms' strategic priorities. Ghisetti and Rennings (2014) highlighted that innovations focused on energy and resource efficiency enhance profitability, while those targeting pollution reduction may incur high initial costs, potentially impacting competitiveness. Liu *et al.* (2024) supported this by showing that high-quality green innovations, such as cleaner production technologies, significantly boost financial performance by increasing competitiveness rather than solely through direct environmental improvements.

In the context of small and medium enterprises, Ji *et al.* (2024) revealed that green process innovation positively influences financial performance, while product innovations yield mixed results. Their findings suggest that government economic support moderates these outcomes, though predefined objectives tied to subsidies may limit financial gains. Similarly, Borsatto and Bazani (2022), in their review of 66 studies, found that 55% reported a positive relationship between green innovation and financial performance, often driven by improved resource efficiency and competitiveness. However, compliance costs can reduce short-term profitability, as noted by Cegarra-Navarro *et al.* (2016).

Institutional context also plays a critical role. Aguilera-Caracuel and Ortiz-de-Mandojana (2013) showed that firms in highly regulated environments achieve better returns from green innovation, while Duque-Grisales *et al.* (2020) emphasized that substantial R&D investments are necessary to maximize its financial benefits. For large U.S. firms, Liu (2024) demonstrated that green innovation enhances financial stability by reducing volatility and credit risk, aligning firms with regulatory and market expectations.

2.2.3. Taxation, firm performance and green innovation

The interaction between taxation, firm performance, and green innovation is particularly important for understanding how fiscal policies influence sustainability. Indeed, favorable tax policies, such as R&D credits, reduce financial constraints and encourage green innovation. However, existing research on tax performance and green innovation is still limited, with most researchers exploring these aspects two by two separately (Song *et al.*, 2020). Furthermore, most previous work has focused on a specific aspect of taxation or innovation, such as environmental taxation, green taxation, tax incentives, technological innovation, or others. Stucki *et al.* (2018) show that tax incentives can stimulate innovation in green products. According to Pan *et al.* (2021), tax incentives improve companies' net cash flow, providing them with sufficient funds to invest in R&D and improve the efficiency of their production in terms of innovation. In the Canadian context Griffith *et al.* (1995) found that tax policy has considerable benefits for research and development. According to Pénard and Poussing (2010), tax incentives have a positive communication effect. As they send a positive signal to financial institutions and private investors, companies can attract more social capital investment.

According to Lei *et al.* (2022), environmental taxes can encourage companies to reduce their emissions, strengthen their capacity to control pollution, and improve the technological level of environmentally friendly products by transforming their production processes and increasing their investments in green innovation, which will increase the market share of their products and eventually improve their performance. This means that technological innovation is undoubtedly the best practice for companies to promote green development and protect public interests, enabling them to ensure both environmental protection and business development. While many studies have focused on the mediating role of green innovation, particularly in the relationship between environmental taxation and environmental responsibility (Amoh *et al.*, 2025), or between CSR and sustainable performance (Tran and Le, 2025), few studies have explored its moderating role, thus leaving a gray area in the understanding of its contingent influence.

To our knowledge, no study has explored the relationship between these three concepts simultaneously and using the same definitions as in our work. However, we can cite a few related articles, such as Xiaowei and Petrovskaya (2022). They found that environmental taxes contribute directly and significantly to improved financial performance and that technological innovation, to a certain extent, produces a mediating effect.

Xiong *et al.* (2023) found that high-tech enterprises in China benefiting from a 15% tax rate incentive achieved significant improvements in innovation performance, which positively impacted financial metrics. Similarly, Huang and Liu (2024) highlighted that tax incentives enhance innovation efficiency by easing financing constraints, enabling firms to allocate resources toward sustainable initiatives. Consistently with prior findings, Sang *et al.* (2024) demonstrated that reductions in corporate income tax rates significantly foster innovation, especially among highly productive firms operating in competitive markets. Using a quasi-natural experiment based on China's tax reform, their findings revealed that tax increases discourage innovation, emphasizing the importance of well-designed tax policies to stimulate innovation-led growth.

Green innovation plays a moderating role in translating tax savings into financial gains. Abdelhakim and Lamia (2022) found that Tunisian firms investing in green innovation reduced their tax liabilities, strengthening their financial structures and growth potential.

Porter and van der Linde (1995) argued that green innovation reduces long-term costs while attracting environmentally conscious consumers, enhancing profitability. However, the extent of these benefits depends on firms' capacity to innovate and the scale of tax incentives offered. Based on this evidence, the following hypotheses are proposed:

H1*: Taxation negatively impacts corporate financial performance.*

H2*: Green innovation positively moderates the relationship between taxation and financial performance.*

3. METHODOLOGY

3.1. Data and sample

To achieve the objectives of this study, we use panel data econometrics by exploiting a sample of American and Chinese companies observed over a period of thirteen years, covering the years 2010 to 2022. This study uses data extracted from the Datastream database. This timeframe captures significant global tax reforms and the increasing emphasis on green innovation. The sample includes 35 American and 25 Chinese publicly traded technology companies. The selection reflects the study's comparative focus on two economies with distinct regulatory frameworks: the United States, a mature economy with competitive tax policies, and China, a rapidly developing economy prioritizing sustainable industrial growth.

American technology firms are more numerous and have a well-established presence in global markets, justifying the slightly larger sample size. Meanwhile, Chinese technology companies, though fewer in number, have experienced remarkable growth and are increasingly important players in the global technology landscape. Limiting the sample to 35 American and 25 Chinese companies allows for a deep analysis while ensuring that the data is consistent, manageable, and representative of broader trends in CSR practices within the industry. This distribution ensures a robust comparative analysis while acknowledging the differences in the corporate ecosystems of the two countries. The technology sector was chosen for our study because it plays a central role in both economies and is heavily impacted by challenges related to innovation and sustainability. Firms in this sector are particularly responsive to tax incentives, making them ideal for analyzing the intersection of taxation, innovation, and financial performance.

3.2. Variable's definition

The study examines the impact of corporate taxation on financial performance, moderated by green innovation. Financial performance is measured by Return on Assets (ROA), a widely accepted indicator of profitability and operational efficiency (Ben Flah *et al.*, 2024; Lajmi *et al.*, 2025a; Lajmi and Shiri, 2025). Corporate taxation is calculated as the ratio of total taxes paid to pre-tax income, noted Cash ETR, captures firms' effective tax burden and financial flexibility (Alkurdi *et al.*, 2023). Green innovation is proxied by annual R&D expenditures, reflecting broader innovation efforts, including sustainability initiatives. In fact, research and development (R&D) is commonly used as an indicator of green innovation, as it reflects companies' investment efforts in developing technologies, processes, and products aimed at reducing environmental impacts. R&D expenditures focused on energy

efficiency, reducing polluting emissions, or the sustainable use of resources demonstrate companies' capacity for environmental innovation. As such, R&D constitutes an indirect but relevant measure of green innovation, widely used in the empirical literature (Makpotche *et al.*, 2024; Lajmi *et al.*, 2025a).

Control variables include firm size (ln of total assets), which reflects resource availability and economies of scale (Lajmi *et al.*, 2021; Lajmi and Yab, 2022; Eche *et al.*, 2023); board size, capturing governance structure and strategic oversight (Shamil *et al.*, 2024; Lajmi *et al.*, 2025a; Lajmi *et al.*, 2025b); and gender diversity, representing the proportion of female directors, linked to improved decision-making and financial stability (Alkurdi *et al.*, 2023; Lajmi *et al.*, 2025a). The ratio of tax expense to pre-tax income, noted GAAP ETR, accounts for direct impacts on cash flow and reinvestment capacity (Eche *et al.*, 2023). This framework provides a comprehensive basis for analyzing the interaction between taxation, green innovation, and financial performance.

3.3. Models' specification

To examine the relationship between taxation, financial performance, and the moderating role of green innovation, we employ econometric models incorporating direct and interaction effects with robustness checks for validation. The baseline model assesses the direct impact of taxation on performance, using Ln ROA as the dependent variable, with tax rate, income taxes, firm size, board size, and gender diversity as predictors:

$$\text{Ln ROA}_{it} = \beta0 + \beta1 \text{ Ln Cash ETR}_{it} + \beta2 \text{ Ln GAAP ETR}_{it} + \beta3 \text{ Gender Diversity}_{it} + \beta4 \text{ Board Size}_{it} + \beta5 \text{ Firm Size}_{it} + \varepsilon_{it} \quad (1)$$

To include green innovation (R&D investment), its direct effect on financial performance is modeled as follows:

$$\text{Ln ROA it} = \beta0 + \beta1 \text{ Ln Cash ETRit} + \beta2 \text{ LnGAAP ETR it} + \beta3 \text{ Green Innovation it} + \beta4 \text{ Gender Diversity it} + \beta5 \text{ Board Size it} + \beta6 \text{ Firm Size it} + \varepsilon \text{ it} \quad (2)$$

The moderating role of green innovation is analyzed by introducing an interaction term between tax rate and R&D investment (noted Moderator_RD):

$$\text{Ln ROA it} = \beta0 + \beta1 \text{ Ln Cash ETRit} + \beta2 \text{ Ln GAAP ETR it} + \beta3 \text{ Green Innovation it} + \beta4 \text{ (Ln Cash ETR it} \times \text{ Green Innovation it)} + \beta5 \text{ Gender Diversity it} + \beta6 \text{ Board Size it} + \beta7 \text{ Firm Size it} + \varepsilon \text{ it} \quad (3)$$

Robustness checks focus on the COVID-19 period (2020-2022 for U.S. firms, extended to 2019 for Chinese firms) to assess consistency under fiscal disruptions. The model for this test follows the baseline structure. This framework provides a rigorous analysis of taxation, green innovation, and financial performance, integrating direct and moderating effects while validating results across diverse contexts. It contributes valuable insights into fiscal policies, innovation, and corporate strategy.

4. EMPIRICAL RESULTS AND DISCUSSIONS

4.1. Descriptive statistics and correlation

Table no. 1 reports the descriptive statistics (mean, standard deviation, minimum and maximum) of each of the variables retained in our empirical study, namely, the dependent, independent and control variables.

Table no. 1 – Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Ln ROA	776	1.189	1.902	-2.725	3.199
Ln Cash ETR	776	2.94	.489	1.747	3.714
Ln GAAP ETR	776	11.533	2.246	7.585	15.245
Board size	776	9.323	2.31	2	15
Gender Equity	776	.321	.467	0	1
Firm size	776	15.806	2.106	10.034	19.936
Invest RD	776	2.403	5.93	0	73.2

The data, drawn from 776 observations of U.S. and Chinese technology firms, highlight variability in financial performance, taxation, green innovation, and structural characteristics, offering a basis for analyzing the relationships among these factors.

Firm performance, measured by the logarithm of return on assets (Ln ROA), has an average of 1.189 with a range from -2.725 to 3.199, reflecting significant differences in firms' ability to generate profits. Taxation, represented by the logarithm of cash ETR (Ln Cash ETR) and income taxes (Ln GAAP ETR), shows averages of 2.94 and 11.533, respectively. These values highlight varying tax burdens, influencing resource allocation for strategic investments.

Green innovation, proxied by R&D investment (mean 2.403, standard deviation 5.93, and a maximum of 73.2), exhibits high dispersion, indicating uneven engagement in innovation. Some firms invest heavily in R&D, potentially leveraging these investments to mitigate taxation's impact on financial performance.

Structural characteristics also provide meaningful insights. Firm size, with an average logarithm of 15.806, indicates diverse resource capacities, while board size (mean 9.323) reflects governance structures that may influence strategic oversight. Gender diversity, with a mean of 0.321, highlights limited but evolving representation of women in leadership roles, potentially affecting decision-making and innovation.

These descriptive statistics underscore the dynamic interplay between taxation, green innovation, and financial performance, influenced by firms' structural and strategic characteristics. To deepen our understanding of the relationships between these variables, we now examine the correlations to identify the direct links between financial performance, taxation, green innovation, and the structural characteristics of our sample.

Table no. 2 presents the correlation matrix, highlighting relationships between financial performance, taxation, green innovation, and structural characteristics. Financial performance (Ln ROA) shows a moderate negative correlation with Cash ETR (-0.274), suggesting that higher taxes reduce profitability by constraining cash flow. Conversely, a positive correlation with GAAP ETR (0.497) indicates that more profitable firms face higher tax liabilities.

Table no. 2 – The pairwise correlations between the variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Ln ROA	1.000						
(2) Ln Cash ETR	-0.274	1.000					
(3) ln GAAP ETR	0.497	-0.138	1.000				
(4) Board size	0.316	-0.141	0.437	1.000			
(5) Gender equity	0.187	-0.134	0.185	0.187	1.000		
(6) firm size	0.443	-0.042	0.703	0.425	0.115	1.000	
(7) invest RD	0.218	-0.107	0.458	0.209	0.241	0.362	1.000

Ln ROA also correlates positively with board size (0.316), gender diversity (0.187), and firm size (0.443), suggesting that larger boards, diverse leadership, and economies of scale enhance profitability. R&D investment (0.218) further supports the role of innovation in driving financial performance.

Among control variables, firm size strongly correlates with income taxes (0.703), while R&D investment shows positive associations with board size (0.209) and gender diversity (0.241). These findings provide foundational evidence supporting the study's hypotheses.

Our models do not exhibit multicollinearity issues, as the correlation between our independent variables remains below 80% and to further confirm the absence of multicollinearity, we examine the Variance Inflation Factor (VIF) values for our independent variables, as shown in Table no. 3.

Table no. 3 – Variance Inflation Factor test

Dimension	VIF	1/VIF
Ln GAAP ETR	2.129	.47
Firm size	2.067	.484
Board size	1.312	.762
Gender equity	1.063	.941
Ln Cash ETR	1.048	.955
Means VIF	1.524	.

Table no. 3 shows that all variables have VIFs below 3, with a mean VIF of 1.524, indicating that there is no significant multicollinearity in the model. Each variable has a tolerance value close to 1, confirming that they are sufficiently independent of each other based on Ding and Stolowy (2003).

To assess whether the variance of error terms is consistent across observations, we conduct a heteroskedasticity test, with results presented in Table no. 4. Detecting heteroskedasticity is essential, as any inconsistency in variance could lead to biased standard errors and impact the robustness of our model. These results help determine if adjustments, such as robust standard errors, are necessary to ensure reliable regression analysis.

Table no. 4 – The heteroskedasticity test

	Coef
Chi2(61)	317.63
P-value	0.0000

White's test for heteroskedasticity produced a chi-squared statistic of 317.63 with a p-value of 0.000, indicating significant heteroskedasticity in the model. This result rejects the null hypothesis of homoscedasticity, confirming that the variance of residuals is not constant across levels of the independent variables. Such a violation can bias standard error estimates, potentially affecting the validity of coefficient significance tests. To address this issue, adjustments to the model, such as robust standard errors, are necessary to ensure reliable and accurate results. Correlations between the explanatory variables were first examined to identify any potential multicollinearity issues. A heteroscedasticity test was then carried out to check for constant error variance. To determine the most appropriate estimation method for the panel data, we compared clustered OLS, random-effects and fixed-effects models using diagnostic tests. The Breusch-Pagan Lagrange multiplier test was applied to assess the suitability of the random-effects model (Table no. 5). Furthermore, the Hausman (1978) test was used to compare the fixed-effects and random-effects estimators (Table no. 6). In this context, the clustered OLS model was selected for the final estimation, with the corresponding results presented in Table no. 7.

Table no. 5 – The Breusch-Pagan Lagrange Multiplier test

	Coef
Chibar-square test value	0.00
P-value	1.000

The Breusch and Pagan Lagrangian multiplier test (Table no. 5) yields a chi-square statistic of 0.00 with a p-value of 1, indicating no significant variation across entities. This result suggests that a random effects model is unnecessary, and a pooled OLS model is more appropriate for the dataset.

To address potential endogeneity, the Hausman test was employed. The null hypothesis (H0) assumes no systematic difference in coefficients, while the alternative (H1) indicates the presence of endogeneity. This ensures the robustness of the econometric analysis.

Table no. 6 –Hausman (1978) specification Test

Durbin (score) chi2(1)	**.83345 (p = 0.3613)**
Wu-Hausman F(1,709)	.826263 (p = 0.3637)

The results shown in Table no. 6 indicate that there is no endogeneity problem. Accordingly, we accept the null hypothesis as our P-value exceeds 5%.

4.2. Empirical results of the impact of taxation on firm performance and discussion

The regression results reveal the interplay between corporate taxation, financial performance, and green innovation. Analyzing American and Chinese technology firms highlights how tax policies and sustainable investments influence financial outcomes, linking findings to existing theories and prior studies.

The regression results, shown in Table no. 7, provide a comprehensive overview of the interactions between taxation, green innovation, and financial performance, for the full sample and the sub-samples representing the US and China.

Table no. 7 – Regression results

Ln ROA	Full Sample	US	China
Ln Cash ETR	-.805***	-.562***	-1.252***
	(.126)	(.158)	(.16)
ln GAAP ETR	.245***	.166***	.354***
	(.028)	(.034)	(.05)
Gender	.288**	.269***	.513**
	(.115)	(.095)	(.207)
Board size	.053**	-.003	.031
	(.024)	(.037)	(.04)
Firm size	.176***	.07	.091*
	(.051)	(.046)	(.053)
Constant	-2.649***	.178	-1.229**
	(.732)	(.835)	(.565)
Mean dependent var	1.189	1.907	0.172
Overall r-squared	0.321	0.137	0.219
Chi-square	2200.312	218.087	252.982
R-squared within	0.319	0.130	0.218
SD dependent var	1.902	1.412	2.040
Number of Obs	776	455	321
Prob > chi2	0.000	0.000	0.000
R-squared between	0.651	0.470	0.309

Note: *** p<.01, ** p<.05, * p<.1

Table no. 7 highlights key relationships between corporate taxation, financial performance, and firm characteristics. The Cash ETR's significant negative coefficient (-0.805, $p < 0.01$) confirms that higher taxes reduce financial performance, supporting Transaction Cost Theory (Coase, 1937; Williamson, 1985), as they constrain cash flow and limit reinvestment, aligning with Djankov *et al.* (2010) and Gadzo *et al.* (2013). Conversely, the positive coefficient for GAAP ETR (0.245, $p < 0.01$) suggests that profitable firms manage higher taxes without compromising performance, aligning with Zimmerman (1983). Firms engaged in CSR may also benefit reputationally, attracting customers and improving profitability despite higher tax obligations.

Gender diversity (0.288, $p < 0.05$) positively influences financial performance, consistent with Stakeholder Theory (Freeman, 2010), as diverse leadership enhances decision-making and innovation (Homayoun *et al.*, 2023). Board size (0.053, $p < 0.05$) shows a positive effect, supporting Legitimacy Theory (Suchman, 1995), with larger boards providing better governance and oversight. Firm size (0.176, $p < 0.01$) positively impacts financial performance, supporting the Natural Resource-Based View (Hart, 1995), as larger firms benefit from resources, economies of scale, and strategic capacity.

These findings establish a baseline for understanding taxation's effects on financial performance and set the stage for country-specific analyses of the United States and China to explore economic and regulatory differences.

Column (2) from Table no. 7 provides significant insights into the relationships between corporate taxation, financial performance, and firm characteristics in the U.S. The negative coefficient for the tax rate (-0.562, $p < 0.01$) confirms that higher tax rates reduce financial performance (Ln ROA), aligning with Transaction Cost Theory. High taxes reduce net profits

and reinvestment capacity while increasing financial constraints. The complexity of state tax environments further amplifies these challenges, as companies operating in high-tax states face greater profitability reductions than those in lower-tax states.

The positive coefficient for income taxes (0.166, $p < 0.01$) indicates that profitable firms manage to sustain strong financial performance despite higher tax obligations, supported by effective tax strategies (Zimmerman, 1983). Such firms may also benefit reputationally from being perceived as socially responsible taxpayers, which can attract customers and enhance profitability. Gender diversity (0.269, $p < 0.01$) significantly improves financial performance, reinforcing Stakeholder Theory (Freeman, 2010). Diverse leadership enhances decision-making, strengthens governance, and aligns with growing investor and regulatory expectations for inclusivity. These attributes build investor confidence, improve transparency, and enable firms to make more balanced strategic decisions, ultimately boosting financial outcomes. Board size (-0.003, $p = 0.934$) and firm size (0.070, $p = 0.129$) show no significant effects, suggesting these factors are not decisive in influencing financial performance in the U.S. context. This could reflect that their advantages are already integrated into other governance or operational mechanisms.

Column (3) of Table no. 7 provides findings for the China sub-sample. The regression results for Chinese firms provide valuable insights into the relationships between taxation, financial performance, and company characteristics within this distinct economic context. The negative and significant coefficient for the tax rate (-1.252, $p < 0.01$) highlights a stronger adverse impact of higher tax rates on financial performance (Ln ROA) compared to the U.S. firms. This suggests that in the Chinese context, tax burdens may pose even greater constraints on firms' cash flow and investment potential, aligning with transaction cost theory (Coase, 1937; Williamson, 1985).

The positive and highly significant coefficient for income taxes (0.354, $p < 0.01$) indicates that profitable firms in China, similar to those in the U.S., manage to maintain strong financial performance despite higher tax obligations. This underscores the importance of effective tax strategies in maintaining profitability under significant tax pressures, in line with Zimmerman (1983).

The coefficient for gender diversity (0.513, $p < 0.05$) shows a significant positive impact on financial performance, reinforcing the notion that diverse leadership contributes to better strategic decision-making and corporate outcomes. This finding supports stakeholder theory (Freeman, 2010), which emphasizes the benefits of meeting stakeholder expectations, including diversity in management. Board size, with a non-significant coefficient (0.031, $p = 0.43$), suggests that, similar to U.S. firms, the size of the board may not play a decisive role in financial performance for Chinese firms. This could point to the quality of governance being more critical than the number of board members. The coefficient for firm size (0.091, $p < 0.1$) is positive and marginally significant, implying that larger firms in China may benefit from economies of scale and resource advantages, although this effect is weaker compared to other factors. The comparison between U.S. and Chinese firms reveals important differences in how taxation and company characteristics influence financial performance. The impact of tax rates is more severe in China, where the negative coefficient (-1.252) is significantly stronger compared to the U.S. (-0.562). The stronger negative impact of tax rates in China may be due to stricter tax policies or fewer opportunities for tax optimization compared to the U.S, making taxes more burdensome for Chinese firms. This suggests that higher tax rates are more restrictive for Chinese firms, possibly due to more stringent tax policies or limited tax planning strategies.

4.3. Empirical results of the moderation of green innovation in the impact of taxation on firm performance and discussion

4.3.1. Results of the impact of green innovation on firm performance

We have now included R&D investment as an independent variable to test its impact on financial performance. Results are given by Table no. 8 below.

Table no. 8 – Results of the model estimation integrating the R&D investment variable

Ln ROA	Coef.		St. Err.		t-value		p-value		[95% Conf		Interval]	
	China	US	China	US	China	US	China	US	China	US	China	US
Ln Cash ETR	-1.29***	-.565***	.165	.159	-7.81	-3.55	0	0	-1.613	-.876	-.966	-.253
R&D Investment	-.7 ***	-.004	.224	.003	-3.13	-1.16	.002	.248	-1.139	-.011	-.261	.003
Ln GAAP ETR	.386 ***	.171***	.046	.034	8.41	5.02	0	0	.296	.104	.477	.238
Gender	.555**	.284***	.216	.095	2.57	2.99	.01	.003	.131	.098	.979	.47
Board size	.035	-.004	.04	.038	0.87	-0.11	.383	.916	-.044	-.078	.114	.07
Firm size	.157 **	.073	.065	.046	2.42	1.58	.015	.115	.03	-.018	.285	.163
Constant	-2.197***	.087	.774	.814	-2.84	0.11	.005	.915	-3.714	-1.509	-.679	1.683

	China	US		China	US
Mean dependent var	0.172	1.907	**SD dependent var**	2.040	1.412
Overall r-squared	0.227	0.137	**Number of Obs**	321	455
Chi-square	300.912	223.043	**Prob > chi2**	0.000	0.000
R-squared within	0.227	0.130	**R-squared between**	0.257	0.472

Note: *** p<.01, ** p<.05, * p<.1

Results show that, for US firms, R&D Investment has a negative coefficient (-0.004) and is not statistically significant ($p = 0.248$). This result suggests that, within this sample, R&D spending does not have a clear, immediate impact on financial performance as measured by Ln ROA. This outcome may indicate that the direct financial returns from R&D investments, particularly those focused on green innovation, may not be realized in the short term and could be counterbalanced by substantial initial costs associated with such projects.

The non-significant result aligns with prior findings in the literature that highlight the complex nature of R&D investments. Ghisetti and Rennings (2014) noted that while green innovation can boost long-term competitiveness and profitability, it often incurs significant upfront expenses that may dampen immediate financial performance. Similarly, Cegarra-Navarro *et al.* (2016) observed that high compliance and innovation costs associated with sustainable practices could limit short-term profitability, despite potential long-term benefits.

For Chinese firms, it becomes clear that while R&D, representing green innovation, is essential for long term growth, it has a significant negative impact on short-term financial performance (-0.7, $p < 0.01$). This suggests that the immediate costs of R&D outweigh its short-term financial benefits, reflecting the resource intensive nature of sustainable innovation. Despite this, Ln Cash ETR continues to have a strong negative impact.

4.3.2. The moderating role of green innovation on the relationship between taxation and firm performance

In this stage of the analysis, we examine the moderating effect of R&D investment on the relationship between taxation and financial performance (measured by Ln ROA) across the full sample, US and Chinese firms (Table no. 9). This allows us to determine whether R&D investment influences the way tax rates affect financial performance and to observe how this interaction differs between the US and China, highlighting potential differences between countries in terms of industrial policies and structures.

Table no. 9 – Results of Green Innovation moderation on taxation and firm performance

Variables	Full sample Ln ROA	USA firms Ln ROA	China firms Ln ROA
Ln Cash ETR	-0.807***	-0.543***	-0.746**
	(0.132)	(0.168)	(0.299)
R&D Investment	-0.00803	0.0247	4.415**
	(0.0442)	(0.0364)	(1.773)
Moderator_RD (1)	-0.00296	-0.0106	-1.803***
	(0.0177)	(0.0142)	(0.659)
Ln GAAP ETR	0.261***	0.173***	0.393***
	(0.0266)	(0.0350)	(0.0440)
Gender equity	0.320***	0.282***	0.602***
	(0.123)	(0.0957)	(0.223)
Board size	0.0518**	-0.00443	0.0231
	(0.0242)	(0.0376)	(0.0399)
Firm size	0.181***	0.0743	0.206***
	(0.0524)	(0.0457)	(0.0690)
Constant	-2.862***	-0.0114	-4.436***
	(0.812)	(0.829)	(1.341)
Observations	776	455	321
Number of Year	13	13	13

Note: (1) Moderator_RD is the interaction term between tax rate and R&D investment (as noted in the equation model).

Results are given by Table no. 9. For U.S. firms, the tax rate has a significant negative impact on financial performance (-0.543, $p < 0.01$), supporting Transaction Cost Theory (Coase, 1937; Williamson, 1985). R&D investment is positive but non-significant (0.0247, $p = 0.34$), as is its moderating effect (-0.0106, $p = 0.27$). Supportive fiscal measures like the Research and Experimentation Tax Credit likely buffer the effects of taxation, enabling firms to sustain financial resilience while encouraging innovation (Hall and Van Reenen, 2000).

In China, the tax rate remains significantly negative (-0.746, $p < 0.05$). Unlike in the U.S., R&D investment is significant and positive (4.415, $p < 0.05$), indicating its independent financial benefits. However, its moderating effect is significantly negative (-1.803, $p < 0.01$), suggesting that higher R&D spending exacerbates the financial strain of higher taxes. This aligns with Ghisetti and Rennings (2014), who noted the high initial costs of green innovation. These results may reflect less comprehensive R&D support in China, where incentives such

as the 2008 corporate tax reform are unevenly applied and insufficient to offset the burden of taxation under high R&D investment levels (Xiong *et al.*, 2023).

4.4. Robustness tests

To test robustness, we analyzed the impact of taxation on firm performance during the COVID-19 period. For U.S. firms, the analysis covers 2020-2022, while for Chinese firms, it extends to 2019 to account for the earlier onset of the pandemic. This narrowed timeframe captures the unique challenges and dynamics firms faced during this period, assessing the consistency of our findings. The Table no. 10 below presents the regression results for U.S. firms during the COVID-19 period.

Table no. 10 – Results of the robustness test

Ln ROA	Coef.		St. Err.		t-value		p-value		[95% Conf		Interval]	
	China	US	China	US	China	US	China	US	China	US	China	US
Ln Cash ETR	-.807**	-.671**	.815	.264	-0.99	-2.54	.025	.013	-2.427	-1.194	.812	-.147
Ln GAAP ETR	.289**	.193*	.133	.116	2.18	1.66	.032	.099	.026	-.037	.553	.424
Gender	-.047	-.069	.418	.278	-0.11	-0.25	.912	.805	-.877	-.621	.784	.483
Board size	.07	-.038	.098	.069	0.71	-0.54	.479	.59	-.125	-.175	.265	.1
Firm size	.094	.154	.128	.093	0.73	1.66	.467	.101	-.161	-.03	.348	.337
Constant	-2.079	-.67	3.037	1.542	-0.68	-0.43	.495	.665	-8.109	-3.73	3.951	2.39

	China	US		China	US
Mean dependent var	0.297	2.119	**SD dependent var**	1.973	1.299
R-squared	0.163	0.199	**Number of Obs**	100	105
F-test	3.668	4.913	**Prob > F**	0.004	0.000
Akaike crit. (AIC)	412.836	340.619	**Bayesian crit. (BIC)**	428.467	356.543

Note: *** p<.01, ** p<.05, * p<.1

For the U.S. sample, the robustness checks confirm the consistency of our findings. The Cash ETR maintained a significant negative impact on financial performance (-0.671, p = 0.013), highlighting increased fiscal pressures during the pandemic. The positive association between income taxes and financial performance persisted (0.193, p = 0.099), though slightly reduced, reflecting firms' ability to manage tax strategies effectively. Governance factors, including board size and firm size, remained insignificant, indicating a strategic focus on immediate fiscal challenges. These results validate the robustness of our analysis, reaffirming the critical role of taxation in shaping financial outcomes during global disruptions.

For the Chinese firms, the robustness checks for the COVID-19 period confirm a consistent negative relationship between the Cash ETR and financial performance (Ln ROA), with a reduced magnitude (-0.807 versus -1.252 in the full period). This indicates that fiscal constraints remained significant but were partly mitigated by adaptive strategies or temporary policy measures during the pandemic. The positive link between GAAP ETR and financial performance persists (0.289 versus 0.354 in the full period), highlighting the role of effective tax planning in maintaining stability under uncertainty. These findings reinforce the resilience of firms and validate the core relationships identified in the broader analysis.

5. CONCLUSION

Our study sheds light on the complex relationship between corporate taxation, financial performance, and the moderating role of green innovation through a comparative analysis of technology firms in the US and China. By examining a sample of 35 U.S. and 25 Chinese listed companies over the period 2010 to 2022, our research provides critical insights into how tax policies affect firm financial performance and how green innovation moderates this relationship.

The results demonstrate that high tax rates significantly constrain financial performance by reducing companies' financial flexibility and limiting their ability to invest in strategic initiatives, particularly those focused on sustainability. However, the impact of taxation on performance varies notably between the two economic contexts. In the U.S., tax management strategies, supported by mechanisms such as R&D tax credits, allow companies to partially offset the negative effects of taxation, fostering financial resilience and innovation. Conversely, for Chinese firms, while R&D investment contributes to long-term performance improvements, it often exacerbates financial pressures in the short term, particularly in the absence of robust and consistent tax support for green innovation.

Our results align with those of Pan *et al.* (2021) and Pénard and Poussing (2010). Pan *et al.* (2021) show that tax incentives improve companies' net cash flow, providing them with sufficient funds to invest in R&D and improve the efficiency of their production in terms of innovation. According to Pénard and Poussing (2010), tax incentives have a positive communication effect. As they send a positive signal to financial institutions and private investors, companies can attract more social capital investment.

According to Lei *et al.* (2022), environmental taxes can encourage companies to reduce their emissions, strengthen their capacity to control pollution, and improve the technological level of environmentally friendly products by transforming their production processes and increasing their investments in green innovation, which will increase the market share of their products and eventually improve their performance. This allows to ensure both environmental protection and business development.

This study makes several contributions. Both theoretically and empirically, this study enriches the literature by addressing an angle that has yet to be thoroughly investigated. Previous research has mainly focused on studying the direct effects of environmental taxation on innovation performance or outcomes. However, the relationship between taxation, green innovation and financial performance remains insufficiently documented. Using a comparative approach, this research fills this gap by jointly analysing environmental taxation, green innovation and corporate financial performance. Through a comparative analysis, our study explores this relationship and highlights the moderating role played by green innovation, shedding new light on the dynamics through which environmental taxation can strengthen or weaken, the financial performance of companies. The comparative approach between the U.S. and China represents a major contribution of this study, as it highlights how differing regulatory and economic environments shape the interplay between taxation, green innovation, and financial performance. This comparison offers valuable insights into the diverse challenges and opportunities firms face, underscoring the need for tailored policy solutions. Furthermore, the robustness tests conducted, particularly during the COVID-19 period, add empirical depth to the findings, reinforcing the validity of the results across varied contexts.

The practical implications of this research are significant for both policymakers and corporate leaders. For governments, it is imperative to design targeted tax policies that not

only reduce the financial burden on companies but also incentivize investment in sustainable technologies. Well-structured tax credits and subsidies for green innovation can play a pivotal role in promoting sustainability while enhancing long-term competitiveness. For businesses, the findings highlight the importance of adopting balanced strategies that integrate tax efficiency with strategic investments in innovation. This dual focus enables firms to navigate fiscal constraints, meet growing societal and environmental expectations, and maintain resilience and competitiveness in an increasingly demanding global marketplace.

However, this study is not without limitations. Using R&D investment as a proxy for green innovation does not distinguish projects specifically targeting sustainability from other forms of innovation. A more precise measure, such as expenditures on certified sustainable initiatives, could enhance future analyses. Additionally, the absence of detailed data on tax incentives explicitly linked to green innovation restricts our ability to fully assess their influence on financial outcomes. Expanding the dataset to include such variables would provide a more comprehensive understanding of the mechanisms at play.

Finally, to obtain a broader perspective, future research could explore these dynamics across other sectors and economies with diverse tax structures and regulatory environments. These extensions would further illuminate the interplay between taxation, green innovation, and financial performance in a global context.

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