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# Environmental Performance and Financing Decisions Impact on Sustainable Financial Development of Chinese Environmental Protection Enterprises

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**Abstract:** Environmental protection firms need to improve their ability to access financing while maintaining good economic performance under mounting environmental pressures. After the integration of trade-off and stakeholder theories, we have constructed a number of mathematical models to investigate the relationship among financing decisions, environmental performance (EP), and economic performance. Unbalanced panel data from environmental protection companies listed on Chinese stock exchanges from 2007 to 2016 were collected and analyzed. Our results have confirmed that debt financing has a significant impact on short- and long-term economic performance. Firms prefer long-term debt over short-term debt to improve their financial sustainability. Internal financing is positively related to performance because the cost of financing is lower. Environmental performance can cause extra financial burden in the short run, but will improve stakeholder relations and profitability in the long run. Our study suggests that environmental performance affects the relationship between financing decisions and economic performance. When EP initiatives are high, debt financing has a greater negative influence on short-term performance, and the effect on long-term performance is mitigated. High EP also reduces the impact of internal financing on performance.

**Keywords:** debt financing; internal financing; environmental performance (EP); short/long-term economic performance

## 1. Introduction

The government's conflicting goals of high economic growth and environmental conservation have created a dilemma [1]. Overextended resources and polluted air, soil, and water have cast a horrific shadow over China. Serious pollution is a feature of 100 of China's large cities and one-third of its major rivers. Seventy-five percent of megacities have air quality that fails to meet acceptable standards (MEPC). The environmental protection industry has expanded its focus from pollution management to the reduction of environmental impact, developing new monitoring technology and finding new energy resources. Investment in the environmental protection sector grew by 145% from 2007 to 2016, and it is the key to achieving sustainable economic and social development (China Statistical Yearbook). The movement towards clean and renewable energy sources is essential if the growing demand for energy is to be satisfied in a sustainable way.

One of the main constraints to investment is financing. Large investments in research and development (R&D) may incur high initial costs and generate volatile revenues. Uncertain industry conditions may reduce the appetite of investors and lenders to provide financing. When internal funds are exhausted, firms need to use debt or external equity and will incur higher costs [2]. Firms with a high proportion of their value in intangible assets can acquire debt with better terms. Most R&D

projects have high initial costs and require significant long-term financing. Firms have to balance debt tax shields, potential bankruptcy costs, and debt levels. The availability and cost of financing are important factors for developing viable new projects.

The environmental protection industry's development plans are guided by government policy [3]. Firms should fulfill their responsibility by implementing environmental policy, reducing pollution emissions, and developing the recycling economy. According to stakeholder theory, environmentally responsible behavior reduces risk and, consequentially, improves economic performance. Izzo and Magnanelli (2017) [4] found that environmental responsibility plays a role in decreasing the cost of debt, and increasing debt capacity. Firms can become more willing to integrate social responsibility into their business practices if it allows them to continue being competitive and profitable [5].

Capital structure and corporate strategy are interrelated, and financing decisions should be consistent with the firm's long-term development strategy [6,7]. Poor environmental performance leads to liabilities and lawsuits. It increases the cost of debt and reduces the ability to raise new debt capital [8,9]. Firms can obtain government subsidies, tax cuts, and tax rebates by investing in environmental protection and green energy. Though investment in environmental protection facilities means increased spending in the short term, the firm can benefit in the long term. Our objective is to examine the impacts of environmental performance and financing decisions on sustainable financial development in the Chinese environmental protection industry.

The environmental protection industry has developed into a complete industrial system. Production environments, environmental services, resource utilization, clean production, and ecological restoration are significant fields of activity. It is also an industrial system that is cross-sectoral and regional. In some fields it can now compete on an international level (water treatment technology, electrostatic precipitation and bag filtration, power plant desulfurization and denitrification equipment). In 2016, there were 6236 firms, employing 389,000 people, with revenue at CNY 266 billion (China Association of Environmental Protection Industry). By 2020 the output value of China's environmental industry will exceed CNY 2.8 trillion (US$404.4 billion), with an average annual growth rate of 15% (China Environment Chamber of Commerce, 2017). This sector will need to complete the industry chain, increase cost-effectiveness and vertically integrate to maintain profit as the market matures.

Our paper contributes to the existing literature in the following ways. First, the relationship between financing choices (external and internal financing) and short- and long-term economic performance in China is discussed. Second, we demonstrate the effects of debt maturity structure on economic performance by employing trade-off theory. Third, in order to measure sustainable financial development, this study integrates different maturities to measure economic performance by using the short-term (ROA) and long-term index (Sustainable Growth Rate). Fourth, the influence of environmental performance on short- and long-term economic performance is examined, by integrating trade-off theory, transaction costs theory and natural resource-based views. We also examine how environmental performance moderates the relationship between financing decisions and economic performance.

This paper is organized as follows: Section 2 discusses pertinent literature and develops hypotheses; Section 3 addresses sample construction and relevant data; Section 4 presents empirical results; and Section 5 provides conclusions.

## 2. Literature Review and Proposed Hypotheses

The paper integrates trade-off theory, pecking order theory, natural resource-based view, agency theory, transaction costs theory, and stakeholder theory to examine the impacts of environmental performance and financing decisions on sustainability development.

### *2.1. The Relationship Between Financing Decisions and Economic Performance*

Capital structure is the mix of debts, equities and hybrid securities used to finance assets and operations. Good financing decisions should lead to optimal capital structure. Conversely, poor decisions can cause financial distress and bankruptcy.

Modigliani and Miller (1958) [10] suggested that capital structure does not matter, implying that the source of financing cannot affect the firm's value. This theory relies on strong assumptions, such as perfect markets and the absence of taxation. Pecking order theory describes the cost of funds from internal sources, which is less than the cost of debt and external equity, meaning that firms prefer internal financing. Watson and Wilson (2002) [11] examined how firms finance growth and concluded that, when retained earnings are exhausted, they use debt. Dybvig and Zender (1991) [12] found that this theory should be based upon costs of adverse selection, and require an ad hoc specification of political incentive and some limitation on the types of financing strategies that may be pursued. Trade-off theory accurately describes the relationship between capital structure and performance. It postulates three factors: agency costs, tax shields, and bankruptcy costs. Profitable firms try to optimize debt level while balancing debt tax shields, bankruptcy costs [13] and the cost of capital. Firms in the environmental protection industry carry a high proportion of intangible assets, can provide good quality pledge to lenders and can use debt financing to obtain tax benefits [14]. Environmental technology is the life of environmental protection industry [15], investment in R&D can affects the profitability of the enterprise through technological innovation. However, uncertainty in national and international economic environments, higher initial costs of R&D may increase their financial burden and risk of bankruptcy.

Barry and Mihov (2015) [16] revealed that firms with high debt underperform in the long run. Yazdanfar and Öhman (2015) [17] found that high debt level may increase firms' value in the short run, but result in greater exposure to agency costs and loss of control. Similar findings were also verified by (Maina and Ishmail, 2014) [18]. They implied that as firms took on more debt, financial performance declined. However, Roden and Lewellen (1995) [19] uncovered a significantly positive association between the ratio of total debt to total assets and profitability. Vithessonthi and Tongurai (2015) [20] concluded that small- and medium-size enterprises (SMEs) prefer debt financing to improve economic performance through higher leverage.

Higher levels of debt limit the opportunity of new financing and aggravate the burden of interest cost in environmental protection industry. Although higher-than-appropriate levels of debt in the capital structure may increase firms' value in the short run, could result in greater exposure to financial distress and increase the risk of bankruptcy. Accordingly, we posit the following:

**Hypothesis 1.** *There is a negative relationship between debt financing and economic performance.*

Stohs and Mauer (1996) [21] argued that firms trade off the benefits and costs of alternative debt maturity structures by taking into account the signaling effects of debt, liquidity risk and tax status. Flannery (1986) [22] argued that high-quality firms issue short-term debt to signal quality to the market. Short-maturity debt enables creditors to frequently evaluate a firm's ability to satisfy its debt, providing the benefits of external monitoring by the debt market [23]. Acquirers with shorter debt maturity realize higher announcement returns and have better long-term stock and operation performance [24]. On the contrary, short-term debt creates liquidity risk that can force firms to forgo investment opportunities due to excessive liquidation threats from lenders [25]. It amplifies a firm's rollover risk, leading to earlier default. In addition, a firm that funds its projects with short-term debt may face financial stress if the cost of debt unexpectedly surges [26].

The tax-based theories explain the increasing present value of tax benefits due to long-term debt. Brick and Ravid (1985) [27] showed that the interest tax shield can be enhanced by increasing the proportion of debt payments allocated to long-term debt. Mauer and Lewellen (1987) [28] maintained

that long-term debt have a positive effect on the value of a firm. On the contrary, the effect of tax shield could be more than offset by the underinvestment cost, as proposed by the agency theory.

The choice of debt maturity is influenced very little by agency problems and information asymmetry for SMEs. The main factors are the probability of bankruptcy and maturity-matching [29]. Environmental protection firms belonging to R&D intensive and high-growth industries have the lowest likelihood of survival [30]. Thus, short-maturity debt increases potential costs of illiquidity, and thereby enhances liquidity risk [31]. Long-term debt should be in a positive relationship with returns under normal yield shapes due to tax benefits. Leland and Toft (1996) [32] argued that companies with high degree of leverage are tended to choose longer maturity debt to avoid suboptimal liquidation. As stated by Hajiha and Akhlaghi (2013) [33], firms will have more time to repay their debt. Accordingly, we posit the following:

**Hypothesis 2.** *There is a positive relationship between long-term debt financing and economic performance.*

**Hypothesis 3.** *There is a negative relationship between short-term debt financing and economic performance.*

Eriotis et al. (2011) [34] concluded that financing investment activities from internal sources was more profitable than sourcing borrowed capital. Even without consideration of the high costs of external financing, there should still be a negative relationship between profitability and the use of external financing [35]. However, Almeida et al. (2004) [36] verified that highly profitable firms facing high costs for external financing tend to direct cash flows toward liquid assets and have a low propensity to apply them to the reduction of external financing. Although the use of internal sources of financing can be less risky, it can lead to complaints from shareholders when firms have to choose between applying net income to dividends or growth.

Internal funds are a secure, independent and stable source of financing, especially in economic cycles where firms encounter obstacles in the financial market. As environmental protection industry is dominated by SMEs, government support is absent in most circumstances. Thus, firms that self-finance to a greater degree enjoy the confidence of the banks and lower financial risk. Accordingly, we posit the following:

**Hypothesis 4.** *There is a positive relationship between internal financing and economic performance.*

### *2.2. The Relationship between Environmental Performance and Economic Performance*

The natural resource-based view was developed to add environmental variables to resource-based theory. Hart and Dowell (2011) [37] argued that firms can gain competitive advantage by developing "capabilities that facilitate environmentally sustainable economic activity". They can obtain superior performance by implementing proactive environmental strategies [38]. The view contends that competitive advantages are rooted in a firm's capability to facilitate environmentally sustainable economic activity.

According to trade-off theory, firms need to make a trade-off between environmental protection investment and maintaining good economic performance. By improving environmental investment, firms can obtain government subsidies, tax cuts, or tax rebates through environmental protection and energy transformation. Meanwhile, environmental practices can increase a firm's competitive advantage [39]. Firms can increase product sales, expand their market share and obtain environmental permits for new products fast through protect the environment and develop a positive social image. In contrast, developing an environmental strategy entails substantial investment and long-term commitment to market development for firms. Friedman (1970) [40] uncovered that environmental protection is articulated with additional costs imposed by the government, which would erode a firm's competitiveness and divert manager's responsibility to maximize profitability. Additionally, poor environmental performance may face other penalties, such as having production suspended

production by the government or being prohibited from expanding production capacity by industrial policy.

Chang (2015) [41] found that firms should abide by environmental policy to improve energy efficiency and reduce emissions. In practice, improving environmental performance (EP) may reduce economic performance in the short term. Excessive environmental R&D expenditures greatly reduce profit margins eventually causes a competitive disadvantage. In contrast, Cai and He (2014) [42] found that environmentally responsible firms experienced long-term abnormal returns. Benefits included increased operational efficiency and reputation, and reductions to the risk of environmental disasters, and improve economic performance [43,44]. Accordingly, we posit the following:

**Hypothesis 5.** *There is a positive relationship between environmental performance and long-term economic performance*.

**Hypothesis 6.** *There is a negative relationship between environmental performance and short-term economic performance*.

### *2.3. The Interactions of Financing Decisions and Environmental Performance on Economic Performance*

Direct or indirect financing of firms may be subject to credit institutions or the Securities Regulatory Commission. Therefore, although investment in environmental protection facilities require increased spending in the short term, accomplishment of R&D can efficiently employ a firm's resources and energy and attract corresponding benefits in the medium and long term. Improving environmental performance requires increased environmental protection funds and resources during the current year. However, funds and resources capacities are often limited. Thus, increasing investment in environmental protection will inevitably decrease the investment in normal production management, such that the reduction of these inputs will reduce the financial performance of the current year. Schaumann (2007) [45] suggested that improving EP could increase short term profitability by mitigating energy operating costs and offset the initial high capital costs in the long-term.

The environmental protection industry is heavily guided by the government's policies (Lighart and Vander, 1999) [3]. For example, the Environmental Law of the People's Republic of China was initiated in 2015. Some rules and regulations of corporate environmental protection are also included in the 13th Five-Year Strategic Plans in China (e.g., the carbon emission rights trading scheme has been approved in seven pilot provincial regions). Firms actively engaged in environmental conservation investment may gain financial grants, favorable industrial policies, or other preferential financial supports that mitigate business risks. For example, the China Banking Regulatory Commission (CBRC) requires all state-owned commercial banks to strictly execute green-credit policies in which environmental performance is a crucial benchmark. We expected investment in environmental protection behaviors to play a role in decreasing agency costs of debt, increasing debt capacity, mitigating initial capital costs and improving financial performance. Accordingly, we posit the following:

**Hypothesis 7.** *The negative effect of total debt ratio on economic performance will mitigate as the environmental performance enhances*.

Firms increase their environmental investment budget to enhance the level of environmental performance as well as improve production efficiency through technological innovation. If the earnings are insufficient to cover the investment cost, they will negatively impact the enterprise value and damage the interests of shareholders. As we know, environmental protection behavior sends a good signal to investors, thereby reducing external financing costs, but has nothing to do with the internal financing. Excessive environmental investment would take up internal funds and offset the benefits of internal financing. Accordingly, we posit the following:

**Hypothesis 8.** *The positive effect of internal financing on economic performance will decrease as environmental performance is enhanced.*

## 3. Research Methodology

### *3.1. Data Collection and Variables Definition*

The study used unbalanced panel data consisting of all of the 65 listed Chinese firms on the Shanghai and Shenzhen Stock Exchanges from 2007 to 2016, specialized in environmental protection products and services. We used a large sample and a longer period of time to ensure reliability and to reduce measurement error. We excluded companies that received special treatment, had incomplete data, or extreme values (China Stock Market and Accounting Research Database; GTA). In this article, we used STATA analysis software to process data, and test hypotheses. Variables and designations are presented in Table 1.

**Table 1.** Variables and measures.

| Category | | Variable | Symbol | Formula |
|---|---|---|---|---|
| Dependent variable | Short-term performance | Return on Assets | ROA | Net income/Total Assets |
| | Long-term performance | Sustainable growth rate | SGR | Retained profits * net profit rate * (1 + debt/equity ratio) * [1/(total assets/total sales) − 1] |
| Independent variables | External debt financing | Total debt<br>Short-term debt<br>Long-term debt | TDR<br>SDR<br>LDR | Total debt/Total assets<br>Short-term debt/Total assets<br>Long-term debt/Total assets |
| | Internal financing | Retained earnings ratio | RET | (Retained earnings + provisions)/ total assets |
| | Environmental performance | Environmental performance | EP | Growth rate of environmental protection investment |
| Control variables | | Profitability | Pro | Cash flow from operating activities/Total assets |
| | | Book to market | BtM | Book value/Market value at the end of the year |
| | | Non-debt tax shield | Tax | Depreciation/Total assets |
| | | Growth opportunities | Go | Growth rate of sales |

We categorized the economic performance measurements into short-term and long-term. The return on assets ratio (ROA) was defined as the net income to total asset ratio [46]. This is a short-term measure that reflects how a company's earnings respond to managerial policies and to the efficiency of asset utilization during a fiscal year [47]. We used sustainable growth rate (SGR) to reflect stakeholder value creation and profitability in the long run [48].

To assess debt level, we used an approach developed by Abor (2005) [49]. Financial leverage, the independent variable, was measured using the short-term debt ratio (STD), long-term debt ratio (LTD) and total debt ratio (TDR). Twairesh (2014) [50] argued that determinants of financial leverage based only on total liabilities could ignore the effect of different mixtures of short- and long-term debt. The total liabilities/total asset ratio may be a good measure of residual value for shareholders after liquidation, but it is not a good indicator of short-term default risk. Including liabilities that are used for transaction purposes (i.e., accounts payable) and liabilities not related to financing (i.e., pension liabilities) may overstate financial leverage. To assess the level of internal financing, we used the retained earnings ratio to reflect the firm's use of profits compared to the use of external sources to fund projects [50].

Prior studies have measured environmental performance as annual Toxics Release Inventory (TRI) emissions [51,52]. However, there is no environmental data for listed firms in China. As we know, the type and the amount of the environmental protection investment must be approved by the government and the firm [53]. In addition, a higher growth rate indicates better environmental performance [54,55]. Thus, growth rate of environmental protection investment reflects environmental performance. Then, we alternatively employed growth rate of environmental protection investment to measure environmental performance (EP).

### *3.2. Models Building*

Panel data includes repeated measures of one or more variables on one or more firms (repeated cross-sectional time series). Using unbalanced panel data can address this issue. From the perspective of econometrics, panel data can provide more degrees of freedom, information, variation, and less collinearity; and it allows for individual unobserved heterogeneity [56]. This paper has employed panel data models to simulate multi-variable regressions. From the proposed hypotheses, we have the following mathematical equations:

Equation (1):

$$y_{1,t} = \alpha_i + \beta_1 TDR_{(i,t)} + \beta_2 RET_{(i,t)} + \beta_3 EP_{(i,t)} + \beta_4 TDR * EP_{(i,t)} + \beta_5 RET * EP_{(i,t)} + \beta_6 \mathrm{Pro}_{(i,t)} + \beta_7 BtM_{(i,t)} + \beta_8 Tax_{(i,t)} + \beta_9 GO_{(i,t)} + \varepsilon_{i,t}$$

Equation (2):

$$y_{2,t} = \alpha_i + \beta_1 LDR_{(i,t)} + \beta_2 SDR_{(i,t)} + \beta_3 RET_{(i,t)} + \beta_4 EP_{(i,t)} + \beta_5 LDR * EP_{(i,t)} + \beta_6 SDR * EP_{(i,t)} + \beta_7 RET * EP_{(i,t)} + \beta_8 \mathrm{Pro}_{(i,t)} + \beta_9 BtM_{(i,t)} + \beta_{10} Tax_{(i,t)} + \beta_{11} GO_{(i,t)} + \varepsilon_{i,t}$$

where $y_{1,t}$ = ROA, $y_{2,t}$ = Sustainable growth rate, $TDR_{(i,t)}$ = Total debt ratio, $LDR_{(i,t)}$ = Long-term debt ratio, $SDR_{(i,t)}$ = Short-term debt ratio, $RET_{(i,t)}$ = Retained earnings ratio, $EP_{(i,t)}$ = Environmental performance, $\mathrm{Pro}_{(i,t)}$ = Profitability, $BtM_{(i,t)}$ = Book to market ratio, $Tax_{(i,t)}$ = Non-debt tax shield, $GO_{(i,t)}$ = Growth opportunities, $TDR_{(i,t)} * EP_{(i,t)}$ = Total debt ratio * Environmental performance, $LDR_{(i,t)} * EP_{(i,t)}$ = Long-term debt ratio * Environmental performance, $SDR_{(i,t)} * EP_{(i,t)}$ = Short-term debt ratio * Environmental performance, $RET_{(i,t)} * EP_{(i,t)}$ = Retained earnings ratio * Environmental performance, $\varepsilon_{i,t}$ = residual.

When employing the panel data model, three alternatives were pooled: the ordinary least square (OLS) regression model, fixed effect (FE) regression model, and random effect (RE) regression model. When the likelihood test was conducted, the FE regression model was more appropriate. When the Hausman test was done, the RE regression model was more suitable. Otherwise, the OLS regression model could have been used. However, if both the likelihood and Hausman tests are completed (in this paper the number of firms was greater than the number of years), the FE model is more suitable if panel data is not randomly sampled [57]. Conversely, the RE model is more appropriate if panel data is randomly sampled.

Before simulating the regressions, several potential econometric problems needed to be checked. The first one was collinearity between explanatory variables. People may have good reasons to suspect a collinear relation between variables because they may impact each other. This may be a critical problem if we employ just cross-sectional data. As mentioned above, the panel data model can solve the collinearity problem. The second problem was endogeneity between explanatory variables and stochastic error terms, which exists widely in the OLS model and prevents the OLS model from meeting the basic assumption of lack of bias and consistency. We chose to estimate this regression model by adopting the dynamic generalized method of moments (GMM) estimator [58] to solve this problem. Further, we set a GMM estimator [59] with two-step robust standard errors, proposed by (Windmeijer, 2005) [60]; the two-step approach can be computed with two sequential estimation

procedures, the first step estimating the unknown nuisance functions, and the second step estimating the finite dimensional parameters of interest. The procedure often has significant computational advantages over the joint estimation procedure, which can further decrease computational time and increase reliability (e.g., the global maximum is the only local maximum) [61]. Simultaneously, the approach was asymptotically more efficient than a one-step estimator for deal with problems about the existence of unobservable heterogeneity, reciprocal causality and the presence of persistent series.

## 4. Results and Discussion

### *4.1. Empirical Results and Analysis*

An examination of a large cross-section of observations suggests that panel data are better suited to study the dynamics of change [62]. Panel data sets include two dependent variables (ROA and SGR), and five independent variables (total debt, short-term debt, long-term debt, internal financing, environmental performance). Firm age and board size control variables were tested by sensitivity analysis. They did not improve the stability of the models, and did not significantly affect the relationship between dependent and independent variables so we eliminated them. A descriptive statistics and correlations matrix is proposed in Table 2.

**Table 2.** Descriptive statistics and correlations coefficients.

| Construct/ Variables | Mean | Std.Dev | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. ROA | 0.226 | 4.690 | 1 | | | | | | | | | | |
| 2. SGR | 0.0295 | 0.471 | −0.078 | 1 | | | | | | | | | |
| 3. Tdr | 0.565 | 0.501 | −0.095 | −0.168 | 1 | | | | | | | | |
| 4. Sdr | 0.399 | 0.524 | −0.085 | −0.288 | 0.705 | 1 | | | | | | | |
| 5. Ldr | 0.101 | 0.125 | −0.033 | 0.047 | 0.067 | −0.156 | 1 | | | | | | |
| 6. EP | 0.0123 | 0.106 | −0.057 | 0.041 | 0.033 | 0.008 | 0.059 | 1 | | | | | |
| 7. Ret | 0.0187 | 0.629 | 0.182 | 0.124 | −0.064 | −0.074 | 0.046 | −0.127 | 1 | | | | |
| 8. Pro | 0.0179 | 0.231 | 0.192 | −0.153 | −0.052 | −0.035 | −0.042 | −0.084 | −0.298 | 1 | | | |
| 9. Btm | 0.910 | 0.829 | −0.024 | 0.014 | 0.144 | −0.005 | 0.471 | 0.097 | 0.032 | −0.024 | 1 | | |
| 10. Tax | 0.103 | 0.142 | −0.030 | 0.025 | −0.005 | 0.104 | −0.173 | −0.012 | 0.042 | −0.036 | −0.020 | 1 | |
| 11. Go | 1.219 | 16.457 | −0.005 | 0.032 | 0.045 | 0.049 | −0.026 | 0.017 | −0.014 | −0.005 | −0.024 | −0.036 | 1 |

The variables passed the Sargan test ($p > 0.05$) and the Hausman specification test ($p < 0.05$). The GMM model was employed to eliminate the correlation between explanatory variables and stochastic error terms. We set up the GMM estimator with two-step robust standard errors, which dealt with problems associated with the existence of unobservable heterogeneity, reciprocal causality and the presence of persistent series [60]. The use of lagged dependent variables as instruments is intuitively appealing. To obtain consistent regression estimators [58] this method requires the absence of second order correlation in errors. We verified this using the Arellano-Bond test for AR (2) in second differences, and the results shown in Tables 3 and 4 confirm that there is no second-order serial correlation in errors in our model. We also tested the instrument's validity by using the Sargan-Hansen test of moment conditions, and the results, presented in Tables 3 and 4, did not indicate over-identification problems.

**Table 3.** Regression analysis (Equation (1)).

| Dependent Variable | ROA (Model 1) | | SGR (Model 2) | |
|---|---|---|---|---|
| **Model** | **Fixed-Effects Regression** | **GMM** | **Fixed-Effects Regression** | **GMM** |
| Lagged values | | 0.315 *** | | 0.187 *** |
| Tdr | −0.431 *** | −0.298 ** | −0.234 * | −0.744 *** |
| Ep | −0.530 *** | −0.504 * | 1.133 | 0.924 |
| Tdr * Ep | 1.043 *** | 0.965 ** | −2.089 * | −1.796 |
| Ret * Ep | −0.198 *** | −0.450 * | −2.453 *** | −2.108 ** |
| Ret | 0.105 *** | 0.239 * | 0.184 ** | −0.012 |
| Pro | 0.182 | 0.025 | −9.681 *** | −11.312 *** |
| Btm | 0.008 | −0.014 | −0.014 | −0.023 |

**Table 3.** *Cont.*

| Dependent Variable | ROA (Model 1) | | SGR (Model 2) | |
|---|---|---|---|---|
| **Model** | **Fixed-Effects Regression** | **GMM** | **Fixed-Effects Regression** | **GMM** |
| Tax | 0.079 * | 0.102 | 0.046 | −0.170 |
| Go | 0.0193 *** | 0.0150 * | 0.107 *** | 0.147 ** |
| $R^2$ | 0.8076 | | 0.4512 | |
| F [a] | 147.83 | | 30.70 | |
| | (0.000) | | (0.000) | |
| Hausman Test [b] | 213.77 | | 21.45 | |
| | (0.000) | | (0.010) | |
| Number of obs | | 391 | | 394 |
| Number of instruments | | 54 | | 54 |
| Wald chi$^2$ [c] | | 1088.55 | | 5095.96 |
| | | (0.000) | | (0.000) |
| AR(1) test [d] | | −1.081 | | −1.781 |
| | | (0.279) | | (0.074) |
| AR(2) test | | −0.843 | | −0.929 |
| | | (0.398) | | (0.352) |
| Sargan test of | | 46.175 | | 50.716 |
| over-identification [e] | | (0.342) | | (0.195) |

[a] F test provides a test of the pooled OLS model against the fixed effects model based on the OLS residual; [b] Hausman test is the Hausman specification test for fixed effects over random effects; [c] Wald chi$^2$ is the Wald test ($\chi^2$) for model goodness-of-fit Heteroscedasticity is the modified Wald statistic for group-wise heteroscedasticity; [d] Arellano-Bond test for zero autocorrelation in first-differenced errors, $H_0$: no autocorrelation; [e] Sargan test is a statistical test used for testing over-identifying restrictions in a statistical model. $H_0$: over-identifying restrictions are valid; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

**Table 4.** Regression analysis (Equation (2)).

| Dependent Variable | ROA (Model 3) | | SGR (Model 4) | |
|---|---|---|---|---|
| **Model** | **Fixed-Effects Regression** | **GMM** | **Fixed-Effects Regression** | **GMM** |
| Lagged values | | 0.477 *** | | 0.178 *** |
| Sdr | −0.413 *** | −0.198 | −0.556 *** | −0.700 *** |
| Ldr | −0.013 | 0.136 *** | −0.022 | −0.0192 |
| Ep | −0.273 *** | −0.074 | 0.807 | 1.295 * |
| Sdr * Ep | 1.121 *** | 0.724 * | −1.620 | −2.481 * |
| Ldr * Ep | −0.506 | −1.008 ** | −2.066 | −2.545 ** |
| Ret * Ep | −0.253 *** | −0.598 *** | −1.928 ** | −2.679 *** |
| Ret | 0.163 *** | 0.361 *** | −0.063 | −0.152 |
| Pro | 0.645 *** | 0.467 *** | −9.013 *** | −10.803 *** |
| Btm | −0.011 | −0.029 *** | −0.009 | 0.0002 |
| Tax | 0.185 *** | 0.172 ** | 0.221 | 0.083 |
| Go | 0.006 | 0.007 | 0.086 *** | 0.086 ** |
| $R^2$ | 0.777 | | 0.511 | |
| F [a] | 101.01 | | 32.04 | |
| | (0.000) | | (0.000) | |
| Hausman Test [b] | 69.15 | | 26.35 | |
| | (0.000) | | (0.005) | |
| Number of obs | | 394 | | 397 |
| Number of instruments | | 56 | | 56 |
| Wald chi$^2$ [c] | | 2214.83 | | 3034.77 |
| | | (0.000) | | (0.000) |
| AR(1) test [d] | | −1.122 | | −1.606 |
| | | (0.261) | | (0.108) |
| AR(2) test | | 0.190 | | −0.961 |
| | | (0.848) | | (0.336) |
| Sargan test of | | 48.265 | | 46.047 |
| over-identification [e] | | (0.268) | | (0.347) |

[a] F test provides a test of the pooled ordinary least square (OLS) model against the fixed effects model based on the OLS residuals; [b] Hausman test is the specification test for fixed effects over random effects; [c] Wald chi$^2$ is the Wald test ($\chi^2$) for model goodness-of-fit Heteroscedasticity is the modified Wald statistic for group-wise heteroscedasticity; [d] Arellano-Bond test for zero autocorrelation in first-differenced errors, $H_0$: no autocorrelation; [e] Sargan test is a statistical test used for testing over-identifying restrictions in a statistical model. $H_0$: over-identifying restrictions are valid; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

### *4.2. Tests of Hypotheses and Discussion*

From Table 3, the coefficient of TDR in model 1 was $\beta = -0.298$, with statistical significance at the 5% level. The coefficient of TDR in model 2 was $\beta = -0.744$, with a statistical significance at the 1% level. Debt financing had a statistically significant and negative impact on economic performance (ROA and SGR) that was consistent with Barry and Mihov (2015) [15] and Yazdanfar and Öhman (2015) [16]. This result supports Hypothesis 1. Increasing the proportion of debt financing in the capital structure does decrease economic performance. Increased debt will escalate the costs of reorganization and liquidation, and limit the opportunity for new financing. The environmental protection industry is technology intensive and its sensitivity to the technological revolution can increase the probability of bankruptcy. The level of debt financing does have a negative relationship with economic performance.

From Table 4, the coefficient of LDR in model 3 was $\beta = 0.136$, with a statistical significance at the 1% level. The coefficient of LDR in model 4 was $\beta = -0.019$ ($p > 0.1$). Long-term debt financing had a statistically significant and positive impact on short-term economic performance (ROA), which was consistent with Mauer and Lewellen (1987) [28] and Hajiha and Akhlaghi (2013) [33]. This result partially supports Hypothesis 2. Although the transaction costs of long-term debt are greater than the cost of funds in an unbalanced capital structure, intangible assets may serve as good collateral for more debt financing. Due to high initial R&D costs in the environmental protection industry, firms will require significant long-term financing to keep environmental projects running. Sustained and stable cash flow from the projects in the long run will support more investment opportunities, avoid suboptimal liquidation, and improve financial performance. The long-term debt ratio has a positive relationship with economic performance.

From Table 4, the coefficient of SDR in model 3 was $\beta = -0.198$ ($p > 0.1$). The coefficient of SDR in model 4 was $\beta = -0.700$, with a statistical significance at the 1% level. Short-term debt has a statistically significant and negative impact on economic performance (SGR), which is consistent with He and Xiong (2012) [26] and Datta et al. (2005) [31]. This result partially supports Hypothesis 3. Short-term debt financing is convenient and flexible. However, firms which rely on it may be affected by interest rate volatility. Given that short-term debts normally require longer periods to realize their full potential, firms may have to give up more profitable projects. Thus, short-term debt ratio has a negative relationship with economic performance.

From Tables 3 and 4, the effect of the retained earnings ratio on short-term performance was both positive and significant, suggesting that internal financing will improve performance (ROA). That is consistent with Eriotis et al. (2011) [34] and (Strebulaev, 2007) [35]. Clearly, this result partially supports Hypothesis 4. Internal financing does not incur the interest costs associated with loans. Since the risks associated with internal financing are lower, environmental protection firms that have relied on it may have better access to bank loans and to capital markets. Internal financing has a positive relationship with ROA.

From Tables 3 and 4, EP had a statistically significant and negative impact on short-term performance (ROA) and EP had a statistically significant and positive impact on long-term performance (SGR). This result supports Hypotheses 5 and 6. Enhancing EP and increasing the environmental burden implies extra costs that might hurt economic performance in the short term. Thus, EP has a negative relationship with short-term performance. However, improving environmental investment can help to obtain government subsidies, rewards, tax cuts, and tax rebates. Environmental practices can increase a firm's competitive advantage through technical innovation. Improving EP will improve the relationship with stakeholders and reduce transaction costs. Thus, environmental responsibility will enhance a firm's reputation, provide long-term sustainability [63], and increase long-term profitability [42]. EP has a positive relationship with long-term performance.

From Table 3, the coefficient of TDR * EP in model 1 was $\beta = 0.965$, with a statistical significance at the 5% level. The negative relationship between TDR and short-term economic performance was higher when EP was high. This result partially supports Hypothesis 7. Environmental protection incurs additional costs imposed by government that can erode competitiveness. Overinvestment in

environmental protection can aggravate the default risk and reduce economic performance in the short term. From Table 4, the coefficient of LDR * EP was $\beta = -1.008$, with a statistical significance at the 5% level in model 3. The positive relationship between LDR and short-term economic performance will be weaker when EP is high. Capital investment in EP may increase the financial burden, decrease the financial liquidity, reduce the long-term debt capability, and ultimately reduce profitability in the short run. The coefficient of SDR * EP was both positive and significant (10%) in model 3. SDR negatively related to short-term performance and was higher when EP was high. Extra environmental governance costs may increase operating costs, decrease the velocity of capital, and reduce short-term economic performance. The coefficient of SDR * EP was both negative and significant (10%) in model 4. Sustainable strategies allow firms to alleviate short-term debt pressure and obtain value in the long run. From Tables 3 and 4, the coefficients of Ret * EP were both negative and significant. The positive impact of internal financing on performance was weaker when EP was high. This result supports Hypothesis 8. The environmental protection industry produces positive externalities. Firms try to obtain low cost external financing through environmental conservation but the extra investment may reduce retained earnings and erode the positive effect of internal financing. Thus, the positive effect of internal financing on economic performance is weakened by higher environmental performance.

## 5. Conclusions and Policy Implications

We found evidence that the total debt ratio is negatively related to short-term economic performance. There is a positive relationship between long-term debt and economic performance. Due to high initial R&D costs in this industry, firms prefer longer maturity debt to avoid suboptimal liquidation. Sustained and stable cash flow from projects in the long run will support more investment opportunities. Short-term debt has a negative relationship with long-term economic performance. Short-term debt increases the sensitivity to interest rate volatility. Given that short-term debts normally require longer periods to realize their full potential, firms may have to give up profitable projects. This study implies that internal financing is positively related to economic performance since it carries lower financing costs.

We integrated trade-off and stakeholder theories to examine the impacts of environmental performance and financing decisions on sustainable financial development. First, we found evidence that environmental performance is more likely to result in extra financial burden and hurt economic performance in the short-run. However, firms can obtain government subsidies and tax cuts to enhance brand value and long-term performance when they pursue more technical innovation. Second, good environmental performance allows firms to finance with lower capital costs, and improve their sustainable value in the long term. Excessive environmental investment will decrease liquidity and short-term performance. Financing decisions will impact economic performance. The negative effect of debt financing on short-term performance was increased by higher environmental performance, and the negative relationship between debt financing and long-term performance was mitigated when EP was high. In addition, the effect of internal financing on performance was weakened by higher environmental performance.

Improving the financing environment and environmental performance have become significant objectives in the Five-Year Strategic Plans in China. The trade-off relationship between economic growth and environmental governance exhibited by the environmental protection industry has attracted a lot of attention. Firms should make suitable financing decisions and use rational leverage to maintain sustainable growth. Environmental performance is also an important way for lenders to evaluate corporate risks and determine the appropriate interest rate. Technology is central to the environmental protection industry. Environmental protection firms can reallocate their resources to high return sectors like design, technology innovation through capital accumulation and increased R&D investment. Firms should increase their environmental investment budget to enhance the level of environmental performance, as well as improve production efficiency through technological innovation. This competitive advantage will offset their expenditures on technology investments.

Further, firms should develop high-tech, patented and high-end products. On the governance side, the establishment of a policy mix containing environmental protection systems, financial supporting policies, and sustainable financial development is recommended. The appropriate polices can promote and sustain voluntary corporate environmental protection behavior. They should improve the standards of intellectual property rights protection and optimize their financing environment as soon as possible, not only in the limited pilot regions, but throughout the whole region.

Limitations of this study are related to the small number of firms included in the analysis of publicly listed environmental protection firms. Future studies should expand their sample to include unlisted firms. They should add other synthetic environmental performance indexes based on GRI Guidelines (Global Reporting Initiative), such as material consumption efficiency, energy-saving, pollution control, cleaning products and services, and environmental management.

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