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What Affects the Corporate Performance of Listed Companies in China's Agriculture and Forestry Industry?

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Abstract: China is embarking on a new journey to build a comprehensive socialist modern state in the new era. Modernization of agriculture and forestry is the basis of agricultural modernization, but China's traditional agriculture and forestry industry are facing a more serious crisis of independent research and innovation. As the listed agroforestry companies are directly facing the demands of the market, it becomes essential to study the technological innovation of listed agroforestry companies. Therefore, this paper investigates the relationship between R&D innovation, corporate management, supply chain management, growth capacity, debt servicing capacity, and corporate performance of listed agroforestry companies. Based on the annual panel data of agroforestry listed companies in the CSMAR database from 2010–2021, the empirical study was conducted using panel PVAR models, OLS, 2SLS, LIML, and GMM estimation. The findings show that: (1) Granger causes affecting the supply chain management of listed companies in agroforestry are corporate management, debt servicing capacity, and growth capacity. Granger causes affecting the debt servicing capacity of listed companies in the agroforestry industry are R&D innovation, growth capacity, and corporate performance. Among them, there is a causal influence relationship between debt servicing capacity and corporate performance. (2) R&D innovation, corporate management, supply chain management, growth capacity, debt servicing capacity, and corporate performance contribute the most to its own impulse response, with an average contribution of 87.4%, 81.8%, 86.9%, 96.9%, 86.5%, and 94.7%, respectively. Compared to the other variables, the impulse response contribution of debt servicing capacity to corporate performance was the largest. (3) When supply chain management and growth capability play a fully mediating role, there is a significant positive effect of R&D innovation on corporate performance. Finally, we offer some policy recommendations and suggestions to the Chinese government, as well as some suggestions on how Chinese-listed companies in the agroforestry industry can improve their corporate performance. This paper provides a Chinese case study on the corporate performance of listed companies in the global agroforestry industry.

Keywords: listed agroforestry companies; R&D innovation; corporate performance; PVAR; mediating effects

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1. Introduction

According to data released by the World Food and Agriculture Organization (FAO) in 2022, 78 million more people will be food insecure by 2030 than in the absence of the epidemic. In addition, 2.3 billion people will suffer from food insecurity in 2021, half of whom (1.15 billion) live in Asia; more than a third (795 million) in Africa; about 12% (268 million) live in Latin America and the Caribbean; and nearly 4% (89 million) in North

America and Europe [1]. Ukraine halted food exports following the outbreak of the Russia–Ukraine conflict, pushing the international food commodity price index to its highest ever since records began in 1990 in March. The latest food security status update by the World Bank shows that global domestic food price inflation remains high. Information from April to July 2022 shows that almost all low and middle-income countries are experiencing high inflation [2]. The issue of food security was mentioned again at the 20th National People's Congress of China on 16 October 2022. The importance of food security for China's economic development was further emphasized by the demand to strengthen the roots of food security on all fronts and to fully implement the party and government's responsibility for food security [3]. Extreme weather events such as droughts intensify extreme heat waves, and heat waves have increased in frequency and severity and are more likely to occur in the future due to the increased concentration of greenhouse gases in the atmosphere [4]. Agroforestry systems are widely considered to contribute to climate change mitigation due to their carbon storage and sequestration capacity [5]. Agroforestry systems also provide a range of ecological benefits, such as reducing nutrient leaching, thereby improving water quality, enhancing biodiversity, sequestering carbon, climate regulation, and preventing erosion [6]. Agroforestry is a significant contributor to the carbon sink capacity of ecosystems and is both a source of carbon emissions and an essential source of carbon sequestration. Agroforestry has low economic returns but tremendous potential for emission reduction. If properly adjusted, payments for emission reduction benefits can be a management strategy to incentivize cleaner agricultural production [7]. China strives to reach peak CO_2 emissions by 2030 and be carbon neutral by 2060 [8–10].

In the face of the world's current crises, including increasing population numbers, climate change, or degradation of agroecosystems associated with declining agricultural productivity, there is a need for approaches that can ensure food security [11]. The development of agroforestry in China is currently constrained by multiple factors, such as a lack of innovation in agricultural seeds, high dependence on imports for many crops, and the emergence of critical technologies. Agricultural innovation needs to be given high priority by Chinese society. As listed agroforestry companies face the market demand directly, they are in a better position to grasp the market direction of agroforestry products. Therefore, it is essential to study the technological innovation of listed agroforestry companies. This paper selects annual panel data of agroforestry listed companies from 2010 to 2021 from the CSMAR database. It uses a panel PVAR model to explore the relationship between R&D innovation, corporate management, supply chain management, growth capacity, debt servicing capacity, and corporate performance of agroforestry-listed companies in five dimensions. At the same time, instrumental variable methods such as 2SLS, LIML, and GMM estimation were used to provide insights into the reasons for the lagging R&D innovation in Chinese agroforestry. In addition, our research was supported by the National Social Science Foundation of China (72003158).

For innovation in the agricultural sector, most scholarly research has focused on studies of innovation in agro-related bioproducts. For example, Correa et al. (2022) [12] investigated the Brazilian involvement in developing technologies for producing second-generation ethanol from biomass. Recent research offers different technological pathways for the private and public sectors, ranging from low-carbon or non-carbon technologies that reduce sources of greenhouse gases (GHG) to carbon capture and storage innovations that address the consequences of global warming [13–15]. Innovation research in the forest sector focuses on innovative governance [16], forestry [17,18] the wood industry, and the economy [19,20] and social innovation [21–23], among other areas.

The innovation of corporate systems in the agroforestry sector has also been studied. For example, some scholars analyze the decision-making process of French winemakers in adapting to climate change and how the institutional and relational context of the innovation system, including the clean technology regime, influences these decisions [24]. Zhao et al. (2022) [25] explore the idea of promoting green innovation based on internal

factors, using the 2015 to 2020 Chinese A-share list of heavily polluting firms to explore the relationship between board size, openness, and green innovation.

In summary, previous studies by scholars, both on green technology innovation in agroforestry products and on the institutional level in the agroforestry industry, have only started from a particular dimension, generalizing from a point to a point and lacking in systematization and completeness. The main innovation of this paper is that we use the PVAR model to investigate the relationship between R&D innovation, corporate management, supply chain management, growth capacity, debt servicing capacity, and corporate performance of listed agroforestry companies more entirely and systematically in five dimensions. We find that R&D innovation significantly impacts firm performance, while supply chain management and growth capacity play a fully mediating role in the above relationship. At the same time, we use 2SLS, LIML, and GMM estimation methods to investigate the reasons for the lagging R&D innovation in China's agroforestry industry, filling a gap in theoretical research on the R&D innovation of listed companies in the agroforestry industry. Our study provides a Chinese case study on the corporate performance of listed companies in the agroforestry industry.

2. Data and Methodology

2.1. Data Sources

The data used in this study are mainly from the CSMAR database, data published by the National Bureau of Statistics, the State Forestry Administration, and other official websites. As some of the data had missing values, we used the mean value to fill in, and then we performed winsor2 tail shrinking on the data. Since there are only 88 listed companies in the agriculture, forestry, animal husbandry, and fishery industries in China (including ST), removing the ST category leaves only 43 listed companies in the agriculture, forestry, animal husbandry, and fishery industries with research value. Finally, we screened out a strong panel of 40 A-share listed companies in the agriculture, forestry, and fishery industries for the period 2010–2021. Descriptive statistics for the variable data are shown in Table 1.

Table 1. Descriptive statistics of variable data.

Variable	Obs	Mean	Std. dev.	Min	Max
code	480	20.5	11.555440	1	40
year	480	2015.5	3.455654	2010	2021
R&D Innovation (R&D)	480	0.012909	0.021338	0.000275	0.167384
Corporate Management (CM)	480	0.022126	0.020605	0.002041	0.147030
Supply Chain Management (SCM)	480	0.005963	0.020917	0.000229	0.150879
Growth Capability (Growth)	480	0.001059	0.005621	0.000167	0.121723
Debt Servicing Capacity (DSC)	480	0.001957	0.001050	0.000908	0.013591
Corporate Performance (CP)	480	0.000416	0.000055	0.000183	0.001052

2.2. Methodology

Firstly, we used the entropy weighting method to downscale the original data, assigning indicator weights to the 32 secondary indicator data through scientific calculation of statistical software, and finally transforming them into six core variables to facilitate our next mathematical modeling. Secondly, we used the PVAR model for mathematical modeling and built five different models to investigate the impact relationship between R&D innovation, corporate management, supply chain management, growth capability, debt servicing capability, and corporate performance of listed agroforestry companies. Then, we used OLS, 2SLS, LIML, and GMM methods to conduct in-depth analysis on the relationship between R&D innovation and corporate performance of listed agroforestry companies. Finally, we selected supply chain management and growth capability as mediating variables, respectively, and ran 1000 iterations using the bootstrap random sampling

method. The relationship between R&D innovation and corporate performance was further investigated.The method Flow chart is shown in Figure 1.

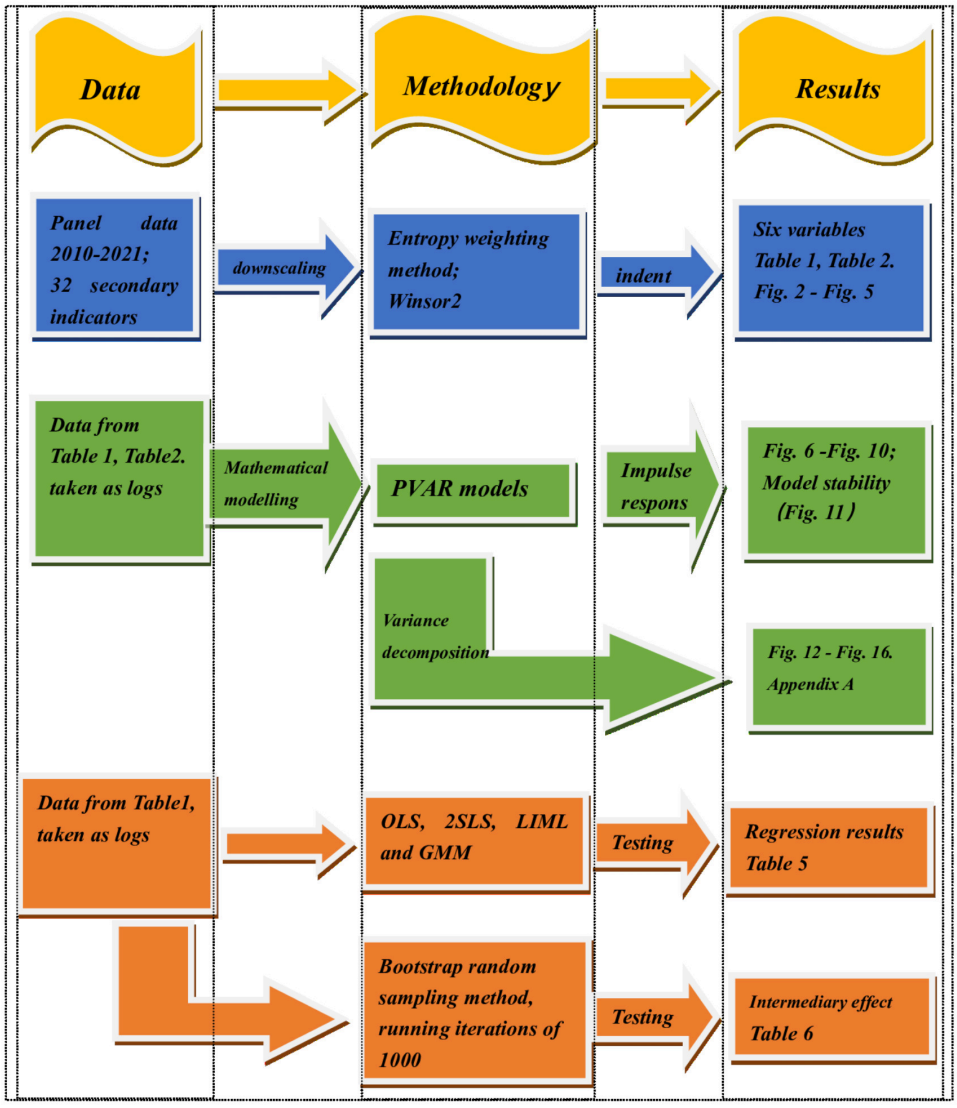

Figure 1. Methodology flowchart. From the left, the first column shows the data used, the second column shows the method used, and the third column shows the conclusions drawn or the results of the model running.

2.3. Variables

2.3.1. Indicator Selection

(1) R&D innovation

Innovation in the agroforestry sector is a growing research interest, where increasing attention is paid to the institutional, policy, and social dimensions, particularly regarding how to support innovation in the sector [26]. The forest sector needs to be more innovative than it has been to date, and government policy can play an essential role in encouraging innovation in the forest sector [27]. Therefore, for the variable R&D innovation, we selected the following indicators: number of R&D personnel [28], number of R&D personnel as a percentage (%), amount of R&D investment [29], the ratio of R&D investment to operating income (%), amount of R&D investment (expenditure) expensed, amount of R&D investment (expenditure) capitalized [30], and the ratio of capitalized R&D investment (expenditure) to R&D investment (%).

(2) Corporate management

The challenge for managers is to balance these strengths and weaknesses to maintain economically and biologically sustainable systems that meet production objectives [31]. Therefore, for the variable company management, we selected the following indicators: equity concentration indicator1 (%), size of the board of directors, whether the effective controller is the chairman or general manager, number of shares held by the chairman [32], percentage of shares held by the chairman (%), total remuneration of the top three executives, total remuneration of executives [33], number of executives, and number of shares held by executives [34].

(3) Supply chain management

The reduction of trade barriers, advances in production and logistics, and the growing demand for agricultural products have given a strong impetus to trade and global supply chains [35]. Increasingly, companies recognize that they have a responsibility and a role to play in sustainable development. From large multinational agribusinesses to upstream and downstream suppliers such as traders, cooperatives, farmers, and retailers, the adverse impacts of business activities can have lasting effects on people in all types of commodity-sourcing communities around the world. Therefore, for variable supply chain management, we have selected the following indicators: net inventory, accounts payable turnover, total asset turnover [36], accounts receivable turnover, and inventory turnover [37].

(4) Growth capability

The ability to grow reflects the prospects of a company. Net asset growth, liquidity (CR), leverage (DER), and profitability (ROE) have a significant impact on dividend policy (DPR) [38]. The following indicators were selected for the variable growth capacity: growth rate of return on net assets, net profit growth rate [39], operating income growth rate [40], and net assets per share.

(5) Debt servicing capacity

Debt financing, while helping to enhance a company's profitability, is detrimental to its ability to grow in the future [41]. Thus, corporate debt service capacity is essential for a company. For the variable debt service capacity, we have selected the following indicators: cash ratio, equity ratio, and gearing ratio [42].

(6) Corporate performance

In general, the corporate performance uses profitability indicators, including six items: operating profit margin, cost margin, surplus cash protection multiple, return on total assets, return on net assets, and return on capital [43]. For the variables of corporate performance, we selected the following indicators: return on net assets [44], return on investment, operating profit margin [45], and return on total assets.

2.3.2. Variable Relationships

(1) The scatter plot of the relationship between R&D innovation (lnR&D), corporate management (lnCM), and corporate performance (lnCP) is shown in Figure 2, from which we can see that the scatter distribution of R&D innovation (lnR&D), corporate management (lnCM), and corporate performance (lnCP) is unbalanced and uneven. The scatter plot of the relationship between company management (lnCM), growth capability (lnGrowth), and corporate performance (lnCP) is shown in Figure 3, from which we can see that there is a relatively clear linear relationship between company management (lnCM) and corporate performance (lnCP).

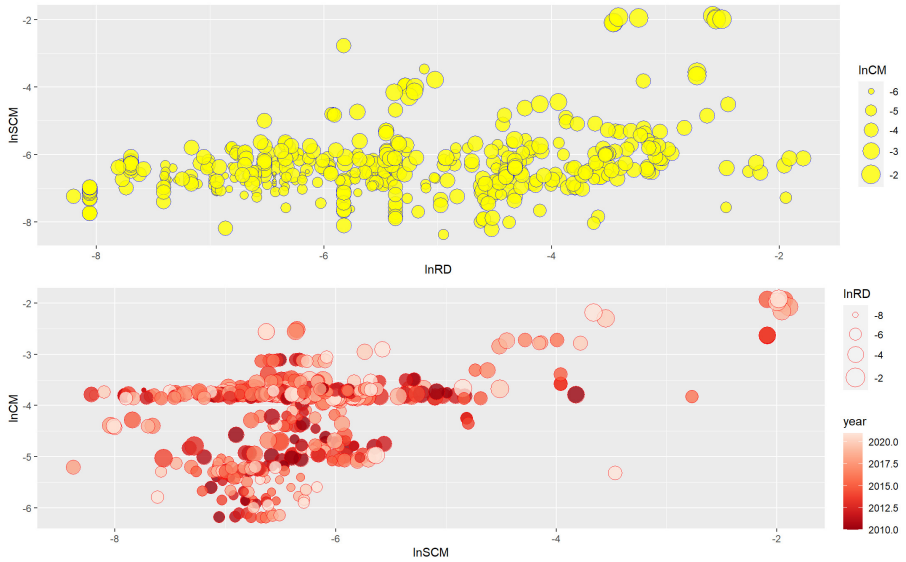

Figure 2. The scatter plot above (in yellow) represents: the relationship between R&D innovation (lnR&D) and supply chain management (lnSCM); the scatter plot below (in red) represents: the relationship between corporate management (lnCM) and supply chain management (lnSCM).

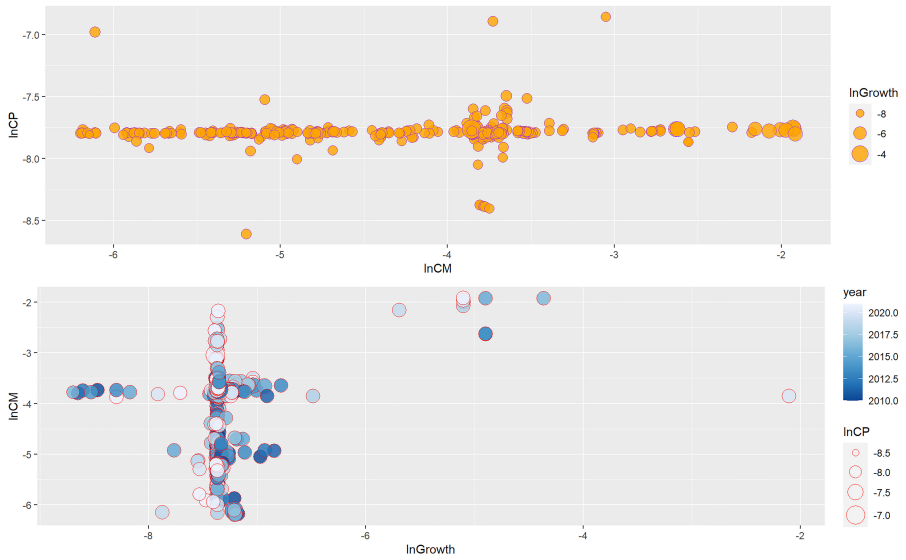

Figure 3. The scatter plot above (in orange) represents: the relationship between corporate management (lnCM) and corporate performance (lnCP); the scatter plot below (in purple) represents: the relationship between corporate management (lnCM) and growth capacity (lnGrowth).

(2) The scatter diagram of the relationship between debt servicing capacity (lnDSC), growth capacity (lnGrowth), and corporate performance (lnCP) is shown in Figure 4, from which we can see that there is a relatively significant linear relationship between debt servicing capacity (lnDSC) and corporate performance (lnCP). The scatter plot of the relationship between R&D innovation (lnR&D), debt service capacity (lnDSC), and supply chain management (lnSCM) is shown in Figure 5, from which we can see that the scatter distribution of R&D innovation (lnR&D), debt service capacity (lnDSC), and supply chain management (lnSCM) is unbalanced and uneven.

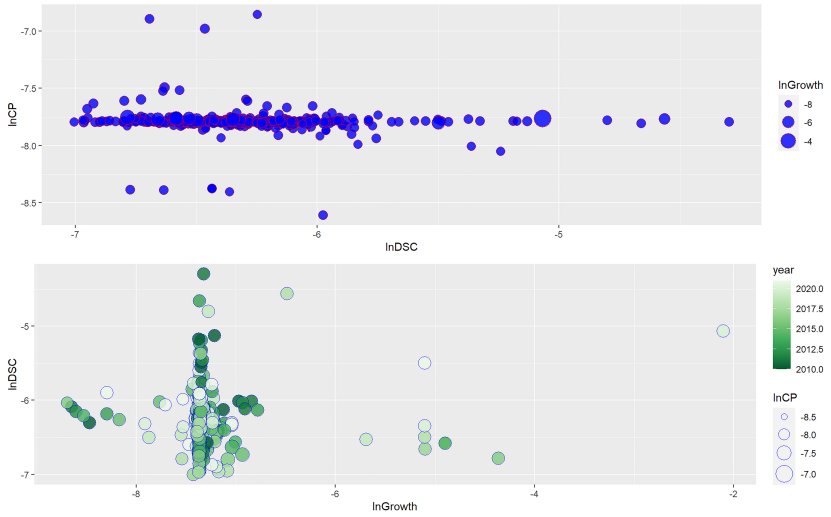

Figure 4. The scatter plot above (in blue) represents: the relationship between debt service capacity (lnDSC) and corporate performance (lnCP); the scatter plot below (in green) represents: the relationship between debt service capacity (lnDSC) and growth capacity (lnGrowth).

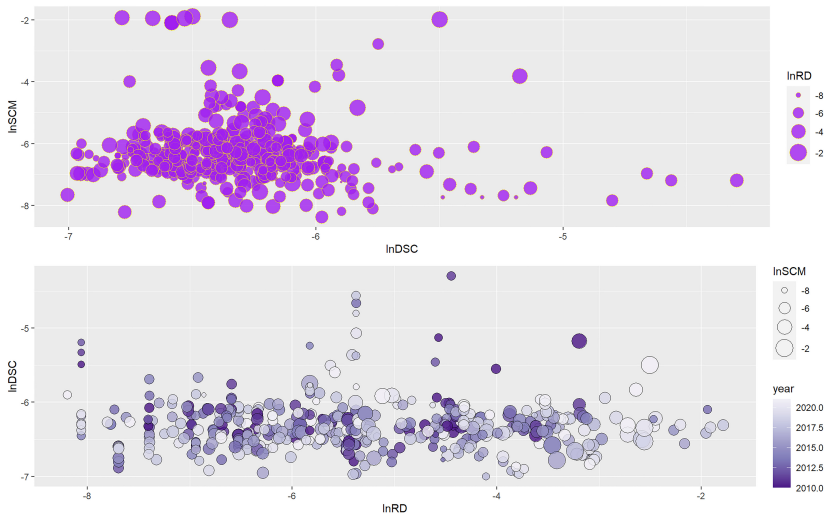

Figure 5. The scatter plot above (in magenta) represents: the relationship between debt service capacity (lnDSC) and supply chain management (lnSCM); the scatter plot below (in purple) represents: the relationship between debt service capacity (lnDSC) and R&D innovation (lnR&D).

2.3.3. Entropy Weighting Method

The entropy weighting method is an objective weighting method based on the idea of entropy in basic information theory to calculate the weight of each indicator in the comprehensive index system. It makes weighting judgments based on the size of the information load of the data, which can reduce the influence of human subjectivity on the evaluation results and make the evaluation results more realistic [46,47]. In this paper, the entropy method was used to reduce the dimensionality of the data and determine the indicator weights. The exact calculation process is shown below.

Step 1: Determine whether there are negative numbers in the input matrix and, if so, renormalize to a non-negative interval. The normalized matrix Z_{ij} is obtained:

$$Z_{ij} = \frac{x_{ij} - \min\{x_{1j}, x_{2j}, \ldots, x_{ij}\}}{\max\{x_{1j}, x_{2j}, \ldots, x_{ij}\} - \min\{x_{1j}, x_{2j}, \ldots, x_{ij}\}}. \quad (1)$$

Step 2: Calculate the weight of the ith sample under the jth indicator and consider it as the probability used in the relative entropy calculation. Calculate the probability matrix P_{ij}:

$$P_{ij} = \frac{Z_{ij}}{\sum_{i=1}^{n} Z_{ij}}. \quad (2)$$

Step 3: Calculate the information entropy e_j of each indicator, calculate the information utility value d_j and normalize it to obtain the entropy weight of each indicator:

$$e_j = -k \sum_{i=1}^{n} p_{ij} \log(p_{ij}),\ (j = 1, 2, \ldots, m), \quad (3)$$

Among them,

$$k = \frac{1}{\log n} > 0,\ e_j \geq 0, \quad (4)$$

$$d_j = 1 - e_j. \quad (5)$$

Step 4: The weights w_j are calculated for each indicator,

$$w_j = \frac{d_j}{\sum d_j}. \quad (6)$$

Finally, through the entropy weighting method, we obtained the results of the construction of the indicator system and the assignment of indicator weights in this paper, as shown in Table 2.

Table 2. Index selection and weight assignment.

Variables	Indicators	Weights
Research and Development Innovation (R&D)	X1 = Number of R&D staff	0.025348
	X2 = Number of R&D staff as a percentage (%)	0.015784
	X3 = Amount of R&D investment	0.033095
	X4 = R&D investment as a percentage of operating revenue (%)	0.023971
	X5 = Amount of R&D inputs (expenses) expensed	0.033869
	X6 = Amount of R&D investment (expenditure) capitalized	0.076709
	X7 = Capitalized R&D investment (expenditure) as a percentage of R&D investment (%)	0.051822
Corporate Management (CM)	X8 = Equity concentration indicator1 (%)	0.003983
	X9 = Board size	0.00534
	X10 = Whether the actual controller is the chairman or general manager	0.018003
	X11 = number of shares held by the chairman	0.046478
	X12 = Chairman's shareholding (%)	0.081623
	X13 = Total compensation of top three executives	0.037186
	X14 = Total executive compensation	0.074338
	X15 = Number of executives	0.001475
	X16 = number of shares held by executives	0.050831
Supply Chain Management (SCM)	X17 = Net Inventory	0.021952
	X18 = Accounts payable turnover ratio	0.095599
	X19 = Total asset turnover ratio	0.033429
	X20 = Accounts receivable turnover ratio	0.062244
	X21 = Inventory turnover ratio	0.051612
Growth capacity (Growth)	X22 = Revenue on net assets growth rate	0.012597
	X23 = Net profit growth rate	0.000108
	X24 = Operating income growth rate	0.121145
	X25 = Net asset per share growth rate	0.000072

Table 2. *Cont.*

Variables	Indicators	Weights
Debt Service Capacity (DSC)	X26 = Cash ratio	0.013378
	X27 = Equity ratio	0.003005
	X28 = Gearing ratio	0.003859
Corporate performance (CP)	X29 = Revenue on net assets	0.000133
	X30 = Revenue on investment	0.000860
	X31 = operating profit margin	0.000059
	X32 = Revenue on total assets	0.000090

2.4. Smoothing Tests

In order to ensure that the data have good stationarity, we use four different methods to test the stationarity of the data, namely the heterogeneous root test (IPS), the homogeneous root test (LLC), the ADF–Fisher test, and the PP–Fisher test, and the test results are shown in Table 3. From Table 3, we can conclude that all data used in this paper are balanced panel data. All six series (lnR&D, lnCM, lnSCM, lnGrowth, lnDSC, lnCP) rejected the original hypothesis of smoothness of variables in all four tests and all were significant at the 1% level, indicating that the data used have good smoothness and can be estimated by PVAR models.

Table 3. Results of stationarity test.

Variable	IPS	LLC	ADF–Fisher	PP–Fisher
lnR&D	−10.332 ***	−23.820 ***	541.025 ***	979.315 ***
	(0.000)	(0.000)	(0.000)	(0.000)
lnCM	−8.779 ***	−23.812 ***	566.063 ***	1097.357 ***
	(0.000)	(0.000)	(0.000)	(0.000)
lnSCM	−11.199 ***	−25.701 ***	485.274 ***	1119.771 ***
	(0.000)	(0.000)	(0.000)	(0.000)
lnGrowth	−10.172 ***	−270.127 ***	498.233 ***	1634.031 ***
	(0.000)	(0.000)	(0.000)	(0.000)
lnDSC	−10.122 ***	−25.230 ***	426.216 ***	1224.023 ***
	(0.000)	(0.000)	(0.000)	(0.000)
lnCP	−5.965 ***	−26.781 ***	331.648 ***	1398.684 ***
	(0.000)	(0.000)	(0.000)	(0.000)

Note: *** indicates significance at the 1% level.

3. Empirical Analysis

3.1. PVAR Model Construction

(1) To explore the relationship between R&D innovation, corporate management, supply chain management, and debt service capacity, we develop model 1 as shown in Equation (7):

$$L_{RCSDit} = \omega_i \cdot L_{RCSDit-1} + E_{it} \tag{7}$$

Among them,

$$L_{RCSDit} = \begin{bmatrix} \ln R\&D_{it} \\ \ln CM_{it} \\ \ln SCM_{it} \\ \ln DSC_{it} \end{bmatrix}, L_{RCSDt-1} = \begin{bmatrix} \ln R\&D_{it-1} \\ \ln CM_{it-1} \\ \ln SCM_{it-1} \\ \ln DSC_{it-1} \end{bmatrix},$$

$$\omega_i = \begin{bmatrix} \alpha_1 & \beta_1 & \gamma_1 & \rho_1 \\ \alpha_2 & \beta_2 & \gamma_2 & \rho_2 \\ \alpha_3 & \beta_3 & \gamma_3 & \rho_3 \\ \alpha_4 & \beta_4 & \gamma_4 & \rho_4 \end{bmatrix}, E_{it} = \begin{bmatrix} \varepsilon_{it} \\ \mu_{it} \\ v_{it} \\ \phi_{it} \end{bmatrix}.$$

(2) To explore the relationship between R&D innovation, supply chain management, growth capacity, and debt service capacity, we develop model 2 as shown in Equation (8):

$$L_{RSGDit} = \omega_i \cdot L_{RSGDit-1} + \Omega_j \cdot L_{RSGDit-2} + E_{it}. \quad (8)$$

Among them,

$$L_{RSGDit} = \begin{bmatrix} \ln R\&D_{it} \\ \ln SCM_{it} \\ \ln Growth_{it} \\ \ln DSC_{it} \end{bmatrix}, L_{RSGDt-1} = \begin{bmatrix} \ln R\&D_{it-1} \\ \ln SCM_{it-1} \\ \ln Growth_{it-1} \\ \ln DSC_{it-1} \end{bmatrix}, L_{RSGDt-2} = \begin{bmatrix} \ln R\&D_{it-2} \\ \ln SCM_{it-2} \\ \ln Growth_{it-2} \\ \ln DSC_{it-2} \end{bmatrix}$$

$$\omega_i = \begin{bmatrix} \alpha_1 & \beta_1 & \gamma_1 & \rho_1 \\ \alpha_2 & \beta_2 & \gamma_2 & \rho_2 \\ \alpha_3 & \beta_3 & \gamma_3 & \rho_3 \\ \alpha_4 & \beta_4 & \gamma_4 & \rho_4 \end{bmatrix}, \Omega_j = \begin{bmatrix} \eta_1 & \theta_1 & \sigma_1 & \varsigma_1 \\ \eta_2 & \theta_2 & \sigma_2 & \varsigma_2 \\ \eta_3 & \theta_3 & \sigma_3 & \varsigma_3 \\ \eta_4 & \theta_4 & \sigma_4 & \varsigma_4 \end{bmatrix}, E_{it} = \begin{bmatrix} \varepsilon_{it} \\ \mu_{it} \\ v_{it} \\ \phi_{it} \end{bmatrix}.$$

(3) To explore the relationship between corporate performance, corporate management, supply chain management, and debt service capacity, we develop model 3 as shown in Equation (9):

$$L_{CCSDit} = \omega_i \cdot L_{CCSDit-1} + E_{it}. \quad (9)$$

Among them,

$$L_{CCSDit} = \begin{bmatrix} \ln CP_{it} \\ \ln CM_{it} \\ \ln SCM_{it} \\ \ln DSC_{it} \end{bmatrix}, L_{CCSDit-1} = \begin{bmatrix} \ln CP_{it-1} \\ \ln CM_{it-1} \\ \ln SCM_{it-1} \\ \ln DSC_{it-1} \end{bmatrix},$$

$$\omega_i = \begin{bmatrix} \alpha_1 & \beta_1 & \gamma_1 & \rho_1 \\ \alpha_2 & \beta_2 & \gamma_2 & \rho_2 \\ \alpha_3 & \beta_3 & \gamma_3 & \rho_3 \\ \alpha_4 & \beta_4 & \gamma_4 & \rho_4 \end{bmatrix}, E_{it} = \begin{bmatrix} \varepsilon_{it} \\ \mu_{it} \\ v_{it} \\ \phi_{it} \end{bmatrix}.$$

(4) To explore the relationship between corporate performance, corporate management, growth capacity, and debt service capacity, we develop model 4 as shown in Equation (10):

$$L_{CCGDit} = \omega_i \cdot L_{CCGDit-1} + \Omega_j \cdot L_{CCGDit-2} + E_{it}. \quad (10)$$

Among them,

$$L_{CCGDit} = \begin{bmatrix} \ln CP_{it} \\ \ln CM_{it} \\ \ln Growth_{it} \\ \ln DSC_{it} \end{bmatrix}, L_{CCGDit-1} = \begin{bmatrix} \ln CP_{it-1} \\ \ln CM_{it-1} \\ \ln Growth_{it-1} \\ \ln DSC_{it-1} \end{bmatrix}, L_{CCGDit-2} = \begin{bmatrix} \ln CP_{it-2} \\ \ln CM_{it-2} \\ \ln Growth_{it-2} \\ \ln D_{it}C_{it-2} \end{bmatrix},$$

$$\omega_i = \begin{bmatrix} \alpha_1 & \beta_1 & \gamma_1 & \rho_1 \\ \alpha_2 & \beta_2 & \gamma_2 & \rho_2 \\ \alpha_3 & \beta_3 & \gamma_3 & \rho_3 \\ \alpha_4 & \beta_4 & \gamma_4 & \rho_4 \end{bmatrix}, \Omega_j = \begin{bmatrix} \eta_1 & \theta_1 & \sigma_1 & \zeta_1 \\ \eta_2 & \theta_2 & \sigma_2 & \zeta_2 \\ \eta_3 & \theta_3 & \sigma_3 & \zeta_3 \\ \eta_4 & \theta_4 & \sigma_4 & \zeta_4 \end{bmatrix}, E_{it} = \begin{bmatrix} \varepsilon_{it} \\ \mu_{it} \\ v_{it} \\ \phi_{it} \end{bmatrix}.$$

(5) To explore the relationship between corporate performance, supply chain management, growth capacity, and debt service capacity, we develop model 5 as shown in Equation (11):

$$L_{CSGDit} = \omega_i \cdot L_{CSGDit-1} + \Omega_j \cdot L_{CSGDit-2} + E_{it}. \quad (11)$$

Among them,

$$L_{CSGDit} = \begin{bmatrix} \ln CP_{it} \\ \ln SCM_{it} \\ \ln Growth_{it} \\ \ln DSC_{it} \end{bmatrix}, L_{CSGDt-1} = \begin{bmatrix} \ln CP_{it-1} \\ \ln SCM_{it-1} \\ \ln Growth_{it-1} \\ \ln DSC_{it-1} \end{bmatrix}, L_{CSGDt-2} = \begin{bmatrix} \ln CP_{it-2} \\ \ln SCM_{it-2} \\ \ln Growth_{it-2} \\ \ln DSC_{it-2} \end{bmatrix},$$

$$\omega_i = \begin{bmatrix} \alpha_1 & \beta_1 & \gamma_1 & \rho_1 \\ \alpha_2 & \beta_2 & \gamma_2 & \rho_2 \\ \alpha_3 & \beta_3 & \gamma_3 & \rho_3 \\ \alpha_4 & \beta_4 & \gamma_4 & \rho_4 \end{bmatrix}, \Omega_j = \begin{bmatrix} \eta_1 & \theta_1 & \sigma_1 & \varsigma_1 \\ \eta_2 & \theta_2 & \sigma_2 & \varsigma_2 \\ \eta_3 & \theta_3 & \sigma_3 & \varsigma_3 \\ \eta_4 & \theta_4 & \sigma_4 & \varsigma_4 \end{bmatrix}, E_{it} = \begin{bmatrix} \varepsilon_{it} \\ \mu_{it} \\ v_{it} \\ \phi_{it} \end{bmatrix}.$$

3.2. PVAR Model Results

(1) As can be seen from Figure 6, the impulse response of R&D innovation to itself is strong, with a significant positive impact from period 1 to period 6, but the trend of positive impact gradually decreases. The impulse response of company management is more robust for itself, with a significant positive impact from period 1 to period 6, but the trend of positive impact gradually decreases. The impulse response of supply chain management to corporate management is more robust, with a continuous significant positive influence from periods 1 to 4, with the positive influence trends increasing and then gradually decreasing. The impulse response of supply chain management on itself is more robust, with a significant positive effect in period 1. The impulse response of supply chain management to debt service capacity is strong, with a significant positive effect from period 1 to period 3, with the positive effect trend increasing and then decreasing. Debt service capacity has a more robust impulse response on itself, with a significant positive effect from period 1 to period 6, but the positive effect tends to fade.

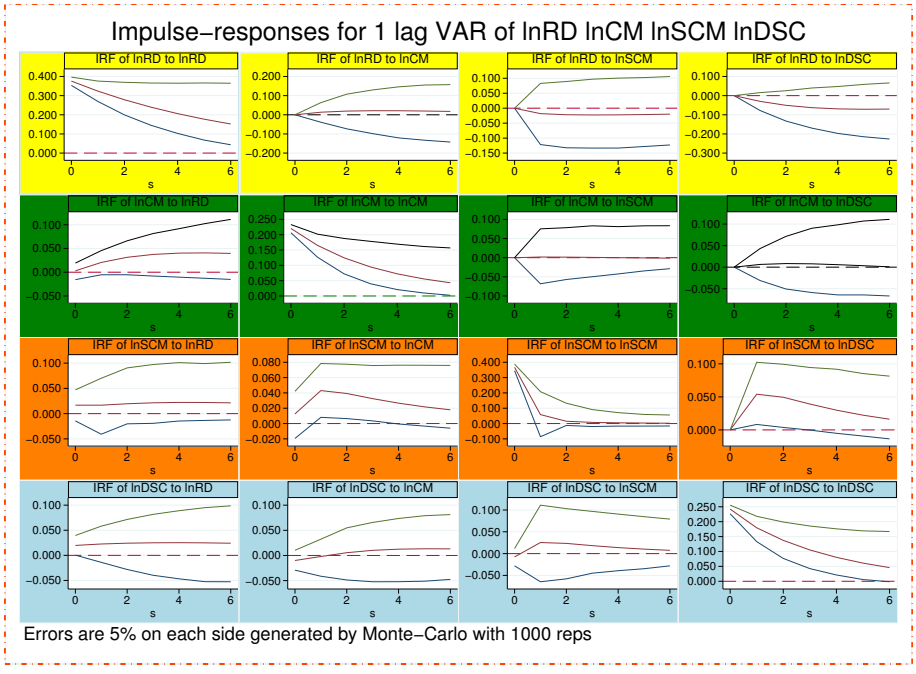

Figure 6. The first row (in yellow) indicates, respectively, impulse responses of R&D innovation to itself (lnR&D), corporate management (lnCM), supply chain management (lnSCM), and debt servicing capacity (lnDSC); the second row (green) indicates, respectively, impulse responses of corporate management to R&D innovation (lnR&D), itself (lnCM), supply chain management (lnSCM), and debt servicing capacity (lnDSC); the third row (in orange) indicates, respectively, the impulse responses of supply chain management to R&D innovation (lnR&D), corporate management (lnCM), itself (lnSCM), and debt servicing capacity (lnDSC); the fourth row (in light blue) indicates, respectively, the impulse responses of the debt servicing capacity to R&D innovation (lnR&D), corporate management (lnCM), supply chain management (lnSCM), and itself (lnDSC).

(2) From Figure 7, the impulse response of R&D innovation to itself is strong, with a significant positive impact from period 1 to period 6, but the positive trend gradually decreases. Supply chain management has a more robust impulse response to itself, especially in period 1, but the positive trend disappears in period 2. The impulse response of supply chain management to debt service capacity is strong, with a significant positive impact from period 1 to period 4, and the positive impact tends to increase gradually. Growth capacity has a more robust impulse response on itself, with a significant positive impact from period 1 to period 3, with a trend of weakening and then strengthening, then weakening again, disappearing in period 3. Debt service capacity has a more robust impulse response on its own, with a significant positive effect from period 1 to period 3, but the positive effect tends to diminish.

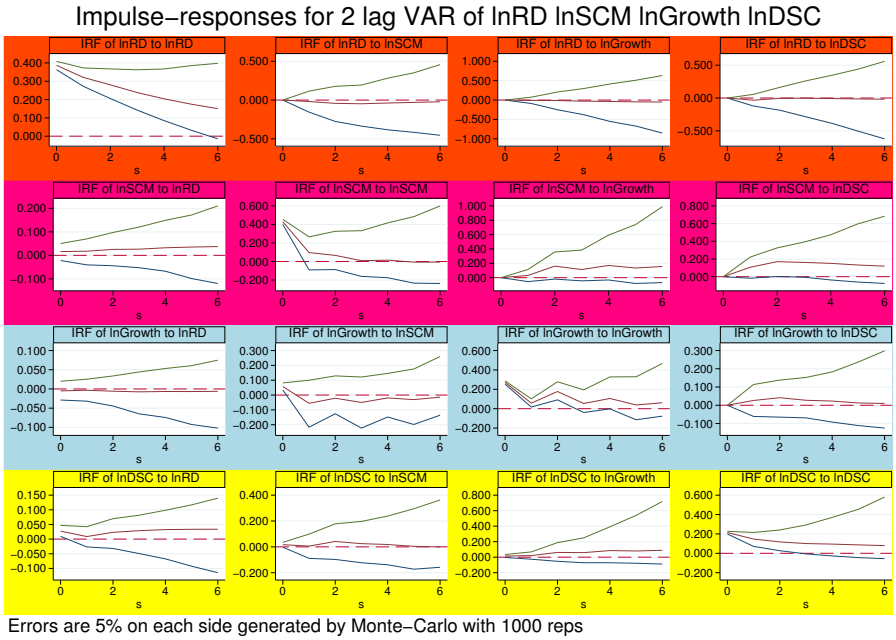

Figure 7. The first row (in orange) indicates, respectively, the impulse response of R&D innovation to itself (lnR&D), supply chain management (lnSCM), growth capacity, and debt servicing capacity (lnDSC); the second row (in magenta) indicates, respectively, the impulse response of supply chain management to R&D innovation (lnR&D), itself (lnSCM), growth capacity (lnGrowth), and debt servicing capacity (lnDSC); the third row (in light blue) indicates, respectively, the impulse responses of growth capacity to R&D innovation (lnR&D), supply chain management (lnSCM), itself (lnGrowth), and debt servicing capacity (lnDSC); the fourth row (in yellow) indicates, respectively, the impulse responses of the debt servicing capacity to R&D innovation (lnR&D), supply chain management (lnSCM), growth capacity (lnGrowth), and itself (lnDSC).

(3) As shown in Figure 8, the impulse response of corporate performance to itself is strong, but there is a significant positive effect only in period 1, and the positive effect tends to diminish. The impulse response of company management to itself is more robust, with a significant positive effect from period 1 to period 6, but the positive effect tends to weaken. The impulse response of supply chain management to corporate management is more robust, with a continuous significant positive influence from periods 1 to 4, with the positive influence trend increasing and then gradually decreasing. The impulse response of supply chain management on itself is more robust, with a significant positive effect only in period 1. The impulse response of supply chain management on debt service capacity is more robust, with a significant positive effect from period 1 to period 3, with the positive effect trend increasing and then decreasing. The impulse response of debt service capacity to corporate performance is more robust, with a significant positive impact from period 1 to period 6, but the positive impact tends to increase and decrease. The impulse response

of debt service capacity is more robust, with a significant positive impact from periods 1 to 4, but the positive impact tends to diminish.

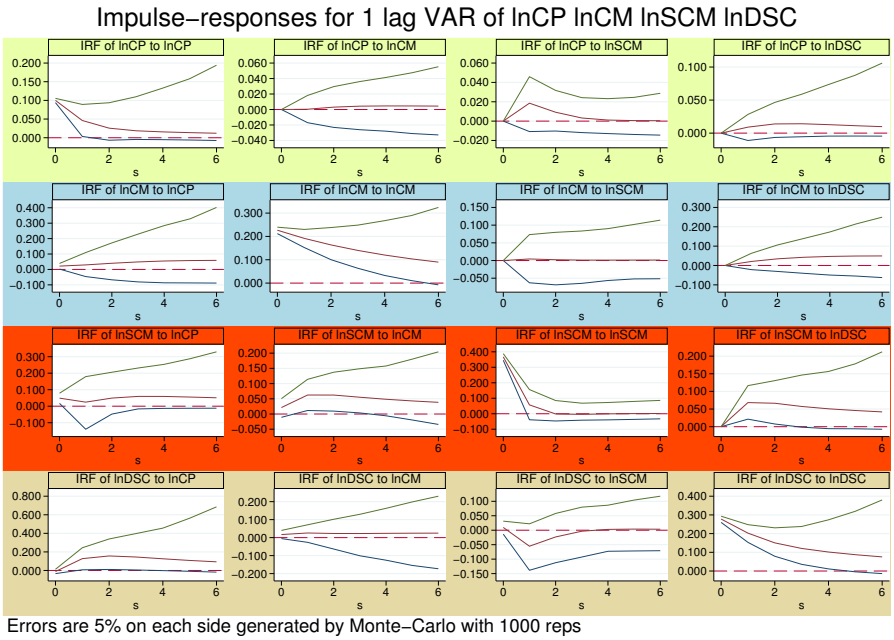

Figure 8. The first row (in light green) indicates, respectively, the impulse response of corporate performance to itself (lnCP), corporate management (lnCM), supply chain management (lnSCM), and debt servicing capacity (lnDSC); the second row (in light blue) indicates, respectively, the impulse responses of corporate management to corporate performance (lnCP), itself (lnCM), supply chain management (lnSCM), and debt servicing capacity (lnDSC); the third row (in orange) indicates, respectively, the impulse responses of supply chain management on corporate performance (lnCP), corporate management (lnCM), itself (lnSCM), and debt servicing capacity (lnDSC); and the fourth row (in khaki) indicates, respectively, the impulse responses of solvency to corporate performance (lnCP), corporate management (lnCM), supply chain management (lnSCM), and itself (lnDSC).

(4) As shown in Figure 9, the impulse response of corporate performance to itself is strong, with a significant positive effect from period 1 to period 2, but the positive effect tends to weaken. The impulse response of corporate performance on growth capacity is strong, with a significant positive effect from period 1 to period 5, and the positive effect tends to increase. The impulse response of corporate performance to debt service capacity is strong, with a significant positive impact continuously from period 1 to period 5, and the positive impact tends to increase gradually. The impulse response of corporate management to itself is more robust, with a significant positive impact continuously from period 1 to period 6, but the positive impact tends to diminish gradually. Growth capacity has a more robust impulse response on itself, with a significant positive impact from period 1 to period 3, with the trend of impact weakening and then strengthening, then weakening again, before disappearing in period 3. The impulse response of debt service capacity to corporate performance is more robust, with a significant positive impact from period 1 to period 4, with the impact trend increasing and then decreasing. The impulse response of debt service capacity to itself is more robust, with a significant positive impact continuously from period 1 to period 6, but the positive impact tends to diminish.

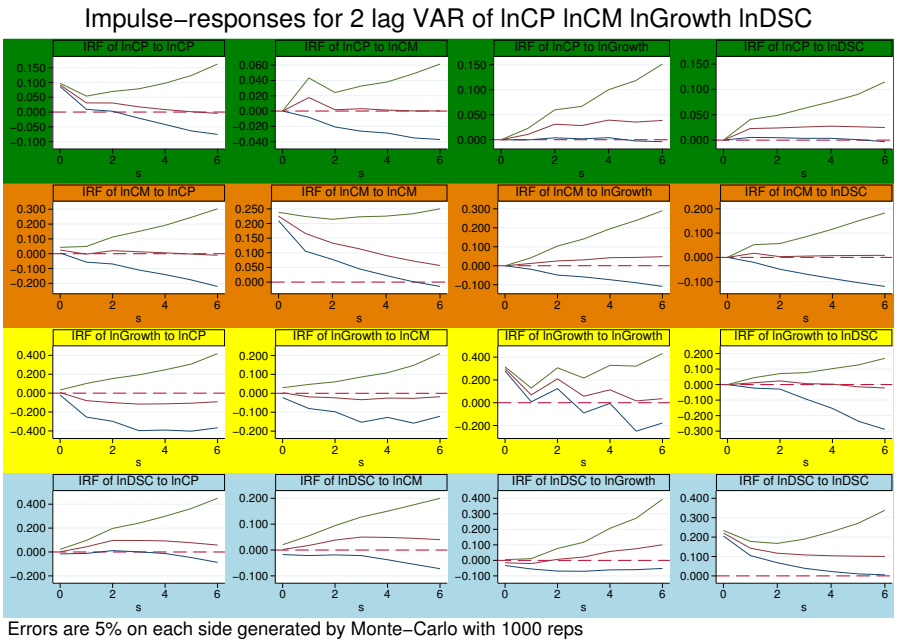

Figure 9. The first row (in green) indicates, respectively, the impulse response of the corporate performance to itself (lnCP), corporate management (lnCM), growth capacity (lnGrowth), and debt service capacity (lnDSC); the second row (in orange) indicates, respectively, the impulse responses of corporate management on corporate performance (lnCP), itself (lnCM), growth capacity (lnGrowth), and debt servicing capacity (lnDSC); the third row (in yellow) indicates, respectively, the impulse responses of growth capacity to corporate performance (lnCP), corporate management (lnCM), itself (lnGrowth), and debt servicing capacity (lnDSC); the fourth row (in light blue) indicates, respectively, the impulse responses of debt servicing capacity to corporate performance (lnCP), corporate management (lnCM), growth capacity (lnGrowth), and itself (lnDSC).

(5) As can be seen from Figure 10, the impulse response of company management to itself is stronger, with a significant positive impact from period 1 to period 6, but the positive trend gradually decreases. Supply chain management has a strong impulse response to corporate management, with a significant positive effect from period 1 to period 5, and the positive effect tends to increase and then decrease. Supply chain management has a more robust impulse response on debt service capacity, with a significant positive impact from period 1 to period 3, and the positive impact trend is increasing and then decreasing. Growth capacity has a more robust impulse response to itself, with a significant positive impact continuously from period 1 to period 3, but the positive impact trend decreases, then increases, and finally decreases and disappears. Debt service capacity has a more robust impulse response on its own, with a continuous significant positive effect from period 1 to period 6, but the positive effect tends to diminish.

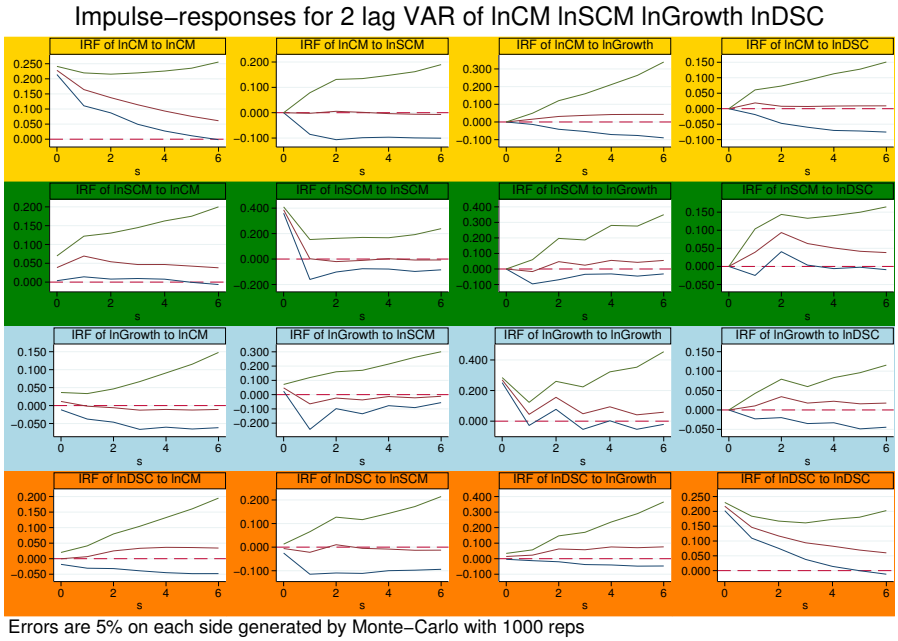

Figure 10. The first row (in yellow) indicates, respectively, the impulse response of corporate management to itself (lnCM), supply chain management (lnSCM), growth capacity (lnGrowth), and debt service capacity (lnDSC); the second row (in green) indicates, respectively, the impulse responses of supply chain management to corporate management (lnCM), itself (lnSCM), growth capacity (lnGrowth), and debt servicing capacity (lnDSC); the third row (in light blue) indicates, respectively, the impulse responses of growth capacity to corporate management (lnCM), supply chain management (lnSCM), itself (lnGrowth), and debt servicing capacity (lnDSC); the fourth row (in orange) indicates, respectively, the impulse responses of debt servicing capacity to corporate management (lnCM), supply chain management (lnSCM), growth capacity (lnGrowth), and itself (lnDSC).

3.3. Robustness Tests

The results of the robustness tests for our five pvar models are shown in Figure 11. All variables in these five pvar models fall within the unit circle, indicating that the robustness of each model is very good.

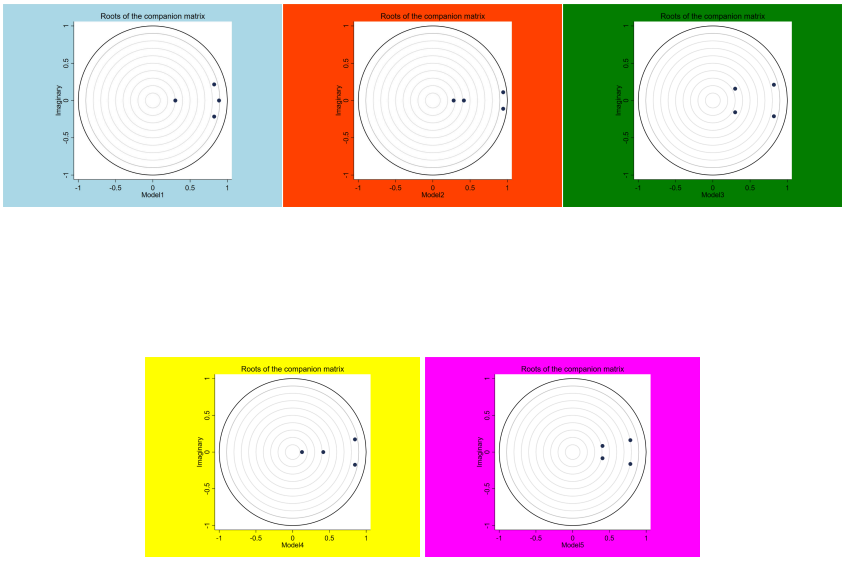

Figure 11. Stability test results for Model 1−5. All four variables (the four black dots) fall within the unit circle, which indicates that these models are stable.

3.4. Granger Causality Test

The results of the Granger causality test are shown in Table 4. Thus, we can conclude the following.

Table 4. Results of Granger causality tests.

Model	Cause and Effect	chi2	df	*p*-Value
Model 1	lnR&D → lnSCM	0.084	1	0.772
	lnCM → lnSCM	3.709 **	1	0.054
	lnDSC→ lnSCM	3.546 **	1	0.060
	ALL → lnSCM	10.913 ***	3	0.012
Model 2	lnGrowth→lnSCM	7.316 **	2	0.026
	ALL → lnSCM	17.730 ***	6	0.007
	lnR&D → lnDSC	4.633 *	2	0.099
	ALL → lnDSC	14.198 **	6	0.027
Model 3	lnCM → lnSCM	3.853 **	1	0.050
	lnDSC→ lnSCM	5.1415 **	1	0.023
	ALL → lnSCM	12.266 ***	3	0.007
	lnCP → lnDSC	3.845 **	1	0.050
Model 4	lnDSC→ lnCP	4.836 *	2	0.089
	lnCM → lnDSC	0.948	2	0.622
	lnGrowth→lnDSC	5.123 *	2	0.077
	ALL → lnDSC	16.573 ***	6	0.011
Model 5	lnCM → lnSCM	9.649 ***	2	0.008
	lnGrowth→lnSCM	10.207 ***	2	0.006
	lnDSC→ lnSCM	8.666 ***	2	0.013
	ALL → lnSCM	28.840 ***	6	0.000

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

In model 1, company management (lnCM) is the Granger cause that affects supply chain management (lnSCM), and the *p*-value is significant at the 5% level; debt service capacity (lnDSC) is the Granger cause that affects supply chain management (lnSCM), and the *p*-value is significant at the 5% level; finally, we find that company management and debt service capacity are the Grangers. Finally, we find that corporate management and debt service capacity are the Granger causes that affect supply chain management simultaneously, and the *p*-value is significant at the 1% level.

In model 2, growth capacity (lnGrowth) is the Granger cause of supply chain management (lnSCM), and the *p*-value is significant at the 5% level.) (lnDSC) is the Granger cause of debt service capacity, and the *p*-value is significant at the 10% level; lnR&D, lnGrowth, and lnSCM are the Granger causes of debt service capacity (lnDSC) at the same time, and the *p*-value is significant at the 5% level. Finally, we find that corporate management and debt service capacity are Granger causes of supply chain management (lnSCM) simultaneously, and the *p*-value is significant at the 1% level.

In model 3, company management (lnCM) is the Granger cause of supply chain management (lnSCM), and the *p*-value is significant at the 5% level; debt service capacity (lnDSC) is the Granger cause of supply chain management (lnSCM), and the *p*-value is significant at the 5% level; company management (lnCM) and debt service capacity (lnDSC) are the Granger causes of supply chain management at the same time, and the *p*-value is significant at the 1% level. (lnCM) and debt service capacity (lnDSC) are the Granger causes of supply chain management, and the *p*-value is significant at the 1% level. Corporate performance (lnCP) is the Granger cause of debt service capacity (lnDSC), and the *p*-value is significant at the 5% level.

In model 4, lnDSC is the Granger cause of lnCP, and the *p*-value is significant at the 10% level; lnGrowth is the Granger cause of lnDSC, and the *p*-value is significant at the 10% level. Finally, we find that corporate performance (lnCP), corporate management (lnCM),

and growth (lnGrowth) are also Granger causes of debt service capacity (lnDSC), and the *p*-values are significant at the 1% level.

In model 5, corporate management (lnCM) is the Granger cause of supply chain management (lnSCM) and the *p*-value is significant at 1% level; Growth capacity (lnGrowth) is the Granger cause of supply chain management (lnSCM) and the *p*-value is significant at 1% level; Debt service capacity (lnDSC) is the Granger cause of supply chain management (lnSCM), and the *p*-value is significant at 1% level. The *p*-value is significant at the 1% level. Company management (lnCM), growth capacity (lnGrowth), and debt service capacity (lnDSC) are the Granger causes of supply chain management (lnSCM), and the *p*-value is significant at the 1% level.

In summary: (1) corporate management, debt service capacity, and growth are the Granger causes of supply chain management. (2) R&D innovation, growth capacity, and corporate performance are the Granger causes affecting debt service capacity. (3) Debt service capacity and corporate performance are Granger causes that influence each other.

3.5. Variance Decomposition

The results of the variance decomposition are shown in Figures 12–16, where we can conclude the following.

As shown in Figure 12, in model 1, R&D innovation (lnR&D) contributes 86.8% of its own impulse response and has a significant *p*-value at the 1% level. Corporate management (lnCM) contributes 75% to its own impulse response, and the *p*-value is significant at the 1% level; corporate management (lnCM) has a more significant contribution to the supply chain management (lnSCM) impulse response at 19.6%, and the *p*-value is significant at the 10% level. Debt service capacity (lnDSC) contributes 22.3% to the impulse response of supply chain management (lnSCM), and the *p*-value is significant at the 10% level; debt service capacity (lnDSC) contributes 74.1% to its own impulse response, and the *p*-value is significant at the 1% level.

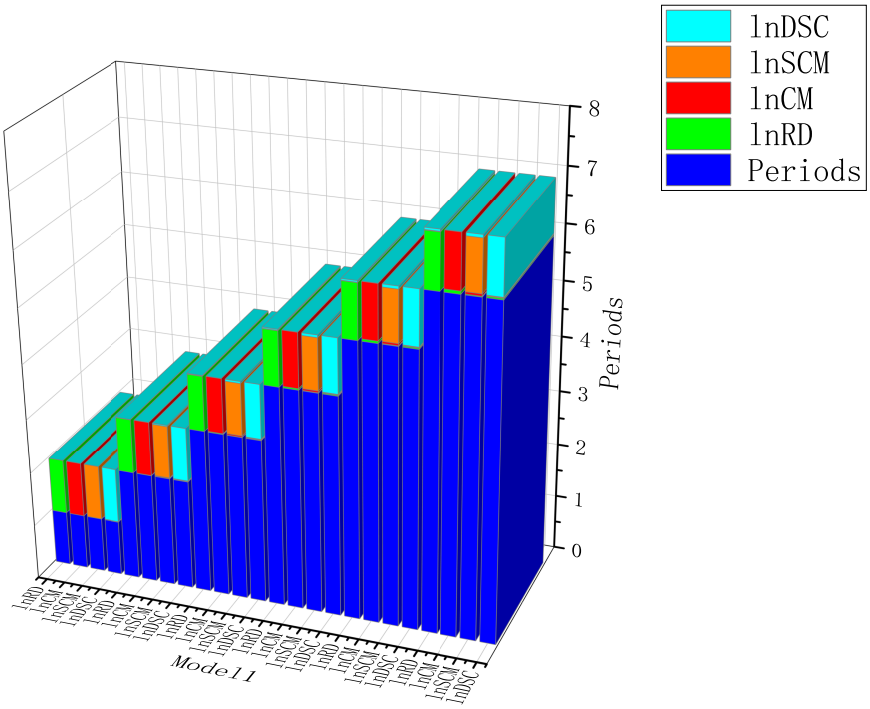

Figure 12. The graph shows the results of the variance decomposition of model 1. The horizontal axis indicates the different variables, including debt servicing capacity (lnDSC) (in light blue), supply chain management (lnSCM) (in orange), corporate management (lnCM) (in red) and R&D innovation (lnR&D) (in green), and the vertical axis indicates the contribution of each variable at different lags (see Appendix A for specific figures), and the blue area indicates the number of periods lagged.

As shown in Figure 13, in model 2, the contribution of R&D innovation (lnR&D) to its own impulse response is 88%, and the *p*-value is significant at the 1% level. Growth capacity (lnGrowth) contributes 20.9% to its own impulse response, and the *p*-value is significant at the 5% level; Debt service capacity (lnDSC) contributes 48% to the impulse response of supply chain management (lnSCM), and the *p*-value is significant at the 5% level; Debt service capacity (lnDSC) contributes 78.9% to its own impulse response, and the *p*-value is significant at the 1% level.

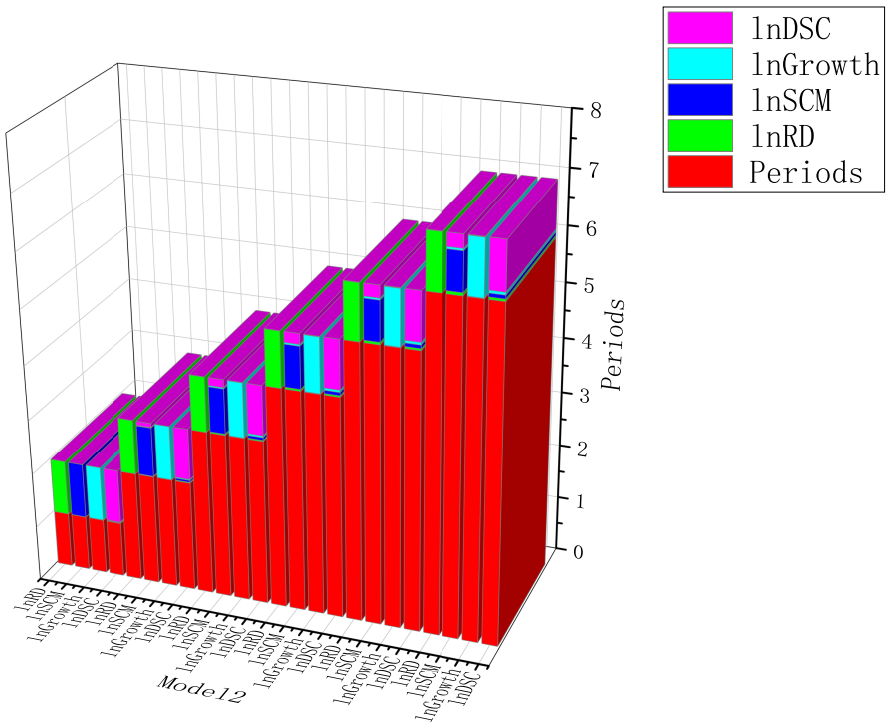

Figure 13. The graph shows the results of the variance decomposition of Model 2. The horizontal axis indicates the different variables including debt servicing capacity (lnDSC) (in Magenta), growth capacity (lnGrowth) (in light blue), supply chain management (lnSCM) (in blue), and R&D innovation (lnR&D) (in green), the vertical axis indicates the contribution of each variable at different lags (see Appendix A for specific figures), and the red area indicates the number of periods lagged.

As shown in Figure 14, in model 3, the contribution of corporate management (lnCM) to its own impulse response is 83.9%, and has a *p*-value significant at the 1% level. The contribution of corporate management (lnCM) to the impulse response of supply chain management (lnSCM) is 24.3%, and the *p*-value is significant at the 5% level. In comparison, the contribution of corporate performance (lnCP) to the impulse response of debt servicing capacity (lnDSC) is 42.4%, and the *p*-value is significant at the 5% level. The contribution of corporate performance (lnCP) to its own impulse response is 44.2%, and the *p*-value is significant at the 10% level. The contribution of debt servicing capacity (lnDSC) to the impulse response of supply chain management (lnSCM) is 24.6%, and the *p*-value is significant at the 5% level. The contribution of debt service capacity (lnDSC) to its own impulse response is 72.9%, and the *p*-value is significant at the 1% level.

As shown in Figure 15, in model 4, the contribution of corporate performance (lnCP) to the own impulse response is 44.2%, and the *p*-value is significant at the 10% level. The contribution of corporate performance (lnCP) to the impulse response of debt service capacity (lnDSC) is 32.5%, and the *p*-value is significant at the 5% level. Corporate management (lnCM) contributes 84.1% to its own impulse response, and the *p*-value is significant at the 1% level. Growth capacity (lnGrowth) contributes 26.6% of the impulse response and is significant at the 5% level, while debt service (lnDSC) contributes 70.4% of the impulse response and is significant at the 1% level.

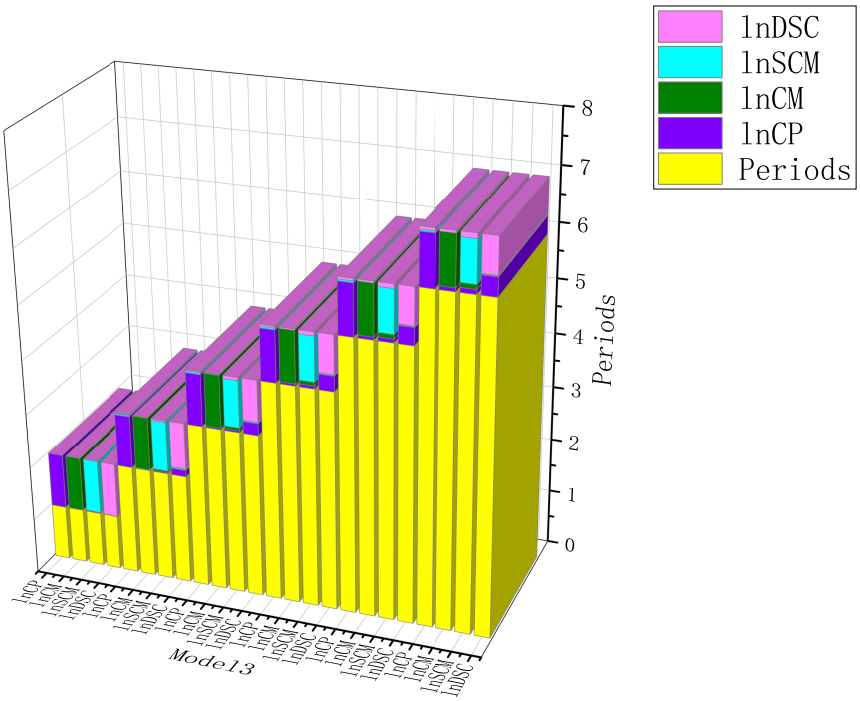

Figure 14. The graph shows the results of the variance decomposition of Model 3. The horizontal axis indicates the different variables including debt servicing capacity (lnDSC) (in Magenta), supply chain management (lnSCM) (in light blue), corporate management (lnCM) (in green), and corporate performance (lnCP) (in blue), the vertical axis indicates the contribution of each variable at different lags (see Appendix A for specific figures), and the yellow area indicates the number of periods lagged.

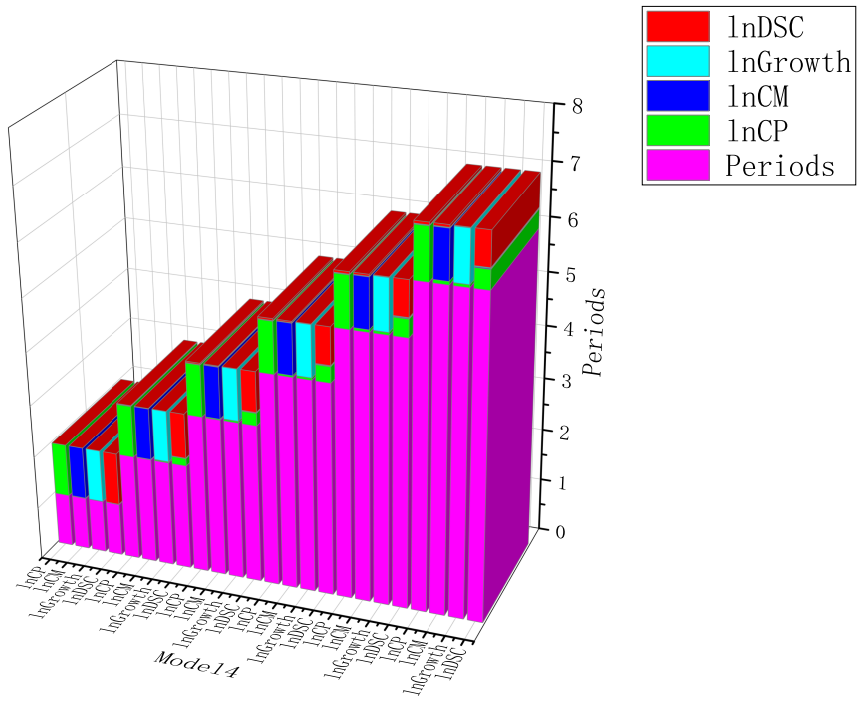

Figure 15. The graph shows the results of the variance decomposition of Model 4. The horizontal axis indicates the different variables including debt servicing capacity (lnDSC) (in red), growth capacity (lnGrowth) (in light blue), corporate management (lnCM) (in blue), and corporate performance (lnCP) (in light green), the vertical axis indicates the contribution of each variable at different lags (see Appendix A for specific figures), and the magenta area indicates the number of periods lagged.

As shown in Figure 16, in model 5, the contribution of corporate management (lnCM) to its own impulse response is 84%, and has a *p*-value significant at the 1% level. The contribution of corporate management (lnCM) to the impulse response of supply chain management (lnSCM) is 24.1%, and the *p*-value is significant at the 5% level. Growth capacity (lnGrowth) contributes 30.3% to its own impulse response and has a significant *p*-value at the 10% level. Debt service capacity (lnDSC) contributes 25% of the impulse response to supply chain management (lnSCM) and has a significant *p*-value at the 5% level. Debt service capacity (lnDSC) contributes 76.5% of its own impulse response and has a significant *p*-value at the 1% level.

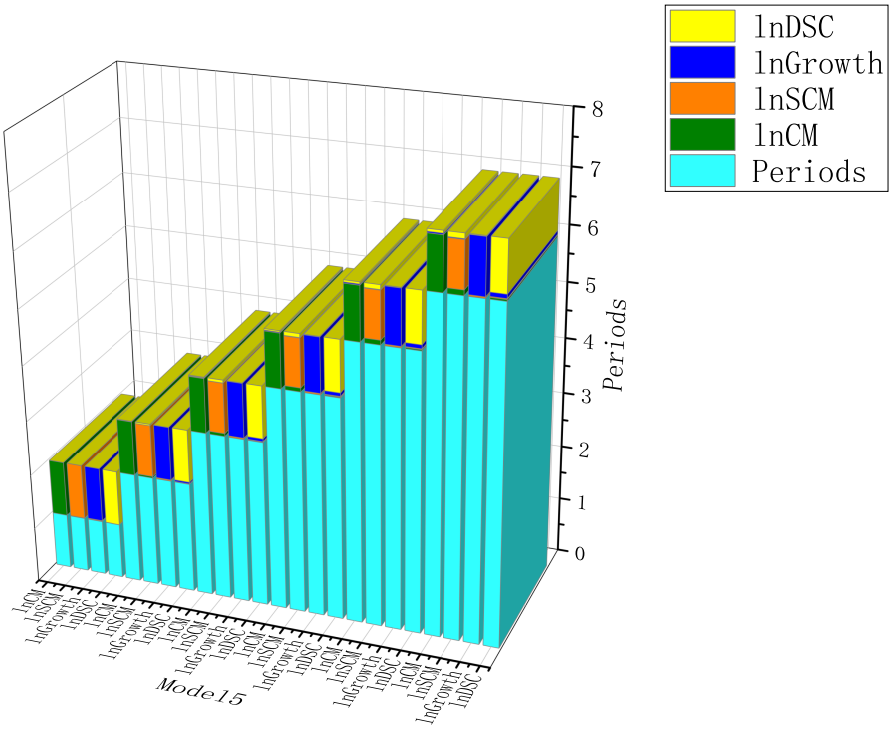

Figure 16. The graph shows the results of the variance decomposition of Model 5. The horizontal axis indicates the different variables including debt servicing capacity (lnDSC) (in yellow), growth capacity (lnGrowth) (in blue), supply chain management (lnSCM) (in orange), and corporate management (lnCM) (in green); the vertical axis indicates the contribution of each variable at different lags (see Appendix A for specific figures), and the light blue area indicates the number of periods lagged.

In summary: (1) R&D innovation, corporate management, supply chain management, growth capability, debt servicing capability, and corporate performance contribute the most to their own impulse responses, with an average of 87.4%, 81.8%, and 86.9%. The average contribution of the impulse responses was 87.4%, 81.8%, 86.9%, 96.9%, 86.5%, and 94.7%, respectively. (2) Solvency contributes more to the impulse response of corporate performance, with an average contribution of 21.7%.This may be because some agricultural products have been dependent on government subsidies for a long time, and the debt servicing capacity of listed companies in the agriculture and forestry industry has been weak, which has become a key factor affecting the corporate performance of listed companies in the agriculture and forestry industry.

3.6. Analysis of Regression Results

3.6.1. Regression Results

We analyzed the relationship between R&D innovation and firm performance using OLS, 2SLS, LIML, and GMM, respectively, and the regression results are shown in Table 5.

Firstly, we find that R&D innovation (lnR&D) is insignificant in the OLS regression. This may be due to the endogeneity problem. In the results of the pvar model, we found

that supply chain management (lnSCM) and growth capability (lnGrowth) were not directly related to the explanatory variable firm performance (lnCP), so we selected supply chain management (lnSCM) and growth capability (lnGrowth) as the instrumental variables for the explanatory variable research and development innovation (lnR&D). At the same time, corporate governance (lnCM) and debt-servicing capacity (lnDSC) were included as control variables. We find that the coefficients of each variable in the results of the 2SLS, LIML, and GMM models become highly significant after including the instrumental variables. This suggests that the effect of R&D innovation on corporate performance may be mediated through the instrumental variables supply chain management and growth capacity. This is also consistent with the results of the PVAR model, where there is no direct effect between R&D innovation and corporate performance.

Table 5. Regression results for different instrumental variable methods.

Variables	**lnCP**			
	OLS	**2SLS**	**LIML**	**GMM**
lnR&D	0.000371	0.0249 ***	0.0269 ***	0.0203 ***
	(0.0014)	(0.0067)	(0.0074)	(0.0050)
lnCM	0.00418 *	−0.0120 **	−0.0133 **	−0.00861 *
	(0.0024)	(0.0060)	(0.0064)	(0.0049)
lnDSC	−0.0278 ***	−0.0210 *	−0.0204 *	−0.0251 **
	(0.0093)	(0.0112)	(0.0114)	(0.0101)
Constant	−7.948 ***	−7.841 ***	−7.832 ***	−7.876 ***
	(0.0586)	(0.0763)	(0.0790)	(0.0666)
Observations	480	480	480	480

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

3.6.2. Testing

(1) Excess test

The overidentification test's result was a chi2 = 1.38234 with a *p*-value of 0.2397, so the original hypothesis was accepted, and both supply chain management (lnSCM) and growth capability (lnGrowth) were considered to be exogenous.

(2) Weak instrumental variables test

The test result of weak instrumental variables is *p*-value = 0.0000, and since the F-statistic is 28.4745, which is greater than 10, the original hypothesis of "there are weak instrumental variables" is rejected, and it is considered that there are no weak instrumental variables.

(3) Hausman's test

The results of the Hausman test show that chi2 = 13.26 and Prob > chi2 = 0.0003. Obviously, the regression results obtained by the instrumental variable method are more stable and reliable than the OLS regression results.

(4) Mediating effect test

To further investigate the relationship between R&D innovation and firm performance, we selected supply chain management and growth capability as mediating variables, respectively. The results of the mediating effect test are shown in Table 6, where we ran 1000 iterations using two bootstrap random sampling methods. Finally, we find that none of the direct effects of R&D innovation on firm performance are significant; instead, the indirect effects are all significant at the 1% level. There is a significant positive effect of R&D innovation on firm performance, with supply chain management and growth capability playing a fully mediating role in the above relationship.

Table 6. Results of the intermediate effects test.

Intermediate Variables	Effects	Observed Coefficient	Bootstrap Std. Err.
lnSCM	Indirect effect	0.001266 ***	0.000434
	Direct effect	−0.000895	0.001495
lnGrowth	Indirect effect	0.000905 ***	0.000198
	Direct effect	−0.000534	0.001467
Intermediate variables	z	$p > z$	Normal-based [95% conf.interval]
lnSCM	2.91	0.004	[0.000414, 0.002117]
	−0.6	0.549	[−0.003825, 0.002034]
lnGrowth	4.56	0.000	[0.000516, 0.001294]
	−0.36	0.716	[−0.003410, 0.002342]

Note: *** indicates significance at the 1% level.

4. Conclusions and Recommendations

4.1. Conclusions

(1) Corporate management, debt servicing capacity, and growth capacity are the Granger causes affecting supply chain management. R&D innovation, growth capability, and corporate performance are Granger causes affecting debt servicing capacity. Debt servicing capacity and corporate performance are Granger causes that influence each other.

(2) R&D innovation, corporate management, supply chain management, growth capability, debt servicing capacity, and corporate performance contribute the most to their own impulse responses with an average percentage of contribution values of 87.4%, 81.8%, 86.9%, 96.9%, 86.5%, and 94.7%. Debt servicing capacity contributed more to the impulse response of corporate performance, with an average contribution of 21.7%. Due to the long-term reliance on government subsidies for some agricultural products, the debt servicing capacity of listed companies in the agriculture and forestry industry has been weak, making it an essential factor affecting the corporate performance of listed companies in the agriculture and forestry industry.

(3) R&D innovation has a significant positive impact on corporate performance, while supply chain management and growth capability play a fully mediating role in the above relationship. Supply chain management is the most core competitiveness of listed companies in the agriculture and forestry industry, and is the key to corporate profitability. Growth capability is the key capability for business development. For listed companies in the agroforestry industry, enterprises can only achieve sustainable profitability if both supply chain capability and growth capability can be guaranteed. R&D innovation can only have a positive impact on corporate performance.

4.2. Recommendations

(1) For listed companies in agriculture and forestry, it is not enough just to increase the investment in R&D innovation if they want to improve their science and technology innovation capability because the impact of R&D innovation on enterprise performance is achieved through the instrumental variables supply chain management and growth ability. Secondly, the company's own growth ability is also important for R&D innovation, mainly because the R&D investment in science and technology innovation is generally large, and the return is slow. Therefore, only listed companies with strong growth ability can adapt to rapid market changes and realize the R&D investment in time.

(2) For the government, it should increase the support for scientific and technological innovation of listed companies in agriculture and forestry. In addition to the necessary financial subsidies, a certain percentage of tax relief or deduction can be given to the R&D expense items of listed companies in terms of taxation. At the same time, the government should reduce unnecessary taxes in the supply chain of agricultural products, and the key is the implementation of concessions in place. Focus on key industrial chains and major investment projects to clear blockages and unblock difficulties, and focus on leading

enterprises to strengthen factor protection, as well as the overall support of large and medium-sized enterprises and full resumption of production. For enterprises, efforts should be made to upgrade the industrial chain and supply chain. We will upgrade the industrial base and modernize the industrial chain. At the same time, we will carry out digital transformation actions, improve flexibility and synergy, and promote the circulation of factors. Smooth the cycle of industrial chains and supply chains across the board and form a long-term mechanism. Give agricultural products as many concessions and subsidies as possible. Suppose the government can grant more interest concessions or issue interest-free loans to listed agroforestry companies in its bank credit policy. In that case, it can help to ease the pressure of debt servicing for listed agroforestry companies, which may help the rapid growth of listed agroforestry companies and further be able to promote the prosperity of this domestic agricultural products market, playing a positive role in stabilizing the market price of agricultural products and promoting the development of the agroforestry industry.

(3) Pay attention to the cultivation of talents in the agriculture and forestry industry. Interdisciplinary crossover is an inevitable requirement for the development of agroforestry and an urgent need for industrial change. Agroforestry companies need to make efforts in designing talent training programs and other aspects. Further improve the evaluation system, vigorously create a culture of interdisciplinary research, recognize and master the laws in practice, and solidly promote the cultivation of complex, innovative talents, which will provide rich and high-quality "talent resources" for the in-depth implementation of innovation-driven development, company management, and other strategies.

5. Discussion

5.1. Insufficient Research

Although we selected 12 years of strong panel data for listed companies in the agroforestry industry from 2010–2021, 32 secondary-level indicators were selected for the study. However, we believe that these indicators are far from sufficient. After all, the agroforestry industry is a very complex system. The mathematical model we constructed using these indicators is still inadequate and needs to be further optimized.

5.2. Future Perspectives

In the future, we will collect more data from more databases on the Chinese agriculture and forestry industry. At the same time, we will add more indicators to improve and expand the mathematical model we have built. For example, we may also collect some indicators and data from non-listed companies by means of questionnaires to supplement our research.

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Appendix A

Table A1. Results of the variance decomposition of the five models.

	Variables	Periods	lnR&D	lnCM	lnSCM	lnDSC
Model1	lnR&D	1.000	1.000	0.000	0.000	0.000
	lnCM	1.000	0.000	1.000	0.000	0.000
	lnSCM	1.000	0.002	0.001	0.997	0.000
	lnDSC	1.000	0.007	0.002	0.001	0.991
	lnR&D	2.000	0.994	0.001	0.001	0.004
	lnCM	2.000	0.006	0.994	0.000	0.001
	lnSCM	2.000	0.004	0.014	0.962	0.020
	lnDSC	2.000	0.010	0.001	0.008	0.981
	lnR&D	3.000	0.985	0.002	0.002	0.010
	lnCM	3.000	0.015	0.983	0.000	0.001
	lnSCM	3.000	0.006	0.024	0.933	0.036
	lnDSC	3.000	0.013	0.001	0.011	0.974
	lnR&D	4.000	0.975	0.003	0.003	0.019
	lnCM	4.000	0.027	0.971	0.000	0.002
	lnSCM	4.000	0.009	0.030	0.915	0.046
	lnDSC	4.000	0.017	0.002	0.013	0.968
	lnR&D	5.000	0.965	0.003	0.004	0.028
	lnCM	5.000	0.040	0.958	0.000	0.002
	lnSCM	5.000	0.012	0.035	0.902	0.051
	lnDSC	5.000	0.021	0.003	0.013	0.963
	lnR&D	6.000	0.955	0.004	0.005	0.036
	lnCM	6.000	0.053	0.945	0.000	0.002
	lnSCM	6.000	0.015	0.037	0.894	0.054
	lnDSC	6.000	0.025	0.004	0.014	0.957
	Variables	**Periods**	**lnR&D**	**lnSCM**	**lnGrowth**	**lnDSC**
Model2	lnR&D	1.000	1.000	0.000	0.000	0.000
	lnSCM	1.000	0.004	0.996	0.000	0.000
	lnGrowth	1.000	0.000	0.006	0.994	0.000
	lnDSC	1.000	0.012	0.012	0.001	0.975
	lnR&D	2.000	0.999	0.000	0.001	0.001
	lnSCM	2.000	0.013	0.902	0.014	0.071
	lnGrowth	2.000	0.000	0.006	0.992	0.002
	lnDSC	2.000	0.016	0.036	0.019	0.929
	lnR&D	3.000	0.997	0.000	0.001	0.002
	lnSCM	3.000	0.024	0.811	0.024	0.141
	lnGrowth	3.000	0.001	0.007	0.988	0.005
	lnDSC	3.000	0.021	0.049	0.033	0.897
	lnR&D	4.000	0.996	0.000	0.001	0.003
	lnSCM	4.000	0.034	0.748	0.031	0.188
	lnGrowth	4.000	0.001	0.007	0.984	0.007
	lnDSC	4.000	0.028	0.057	0.040	0.876
	lnR&D	5.000	0.995	0.000	0.001	0.004
	lnSCM	5.000	0.043	0.706	0.034	0.217
	lnGrowth	5.000	0.001	0.008	0.982	0.010
	lnDSC	5.000	0.034	0.061	0.045	0.860
	lnR&D	6.000	0.994	0.000	0.001	0.005
	lnSCM	6.000	0.052	0.677	0.037	0.235
	lnGrowth	6.000	0.001	0.008	0.980	0.011
	lnDSC	6.000	0.041	0.063	0.048	0.849

Table A1. *Cont.*

	Variables	Periods	lnCP	lnCM	lnSCM	lnDSC
Model3	lnCP	1.000	1.000	0.000	0.000	0.000
	lnCM	1.000	0.009	0.991	0.000	0.000
	lnSCM	1.000	0.017	0.003	0.979	0.000
	lnDSC	1.000	0.002	0.004	0.001	0.993
	lnCP	2.000	0.966	0.000	0.027	0.007
	lnCM	2.000	0.015	0.980	0.000	0.005
	lnSCM	2.000	0.020	0.029	0.920	0.031
	lnDSC	2.000	0.118	0.007	0.023	0.852
	lnCP	3.000	0.947	0.001	0.032	0.021
	lnCM	3.000	0.025	0.962	0.000	0.014
	lnSCM	3.000	0.034	0.051	0.859	0.056
	lnDSC	3.000	0.219	0.008	0.020	0.753
	lnCP	4.000	0.933	0.002	0.031	0.034
	lnCM	4.000	0.037	0.939	0.000	0.024
	lnSCM	4.000	0.052	0.066	0.809	0.072
	lnDSC	4.000	0.278	0.009	0.017	0.696
	lnCP	5.000	0.922	0.003	0.030	0.044
	lnCM	5.000	0.051	0.914	0.000	0.035
	lnSCM	5.000	0.069	0.076	0.771	0.083
	lnDSC	5.000	0.312	0.010	0.015	0.663
	lnCP	6.000	0.914	0.005	0.030	0.052
	lnCM	6.000	0.065	0.890	0.000	0.045
	lnSCM	6.000	0.083	0.083	0.742	0.092
	lnDSC	6.000	0.332	0.012	0.014	0.642
	Variables	**Periods**	**lnCP**	**lnCM**	**lnGrowth**	**lnDSC**
Model4	lnCP	1.000	1.000	0.000	0.000	0.000
	lnCM	1.000	0.008	0.992	0.000	0.000
	lnGrowth	1.000	0.002	0.001	0.997	0.000
	lnDSC	1.000	0.000	0.004	0.005	0.991
	lnCP	2.000	0.983	0.000	0.007	0.010
	lnCM	2.000	0.011	0.980	0.004	0.005
	lnGrowth	2.000	0.021	0.002	0.976	0.002
	lnDSC	2.000	0.139	0.006	0.006	0.850
	lnCP	3.000	0.966	0.001	0.010	0.023
	lnCM	3.000	0.019	0.960	0.008	0.013
	lnGrowth	3.000	0.033	0.002	0.961	0.004
	lnDSC	3.000	0.237	0.008	0.008	0.747
	lnCP	4.000	0.954	0.001	0.012	0.033
	lnCM	4.000	0.031	0.936	0.010	0.023
	lnGrowth	4.000	0.040	0.002	0.951	0.007
	lnDSC	4.000	0.294	0.010	0.011	0.685
	lnCP	5.000	0.944	0.002	0.013	0.041
	lnCM	5.000	0.045	0.910	0.012	0.033
	lnGrowth	5.000	0.045	0.002	0.944	0.009
	lnDSC	5.000	0.327	0.013	0.013	0.647
	lnCP	6.000	0.937	0.003	0.013	0.047
	lnCM	6.000	0.059	0.884	0.014	0.044
	lnGrowth	6.000	0.048	0.002	0.939	0.011
	lnDSC	6.000	0.348	0.015	0.015	0.622

Table A1. *Cont.*

	Variables	Periods	lnCM	lnSCM	lnGrowth	lnDSC
Model5	lnCM	1.000	1.000	0.000	0.000	0.000
	lnSCM	1.000	0.006	0.994	0.000	0.000
	lnGrowth	1.000	0.001	0.017	0.982	0.000
	lnDSC	1.000	0.000	0.000	0.002	0.998
	lnCM	2.000	0.990	0.001	0.005	0.004
	lnSCM	2.000	0.029	0.945	0.000	0.026
	lnGrowth	2.000	0.001	0.022	0.974	0.002
	lnDSC	2.000	0.002	0.007	0.029	0.962
	lnCM	3.000	0.976	0.001	0.010	0.013
	lnSCM	3.000	0.051	0.896	0.003	0.050
	lnGrowth	3.000	0.001	0.024	0.969	0.006
	lnDSC	3.000	0.007	0.011	0.048	0.934
	lnCM	4.000	0.960	0.002	0.014	0.024
	lnSCM	4.000	0.068	0.858	0.007	0.067
	lnGrowth	4.000	0.002	0.024	0.965	0.009
	lnDSC	4.000	0.014	0.014	0.058	0.914
	lnCM	5.000	0.944	0.003	0.018	0.035
	lnSCM	5.000	0.081	0.828	0.010	0.080
	lnGrowth	5.000	0.003	0.024	0.962	0.011
	lnDSC	5.000	0.021	0.015	0.065	0.899
	lnCM	6.000	0.928	0.004	0.022	0.046
	lnSCM	6.000	0.092	0.805	0.013	0.090
	lnGrowth	6.000	0.003	0.024	0.960	0.013
	lnDSC	6.000	0.029	0.016	0.069	0.886

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