Scientific Research Publishing

American Journal of Industrial and Business Management, 2026, 16(5), 515-524
https://www.scirp.org/journal/ajibm
ISSN Online: 2164-5175
ISSN Print: 2164-5167

The Impact of Debt Leverage on Corporate Innovation Resilience: An Empirical Study Based on the Internet Industry

Lu Jin, Min Li

School of Finance and Economics, Wuhan College, Wuhan, China
Email: lujin2@ln.hk

How to cite this paper: Jin, L., & Li, M. (2026). The Impact of Debt Leverage on Corporate Innovation Resilience: An Empirical Study Based on the Internet Industry. *American Journal of Industrial and Business Management, 16,* 515-524.
https://doi.org/10.4236/ajibm.2026.165027

Received: May 8, 2026
Accepted: May 18, 2026
Published: May 21, 2026

Abstract

Taking A-share listed Internet and related digital service enterprises as the research objects, this paper uses financial and R&D data from 25 listed companies over 2021-2025. Since IR and Growth are measured by growth rates requiring prior-year values, the final regression sample covers fiscal years 2022-2025, generating 100 firm-year observations. Corporate innovation resilience is measured by the growth rate of R&D expenses, debt leverage is measured by the asset-liability ratio, and firm size, profitability, and growth ability are controlled for. The results show that debt leverage is negatively associated with corporate innovation resilience, indicating that a higher debt level may exert pressure on enterprises' continuous R&D investment. However, this effect does not show stable statistical significance in the sample. By contrast, corporate growth ability and firm size have a more pronounced effect on innovation resilience. The study suggests that Internet enterprises should reasonably control debt scale, optimize financing structure, and improve business growth ability and R&D investment efficiency in the process of enhancing innovation resilience.

Keywords

Debt Leverage, Innovation Resilience, Internet Industry, R&D Investment, Capital Structure

1. Introduction

The Internet industry is an important component of the digital economy. It is characterized by rapid technological iteration, fast business-model renewal, and intense market competition. Against the background of increasing uncertainty in

the external environment, whether enterprises can continuously maintain R&D investment and technological upgrading capabilities has become an important factor affecting their long-term competitiveness. Compared with traditional industries, Internet enterprises rely more heavily on technological platforms, data resources, and product innovation. Their innovation activities are related not only to short-term business growth but also to their ability to achieve sustainable development when facing market fluctuations and external shocks. Therefore, corporate innovation resilience has gradually become an important perspective for observing the high-quality development of Internet enterprises.

Innovation resilience emphasizes the ability of enterprises to maintain, recover, and enhance innovation capability under external shocks, operational pressure, or resource constraints. Hamel and Valikangas (2003) argue that resilience reflects an organization's ability to continuously adapt and renew itself in a changing environment. For Internet enterprises, innovation resilience is usually reflected in the continuity of R&D investment, the stability of technological renewal, and the flexibility of innovation resource allocation. As an important foundation of innovation activities, R&D investment can, to a certain extent, reflect enterprises' capability for continuous innovation.

Corporate innovation activities require financial support, and capital structure affects enterprises' ability to invest in long-term R&D projects. Modigliani and Miller (1958) laid the foundation for subsequent studies on corporate financing structure by examining the relationship between capital structure and firm value. Jensen and Meckling (1976) analyzed the impact of debt financing on firm behavior from the perspective of agency costs. For Internet enterprises, moderate debt can provide financial resources for business expansion and technological R&D, but excessive debt may increase interest burdens and repayment pressure, thereby crowding out R&D investment. Existing studies have paid considerable attention to the relationship among capital structure, financing constraints, and corporate innovation, yet there remains room for further empirical research on debt leverage and corporate innovation resilience in the Internet industry. Therefore, this paper uses listed Internet companies as the sample to analyze the impact of debt leverage on corporate innovation resilience.

2. Theoretical Analysis and Research Hypothesis

Debt leverage reflects the proportion of a firm's assets financed by debt and is an important indicator of capital structure and financial risk. Debt financing has a dual effect on corporate innovation. On the one hand, debt financing can alleviate the shortage of internal funds and provide external financial support for business expansion and technological R&D. For Internet enterprises in a stage of rapid development, external funds help expand user scale, strengthen platform construction, and continuously promote product iteration.

On the other hand, a high level of debt may weaken corporate innovation resilience. First, debt financing involves fixed repayment schedules and interest ex-

penses, which increase cash-flow pressure. When enterprises face market fluctuations or operational uncertainty, management may prioritize short-term debt repayment and cash-flow security, thereby reducing investment in long-term projects such as R&D. Second, innovation activities are characterized by long cycles, high risks, and uncertain returns, whereas debt financing usually requires stable repayment. A maturity mismatch may therefore exist between innovation activities and debt financing. Hall and Lerner (2010) point out that R&D and innovation activities generally face financing constraints and external financing costs, and financial conditions affect enterprises' innovation investment. Aghion et al. (2004) also find that innovative firms have special characteristics in terms of financing structure and that financial structure affects R&D activities.

For Internet enterprises, R&D investment often requires continuity. If a firm's debt level is too high, repayment pressure may lead it to reduce R&D expenses when operational pressure rises, thereby affecting its ability to maintain or increase R&D investment across years. Bhagat and Welch (1995) and Brown et al. (2009) both use R&D investment as an important indicator for analyzing corporate innovation activities and emphasize the important influence of financing conditions on R&D investment. Based on the above analysis, this paper proposes the following research hypothesis:

H1: Debt leverage has a negative impact on corporate innovation resilience.

3. Research Design

3.1. Sample Selection and Data Sources

This paper selects A-share listed Internet and related digital service enterprises as the research sample. According to the Guidelines for the Industrial Classification of Listed Companies issued by the JR/T 0020-2024 (China Securities Regulatory Commission, 2024), the industrial classification of listed companies includes "I Information Transmission, Software and Information Technology Services", under which there are subcategories such as "64 Internet and Related Services" and "65 Software and Information Technology Services". Based on this classification standard and the main business characteristics of listed companies, this paper mainly selects firms whose businesses are closely related to Internet platforms, online games, digital content, cybersecurity, cloud computing, data services, Internet media, software, and information technology services.

Considering the research topic, data availability, and sample continuity, this paper finally selects 25 listed companies as research objects, including East Money, Hithink RoyalFlush Information Network, 360 Security Technology, Kunlun Tech, 37 Interactive Entertainment, Kingnet Network, Perfect World, G-bits Network Technology, Ourpalm, Mango Excellent Media, Giant Network, Zhejiang Century Huatong Group, Beijing Shenzhou Taiyue Software, Youzu Interactive, Wuxi Boton Technology, Shenzhen ZQGame, Hangzhou Shunwang Technology, ChineseAll Digital Publishing Group, Zhejiang Daily Digital Culture Group, Hubei Century Network Technology, Shanghai Ganglian E-Commerce Holdings,

Beijing Zhidemai Technology, Daily Interactive, UCloud Technology, and People.cn. These enterprises are involved in Internet financial information services, cybersecurity, online games, digital content, Internet media, cloud computing, and data services, and are therefore closely related to the Internet industry and the digital economy.

The underlying data used in this paper cover the period from 2021 to 2025, while the final regression sample covers fiscal years 2022 to 2025. This is because corporate innovation resilience, denoted as IR, is measured by the growth rate of R&D expenses, and Growth is measured by the growth rate of operating revenue. Both indicators require prior-year values as the calculation base. Therefore, the 2021 data on R&D expenses and operating revenue are used only to calculate the 2022 values of IR and Growth, and 2021 itself is not included as a regression observation. In the regression analysis, Lev, Size, ROA, IR, and Growth are all matched to the fiscal years from 2022 to 2025. As a result, the final regression sample consists of 25 listed firms over four fiscal years from 2022 to 2025, generating 100 firm-year observations.

The sample screening procedure is as follows. First, A-share listed companies in the CSRC category of "I Information Transmission, Software and Information Technology Services" are selected, mainly including firms classified under "64 Internet and Related Services" and "65 Software and Information Technology Services". Second, firms whose main businesses are not closely related to Internet platforms, online games, digital content, cybersecurity, cloud computing, data services, Internet media, software, or information technology services are excluded. Third, ST and *ST firms are excluded to avoid the influence of abnormal financial conditions. Fourth, firms or observations with missing key variables, including R&D expenses, operating revenue, total assets, total liabilities, and net profit, are excluded. Fifth, observations with obvious abnormalities are excluded. In this paper, obvious abnormalities refer to cases in which key accounting items are missing or inconsistent across data sources, total assets, previous-year R&D expenses, or previous-year operating revenue are non-positive so that ratio or growth-rate indicators cannot be calculated properly, or the reported data contain apparent unit errors or data-entry errors after cross-checking with annual reports and database records. After applying the above screening rules, 25 listed companies are finally retained as the research sample.

The data required in this paper mainly include R&D expenses, operating revenue, total assets, total liabilities, and net profit. These data are mainly obtained from listed companies' annual reports, Eastmoney Choice data, and periodic reports disclosed on CNINFO. To ensure the reliability and consistency of the empirical analysis, the data are checked and matched across firms and years before the regression analysis is conducted.

3.2. Variable Design

1) Dependent variable: corporate innovation resilience. This paper takes corporate innovation resilience as the dependent variable, denoted as IR. Corporate

innovation resilience mainly reflects an enterprise's ability to continuously maintain R&D investment under changes in the external environment or operational pressure. Considering that the innovation activities of Internet enterprises are usually based on R&D investment, this paper measures corporate innovation resilience by the growth rate of R&D expenses. A higher value indicates faster growth in R&D expenses and stronger capability for continuous innovation. The formula is as follows:

IR = (Current-year R&D expenses − Previous-year R&D expenses)/Previous-year R&D expenses

In the empirical analysis, IR is calculated for fiscal years 2022-2025, while the 2021 R&D expense is used only as the base value for calculating the 2022 IR.

2) Explanatory variable: debt leverage. The core explanatory variable in this paper is debt leverage, denoted as Lev. Debt leverage measures the proportion of a firm's assets financed by debt and reflects its capital structure and financial risk level. This paper uses the asset-liability ratio to measure debt leverage. The formula is as follows:

Lev = Total liabilities/Total assets

3) Control variables. To reduce the influence of other firm characteristics on innovation resilience, this paper selects firm size, profitability, and growth ability as control variables. Firm size is denoted as Size and is measured by the natural logarithm of total assets. Profitability is denoted as ROA and is measured by the ratio of net profit to total assets. Growth ability is denoted as Growth and is measured by the growth rate of operating revenue. The formulas are as follows:

Size = ln(Total assets)

ROA = Net profit/Total assets

Growth = (Current-year operating revenue − Previous-year operating revenue)/Previous-year operating revenue

Similarly, Growth is calculated for fiscal years 2022-2025, and the 2021 operating revenue is used only as the base value for calculating the 2022 revenue growth rate (Table 1).

Table 1. Variable definitions.

Variable Type	Variable Name	Symbol	Measurement	Required Data
Dependent variable	Corporate innovation resilience	IR	Growth rate of R&D expenses	R&D expenses
Explanatory variable	Debt leverage	Lev	Total liabilities/total assets	Total liabilities; total assets
Control variable	Firm size	Size	Natural logarithm of total assets	Total assets
Control variable	Profitability	ROA	Net profit/total assets	Net profit; total assets
Control variable	Growth ability	Growth	Growth rate of operating revenue	Operating revenue

3.3. Model Construction

To examine the impact of debt leverage on corporate innovation resilience, this paper constructs the following regression model:

IR = alpha + beta Lev + gamma Size + delta ROA + theta Growth + epsilon

In this model, IR represents corporate innovation resilience, Lev represents debt leverage, Size represents firm size, ROA represents profitability, Growth represents growth ability, and epsilon is the random error term. If beta is negative, debt leverage may weaken corporate innovation resilience; if beta is significantly negative, the inhibitory effect is statistically supported.

4. Empirical Results Analysis

4.1. Descriptive Statistics

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. dev.	Min	Max
IR	100	−0.0024	0.179219	−0.39	0.59
Lev	100	0.2897	0.17626	0.08	0.87
Size	100	22.8533	1.250164	20.4	26.7
ROA	100	0.0345	0.1096401	−0.42	0.3
Growth	100	0.0376	0.2340902	−0.41	0.73

The descriptive statistics show that the number of observations for all main variables is 100, indicating that the sample data are relatively complete. In terms of corporate innovation resilience, the mean value of IR is −0.0024, which is close to zero. This indicates that the growth of R&D expenses among the sample Internet enterprises is generally stable during the research period, but the overall growth momentum is not strong. Its standard deviation is 0.1792, with a minimum of −0.39 and a maximum of 0.59, indicating large differences in R&D investment changes across enterprises and years and suggesting a certain degree of differentiation in innovation resilience. In terms of debt leverage, the mean value of Lev is 0.2897, indicating that the average asset-liability ratio of the sample firms is about 28.97%, which represents a moderate overall debt level. However, its minimum value is 0.08 and its maximum value is 0.87, indicating substantial differences in capital structure among firms and relatively high debt levels for some individual enterprises. In terms of firm size, the mean value of Size is 22.8533 and the standard deviation is 1.2502, suggesting differences in asset scale and resource base among the sample firms. In terms of profitability, the mean value of ROA is 0.0345, indicating an average return on assets of about 3.45% and an overall moderate level of profitability. The minimum value of −0.42 indicates that some enterprises experienced losses. In terms of growth ability, the mean value of Growth is 0.0376, indicating that the average growth rate of operating revenue is about

3.76%, showing slight overall growth. However, the minimum value is −0.41 and the maximum value is 0.73, indicating large differences in growth ability across enterprises. Overall, the sample firms differ in innovation resilience, debt level, profitability, and growth ability, making them suitable for subsequent correlation and regression analyses (Table 2).

4.2. Correlation Analysis

Table 3. Correlation analysis.

	IR	Lev	Size	ROA	Growth
IR	1.0000				
Lev	−0.0384	1.0000			
	0.7045				
Size	0.2579	0.3354	1.0000		
	0.0096	0.0006			
ROA	0.2119	−0.2243	0.2288	1.0000	
	0.0343	0.0249	0.0220		
Growth	0.4164	−0.0346	0.0966	0.2747	1.0000
	0.0000	0.7323	0.3393	0.0057	

The correlation analysis shows that the correlation coefficient between debt leverage Lev and corporate innovation resilience IR is −0.0384, indicating a negative correlation. This suggests that enterprises with higher debt levels may have relatively lower growth rates of R&D expenses. However, this result does not pass the significance test, indicating that the simple linear correlation between the two variables is not obvious. The correlation coefficient between firm size Size and IR is 0.2579 and is significant at the 1% level, indicating that larger enterprises usually have stronger resource bases and R&D investment capabilities and therefore higher innovation resilience. The correlation coefficient between profitability ROA and IR is 0.2119 and is significant at the 5% level, indicating that more profitable enterprises are more likely to maintain growth in R&D investment. The correlation coefficient between growth ability Growth and IR is 0.4164 and is significant at the 1% level, indicating that enterprises with faster operating revenue growth also have stronger innovation resilience. In addition, Lev is significantly positively correlated with Size, indicating that larger enterprises tend to have relatively higher debt levels. Lev is significantly negatively correlated with ROA, indicating that firms with higher debt levels may have relatively weaker profitability. Overall, the correlation analysis preliminarily indicates a negative but insignificant relationship between debt leverage and corporate innovation resilience, while firm size, profitability, and growth ability show more obvious positive relationships with innovation resilience (Table 3).

4.3. Regression Results Analysis

Table 4. Analysis of regression results.

Source	SS	df	MS	Number of obs = 100		
Model	0.740039443	4	0.18500986	F (4, 95) = 7.20		
Residual	2.43978456	95	0.02568194	Prob > F = 0.0000		
Total	3.179824	99	0.03211943	R-squared = 0.2327 Adj R-squared = 0.2004 Root MSE = 0.16026		
IR	Coefficient	Std. err.	t	*P*> |t|	[95% conf. interval]	
Lev	−0.1044539	0.1027012	−1.02	0.312	−0.3083416	0.0994338
Size	0.0357386	0.0144986	2.46	0.015	0.0069551	0.064522
ROA	0.0443262	0.1650771	0.27	0.789	−0.2833933	0.3720457
Growth	0.2919133	0.0716117	4.08	0.000	0.1497462	0.4340804
_cons	−0.8013888	0.3190772	−2.51	0.014	−1.434837	−0.1679404

The regression results show that the sample size is 100, the F-statistic is 7.20, and Prob > F is 0.0000, indicating that the model as a whole passes the significance test and has certain explanatory power. The R-squared is 0.2327 and the adjusted R-squared is 0.2004, indicating that the model can explain about 23.27% of the variation in corporate innovation resilience. Regarding the core explanatory variable, the regression coefficient of debt leverage Lev is −0.1045, indicating a negative relationship between debt leverage and corporate innovation resilience. In other words, with other conditions unchanged, the higher the debt level of an enterprise, the lower its growth rate of R&D expenses may be, and the weaker its innovation resilience may become. However, the *P*-value is 0.312, which does not pass the significance test, indicating that this negative effect is not statistically significant in the sample. Therefore, the research hypothesis is supported only in terms of direction. Regarding the control variables, the coefficient of firm size Size is 0.0357 and is significant at the 5% level, indicating that larger firms have stronger resource bases and R&D investment capabilities, which helps improve innovation resilience. The coefficient of growth ability Growth is 0.2919 and is significant at the 1% level, indicating that the faster the growth of operating revenue, the more obvious the growth in R&D investment and the stronger the innovation resilience. The coefficient of profitability ROA is positive but not statistically significant, suggesting that profitability does not have an obvious direct effect on innovation resilience. Overall, debt leverage has a negative but insignificant impact on corporate innovation resilience, while firm size and growth ability are more important factors affecting the innovation resilience of Internet enterprises (Table 4).

5. Conclusions and Recommendations

Using a balanced panel of 25 A-share Internet and related digital service enterprises from 2022 to 2025, with 2021 data used as the base year for calculating

growth-rate variables, this paper empirically analyzes the impact of debt leverage on corporate innovation resilience. The study finds that debt leverage has a negative effect on corporate innovation resilience, indicating that a higher debt level may increase repayment pressure and weaken enterprises' ability to continuously invest in R&D to some extent. However, this effect does not pass the significance test, suggesting that the inhibitory effect of debt leverage on innovation resilience is not stable in this sample. By contrast, corporate growth ability and firm size have more pronounced effects on innovation resilience, indicating that enterprises with faster revenue growth and stronger resource bases are more capable of maintaining growth in R&D investment.

Based on the above conclusions, this paper puts forward the following recommendations. First, Internet enterprises should reasonably control debt scale and avoid excessive dependence on debt financing. When expanding business scale and increasing R&D investment, enterprises should maintain moderate financial leverage in accordance with their cash-flow conditions and solvency. Second, enterprises should optimize financing structure, broaden diversified financing channels such as equity financing, internal accumulation, and strategic investment, and reduce the crowding-out effect of short-term debt pressure on R&D investment. Third, enterprises should improve growth ability and capital utilization efficiency by expanding revenue sources, optimizing business structure, and focusing on core technology R&D, thereby providing stable resources for continuous innovation.

This paper still has some limitations. First, the sample is mainly concentrated in A-share Internet and related digital service enterprises, and the sample size and industry coverage remain limited. Second, this paper uses the growth rate of R&D expenses to measure corporate innovation resilience. Although this indicator can reflect continuous changes in R&D investment, it does not fully consider dimensions such as patent output, R&D personnel, and the transformation of technological achievements. Future research can expand the sample scope and combine multiple innovation indicators to further examine the impact of capital structure on corporate innovation resilience.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Aghion, P., Bond, S., Klemm, A., & Marinescu, I. (2004). Technology and Financial Structure: Are Innovative Firms Different? *Journal of the European Economic Association, 2,* 277-288. https://doi.org/10.1162/154247604323067989

Bhagat, S., & Welch, I. (1995). Corporate Research & Development Investments International Comparisons. *Journal of Accounting and Economics, 19,* 443-470. https://doi.org/10.1016/0165-4101(94)00391-h

Brown, J. R., Fazzari, S. M., & Petersen, B. C. (2009). Financing Innovation and Growth: Cash Flow, External Equity, and the 1990s R&D Boom. *The Journal of Finance, 64,* 151-

185. https://doi.org/10.1111/j.1540-6261.2008.01431.x

China Securities Regulatory Commission (2024). *Industry Statistical Classification and Codes for Listed Companies (JR/T 0020-2024).* (In Chinese) https://www.csrc.gov.cn/csrc/c101954/c7520291/7520291/files/%E9%99%84%E4%BB%B61%EF%BC%9A%E3%80%8A%E4%B8%8A%E5%B8%82%E5%85%AC%E5%8F%B8%E8%A1%8C%E4%B8%9A%E7%BB%9F%E8%AE%A1%E5%88%86%E7%B1%BB%E4%B8%8E%E4%BB%A3%E7%A0%81%E3%80%8B.pdf

Hall, B. H., & Lerner, J. (2010). The Financing of R&D and Innovation. In B. H. Hall, & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation* (Vol. 1, pp. 609-639). Elsevier. https://doi.org/10.1016/s0169-7218(10)01014-2

Hamel, G., & Valikangas, L. (2003). The Quest for Resilience. *Harvard Business Review, 81,* 52-65.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics, 3,* 305-360. https://doi.org/10.1016/0304-405x(76)90026-x

Modigliani, F., & Miller, M. H. (1958). The Cost of Capital, Corporation Finance and the Theory of Investment. *The American Economic Review, 48,* 261-297.