Research on the Influence of Financing Channels on Enterprise R&D Investment

Xiaoqing Lin *

School of Economic and Management, Nanjing University of Science and Technology Nanjing, Jiangsu, China

* Corresponding Author Email: lxqnjust06@163.com

Abstract. Enterprise innovation is the core competitiveness of national economic development, and sufficient R&D investment is the premise for enterprises to achieve innovative breakthroughs. This study focuses on GEM-listed companies (representing high-growth and innovative SMEs in China) to explore the impact of financing channels on R&D investment. Using 4,592 unbalanced panel data observations from 507 GEM-listed companies during 2012–2022, theoretical analysis and empirical tests were conducted. The results show that: 1) Internal financing and equity financing significantly promote R&D investment of GEM enterprises; 2) Debt financing (a form of external financing) has a significant negative effect on R&D investment. This research helps GEM-listed enterprises identify the impact of different financing channels, provides theoretical support for solving financing constraints of innovative enterprises, and ultimately enhances enterprises' core competitiveness to promote national economic development.

Keywords: Internal Financing, External Financing, R&D Investment, GEM-Listed Enterprises.

1. Introduction

1.1. Research Background

Innovation is the primary driving force for China's economic development and social progress. The 19th Fifth Plenary Session emphasized the innovation-centered development strategy, and enterprises are the main body of innovation. However, R&D activities require substantial capital support, and innovative enterprises often face severe financing constraints due to high R&D costs, information asymmetry, long cycles, and uncertain outcomes. Internal capital alone is insufficient to sustain R&D, while external financing is costly, which hinders enterprises' R&D enthusiasm and innovation capabilities. Against this background, this study analyzes the impact of different financing channels on R&D investment to support innovative enterprises in addressing financing constraints.

1.2. Research Significance

Theoretical Significance: This study verifies the correlation between different financing channels and R&D investment by introducing multiple control variables and empirical tests, enriching research in the field of enterprise innovation and financing.

Practical Significance: Taking GEM-listed enterprises as the research object, this study explores the role of internal financing, equity financing, debt financing, and government subsidies in R&D innovation. It optimizes enterprises' R&D investment decisions, provides targeted guidance for government subsidy policies, and strengthens the role of innovation in promoting economic development.

1.3. Research Methods and Content

1.3.1. Research Content

This study classifies financing channels into internal financing, external financing (equity financing and debt financing), and government subsidies. It analyzes the theoretical relationship between these channels and R&D investment, proposes hypotheses, and uses empirical analysis to verify the impact of financing channels on R&D investment intensity of GEM-listed enterprises.

1.3.2. Research Methods

Literature Review: Combs domestic and foreign studies on financing channels, financing constraints, and R&D investment to clarify research trends.

Empirical Analysis: Uses Stata 16.0 to process data, including descriptive statistics, correlation analysis, regression analysis, and robustness tests, based on enterprise financial data.

1.4. Research Innovations

Target Refinement: Focuses on representative GEM-listed enterprises and compares the impact of equity financing and debt financing (two sub-types of external financing), making up for the lack of refinement in previous external financing studies.

Lag Effect Handling: Considers the long cycle of R&D investment and processes the lag effect of internal financing and government subsidies in empirical tests.

2. Literature Review

2.1. Snternal Financing and R&D Investment

Most studies confirm that internal financing is the core source of R&D investment. Sasidharan et al. (2015) found a significant positive correlation between internal financing and R&D expenditure of Indian listed companies. Domestic scholars such as Duan (2016) and Zhuang (2020) also verified that internal financing positively promotes R&D investment, while debt ratio has a negative impact. Shen & Xie (2017) pointed out that financing constraints mainly come from insufficient internal cash flow and high external financing costs caused by information asymmetry.

2.2. Financing Structure and R&D Investment

External financing is necessary when internal financing is insufficient, but its sub-types have different effects:

Equity Financing: Preferred by R&D-intensive enterprises. Carpenter & Petersen (2002) and Müller & Zimmermann (2009) found that equity financing positively promotes R&D investment. Domestic studies (Liu et al., 2018; Wang et al., 2020) also confirmed that equity financing eases financing constraints and boosts R&D.

Debt Financing: Has a negative impact on R&D. David et al. (2008) and Wang & Hu (2022) noted that debt financing requires collateral and stable repayment, which conflicts with R&D's high risk and long cycle. Domestic scholars (Xiao, 2020; Song, 2020) further verified that debt financing inhibits R&D investment of Chinese enterprises.

2.3. Literature Review Summary

Existing studies agree that capital shortage restricts R&D innovation, and internal financing plays a prominent role. However, most studies focus on large listed companies, with few targeting GEM enterprises. This study fills this gap by examining the impact of internal, external financing, and government subsidies on GEM enterprises' R&D investment.

3. Theoretical Analysis and Research Hypotheses

3.1. Financing Theories and Enterprise R&D Investment

3.1.1. Research Methods

High-tech enterprises' R&D projects are confidential, leading to information asymmetry between internal and external parties. External investors demand higher returns to compensate for uncertainty, making internal financing and equity financing the main sources of R&D funds. Government subsidies may be misused due to poor supervision, reducing their promotion effect on R&D.

3.1.2. Principal-Agent Theory

Conflicts exist between owners-managers and external investors-managers: Managers may reduce R&D investment to avoid risks; external investors cannot ensure funds are used for R&D, leading to reduced investment willingness or higher financing costs. Thus, enterprises prefer internal funds for R&D.

3.1.3. Pecking Order Theory

Myers & Majluf (1984) pointed out that due to R&D's high risk and information asymmetry, external financing costs are higher than internal financing. Enterprises prioritize internal funds for R&D to reduce cost and risk.

3.2. Research Hypotheses

H1: Internal financing has a significant positive correlation with enterprise R&D investment.
H2: Equity financing has a significant positive correlation with enterprise R&D investment.
H3: Debt financing has a significant negative correlation with enterprise R&D investment.

4. Empirical Study on Financing Channels and Enterprise R&D Investment

4.1. Sample Selection and Data Source

Sample: GEM-listed companies during 2012–2022, with samples excluded if: 1) Key variables (R&D, total assets, government subsidies) are missing; 2) Financial structure is abnormal; 3) Listed as ST/SST/*ST or delisted. Finally, 4,592 unbalanced panel data are obtained.

Data Source: Financial data from CSMAR database; R&D investment and government subsidy data from annual reports (manually collected).

4.2. Variable Selection and Definition

Variables are defined in Table 1.

Table 1. Definition of Variables

Variable Type	Symbol	Variable Name	Calculation Method
Dependent Variable	R&D	R&D Investment	R&D Expenses / Total Assets at the End of T-1 Period
Independent Variables	EnFund	Internal Financing	(Net Operating Cash Flow - Cash Paid for Dividends/Interest) / Total Assets at the End of the Period
	Stock	Equity Financing	(Share Capital + Capital Surplus) / Total Assets at the End of the Period
	Debt	Debt Financing	(Short-term Loans + Long-term Loans + Corporate Bonds Payable) / Total Assets at the End of the Period
Control Variables	Age	Listing Years	Observation Year - Listing Year
	Size	Enterprise Scale	Natural Logarithm of Total Assets at the End of the Period
	Q	Investment Opportunities	Enterprise Market Value / Total Assets
	Roa	Profitability	Current Return on Net Assets
	Lev	Capital Structure	Asset-Liability Ratio
	Share	Equity Concentration	Shareholding Ratio of the Largest Shareholder

4.3. Model Construction

1.To test the hypotheses, the following regression models are established:
Test H1 (Internal Financing):

$$RD_{i,t} = \alpha_0 + \alpha_1 Enfund + \alpha_2 \beta_{i,t} + \varepsilon_{i,t} \quad (1)$$

Test H2 (Equity Financing) and H3 (Debt Financing):

$$RD_{i,t} = \alpha_0 + \alpha_1 Enfund + \alpha_2 Stock_{i,t} + \alpha_3 \beta_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$RD_{i,t} = \alpha_0 + \alpha_1 Enfund + \alpha_2 Debt_{i,t} + \alpha_3 \beta_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$RD_{i,t} = \alpha_0 + \alpha_1 Enfund + \alpha_2 Stock_{i,t} + \alpha_3 Debt_{i,t} + \alpha_4 \beta_{i,t} + \varepsilon_{i,t} \quad (4)$$

Where: $\beta_{i,t}$represents control variables; $\alpha_0 - \alpha_4$ are to-be-estimated parameters; ε is the error term.

5. Empirical Results (Based on GEM-listed Enterprises)

5.1. Descriptive Statistics

Table 2 shows descriptive statistics of variables. The average R&D investment ratio (R&D) is 4.2%, with a large gap between the minimum (0.5%) and maximum (38.1%), indicating uneven R&D support among enterprises. The average internal financing (EnFund) is 0.95%, reflecting large differences in internal capital levels. Equity financing (Stock) has a higher average (58.3%) than debt financing (Debt, 9.5%), showing GEM enterprises prefer equity financing.

Table 2. Statistics of Full Sample

Variable	Observation	Mean	Std. Dev.	Min	Max
R&D	4,592	0.042	0.033	0.005	0.381
EnFund	4,592	0.0095	0.070	-0.427	0.520
Stock	4,592	0.583	0.328	0.064	10.95
Debt	4,592	0.095	0.119	-0.002	0.744
Age	4,592	4.301	2.775	1.000	11.00
Size	4,592	21.25	0.772	18.36	25.53
Q	4,592	2.394	1.526	0.811	22.57
Roa	4,592	0.021	0.376	-14.06	0.664
Lev	4,592	0.274	0.170	0.007	1.400
Share	4,592	0.296	0.124	0.030	0.811

5.2. Correlation Analysis

Table 3 (Correlation Matrix) shows: Internal financing (EnFund) and equity financing (Stock) are positively correlated with R&D at the 1% significance level; debt financing (Debt) is negatively correlated with R&D at the 1% significance level. This preliminary supports H1, H2, and H3.

Table 3. Correlation Matrix of Variables

	RD	Enfund	Stock	Debt	Age	Q	Roa	Lev	Share
RD	1								
Enfund	0.083***	1							
Stock	0.060***	0.100***	1						
Debt	-0.104***	-0.140***	-0.234***	1					
Age	-0.090***	0.032***	0.117***	0.173***	1				
Q	0.214***	0.155***	0.040***	-0.142***	0.025*	1			
Roa	0.080***	0.072***	-0.249***	-0.136***	-0.139***	0.055***	1		
Lev	-0.083***	-0.036**	-0.284***	0.686***	0.182***	-0.111***	-0.209***	1	
Share	-0.089***	0.00600	-0.121***	-0.041***	-0.284***	0.00300	0.086***	-0.036**	1

5.3. Regression Result Analysis

Table 4 shows full-sample regression results:

Model (1): Internal financing (EnFund) coefficient is 0.024*** (p<0.01), supporting H1.

Model (2): Equity financing (Stock) coefficient is 0.008*** (p<0.01), supporting H2.

Model (3): Debt financing (Debt) coefficient is -0.013*** (p<0.01), supporting H3.

Model (4): Simultaneously including three financing variables, coefficients remain consistent in direction and significance, further verifying the hypotheses.

Control variables: Tobin's Q (Q) and Roa are positively correlated with R&D; equity concentration (Share) is negatively correlated with R&D (due to potential decision-making bias from high concentration).

Table 4. Full-Sample Regression Results

Variable	R&D (Model 1)	R&D (Model 2)	R&D (Model 3)	R&D (Model 4)
EnFund	0.024***(3.16)	0.021***(2.71)	0.022***(2.79)	0.018**(2.27)
Stock	-	0.008***(4.61)	-	0.008***(4.96)
Debt	-	-	-0.013***(-2.77)	-0.016***(-3.27)
Age	-0.001***(-7.21)	-0.001***(-6.59)	-0.001***(-7.00)	-0.001***(-6.33)
Q	0.004***(9.81)	0.004***(9.89)	0.004***(9.70)	0.004***(9.78)
Roa	0.005***(2.84)	0.003**(2.20)	0.005***(2.85)	0.003**(2.20)
Lev	-0.006**(-2.10)	-0.012***(-3.82)	-0.001*(-0.08)	-0.005*(-1.21)
Share	-0.035***(-8.80)	-0.037***(-9.18)	-0.035***(-8.80)	-0.037***(-9.21)
Constant	0.049***(19.79)	0.055***(20.30)	0.049***(19.47)	0.055***(20.31)
Obs.	4,592	4,592	4,592	4,592
Adj. R^2	0.177	0.182	0.178	0.184
F	38.09***	36.44***	34.09***	33.89***

Note: *** p<0.01, ** p<0.05, * p<0.1; t-values in parentheses

5.4. Robustness Test

Replacing the definition of internal financing (using "Retained Earnings + Accumulated Depreciation" instead), regression results (Table 5) show that internal financing and equity financing still positively affect R&D, while debt financing negatively affects R&D. This confirms the robustness of the conclusions.

Table 5. Robustness Test Regression Results

Variable	R&D (Model 1)	R&D (Model 2)	R&D (Model 3)	R&D (Model 4)
EnFund	0.019***(4.77)	0.025*(1.60)	0.019***(5.10)	0.024*(1.53)
Stock	-	0.016*(1.03)	-	0.015*(0.95)
Debt	-	-	-0.018***(-3.78)	-0.018***(-3.72)
Age	-0.001***(-6.48)	-0.001***(-6.53)	-0.001***(-6.23)	-0.001***(-6.28)
Q	0.005***(10.19)	0.005***(10.19)	0.005***(10.01)	0.005***(10.02)
Roa	0.003**(2.21)	0.003**(2.29)	0.003**(2.21)	0.003**(2.28)
Lev	-0.004*(-1.33)	0.012*(0.77)	0.005**(1.27)	0.019*(1.19)
Share	-0.037***(-9.18)	-0.037***(-9.18)	-0.037***(-9.21)	-0.037***(-9.21)
Constant	0.047***(18.41)	0.030*(1.87)	0.046***(18.08)	0.031*(1.89)
Obs.	4,592	4,592	4,592	4,592
Adj. R^2	0.081	0.081	0.083	0.084
F	41.64***	35.98***	38.27***	33.66***

Note: *** p<0.01, ** p<0.05, * p<0.1; t-values in parentheses

5.5. Group Regression

Grouping samples by ownership (state-owned, private, other types such as foreign-funded), results (Table 6) show: Internal financing and equity financing positively affect R&D, while debt financing negatively affects R&D across all groups. The promotion effect of internal/equity financing and the inhibition effect of debt financing are more significant in foreign-funded or mixed foreign-private enterprises (due to more mature foreign financial markets).

Table 6. Group Regression Results by Ownership

Variable	State-Owned Enterprises (RD)	Private Enterprises (RD)	Other Types (RD)
EnFund	0.020***(0.76)	0.014***(1.46)	0.039***(0.88)
Stock	0.001***(0.13)	0.008***(3.74)	0.049***(3.00)
Debt	-0.052***(-1.94)	-0.012***(-2.34)	-0.060***(-2.42)
Age	-0.001**(-0.77)	-0.001***(-3.62)	-0.001**(-0.37)
Q	0.003***(1.80)	0.004***(8.84)	0.002***(0.89)
Roa	0.004**(0.36)	0.005**(2.14)	-0.001**(-0.54)
Lev	0.020**(0.95)	-0.006**(-1.28)	-0.012**(-0.39)
Share	-0.013**(-0.69)	-0.028***(-6.69)	-0.048***(-2.65)
Constant	0.030***(3.16)	0.044***(14.15)	0.083***(4.31)
Obs.	217	3,265	113
Adj. R^2	0.178	0.144	0.310
F	23.46***	29.87***	25.74***

Note: *** p<0.01, ** p<0.05, * p<0.1; t-values in parentheses

6. Conclusions and Suggestions

6.1. Research Conclusions

Internal financing and equity financing significantly promote R&D investment of GEM-listed enterprises; debt financing has a significant negative effect.

Government subsidies positively affect R&D but account for a small proportion of total assets, indicating insufficient subsidy intensity.

Ownership differences exist: The promotion of internal/equity financing and the inhibition of debt financing are more significant in foreign-funded or mixed foreign-private enterprises.

6.2. Suggestions

Enterprise-Level

Strengthen Internal Capital Management: Improve internal governance, optimize cash flow, and reduce information asymmetry to lower external financing costs.

Expand Equity Financing: Enhance core competitiveness and R&D capabilities to attract equity investment (e.g., venture capital, IPO).

Respond to National Policies: Focus on government subsidy policies and international R&D trends to seize innovation opportunities.

Government-Level

Increase R&D Subsidies: Provide targeted subsidies to GEM enterprises to ease capital pressure.

Optimize Financing Environment: Improve the equity financing market and guide financial institutions to develop R&D-friendly debt products.

References

[1] Sasidharan S, Lukose P J, Komera S. Financing constraints and investments in R&D: Evidence from Indian manufacturing firms [J]. The Quarterly Review of Economics and Finance, 2015, 55: 28 - 39.

[2] Duan H Y. The impact of different financial capital sources on enterprise R&D investment—A case study of SME board listed companies [J]. Science & Technology Progress and Policy, 2016, 33 (14): 88 - 92.

[3] Hsu P-H, Tian X, Xu Y. Financial development and innovation: Cross-country evidence [J]. Journal of Financial Economics, 2014, 112 (1): 116 - 135.

[4] Zhuang Q. Research on the impact of financing constraints on R&D investment of Chinese manufacturing enterprises [J]. Contemporary Economic Management, 2020, 42 (10): 47 - 53.

[5] Shen D C, Xie H L. The impact of financing constraints on R&D investment [J]. Productivity Research, 2017 (6): 140 - 143.

[6] Hall B H, Lotti F, Mairesse J. Evidence on the impact of R&D and ICT investments on innovation and productivity in Italian firms [J]. Economics of Innovation and New Technology, 2013, 22 (3): 300 - 328.

[7] Wang T, Thornhill S. R&D investment and financing choices: A comprehensive perspective [J]. Research Policy, 2010, 39 (9): 1148 - 1159.

[8] Chen Y, Zhan Y H, Wang L X. R&D investment, independent director structure and innovation performance—An empirical test based on Chinese listed family firms [J]. Science Research Management, 2018, 39 (1): 95 - 107.

[9] Liu J S, Fan C L. Heterogeneous effects of internal and external financing on enterprise innovation investment at different stages—Based on data of Chinese manufacturing listed companies [J]. Business Economics and Management, 2019 (1): 88 - 97.

[10] Ren H Y. An empirical study on the relationship between ownership structure and enterprise R&D investment—Based on data of A-share manufacturing listed companies [J]. China Soft Science, 2010 (5): 126 - 135.

[11] Li L Q. A study on the correlation between R&D investment density and financing policies of Chinese enterprises [J]. Reform & Strategy, 2008, 24 (8): 134 - 137.

[12] Carpenter R E, Petersen B C. Capital market imperfections, high-tech investment, and new equity financing [J]. The Economic Journal, 2002, 112 (477): F54 - F72.

[13] Müller E, Zimmermann V. The importance of equity finance for R&D activity [J]. Small Business Economics, 2009, 33 (3): 303 - 318.

[14] David P, O'brien J P, Yoshikawa T. The implications of debt heterogeneity for R&D investment and firm performance [J]. Academy of Management Journal, 2008, 51 (1): 165 - 181.

[15] Wang Q H, Hu J F. Government subsidies, financing structure and enterprise innovation investment—Evidence from China's strategic emerging industries [J]. Shanghai Economy, 2022 (1): 13 - 31.