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Revista de Cercetare si Interventie Sociala

ISSN: 1583-3410 (print), ISSN: 1584-5397 (electronic)

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Revista de cercetare și intervenție socială, 2019, vol. 67, pp. 103-113

<https://doi.org/10.33788/rcis.67.7>

Published by:
Expert Projects Publishing House



On behalf of:
„Alexandru Ioan Cuza” University,
Department of Sociology and Social Work
and
HoltIS Association

REVISTA DE CERCETARE SI INTERVENTIE SOCIALA
is indexed by Clarivate Analytics (Web of Science) -
Social Sciences Citation Index
(Sociology and Social Work Domains)

Effects of Leverage Ratio on Corporate Research and Development Expenditure of Small and Medium Enterprises

Ridong HU¹, Wu FAN²

Abstract

With the data of listed companies on SME board in 2014-2017, fixed effect model is utilized for testing the effect of leverage ratio on corporate research and development expenditure of small and medium enterprises from the perspectives of debt maturity, debt source, and innovation heterogeneity. The empirical result reveals significantly negative effects of leverage level on corporate R&D expenditure of domestic SMEs, and such effects become more obvious in enterprises engaging in exploratory innovation. From the perspectives of debt maturity and source, extremely high short-term debt level and excessive dependence on commercial credit as corporate financing channels are the factors in high leverage level restraining corporate R&D expenditure of domestic SMEs.

Keywords: corporate innovation, social research, conventional innovation, risk, dependence.

Introduction

Along with the end of demographic dividend period in China and the gradual transfer of labor intensive industry to Southeast Asia region, domestic small and medium enterprises need to cultivate the core competency through innovation in order to better cope with future challenge. The promotion of corporate innovation relies on the increase in research and development expenditure to satisfy the financing needs of enterprises for product design and process improvement innovation. Domestic SMEs present more than 99% of total number of enterprises, show more than 60% contribution rate to domestic GDP, and offer up to 80% urban employment. Apparently, SMEs have become an important strength for domestic economic rise (Lee *et al.*, 2007). However, the rapid development of domestic

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SMEs also exposes the shortage in the development process, including the major problems of excessive dependence on labor intensive industry, weaker R&D level, and lack of persistence of follow-up development (Hu, & Hu, 2016).

R&D activity reveals the characteristics of large investment, long cycle, and high risks (Hall, 2010; Chen, 2016) and requires persistent and steady cash flow for avoiding losses caused by the interruption (Ju, 2013). According to pecking order theory, corporate preference of source of funds for innovation activity, due to information asymmetry and innovation activity, is ordered internal financing, debt financing, and equity financing (Myers, 1984; Hall, 2010; Tsai, Wang, & Ho 2013; Yue, 2017). It is broadly affirmed that internal financing could enhance corporate investment in innovation. Nevertheless, internal financing generally could not support the persistent R&D activity of SMEs. External financing therefore is an important channel of the source of funds for R&D expenditure of SMEs (Czarnitzki, 2011; Hu, & Hu, 2016). Besides, the relatively strict policy to domestic capital market has debt financing become a primary financing channel for domestic enterprises (Pu, & Zhang, 2016). On one hand, high leverage ratio is a hidden trouble for domestic sound development of economy that “structural de-leveraging”, from the perspectives of risk prevention and long-term and steady economic development, is essential. On the other hand, not being able to rationally reduce the leverage ratio of non-financial enterprises might result in SMEs losing the important source of funds for debt financing to have SMEs fall in the dilemmas of capital shortage and liquidity shortage. It is adverse to the innovation activity of enterprises and would restrain the long-term development of domestic SMEs. Under such background, research on the effect of leverage level on R&D expenditure of SMEs presents certain meanings on coordinating the relationship between “de-leveraging” and “innovation promotion” of domestic SMEs.

Literature review

Effects of leverage level on R&D expenditure of enterprises

Theoretically, high leverage level might hinder corporate research and development expenditure to restrain the debt financing that would specifically appears on the remarkably negative correlations between leverage level and corporate R&D expenditure. First, an enterprise could maximize financial leverage by enhancing the leverage level to control larger cash flow with smaller owned funds for supporting the business activity. However, high leverage ratio would increase corporate financial risks. In comparison with equity financing and internal financing, an enterprise depending too much on debt financing would have to prepare more cash flow to cope with the pressure of interest on debt and

repayment of matured principal. Meanwhile, most debt financing, with fixed interests, could hardly be adjusted the payment limit with the business situation of enterprises. In consideration of the high risks of innovation activity due to technical uncertainty and market uncertainty, enterprises with high leverage ratio would have to reduce R&D expenditure and choose conservative operation methods to cope with the pressure of capital repayment and interest (Gu & Zhuang, 2016). It is also considered in pecking order theory that debt financing could better benefit corporate R&D activity and maximize corporate value than other external financing. Nonetheless, enterprises still prefer internal financing for R&D activity. Second, the signal model of capital structure (Ross, 1977) reveals that enterprises could deliver positive signals to investors by properly enhancing the leverage ratio, when there is information asymmetry, to acquire more financing support. However, according to asset substitution theory proposed by Myers (1977), high leverage level would enhance business owners' motivation for excessive risks and increase the possibility to have the enterprises fall into debt crises. Conservative investors might reduce the investment in enterprises with high debt level that the financing cost of the enterprises is increased to cause negative effects on the R&D activity and even the daily business activity (Zhou, & Sheng, 2004). Finally, increasing leverage ratio might increase the principal-agent problem between business owners and managers. Stockholders expect that managers could make investment decisions to maximize corporate value, while managers with risk aversion would prefer the investment with smaller risks, low costs, and fast benefits, when the enterprises appear higher negative leverage ratio, and give up the investment with high net present value but longer cycle and higher costs. By combining above analyses with the objective fact of current domestic enterprises with high leverage ratio and the research conclusion of Liu and Liu (2011), Xiao, Tan, and Zhou (2014), and Zhong (2016) on domestic listed companies, the first hypothesis is proposed in this study.

H1: Leverage level shows significantly negative correlations with corporate R&D expenditure.

Effects of debt source and maturity difference on R&D expenditure

To further discuss the effect of types of debt on corporate research and development expenditure, corporate leverage ratio is further classified according to debt maturity and source. Referring to the analyses of Wen (2010) and Wang, Lo, and Liu (2019), corporate debt is divided, according to debt source, into commercial credit liability and bank lending credit liability, and the correspondent types of debt are measured with commercial credit leverage and bank credit leverage. On one hand, commercial credit presents the characteristics of short repayment time and more dispersion that high commercial credit leverage would enhance the pressure of debt repayment for enterprises and could hardly support innovation activity. On

the other hand, the period of bank loan is distinct, corporate autonomic decision space is smaller as the use of loan would be supervised by the banks, and banks would carefully inspect enterprises and request sufficient collateral of enterprises to control the risks. The innovation output presents certain asset specificity, which reveals relatively low value as collateral for a bank. Moreover, adverse selection resulted from information asymmetry might have a bank offer inadequate loan for SMEs. As a result, it is considered that bank lending leverage of SMEs would not appear negative effects on corporate R&D expenditure. Based on above analyses, the second hypothesis is proposed.

H2: Commercial credit leverage reveals remarkably negative correlations with R&D expenditure, while bank lending leverage does not appear notably negative effects on corporate R&D expenditure.

From the perspective of debt repayment period, corporate debt could be divided into long-term debt and short-term debt. Referring to Kim and Lee (2008), long-term leverage ratio and short-term leverage ratio are measured in this study. Corporate innovation activity generally shows the characteristics of long period and high adjustment cost (Ju, 2013). From the perspective of maturity fit theory, an enterprise should prefer long-term debt for R&D activity (Zhao, & Yeh, 2016). However, according to liquidity preference theory, long-term debt presents higher direct financing cost. Due to the adverse selection problem resulted from information asymmetry; SMEs might hardly acquire long-term debt to support the R&D activity. Short-term debt might be more easily acquired, but depending too much on short-term debt would cause certain pressure on corporate cash flow, weaken corporate innovation motivation, and force enterprises making profits shortly, steadily, and fast to prevent from debt default (Chen, Zhang, & Zhai, 2016). From *Table 1*, domestic listed SMEs present far lower long-term debt level than short-term debt level, revealing that domestic SMEs might depend too much on short-term debt. The third hypothesis is therefore proposed.

H3: Short-term leverage ratio presents significantly negative correlations with corporate R&D expenditure, while long-term leverage level does not show negative effects on corporate R&D expenditure.

Effects of corporate innovation activity difference

From the perspective of the heterogeneity of corporate innovation activity, conventional innovation products are generally recombined with original products to become new products (Zhao, & Yeh, 2016) that the R&D risk and market risk are relatively lower. Exploratory innovation is comparatively radical and the research and development cycle is relatively longer. The innovation products are often

the new products in the entire market (Jansen, Bosch, & Volberda 2006) that the success rate of exploratory innovation and the market acceptance of the innovation output can hardly be estimated. For this reason, creditors would request higher return on invested capital from enterprises with exploratory innovation, comparing to those with conventional innovation, to compensate the risk. In consideration of term structure fit theory and the fact of high leverage ratio of domestic enterprises, the fourth hypothesis is proposed in this study.

H4: Leverage ratio reveals notably negative correlations with R&D expenditure of enterprises with exploratory innovation, and leverage level appears larger negative effects on enterprises with exploratory innovation than on enterprises with conventional innovation.

Methodology

Indicator selection

Dependent variable: R&D_{it} is a dependent variable, standing for the R&D expenditure of a company *i* at the year *t*, where common corporate R&D intensity (R&D expenditure/revenue) is used for the measurement.

Core explanatory variable: LEV_{it} represents the leverage level of an enterprise *i* at the year *t*. Referring to the research method of Zhong (2016), total liability/total asset to corporate leverage level is measured. In the analysis of the effect of corporate debt maturity on R&D expenditure, XLEV_{it} stands for the leverage level at different maturity. Referring to Kim and Lee (2008), current liability/total asset and long-term debt/total asset are used for measuring short-term leverage ratio (SLEV_{it}) and long-term leverage ratio (LLEV_{it}) of enterprises. When discussing the effect of debt source on corporate R&D expenditure, XLEV__{it} represents leverage level from different sources. Bank lending/total asset and commercial credit lending/total asset to bank lending credit leverage level (BLEV_{it}) and corporate commercial credit leverage level (CLEV_{it}) are measured in this study, where corporate bank credit lending amount is the sum of end short-term debt and end long-term debt in the balance sheet of an enterprise, and corporate commercial credit lending amount is the sum of end accounts payable, end advances from customers, and end notes payable in the balance sheet.

Sample object

Listed companies on SME board in 2014-2017 are selected as the initial samples, and relevant research are referred to select the initial data based on following principles. First, to exclude the effect of samples with abnormal financial situation on the analysis result, listed companies labeled ST and ST* in the observation

period are excluded. Second, in consideration of the notably different financial structure between companies in financial industry and those in other industries, listed companies in financial industry are excluded. Third, in consideration of the difference in financial statements between enterprises listed in the year and in other years, the observation of companies listed in the year of observation is excluded. Fourth, the observation of samples with missing dependent variable and explanatory variable in the year is removed. Fifth, companies with abnormal financial statements, i.e. samples with the total asset less than 0 and the intangible assets or fixed assets higher than the total asset, are removed. Finally, to remove the effect of extreme values on the analysis result, first and last 1% sample data are removed. The data used in this study are acquired from CSMAR listed company database and cinfo (a listed company information exposure website assigned by Securities and Futures Commission).

Analysis method

Regression analysis is applied to understand the effects of leverage ratio on corporate research and development expenditure of small and medium enterprises

Results

Correlations between leverage level and corporate R&D expenditure

The analysis result is shown in *Table 1*. For testing H1, the analysis result reveals significant effects of LEV_{it} (-0.188**) on R&D expenditure and remarkable effects of LEV_{it-1} (-0.206***) on R&D expenditure. H1 is therefore supported.

Table 1. Effects of leverage ratio on R&D expenditure of SMEs

	R&D expenditure	
	Beta	Beta
LEV _{it}	-0.188**	
LEV _{it-1}		-0.206***
F	37.462	45.183
significance	0.000***	0.000***
R ²	0.341	0.388
adjusted R ²	0.325	0.361

Note: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Correlations between credit leverage, lending leverage and R&D expenditure

To test H2, the analysis result, *Table 2*, does not appear notable effects of BLEVit (0.121) on R&D expenditure in non-state-owned enterprises, but shows significant effects of CLEVit (-0.233***) on R&D expenditure. In state-owned enterprises, BLEVit (-0.145) does not reveal remarkable effects on R&D expenditure, while CLEVit (-0.192**) appears notable effects on R&D expenditure. Accordingly, H2 is supported.

Table 2: Effects of credit leverage and lending leverage on R&D expenditure

	non-national R&D expenditure	non-national R&D expenditure	national R&D expenditure	national R&D expenditure
	Beta	Beta	Beta	Beta
BLEVit	0.121		-0.145	
CLEVit		-0.233***		-0.192**
F	24.621	28.155	19.626	22.942
significance	0.000***	0.000***	0.000***	0.000***
R2	0.237	0.276	0.197	0.218
adjusted R2	0.221	0.265	0.184	0.205

Note: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Correlations between short-term leverage ratio, long-term leverage ratio and R&D expenditure

To test H3, the analysis result, *Table 3*, shows that LLEVit (0.023) does not significantly affect R&D expenditure in non-state-owned enterprises, while SLEVit (-0.211***) reveals remarkable effects on R&D expenditure. In state-owned enterprises, LLEVit (-0.096) does not notably affect R&D expenditure, while SLEVit (-0.188**) appears significant effects on R&D expenditure. Consequently, H3 is supported.

Table 3. Effects of short-term leverage ratio and long-term leverage ratio on R&D expenditure

	non-national R&D expenditure	non-national R&D expenditure	national R&D expenditure	national R&D expenditure
	Beta	Beta	Beta	Beta
LLEVit	0.023		-0.096	
SLEVit		-0.211***		-0.188**
F	31.425	37.662	28.176	34.557
significance	0.000***	0.000***	0.000***	0.000***
R2	0.306	0.362	0.269	0.331
adjusted R2	0.295	0.348	0.251	0.317

Note: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Correlations between leverage ratio and R&D expenditure of enterprises with different innovation models

For testing H4, the analysis result, Table 4, reveals remarkable effects of LEVit (-0.262***) on R&D expenditure in exploratory enterprises. In conventional enterprises, LEVit (-0.247***) shows notable effects on R&D expenditure that H4 is supported.

Table 4. Effects of leverage ratio on R&D expenditure of enterprises with different innovation models

	R&D expenditure of exploratory enterprises	R&D expenditure of conventional enterprises
	Beta	Beta
LEVit	-0.262***	-0.247***
F	44.162	37.835
significance	0.000***	0.000***
R2	0.416	0.363
adjusted R2	0.407	0.349

Note: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Conclusion

Based on the data of non-financial listed companies on SME board in 2014-2017, the relationship between leverage level and R&D expenditure of domestic SMEs is studied. The conclusion is summarized as followings. First, leverage level of domestic SMEs currently presents notably negative effects on corporate R&D expenditure, and the effects are realized in non-state owned SMEs and state-owned SMEs. Second, from the perspective of debt maturity structure, too much dependence on short-term debt for corporate financing channel is the factor in restraining SMEs preceding R&D activity. Long-term debt level, on the other hand, does not show significantly negative effects on R&D activity of SMEs. Third, from the perspective of debt source, high commercial credit leverage level has become a bottleneck for SMEs preceding innovation. Finally, exploratory innovation activity reveals higher risks than conventional innovation activity that SMEs with exploratory innovation would remarkably suffer from larger negative effects from leverage level than those with conventional innovation.

Suggestion

According to above empirical conclusion and analyses, the following policies are suggested in this study. From the perspective of debt maturity, long-term debt level of domestic SMEs does not restrain corporate R&D activity. For creditors, the risk of long-term debt is larger than it of short-term debt that higher risk premiums would be requested. Sound legal systems therefore should be made to fully protect creditors' rights and interests, reduce possible default risk, and allow SMEs fully utilizing long-term debt for supporting the R&D activity. From the perspective of debt source, an enterprise should well manage the debt to avoid depending too much on commercial credit liability. On the other hand, guarantee systems for research loan should be completed to guarantee high-confidential, high-risk, and not-collateral R&D activity through guarantee institutions and insurance to release the information asymmetry between banks and SMEs and enhance the accessibility of research loan of SMEs.

To further develop domestic financial market, the development of bond market could enlarge corporate debt financing channels; on the other hand, domestic SMEs are relatively lack of equity financing, compared to other developed countries. Relevant financial markets should be further developed to enrich corporate equity financing channels and reduce the dependence on debt financing. Furthermore, in consideration of the difference in corporate innovation activity, certain tax preference and subsidies for exploratory innovation could be offered to encourage the innovation of enterprises to further enhance the core competency.

The function of internal financing to corporate innovation activity has been approved in academia that taxes and administrative fees could be cut to reduce the burden of domestic SMEs and reinforce the R&D activity ability.

Acknowledgements

The Project is supported by National Cultural Masters and “Four in a batch” Talents Funded by Self-selected

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