Study on the Relationship Between R&D Expenditures, Capital Structure and Enterprise Innovation Performance

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Abstract

Studies have shown that R&D expenditures affect innovation performance, while R&D expenditures associated with capital structure. In this paper, we choose listed company in Henan Province by using empirical analysis, found that R&D intensity is inversely proportional to the asset-liability ratio, asset-liability ratio has negative correlation with performance, and put forward relevant proposals.

Key words: Capital structure; R&D; Innovation performance

INTRODUCTION

Innovation is a strategic choice of the world to seek development, China is committed to building an innovative country, technological innovation becomes more important in national development strategies, R&D expenditure is an important guarantee for the promotion of innovation. Recently, the scale and strength of R&D expenditure increased more and more, while driving the company's R&D expenditure. The data according to the China Science and Technology Statistics show that our R&D expenditure was 1.02984 trillion yuan in 2012, accounting for 1.98% of GDP, and corporate expenditures were 784.22 billion yuan, which was 76.1% of total expenditures. We can see that companies have become the main expenditures of R&D expenditure funds.

While R&D expenditure and the ratio to GDP of our country continued to increase every year, we can see that the national emphasis on R&D expenditures. R&D expenditure of companies became much When they implement product differentiation strategy, which because of corporate R&D expenditure due to the differences arising from the different corporate strategy. R&D expenditure is conducive to enhancing innovation performance, and capital structure has a significant impact on the behavior of corporate R&D expenditures. Corporate strategy of R&D expenditure is closely related to value drivers such as cash flow, capital cost and competitive advantage, and there has a long-term impact. The implementation of R&D expenditure needs financial support.

From the view of corporate, R&D expenditure is the driving force for growth in value. There is significant meaning to research Capital structure, the value of corporate R&D expenditure on corporate innovation performance, and to obtain adequate sources of funding, as well as a reasonable capital structure to increase the intensity of R&D expenditures to maximize improve innovation performance. There has a certain reference value for small and medium sized high-tech enterprises to raise funds to promote R&D expenditure, to improve the innovation capability and enhance core competitiveness of enterprises.

1. THEORETICAL REVIEW OF DEVELOPMENT

1.1 Capital Structure and R&D Expenditures

R&D expenditures are affected by many factors, such as socio-cultural values in macro level aspect, the government's policies for R&D subsidies and tax relief, and institutional environment; corporate governance structure, the nature of ownership, enterprise-scale in micro level aspect etc.; R&D personnel and R&D funding in supply aspect, and financing sources including research and development funding is the subject of this study. That is, whether the capital structure has an impact on the strategic choice, especially for business R&D expenditure , and whether the difference of proportion of debt financing or equity financing significantly affects the R&D expenditure .

Wang, Thornhill (2010) found that R&D expenditure has a positive effect for equity financing, and a U shaped relationship with convertible bonds, and inverted U-shaped relationship with loan financing ,which based on difference of the rights between sources of financing and subject of financing. Gustav Martinsson (2010) researched that British businesses internal cash flow and external equity financing are an important source of R&D funding, but business in continental Europe relying solely on internal financing. Brown and Petersen (2011) found that the high-tech sector R&D investment in the United States dependent on public equity financing increased after 2004, reflecting the investors concerned in the high-tech sector R&D increased. Hsu et al. (2013) found that the degree of development of the stock market is critical to corporate R&D investment, the corporate of developed equity market performanced in surplus high level of R&D expenditure, in addition, R&D expenditure of R&D-intensive enterprises has a negative correlation to the development of the credit market.

With the increase of business R&D expenditure efforts, R&D expenditure for theoretical research has gradually increased. The author analyses the view of domestic experts and scholars nearly a decade as following. Wei and Liu (2004) considers asset-liability ratio and technological innovation have a significant positive impact. Xiao (2008) examined the relationship between R&D expenditures and internal cash flow using data for listed companies from 2001 to 2005, found that financing constraints existed in our corporate R&D expenditure. Zhao Ziqiang and Zhao Xianglian (2008) focused on the relationship between debt financing and corporate R&D, used listed companies in China's manufacturing industry as a sample, found that there is significant U relationship between debt levels and R&D expenditure for sample company with the two year data from 2004 to 2005. Liu (2009) found that R&D investment funds mainly Originated from internal earnings and equity financing,

debt has a negative impact on R&D investment; other common sources of funds invested mainly depends equity and debt funds. Rao (2009) found that the development of financial intermediation can effectively alleviate the level of R&D expenditure of financing constraints. Liu (2010) found that corporate tend to take a relatively cautious innovation investment decisions with higher debt, and the lower leverage ratio of corporate capital structure, the better the investment in technical innovation. Tang and Xu (2010) found that R&D expenditures of companies showing the internal funds of over-sensitive. Xie and Fang (2011) found that the development of financial promote R&D activities significantly, especially for private enterprises and small-scale enterprises more obvious. Wen et al. (2011) believed that there is a weak relationship type of financing for our corporate bank loan financing, and demonstrated that a weak relationship lending has a positive impact on business R&D expenditures. Liu sheng qiang, Liu (2011) found that there exist the "double negative" type relationship between debt levels of listed companies and R&D expenditure investment. Domestic scholars Jiang and Mao (2011) showed that there has a negative correlation between SME capital structure and technological innovation performance ,and the use of innovative strategies companies tend more relaxed (low debt) financial structure, in order to alleviate pressure from creditors. Lin (2011) found that the higher rates of corporate debt, the less R&D expenditure it is; Wang and Wei (2012) thought that there is no direct relationship between the two factors. Xia and Lu (2012) analyzed the impact of external equity financing for business R&D expenditure , found a positive correlation between the two factors, and this relationship is more pronounced for small businesses.

1.2 R&D Expenditure and Innovation Performance

R&D expenditures improve the ability of enterprises to absorb existing knowledge and information, and promote it technology spillover, which can improve business innovation research and development capabilities. Researchers come from different countries and regions had got a similar result relevant academics and research object for the market, that is, R&D expenditures have a positive effect on corporate performance (Bosworth & Rogers, 2001; Ren, 2001; Guan & Shi, 2004; Wang et al., 2005; Wu, 2006; Cheng, 2006; Lu & Huang, 2009; Feng, 2010; Lin, 2011; Zhang et al., 2012). Garner (2002) found that the rate of innovation is an important factor affecting the market value of the enterprise, and corporate R&D expenditure will affect the rate of innovation. Some scholars also consider the time factor, R&D expenditures will have an impact on output in the long run (He, 2003). Liang & Zhang (2005) and Yang & Yuan (2013) found that R&D expenditure and innovation performance have a positively relationship consider of the time factor, but the output of R&D investment has a significant effect lag.

Ma wen cong et al. (2013) distinguished emerging industries and traditional industries, found that the former R&D expenditure intensity, intensity of investment in R&D personnel, incentive pay and personnel training have a significant positive impact on innovation performance; while the latter only R&D expenditures and R&D intensity remuneration incentives have significant positive impact on innovation performance.

However, there are some empirical studies show that the relationship between R&D expenditure and corporate performance is not necessarily a significant positive correlation. For example, the effect of the relationship was not significant considered by industry factors (Young & Byren, 2000; Zhu & Lun, 2004; Zhou & Xui, 2007).

1.3 Analysis of the Impact of R&D Expenditure on Innovation Performance From the Source of the Capital Structure

From the above analysis, we can see that capital structure has an impact on business R&D expenditures and other innovative behavior, while R&D expenditure is an important factor affecting innovation performance. R&D expenditure is the allocation of resources for innovation, a key role for the success of innovation. In the decision-making process for the allocation of resources, the control right of corporate has a decisive influence, and therefore the different proportions of the capital structure need to be considered.

Analytical framework of "Capital Structure - Strategic Choices - Enterprise Performance" , which come from Control right theory, financial contract theory shows that companies have different sources of financing in the strategic decision-making and action in the allocation of resources will vary degrees of configuration for key innovation resources. According to the resource-based view, companies use the unique resources and capabilities to develop and maintain a competitive advantage, the basic logic is that internal resources and the ability to increase the company's efficiency and effectiveness. The difference from the internal resource base has led to innovations differences. Given the important role of the allocation of resources for innovation, integrated use of control right theory and the resource-based view, the author considering the resources into effect between capital structure and innovation performance. Control right decided by the capital structure results in different emphasis on innovation strategy for the enterprise, and therefore results different inputs in innovation resources, eventually leading to a difference in innovation performance.

The company invested a lot of R&D expenditure, it indicates that the company tried to innovate, and can usually be predicted that lower debt ratio it is. Business will be uninterrupted, continuous research and development expenditures in the innovation competition station with low financial leverage; when developing new products, funds can be in place in time; when there is a potential benefit, companies can obtain information. Companies will promote its strategic application capabilities with innovative premise, if it maintained adequate support for low financial leverage.

2. AN EMPIRICAL ANALYSIS OF LISTED COMPANIES IN HENAN PROVINCE

The author carried out the data collection for listed companies in Henan Province, which excludes ST companies, and the number of sample enterprises is 56. Collected the underlying assets, the proceeds of the characteristic values of these sample companies a of , and the data come from the GTA database.

2.1 Variable Selection and Characteristics of the Sample Data

This article precluded the method described in the full sample, researched on samples of corporate finance and performance relationship in terms of capital structure, company size, performance indicators, capital intensity, R&D expenditures. Variables are selected as follows.

2.1.1 The Dependent Variable

Financial leverage was taken as the dependent variable with LEV. Its value is represented by the asset-liability ratio, specific formula is expressed as: Asset-liability ratio = Total liabilities ÷ total asset × 100%.

2.1.2 The Independent Variable

Firstly, R&D intensity was taken as a proxy for the innovation variable with INTR&D, specific formula is expressed as: R&D expenditure ÷ sales. The percentage of R&D intensity index reflects the company's innovative variable.

Secondly, corporate performance was taken as independent variables with M: B, specific formula is expressed as: The company's market value ÷ book value of total assets. Simons (2000) proposed that there are two typical performance measures to evaluate company performance: accounting-based and market-based measures. Accounting-based measures can be controlled by managers such as ROE and ROI, these data are more easily manipulated than the market-based tests. Accounting measurement basis maybe underestimate company performance, so there existed a lot of investment in the current period, and expected the accumulation future earnings; while market-based measures of performance usually more objective, and can not be controlled by managers, such as the market value of equity. Therefore, the author uses the ratio of market value and book value to measure corporate performance, including the expected value of future corporate performance.

2.1.3 Control Variables

Firm size is used to measure the size of enterprises with SIZE, calculated by the total assets value of the

natural logarithm of the year. The ratio is converted into approximately equivalent natural logarithm, can improve the model fit to maximize. Corporate earnings were calculated by accounting income total assets of PROFIT; Capital intensity was calculated by the total book value of assets ÷ sales revenue of INTCAPITAL, used to represent enterprise asset utilization efficiency.

Combination of these variables, each variable characteristics of the sample companies were described in Table 1.

Table 1
Characteristics of the Sample Data Table of Listed Companies in Henan

Company code	LEV	INT R&D	M:B	Size	Profit	Intcapital
000400	0.529161	0	2.113727	22.729077	0.063651	1.7024556
000544	0.491204	0	2.366755	21.217172	0.032682	4.988281
000612	0.355605	0	0.916468	22.644206	0.028395	1.440641
000719	0.309731	0	0.656062	21.780018	0.087412	1.2369011
000885	0.582838	0	1.017027	22.387826	0.016437	1.8609844
000895	0.240187	0	3.04928	23.706224	0.223322	0.4053474
000933	0.745495	0	0.87648	24.45128	0.004846	2.0253818
000949	0.59784	0	1.137879	22.183614	0.006947	1.3348208
001896	0.761174	0	1.18907	22.273606	0.055389	1.8799762
002007	0.090272	0	4.701154	21.973997	0.107116	3.81661
002046	0.493052	0	1.375098	21.437806	0.016325	3.8798162
002087	0.610126	0	0.984123	22.281052	0.013455	1.9750279
002132	0.616019	0	1.03128	21.879529	0.004562	2.3888645
002179	0.438977	0	1.022292	22.283398	0.043695	2.3793569
002189	0.35388	0	2.294712	20.452464	0.001441	1.7244969
002216	0.446644	0	2.4415	21.891704	0.035267	1.1645448
002225	0.556037	0	1.011456	21.904085	0.028677	1.7903895
002296	0.171096	0	1.675913	21.317038	0.05624	3.7976885
002321	0.566816	0	1.028319	22.006821	-0.030408	2.5467311
002358	0.268814	0	1.037227	21.721531	0.078946	2.7291313
002406	0.068965	0	0.806317	21.524572	0.045129	2.7113164
002407	0.372863	0	1.230159	21.678337	0.004049	2.4243023
002423	0.398674	0	1.886072	21.789628	-0.014573	2.8710629
002448	0.204426	0	0.917304	21.505214	0.060147	2.5607428
002477	0.615802	0	1.432486	22.478322	0.014136	3.7935767
002535	0.543691	0	0.738635	22.358528	0.043242	3.0134591
002536	0.461189	0	0.726403	21.506178	0.012114	2.371471
002560	0.288653	0	0.577454	21.169801	0.038082	1.9319363
002582	0.177297	0	0.652322	21.214688	0.056183	2.4267483
002601	0.393649	0.0068918	0.921917	21.997184	0.007095	1.9286822
300007	0.227889	0.0012633	1.701332	20.560118	0.025095	3.9606296
300064	0.354504	0	1.568598	21.559838	0.038477	5.5566182
300080	0.380723	0.0082686	1.114827	22.250595	0.000913	3.8696605
300109	0.069475	0	2.064004	19.809714	0.040823	2.4931044
300179	0.149578	0	1.410004	20.515641	0.032895	7.7287126
600020	0.805274	0	0.92399	24.299595	0.011067	15.139243
600066	0.508607	0	1.868832	23.48992	0.062151	1.0628308
600069	0.741339	$2.749×10^{-5}$	1.267566	22.627908	-0.030247	2.5404834

To be continued

Continued

Company code	LEV	INT R&D	M:B	Size	Profit	Intcapital
600121	0.604528	0	0.834195	23.125759	0.019444	0.6402489
600172	0.52086	0	1.280318	22.220813	0.033157	3.6279217
600186	0.744773	0	1.487715	21.747889	-0.064828	1.6885913
600207	0.643743	0	1.414196	21.758497	-0.037773	2.1653562
600222	0.465029	0.0287068	1.676841	21.416364	0.019212	1.9397252
600253	0.773431	0.0253556	1.256644	22.1981	0.003571	4.3716046
600285	0.391594	0.0673931	2.233988	21.189934	0.064255	2.7756439
600312	0.49283	0.1028939	1.786594	22.51538	0.03586	2.6869771
600439	0.420039	0	1.462739	22.069423	0.036652	2.4750628
600469	0.685134	0	1.042063	22.770241	0.032003	1.2070743
600531	0.77586	0	1.1919	22.648196	-0.050753	0.7821607
600569	0.785217	0	0.902542	24.20958	-0.011811	1.6614173
600595	0.773121	0	0.96798	24.010916	-0.008623	3.4280413
600753	0.4789	0	6.827877	19.269765	-0.005611	29.034397
600810	0.650802	0	0.996542	22.604806	-0.000483	0.7204969
600876	0.998972	0	1.890739	20.987206	-0.053523	5.9120191
601666	0.499121	0	0.939607	23.949672	0.030048	1.6064963
601717	0.27608	0.0146681	0.925691	23.302705	0.055312	2.1178768

Table 1 lists the basic situation of each variable sample company data, and there is a detailed analysis as following empirical results. Based on the above analysis of the literature related to the theory, combined with the above information and data, the author will describe and analysis the basic situation of the study, provide the basis of assumptions and model selection theory for the next part of empirical research.

2.2 Theoretical Assumptions

Financial support has a significant role to promote innovation and development of enterprises. However, existing research shows that the more debt under the circumstances, the less corporate innovation activities; on the other hand, less debt and more equity, the more R&D expenditure. Because there is the risk of bankruptcy for debt, results in cash flow decreased. Bank usually concerned about the usage of funds When lending, namely enterprises how to use and invest funds.

There is always a corresponding burden of the financial costs required to gradually squeeze corporate cash flow because of the higher the proportion of debt in the capital structure. The level of debt ratios will affect their ability to innovate, thus affecting innovation performance. Baysinger and Hoskisson (1989) found that there is a significant negative correlation between R&D expenses and corporate financial leverage. Higher debt levels will force executives to give up high-risk, high-yield investment projects, reduce development costs, reduce the level of innovation capacity and performance of enterprises. Capital structure is the core issue of

corporate financing decisions, debt financing costs is lower relative to the cost of equity financing, financial leverage should maximize the earnings per share, and the rational use of financial leverage could increase corporate value. Investment in R&D expenditure will create intangible assets, and the higher risk of intangible assets results in difficult trading in the market, therefore it difficult to support a higher liability. Porter (1996) pointed out that the capital structure can not be seen as irrelevant exogenous variables with respect to strategy, managers must be aware that the appropriate capital structure will promote the effectiveness of corporate strategy and improve performance. Simerly and Li (2000) found that if changes in the capital structure does not match dynamic environment ,there will have a negative impact on the value of company. Leverage and innovation strategy has a negative correlation when considering the impact of the performance for the company. Domestic scholars Jiang and Mao (2011) showed that corporate capital structure and technological innovation performance has a negative correlation , the companies used innovative strategies tend more relaxed (low debt) financial structure, in order to alleviate the pressure from creditors. Taking these documents, I make the hypothesis as following:

Hypothesis 1: R&D intensity and the asset-liability ratio has a negative correlation in Henan listed Companies, that is, companies usually take lower financial leverage when invest more R&D expenditure;

Hypothesis 2: Asset-liability ratio and performance has a negative correlation in Henan listed Companies.

2.3 Results

The sample data were analyzed by use of statistical software SPSS Statistics 19.0 , and the results were as following.

2.3.1 Descriptive Statistical Analysis

Descriptive statistical analysis of the variables are shown in Table 2, following table reports minimum, maximum, mean and standard deviation of the variables in this study.

Table 2
Descriptive Statistics

	N	Minimum	Maximum	Mean	Standard deviation
LEV	56	.068965	.998972	.48156429	.211591076
INT R&D	56	0	0	.00	.017
M:B	56	.577454	6.827877	1.47950384	1.003376513
Size	56	19.269765208911	24.451279586793	22.08666920313150	1.049699941438213
Profit	56	-.064828	.223322	.02530864	.043621360
Intcapital	56	.405347435542	29.034396720727	3.25523461392109	4.120209876004359
Effective *N*	56				

Learned from Table 2, the Asset-liability ratio of sample company is 48.16%, indicating that the space to increase financial support is still very large for Henan listed companies; minimum is 6.9%, which also reflects listed company in Henan Province has lower liability operating rates; maximum is 99%, the difference is great between the company, indicating the existence of debt financing is very different, therefore, which will also affect the degree of concern for creditors.

2.3.2 Variables Correlation Analysis

Specific analysis is shown in Table 3.

Table 3
Correlation Analysis

		LEV	INT R&D	M:B	Size	Profit	Intcapital
				Correlation			
LEV	Pearson Correlation	1	-.014	-.181	.458**	-.598**	.040
	Significant (bilateral)		.919	.182	.000	.000	.773
	N	56	56	56	56	56	56
INT R&D	Pearson Correlation	-.014	1	.073	-.016	.076	-.031
	Significant (bilateral)	.919		.595	.904	.577	.819
	N	56	56	56	56	56	56
M:B	Pearson Correlation	-.181	.073	1	-.393**	.184	.631**
	Significant (bilateral)	.182	.595		.003	.174	.000
	N	56	56	56	56	56	56
Size	Pearson Correlation	.458**	-.016	-.393**	1	.082	-.326*
	Significant (bilateral)	.000	.904	.003		.546	.014
	N	56	56	56	56	56	56
Profit	Pearson Correlation	-.598**	.076	.184	.082	1	-.140
	Significant (bilateral)	.000	.577	.174	.546		.304
	N	56	56	56	56	56	56
Intcapital	Pearson Correlation	.040	-.031	.631**	-.326*	-.140	1
	Significant (bilateral)	.773	.819	.000	.014	.304	
	N	56	56	56	56	56	56

Note. **: At the .01 level significantly correlated (bilateral), *: At the .05 level significantly correlated (bilateral).

As can be seen from the above correlation coefficient, R&D intensity value is -0.014, indicating that R&D intensity and capital structure has a negative correlation, the greater the intensity of R&D, namely the enterprise more emphasis on innovation, the lower the Asset-liability ratio, but showed a more weak negative correlation; performance indicators M:B correlation coefficient is -0.181, and was negatively correlated to asset-liability ratio, indicating that higher corporate performance, the lower asset-liability ratio. Hypothesis

1 and 2 have been verified, but the negative correlation is not too significant.

2.3.3 Regression Analysis

To further examine the relationship between capital structure, R&D strength and performance, the model are as follows:

$LEV = \alpha_0 + \alpha_1 INTR\&D + \alpha_2 M{:}B + \alpha_3 SIZE + \alpha_4 PROFIT + \alpha_5 INTCAPITAL + \varepsilon$.

Where the variables are defined as above, α_0 is a constant, ε is the error term.

The data were linear regression analysis, selected forced into (Enter) method, the specific results of the regression analysis are shown in Table 4.

Table 4
Regression Analysis

Model		Coefficient[a]				
		Non standardized coefficient		Standard coefficient	t	Sig.
		B	Standard error			
1	(Constant)	-2.090	.427		-4.893	.000
	INT R&D	.478	1.064	.038	.449	.655
	M:B	.029	.026	.137	1.120	.268
	Size	.118	.019	.584	6.257	.000
	Profit	-3.238	.447	-.667	-7.237	.000
	Intcapital	.003	.006	.051	.440	.662

Note. a. The dependent variable: LEV

The regression results do not support the original hypothesis. I believe that the results may be a difference due to regional and selected limited number of samples. This article is also initiated attempts to do this problem, and needs to be further studied and discussed in depth.

CONCLUSION

Some researchers have regarded financing as an agent amount for financial relaxation, including leveraged measurement and capital structure. Financial relaxed business usually have a low debt level, if the financial relaxation will promote innovation, then the innovation capacity of enterprises will increase by low debt ratio. Fluctuations in cash flows could potentially jeopardize the investment of R&D expenditure, the company must make cash flow continued to remain competitive position. A smooth, continuous investment in R&D expenditure is very important for innovators, which not allowed to fluctuate with fluctuations in cash flow, financial relaxation will help to avoid the loose cash flow fluctuations occur whenever a bad situation. If companies maintain higher debt ratio, and try to pursue innovative strategies, performance would be reduced; while companies with moderate and low debt ratio, and try to pursue innovation will lead to performance increases.

Business investments in R&D expenditure usually result in uncertainly outputs. In fact, it is important that the effect of risk should be considered for research and innovation activities. Failure is absolutely possible if managers pursue risky projects, such as R&D expenditure, and the investments are negatively correlated with profit and managers compensation.

According to the small sample size data, the author tested the original hypothesis in empirical analysis, made the following recommendations are combined with relevant theoretical analysis. Firstly, it is important to innovate domestic financial support system, and actively exercise coalition government funds and social funds, then built direct financing and indirect financing methods. From earlier theoretical analysis, we learn that financial relaxation is a source of innovation, under certain conditions, low financial leverage will promote innovation. Empirical analysis also found that R&D strength has a negative relationship with performance and asset-liability ratio. The current financial support for listed companies in Henan Province mainly come from the equity financing, and they may be more jointly with banks to start the financial support plan; Secondly, innovation resources investments on R&D expenditure for listed companies in Henan are greater , the state should develop specific policies to regulate and protect. It is very important to develop positive and effective policy, and introduce foreign R&D funding to enhance the role of foreign R&D funding to innovation performance. Promoting their technological innovation resource investment, improve innovation performance. The higher the innovation performance of these companies, the more the introduction of foreign capital ,therefore a good interaction cycle will be formed; Thirdly, listed companies in Henan gradually form   platform of Science and Technology resource sharing ,and the increase of information disclosure and transparency will improve efficiency, avoid risks. According to its characteristics and advantages, explore Combination and strengthen exchanges with universities, research institutions to achieve multi-technology supply and demand cooperation, therefore with the power to enhance innovation performance to list companies in Henan Province. In the actively guide of their business strategy, the companies will obtain financial support, arrange reasonable capital structure, plan rational R&D expenditure, encourage them stable and fast growing, so long-term innovation performance will be achieved.

REFERENCES

Brown, J. R., & Petersen, B. C. (2011). Cash holdings and R&D smoothing. *Journal of Corporate Finance, 17*(3), 694-709.

Brown, J. R., & Petersen, B. C. (2009). Why has the investment-cash flow sensitivity declined so sharply? Rising R&D and equity market developments. *Journal of Banking and Finance,* (33), 971-984.

Carpenter, R. E., & Bruce, C. P. (2002). Capital market imperfections, high-tech investment, and new equity financing. *Economic Journal,* (112), 54-72.

Chai, Y. K., & Gu, X. M. (2014). Financial support of technological SME, R&D and innovation performance. *Science & Technology Progress and Policy, 2.*

David, P., O'Brien, J. P., & Youshikawa, T. (2008). The implications of debt heterogeneity for R&D investment and firm performance. *The Academy of Management Journal, 51*(1), 165-181.

Elisabeth Muller, E., & Volker Zimmermann, V. (2009). The importance of equity finance for R&D activity. *Small Business Economics, 33*(3), 303-318.

Hsu, P.-H., Tian, X., & Xu, Y. (2013). Financial development and innovation: Cross-country evidence. *Journal of Financial Economics, Forthcoming.*

Huergo, E., & Moreno, L. (2011). Does history matter for the relationship between R&D, innovation, and productivity? *Industrial and Corporate Change, 20*(5), 1335-1368.

Lin, Z.- G., Liu, J.-X., & Zhang, T. S. (2011). Enterprise leverage, R&D investment, and firm value. *Taxation and Economy,* (6).

Martinsson, G. (2009). Finance and R&D investments: Is there a debt overhang effect on R&D investments. *CESIS Working Papers,* (174), 3.

Martinsson, G. (2010). Equity Financing and Innovation: Is Europe different from the United States? *Journal of Banking& Finance, 34*(6), 1215-1224.

Mudambi, R., & Swift, T. (2011). Proactive R&D management and firm growth: A punctuated equilibrium model. *Research Policy, 40*(3), 429-488.

Singh, M., & Faircloth, S. (2005). The impact of corporate of debt on long term investment and firm performance. *Applied Economics,* (37), 875-883.

Wang & Thornhill. (2010). R&D investment and financing choices: A comprehensive perspective. *Research Policy, 39*(9), 1148-1159.

Zhang, L.-F. (2013). Financing constraint, high-scale cash holdings and investment efficiency. *Joumal of Shanxi Finance and Economics University,* (4).

Zhou, W. G., & Huang, R. H. (2012). Growth paths of innovation performance, stock of R&D capital, and absorptive capacity. *Science Research Management,* (11).