Research on the impact of the finance structure on innovation investment in Chinese Corporation

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Abstract. In order to explore the potential relationship between the innovation investment and the enterprise financial structure, the work gathered the related data, using KMO and Bartlett's Test to test whether the factors tested could be used in the following factor analysis, and principal component analysis to find the commonalities among several shareholders proportion related factors. Then the work used the regression analysis and ANOVA to test the significance of different financial structure related factors to the innovation. Our empirical results showed that financial structure truly has an inevitable impact on innovation investment. The lower the debt financing, the simpler the financial structure, the later the companies go IPO, the lower the equity capital, the company would devote more to innovation investments. Also, there is no big difference in debt financing, equity financing, internal financing, and cash flow level between the offshore and onshore natural persons.

Keywords: financial structure, innovation investment, regression analysis, principal component analysis, ANOVA

1 Introduction

Nowadays, it is well known that business have already recognized the importance of the research and development in the continuation of the company. For example, Tesla is developing new car models and releasing these models to the market all the time, and Apple renews its iPhone and iPad from year to year. However, right now it it not covered that much in the study. Like, what can the ratio of the debt financing or internal financing tell us about the development of the company? Or, what might be the next step that the company might take?

Thus, in this work, how the financial structure would impact the enterprise innovation investment would be discussed. The purpose for this work is to discover the potential relationship between the different levels of financing structure and the innovation investment especially for China corporation, meanwhile coming up with the idea about corporation prospect from such structure.

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2 Data source and pre-processing

2.1 Data source

The data was extracted from the database from Guotai Junan Securities, a leading securities company in China. The companies included in our raw data are all state-owned corporation or natural person corporation, from 2017 to 2020, if applicable. The data items are related to our focus, like the R&D expense, bond financing, equity financing, as well as the fundamental financial data of the companies, like cash flow, total assets, etc., all coming from the annual reports. The explained variable that will be used later in our regression analysis is the innovation investment, which is derived by dividing R&D expense by total assets.

2.2 Data pre-processing

In our case, firstly the following fundamental data are normalized: cash flow, cash flow level, total assets. The shareholders proportion related data are normalized as well, which include shareholders proportion of the top ten, top five, top two and top one. The method used for the normalization is to firstly trim the values at input thresholds and then perform the zero-mean normalization.

3 Factor analysis for normalized data

After the normalization, it is performed the factor analysis, which is mainly KMO and Bartlet's Test of Sphericity, for the normalized shareholders proportion related data. This test is meant to examine the partial correlation between the variables to see whether the variables were feasible for factor analysis to summarize [1].

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.672
Bartlett's Test of Sphericity	Approx. Chi-Square	9251.958
	df	6
	Sig.	0

It can be concluded from the Table 1 that the KMO value is 0.672, meaning that it would be ideal for factor analysis to commence. Also, the relatively lower p-value from Bartlet's Test of Sphericity indicates that our dataset was suitable for a data reduction technique. Solidating our mind that the factor analysis is feasible, it can be extracted a new factor using PCA. The underlying method used with PCA is Varimax Rotation, which is an important step that maximizes the sum of the variance of the squared loadings, where 'loadings' means correlations between variables and factors[2] . This process would lead to higher factor loadings for a smaller number of variables and lower factor loadings for the rest variables[3]. Then the shrinkage number of factors with higher factor loadings to represent the previous large number of factors can be

extracted[4,5].

Table 2. Commonalities

	Initial	Extraction
Top 10	1	0.812
Top 5	1	0.941
Top 2	1	0.942
Top 1	1	0.797

For the same four shareholders proportion related factors, the common factor variance is checked, discovering that all of them were bigger than 0.2 as are shown in Table 2, meaning that they these factors have a higher commonality and a common factor could be extracted from these four factors.

Table 3. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.492	87.295	87.295	3.492	87.295	87.295
2	0.421	10.537	97.832			
3	0.066	1.641	99.474			
4	0.021	0.526	100			
Extraction Method: Principal Component Analysis.						

From Table 3, the only factor extracted could explain 87.295% of the total variance, which is larger than 50%, consistent with the requirements for the factor analysis.

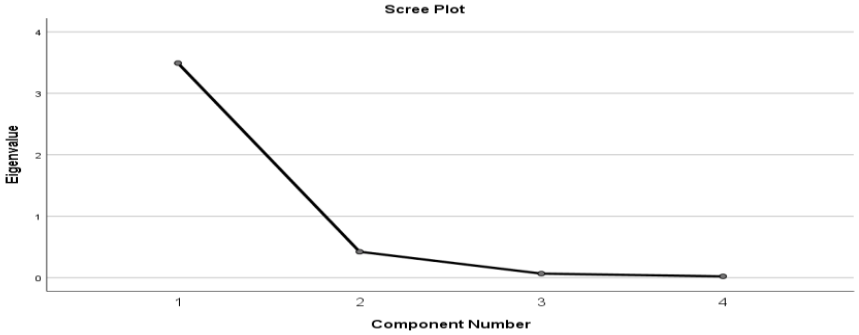

Fig. 1. Scree Plot for Factor Analysis

The Figure 1 shows that the relatively flat curve since the fifth factor indicates it could leave the first four factors for our factor extraction in the next step.

Table 4. Component Matrixa

	Component
	1
Top 2	0.97
Top 5	0.97
Top 10	0.901
Top 1	0.893
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

From Table 4, financing structure, which will be used as an explanatory factor later, can be extracted.

Table 5. Component Score Coefficient Matrixa

	Component
	1
Top 10	0.258
Top 5	0.278
Top 2	0.278
Top 1	0.256
Extraction Method: Principal Component Analysis.	
Varimax Rotation	

According to the component score coefficient matrix which is shown in Table 5, financing structure can be generated from these four shareholders related factors according to the respective factor loadings corresponding to each factor.

According to the parameters shown in Table 5, the factor score function for financial structure is:

$$F = \text{Top } 10 * 0.258 + \text{Top } 5 * 0.278 + \text{Top } 2 * 0.278 + \text{Top } 1 * 0.256\ldots \quad (1)$$

4 Regression analysis, ANOVA, multicollinearity, and contrastive analysis

After deriving the required factors, the work performs the multi-linear regression, which is usually used to model the relationship between two or more explanatory variables and an explained variable through fitting the model to a set of observed data. In our case, the explained variable is the innovation investment, and the explanatory variables include debt financing, equity financing, internal financing, year of listing, asset-liability ratio, and the derived financing structure. In this process, this work would do the F-test, t-test, and the test of multicollinearity.

4.1 Regression Analysis

Table 6. Regression Analysis Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error
1	.185a	0.034	0.034	0.0343
2	.239b	0.057	0.056	0.03391
3	.298c	0.089	0.087	0.03335
4	.305d	0.093	0.091	0.03328
a. Predictors: (Constant), Debt Financing				
b. Predictors: (Constant), Debt Financing, Financing Structure				
c. Predictors: (Constant), Debt Financing, Financing Structure, Year of Listing				
d. Predictors: (Constant), Debt Financing, Financing Structure, Year of Listing, Equity Financing				

The work conducted regression analysis to test the casual relationship between the independent and dependent variables [6]. From the Table 6, it can be concluded that as the R-squared and even the Adjusted R-squared is relatively small, which is still as low as 9.1% even though the results have already included four explanatory variables, there is a large proportion of variance that cannot be explained by our regression model. The goodness of fit is relatively low.

4.2 ANOVA Analysis

Table 7. ANOVA Analysis Summary

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.057	1	0.057	48.814	.000b
	Residual	1.612	1370	0.001		
	Total	1.67	1371			
2	Regression	0.095	2	0.048	41.425	.000c
	Residual	1.574	1369	0.001		
	Total	1.67	1371			
3	Regression	0.148	3	0.049	44.289	.000d
	Residual	1.522	1368	0.001		
	Total	1.67	1371			
4	Regression	0.156	4	0.039	35.127	.000e
	Residual	1.514	1367	0.001		
	Total	1.67	1371			

a. Dependent Variable: Innovation Investment
b. Predictors: (Constant), Debt Financing
c. Predictors: (Constant), Debt Financing, Financing Structure
d. Predictors: (Constant), Debt Financing, Financing Structure, Year of Listing
e. Predictors: (Constant), Debt Financing, Financing Structure, Year of Listing, Equity Financing

The work also conducted ANOVA analysis, which is a statistical test used to test if there is a statistically significant difference between two or more categorical groups testing the variances [7]. For the ANOVA analysis, it can be concluded from Table 7 that as the significance for all models with different number of explanatory variables are all smaller than 0.05, and the F-value is relatively high, which means that there must be at least explanatory variable to be significant, and the model is reasonable and acceptable [8].

4.3 Test for Coefficients and Multicollinearity

Table 8. Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.042	0.001		34.327	0		
	Debt Financing	-0.06	0.009	-0.185	-6.987	0	1	1
2	(Constant)	0.043	0.001		35.109	0		
	Debt Financing	-0.068	0.009	-0.213	-7.985	0	0.968	1.034
	Financing Structure	-0.005	0.001	-0.153	-5.736	0	0.968	1.034
3	(Constant)	-1.832	0.273		-6.715	0		
	Debt Financing	-0.064	0.008	-0.198	-7.523	0	0.961	1.041
	Financing Structure	-0.007	0.001	-0.198	-7.326	0	0.91	1.098
	Year of Listing	0.001	0	0.184	6.872	0	0.926	1.08
4	(Constant)	-1.844	0.272		-6.774	0		
	Debt Financing	-0.069	0.009	-0.214	-7.936	0	0.916	1.092
	Financing Structure	-0.008	0.001	-0.218	-7.781	0	0.848	1.179
	Year of Listing	0.001	0	0.186	6.946	0	0.926	1.08
	Equity Financing	-0.008	0.003	-0.072	-2.656	0.008	0.903	1.107
a. Dependent Variable: Innovation Investment								

For the collinearity test, which is shown in Table 8, it can be concluded that as the

VIF values, which is used to measure the extent to which the variance of a regression coefficient is inflated due to multicollineary, are all smaller than 10, there does not exist a collinearity among explanatory variables [8,9]. Also, for the model which include four factors, it can be concluded that all their significance smaller than 0.05 with positive correlation coefficient for listing of year and negative correlation coefficient for other three factors indicate that the lower debt financing, the later the IPO, the lower the equity financing, and the simpler the financing structure, the more innovation investment for the enterprise.

5 Test for difference between state-owned and natural person and between onshore and offshore enterprise

In this part, the work want to test whether there exists difference in variable factors between state-owned and natural person enterprise. Here, the factors that will be tested are debt financing, equity financing, internal financing and cash flow level.

5.1 Test for Difference between State-owned and Natural Person

Table 9. Independent-Sample Test 1

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	Df	Sig. (2-tailed)
Debt Financing	Equal variances assumed	1.319	0.251	-1.336	876	0.182
	Equal variances not assumed			-1.281	430.136	0.201
Equity Financing	Equal variances assumed	5.12	0.024	-3.27	876	0.001
	Equal variances not assumed			-3.887	708.027	0
Internal Financing	Equal variances assumed	5.142	0.024	0.518	876	0.604
	Equal variances not assumed			0.548	532.484	0.584
Cash Flow Level	Equal variances assumed	1.015	0.314	1.672	876	0.095
	Equal variances not assumed			1.649	456.037	0.1

Apart from the tests above, the contrastive analysis needs to be conducted. It could be seen from Table 9 that the Levene Variance, which is used to test the variances for all samples from a non normal distribution to see whether they are equal, for debt financing and cash flow level are both larger than 0.05, thus the work need to check the results for equal variances assumed [10]. On the other hand, the Levene Variance for equity financing and internal financing are both smaller than 0.5, which means that the work would need to check the results for equal variances not assumed. From the t-test,

the significance of the contrastive analysis for equity financing between state-owned and natural person is smaller than 0.05, indicating that there is a significant difference between these two classifications in equity financing. However, for debt financing, internal financing and cash flow level, there is no significance.

5.2 Test for Difference between onshore and offshore enterprise

Table 10. Group Statistics

	Onshore & Offshore	N	MEAN	SD	SE
Debt Financing	Onshore	710	0.082	0.096	0.004
	Offshore	61	0.074	0.097	0.012
Equity Financing	Onshore	710	0.517	0.286	0.011
	Offshore	61	0.546	0.24	0.031
Internal Financing	Onshore	710	0.166	0.3	0.011
	Offshore	61	0.145	0.208	0.027
Cash Flow Level	Onshore	710	0.099	0.196	0.007
	Offshore	61	0.133	0.169	0.022

Table 11. Independent-Sample Test 2

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	Df	Sig. (2-tailed)
Debt Financing	Equal variances assumed	0.142	0.706	0.638	769	0.523
	Equal variances not assumed			0.631	70.418	0.53
Equity Financing	Equal variances assumed	0.036	0.85	-0.766	769	0.444
	Equal variances not assumed			-0.888	75.499	0.377
Internal Financing	Equal variances assumed	0.153	0.696	0.524	769	0.601
	Equal variances not assumed			0.708	82.957	0.481
Cash Flow Level	Equal variances assumed	0.082	0.775	-1.322	769	0.187
	Equal variances not assumed			-1.497	74.559	0.139

Similarly, from Table 10 and Table 11, as the significance of Levene Variance test

for these four factors are all larger than 0.05, indicating that the work also need to check equal variances assumed. From t-test results, it can be concluded that the significances for all these four factors are larger than 0.05, which means that there is no big difference in debt financing, equity financing, internal financing and cash flow level between the offshore and onshore natural persons.

6 Conclusion

In a conclusion, this work discusses the potential influence of the financing structure on innovation investment especially for China Corporation. The work also takes into account the method of financing, the location of the corporation, the financial fundamentals, and the interaction effect of these factors. To test for the potential influence, KMO and Bartlet's Test of Sphericity, ANOVA, Regression Analysis, and Levene Variance test are used. The results show that finance structure inevitably influences the innovation investment for the China corporation and affect the prospect, while still need more research.

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