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A Note on the Use of Debt by Venture Capital Backed Firms

Rick H. Mull
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Much of the current research regarding the venture capitalist examines samples of venture capital (VC) backed firms rather than the venture capitalist itself. While VC backed firms may represent the most reasonable proxy available for the study of the venture capitalist, consideration of firm-specific characteristics may need to be included to mitigate biased conclusions. Controlling for the determinants of capital structure, we examine the persistence of previously noted differences in capital structure choice and find that VC backing does not systematically alter the use of debt by firms. These results suggest that not controlling for firm specific differences when contrasting VC and non-VC backed firms may lead to inaccurate conclusions in venture capital research.

I. INTRODUCTION

Much of the current research in the certification, monitoring, and capital funding roles of the venture capitalist examines samples of venture capital (VC) backed firms rather than the venture capitalist itself. While VC backed firms may represent the most reasonable proxy available for the study of the venture capitalist, consideration of firm-specific characteristics may need to be included to mitigate biased conclusions. The primary purpose of this note is to show that not controlling for the underlying firm-specific characteristics in VC and non-VC backed firm cross-sectional studies may result in erroneous conclusions.

To illustrate, consider the Megginson and Weiss (1991) (MW) venture capital certification article finding that venture capital (VC) backed firms use less debt than a matched sample of non-venture capital (non-VC) backed firms.¹ Also consider Sahlman (1990), who notes that venture capitalists invest in stages to reduce their exposure to risk of project failure (34.5% of projects examined resulted in

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losses). This suggests high levels of risk associated with VC backed firms. While together both results are consistent with Myers' (1977) point that risky investments are best funded with equity, they also suggest that there may be fundamental capital structure differences between the VC and non-VC backed firms. Thus, the question is raised whether VC and non-VC backed firm capital structure differences are the result of systematic differences between the two sets of firms.

We determine whether differences in capital structure choice found by MW persist after the consideration of firm-specific differences. If they do not, then these findings highlight the importance of controlling for firm-specific characteristics in reducing biased conclusions when using VC backed firms to study the venture capitalist.

Controlling for the determinants of capital structure as described in Titman and Wessels (1988), we find that VC backed firms do not systematically use less debt than non-VC backed firms, suggesting that VC backed firms have different firm specific characteristics than do non-VC backed firms. After controlling for firm specific characteristics influencing capital structure choice, we find that VC involvement does not systematically alter capital structure choice. Even more importantly, these results suggest that not controlling for firm specific differences when contrasting VC and non-VC backed firms may lead to incorrect conclusions in venture capital research.

II. MEGGINSON AND WEISS METHODOLOGY AND RESULTS

The sample used in MW consists of 320 VC backed firms matched with 320 non-VC backed firms having IPOs between January 1983 and December 1987. The firms are first matched by IPO offer size and then three digit SIC code. Financial information is obtained from microfiched IPO prospecti (S-1's), each containing three to five years of historical data. This study uses the original MW sample and eliminates firms with missing required variables. The final sample consists of a matched set of 119 VC and 119 non-VC backed firms.

MW present mean and median difference tests for several sample variables. Of importance in this study are debt level differences. Tests for mean debt level differences between VC (31.3%) and non-VC (32.9%) backed firms are insignificant. However, median difference tests show that VC backed firms have significantly lower book value of debt to book value of total assets ratios than do non-VC backed firms (16.0% VC backed to 21.5% non-VC backed).

MW do not specifically address the basis for these capital structure differences. This paper extends their analysis to determine whether these variations are related to VC backing or to firm-specific characteristics. We do this by employing Titman and Wessels' model to control for firm-specific determinants of capital structure.

III. TITMAN AND WESSELS METHODOLOGY

Titman and Wessels identify eight major determinants of capital structure; (1) collateral value, (2) non-debt tax shields, (3) growth, (4) firm uniqueness, (5) industry, (6) size, (7) profit volatility, and (8) profitability. They additionally identify fifteen proxies for these eight (not directly observable) determinants, with each determinant having several available proxies.

The factor analytic procedure they use (available as the LISREL procedure in SPSS) allows specific relationships between the fifteen proxies and the eight determinants to be identified in a *measurement model*.²

$$x = \Lambda\xi + \delta \quad (1)$$

with:

- $x = 15 \times 1$ vector of fifteen observable proxies
- $\xi = 8 \times 1$ vector of eight unobservable determinants
- $\Lambda = 15 \times 8$ matrix of regression coefficients of x on ξ
- $\delta = 15 \times 1$ vector of errors of measurement

The factor analytic procedure also estimates a *structural equation* model by simultaneously identifying the relationship between the eight determinants estimated above (for which fifteen proxies are identified) and three observable firm debt ratios as follows:

$$y = \Gamma\xi + \varepsilon \quad (2)$$

with:

- $y = 3 \times 1$ vector of observable firm debt ratios
- $\xi = 8 \times 1$ vector of eight unobservable determinants
- $\Gamma = 3 \times 8$ matrix of factor loadings (regression coefficients)
- $\varepsilon = 3 \times 1$ vector of disturbance terms

Titman and Wessels use this estimation procedure with a sample of public firms between 1974 and 1982 for which data was available on the Annual Compustat Industrial files. They evaluate their model and find significant relationships between all fifteen proxies and the eight capital structure determinants. They also find several significant relationships between the eight capital structure determinants and both short and long-term measures of both book and market values of debt ratios.

IV. OUR MODEL AND RESULTS

We begin our analysis by verifying the Megginson and Weiss findings using non-parametric tests on firm total debt to total equity ratios (TDTE). For consistency

with Titman and Wessels, we examine the ratio of total debt to total equity rather than the total debt to total asset ratio used in MW. We then examine the use of debt by VC backed and non-VC backed firms, controlling for firm specific determinant of capital structure. We use a subset of the MW sample, excluding firms without the financial data required by the Titman and Wessels model, and use financial data from two fiscal years prior to the firm's IPO.

We find that the median of TDTE for non-VC backed firms is 1.89, while the median of TDTE for VC backed firms is 1.22. Wilcoxon and median difference tests are significant at the 1% level, suggesting that VC backed firms use less debt than non-VC backed firms. Although we use a different debt measure, these results are consistent with the findings of MW. We now examine whether these observed VC backed and non-VC backed firm debt level differences persist after controlling for specific firm characteristics that influence capital structure choice.

Using the LISREL procedure to control for the determinants of capital structure, we begin by re-estimating the Titman and Wessels model on our dataset. Our *measurement model* results show significant relationships between the eight determinants and the 15 proxies. Our results are similar to those found by Titman and Wessels.³ However, our *structural equation* model produces no significant rela-

Table 1

Model to determine differences in capital structure between venture capital (VC) backed and non-venture capital (non-VC) backed firms with the total book value of debt to total book value of equity ratio as the dependent variable. This model was developed by a LISREL analysis to identify the single most significant proxy for each of the eight capital structure determinants.

$$TDTE = \beta_0 + \beta_1(CV) + \beta_2(NDT) + \beta_3(VO) + \beta_4(U) + \beta_5(S) + \beta_6(G) + \beta_7(P) + \beta_8(IDUM) + \beta_9(VC) +$$

With model variables defined as:

Debt Ratio	TDTE	= total book value of debt / total book value of equity
Collateral Value	CV	= (inventory + gross plant and equipment) / total assets.
Non-Debt Tax Shield	NDT	= depreciation / total assets.
Volatility	VO	= range in earnings / earnings in the last year of range. ^a
Uniqueness	U	= selling expense / total assets.
Size	S	= natural logarithm of sales.
Growth Rate	G	= continuously compounded growth rate in total assets.
Profitability	P	= operating income/ total assets.
Industry	IDUM	= 1 if SIC code 3400 to 4000 and 0 otherwise.b
Venture Capital Backing	VC	= 1 for VC backed and 0 for non-VC backed firms.

Notes: a. Volatility is measured as the range in earnings from two years prior to the IPO to just prior to the IPO (two years of data), divided by earnings just prior to the IPO. Titman and Wessels use a much longer horizon to measure volatility, however our data precludes this measure.

b. Titman and Wessels argue that manufacturers of specialized equipment, those in the 3400 to 4000 SIC code, face unique liquidation costs in the event of a bankruptcy. We include this control variable in our analysis.

Table 2

Ordinary least squares regression to determine differences in capital structure between a matched sample of 119 venture capital (VC) backed and 119 non-venture capital (non-VC) backed firms with the total book value of debt to total book value of equity ratio as the dependent variable. Model variables are defined below.

<i>Variables</i>	<i>Coefficient</i>	<i>T-statistic</i>
Intercept	1.007	(3.827)*
CV (Collateral Value)	1.466	(4.040)*
NDT (Non-Debt Tax Shield)	-0.061	(-0.091)
VO (Volatility)	0.006	(0.807)
U (Uniqueness)	-0.141	(-0.490)
S (Size)	0.026	(0.528)
G (Growth Rate)	-0.007	(-0.396)
P (Profitability)	0.541	(2.378)*
IDUM (Industry)	-0.396	(-2.181)*
VC (Venture Capital Backing)	0.078	(0.414)
Adj. R-sq.	.152	
F-statistic	4.839*	

Notes: *indicates the estimate is significant at the 5% level.

Debt Ratio (TDTE) = total book value of debt / total book value of equity. Collateral Value (CV) = (inventory + gross plant and equipment) / total assets. Non-Debt Tax Shield (NDT) = depreciation / total assets. Volatility (VO) = range in earnings / earnings in the last year of range. Uniqueness (U) = selling expense / total assets. Size (S) = natural logarithm of sales. Growth Rate (G) = continuously compounded growth rate in total assets. Profitability (P) = operating income / total assets. Industry (IDUM) = 1 if SIC code 3400 to 4000 and 0 otherwise. Venture Capital Backing (VC) = 1 for firms with venture capital backing and 0 for non-venture capital backed firms.

tionships between the eight determinants of capital structure and our book values of debt ratios.^{4,5}

Being unable to complete our analysis using the full LISREL model, we employ an alternative procedure. We identify the significant relationships between proxies and determinants in the *measurement model* and use the single most significant proxy for each determinant to estimate firm capital structure. Our model is presented in Table 1 and uses a single proxy for each determinant and an additional dummy variable to control for VC backing.

Table 2 reports the results from OLS regression estimation of our model.⁶ Regression results find collateral value (CV) and profitability (P) significant and positive, and the industry dummy (IDUM) variable significant and negative. The model also explains 15.2% of cross-sectional variability. The venture capital backing (VC) dummy is insignificant, which suggests no difference in debt levels between VC and non-VC backed firms when controlling for capital structure determinants. This result differs from both MW and our median difference tests, and suggests that, after controlling for the firm specific characteristics of capital

structure, VC backing is not a significant determinant of firm capital structure choice. Importantly, this result suggests that in this matched sample, venture capitalists invest in firms whose characteristics do not support the use of as much debt as the non-VC capital backed firms. These findings underscore the importance of controlling for firm specific differences during empirical examinations on the role of the venture capitalist.

V. CONCLUSION

We show that after controlling for the firm specific characteristics of capital structure that there is no difference in the debt levels of VC and non_VC backed firms. These results suggest that venture capitalists do not alter the capital structure choice of the firms they back. Rather, capital structure choice and soliciting venture capital backing may both be endogenous to the firm's investment opportunity set or other firm specific characteristics.⁷ More importantly, and the primary purpose of this note, our results illustrate that differing firm characteristics should be controlled for in studies of cross-sectional differences between venture and non-venture capital backed firms. Not considering these factors may lead to omitted variables, model mis-specification, and erroneous conclusions.

NOTES

1. The seminal work of Megginson and Weiss regarding venture capital certification extends far beyond this single point. We use this single example only to illustrate our point.
2. For a discussion of the LISREL procedure and factor analytic models see Bentler (1983), Joreskog (1977), and Joreskog and Sorbom (1985).
3. Sheridan Titman graciously provided us with their original LISREL code. Since we are using a newer version of LISREL, LISREL IV, we first test our procedure on an approximated replication of Titman and Wessels original dataset, and find results similar to theirs.
4. The LISREL procedure simultaneously estimates the covariance structures of both the measurement and structural equation models. Sample size is a significant constraint in the LISREL procedure, particularly when using large numbers of proxies, capital structure determinants, and debt measures (relative to sample size). After eliminating firms without the data required for the LISREL analysis, we are left with a sample of 238 firms. We believe that this is the primary reason for our lack of significance between the determinants of capital structure and firm debt measures.
5. Since our results for the measurement model are similar to the Titman and Wessels model, we do not present the results of our estimation in tabular form. These tables are available upon request. Also, our method for calculating some proxies differs slightly from Titman and Wessels due to data limitations in our sample. Since our results are similar to theirs, we believe our methods of proxy calculation are reasonable.
6. We believe that identifying the single most significant proxy for each determinant of capital structure in the measurement model avoids the employment of an *ad hoc* procedure. An examination of model variables, including the dummy variable for venture capital backing (VC), show

the highest correlations to be (1) S to P of 0.42, (2) S to G of -0.40 and (3) S to CV of 0.40. All other correlations are below 0.25. A test for model multi-collinearity finds that the model is not poorly defined. Given that we need one proxy for each of the eight determinants of capital structure, we believe the model is reasonable for testing capital structure. Removing S from the model does not alter the interpretation of the results.

7. It may be true that venture capitalists may affect firm specific variables such as size and profitability. However, the question that remains is whether markets react to the presence of venture capital, to firm specific characteristics, or to a combination of both. Our findings suggest that market discipline does not treat VC and non-VC backed firms differently when considering firm capital structure.

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