Revisiting the Capital-Structure Puzzle: UK Evidence

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Keywords: capital-structure, UK, panel data, tobit analysis, determinants.

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Abstract

We explore the potential drivers of corporate capital-structure decision. We apply both fixed effects panel models and random effects tobit models to examine this issue. Based on a sample of 379 firms across the period from 1991 to 2002, we find that corporate characteristics (firm size, firm risk, firm growth rate, firm profitability and asset tangibility) and corporate governance characteristics (board size and outside directorships) are the main drivers of capital-structure of UK firms. In addition, our results show that changing the definition of capital-structure may result in changing the sign and the significance of these potential drivers. Hence, we argue that another dimension of the capital-structure puzzle can be introduced, which is related to the definition of capital-structure used in prior studies. It is worth noting that our aim is not to provide an optimal set of factors that may affect the decision of capital-structure, but to highlight the effect of the different definitions of capital-structure that can be used by different studies, which makes comparison between such studies difficult or even erroneous.

1. Introduction

A substantial literature on accounting and finance has undertaken to identify what drives one of the key corporate financial policies, the capital-structure decision. The study by Modigliani and Miller (1958) was the first to examine this issue. They offered evidence that capital-structure is unrelated to the value of a firm. Five years later, the same authors relaxed the prefect market assumptions and added corporate taxes in their models (Modigliani and Miller, 1963). Consequently, they found that the value of a firm will be enhanced if the level of debt increases. They elucidated their findings by the fact that interest paid is tax-deductible and hence firms would enjoy a debt tax shield when funding their activities by long-term debt. However, Modigliani and Miller (1963) did not take into account bankruptcy-related costs. The findings in Modigliani and Miller (1958, 1963) encouraged many researchers to explore further the drivers of corporate capital-structure decisions. Until now, there has been no general agreement about the capital-structure debate. As a result, it is still unclear what drives capital-structure decisions.

Early literature on the capital-structure puzzle by Myers (1984) examined different capital-structure theories. He found that drivers of firms' decisions to choose debt, equity or hybrid securities are still unknown. The findings in Myers's article challenged researchers to explore this puzzle further. Berens and Cuny (1995: 1185) revisited this puzzle and find that "*debt ratios provide an inappropriate framework for empirically examining the trade-off theory of capital-structure*". In particular, they explained that debt (or debt-to-equity) ratios are misguided and lead to poor and inconsistent results when examining the determinants of corporate capital-structure. In their recent article, Barclay and Smith (2005) revisited the capital-structure puzzle and concluded that different capital-structure theories lead to different and diametrically opposed decisions and outcomes.

The above mentioned papers concentrated only on identifying the firm-specific factors that might affect corporate decision of capital-structure choice, while ignoring corporate governance factors. However, prior research provided evidence that corporate governance mechanisms affect corporate capital-structure decisions (Wen et al., 2002; Du and Dia, 2005; La Rocca, 2007; Driffield et al., 2007; Al-Najjar and Hussainey, 2009). Therefore, a significant feature of this paper is its importance in providing novel contribution to the literature of corporate capital-structure. To the best of our knowledge, this paper uniquely examines the capital-structure puzzle in the UK by applying both panel models and tobit-panel models. Moreover, it is the first paper to include corporate governance factors and firm characteristics when examining the capital-structure puzzle. It is worth noting that our aim is not to provide an optimal set of factors that may affect the capital-structure decision, but to highlight the effect of the different definitions of capital-structure used by prior research, which makes comparison between such studies difficult or even erroneous.

The results show that corporate characteristics, including firm size, business risk, growth rate, profitability and asset tangibility, have an impact on firms' capital-structure. Corporate governance characteristics, including board size and outside directorships, also have an effect on firms' capital-structure. Moreover, we argue that another dimension of the capital-structure puzzle can be introduced, which is related to the definition of capital-structure used in prior studies.

The paper proceeds as follows. Section 2 reviews prior research on the determinants of capital-structure and develops the research hypotheses. Section 3 discusses the research method and data description. The main regression results are presented in Section 4. Finally, Section 5 concludes and suggests areas for future research.

2. Theoretical background and hypotheses

This section reviews relevant empirical studies that examine the extent to which firm characteristics affect the capital-structure decision. A pioneering research article on the determinants of capital-structure was by Titman and Wessels (1988). The authors provided evidence that the size of a firm and its profitability are negatively related to corporate capital-structure, while asset tangibility is positively related to corporate capital-structure. In the same fashion, but using international data, Rajan and Zingales (1995) investigated the capital-structure debate in G7 countries. The authors found that market-to-book ratio and profitability have a negative impact on firms' capital-structure, while asset tangibility and firm size have a positive impact on firms' capital-structure. Ozkan (2001) found that profit, liquidity, non-debt tax shield and growth opportunities are negatively related to capital-structure. In addition, he found limited support for a positive relationship between firm size and capital-structure.

Delcoure (2007) explored the drivers of capital-structure choice in a sample of Central and Eastern European countries. Delcoure's study showed that asset tangibility has a positive effect on firms' capital-structure. The study also showed a negative relationship between profitability and the decision of capital-structure. Other firms' characteristics were used in prior research as determinants of corporate capital-structure. These include asset uniqueness (i.e. Wen et al., 2002) and firm risk (Al-Najjar and Hussainey, 2009). However, the authors did not find the exact hypothesised relationship between asset uniqueness and/or firm risk and corporate capital-structure decision.

The following six research hypotheses are set for the firm-specific effect. These are formulated as follows:

H1: *There is a relationship between profitability and the debt-to-equity ratio.*

H2: *There is a relationship between business risk and the debt-to-equity ratio.*

H3: *There is a relationship between asset tangibility and the debt-to-equity ratio.*

H4: *There is a negative relationship between the growth rate and the debt-to-equity ratio.*

H5: *There is a relationship between firm size and the debt-to-equity ratio.*

H6: *There is a relationship between asset uniqueness and the debt-to-equity ratio.*

Similarly, prior research (for example, Mehran, 1992; Berger et al., 1997; Wiwattanakantang, 1999; Wen et al., 2002; Du and Dia, 2005; Abor and Biekpe, 2005; Al-Najjar and Hussainey, 2009) found that corporate capital-structure decision is also influenced by corporate governance factors. In particular, Mehran (1992), Berger et al. (1997) and Abor and Biekpe (2005) found a significant negative association between the size of the board of directors and debt-to-equity ratios. However, Jensen (1986) found a positive association between higher debt ratios and larger board size. Other researchers (Wiwattanakantang, 1999; Wen et al., 2002; Al-Najjar and Hussainey, 2009) found that there is no significant association between board size and debt-to-equity ratios.

Additionally, Abor and Biekpe (2005) showed positive relationships between capital-structure and board composition (% of outside directors), while Wen et al. (2002) found a negative association between outside directors and capital-structure. However, Al-Najjar and Hussainey (2009) found no association between the two variables.

Finally, Wiwattanakantang (1999) found that managerial shareholdings have consistent positive influence on family-owned firm leverage. Al-Najjar and Hussainey (2009) found that insider ownership is the main corporate governance factor affecting firms' capital-structure.

Given the above mixed results, we also revisit this research area and examine the association between corporate governance and capital-structure. In particular, we set the

following three research hypotheses for the impact of corporate governance mechanisms on firms' capital-structure decision. These are formulated as follows:

H7: *There is a relationship between insider ownership and debt-to-equity ratio.*

H8: *There is a negative relationship between outside directorship and debt-to-equity ratio.*

H9: *There is a negative relationship between board size and debt-to-equity ratio.*

Finally, we examine the extent to which firm characteristics and corporate governance factors are equal across capital-structure models. To examine this research issue, we use panel models and random effects tobit models. We also use three different definitions of capital-structure; namely, long term debt-to-equity ratio, debt-to-capital ratio and debt-to-equity ratio, and hypothesise that each determinant has the same effect across the capital-structure models.

3. Empirical Tests

In this paper, we use a panel fixed effects regression model to investigate the determinants of capital-structure for a sample of 379 non-financial UK firms for the period from 1991 to 2002. The study investigates the following model:

$$Lev_{it} = \alpha + \beta' X_{it} + \varepsilon_{it}$$

Where the dependent variable (Lev_{it}) is (long term debt-to-equity ratio, debt-to-capital ratio and debt-to-equity ratio). α is the intercept. β' is the row vector of slope coefficients of regressors. X_{it} is the column vector of financial variables for firm i at time t; this vector is made up of the following: ROCE (Return on Capital Employed); BETA (Risk for the Firm); TANG (Fixed Assets Ratio); MB (Market-to-Book Ratio); FIRM SIZE (The Natural Logarithm of the Total Assets); ASSET UNIQUENESS (Research and Development

divided by Sales); CHS (Closely Held Shares); Number of Non-executive Directors on Board and Board of Directors Size. ε_{it} is the Residual Error for Firm i at Year t.

It is also worth noting that we used the tobit models to check the robustness of our models. The formula of the tobit model is expressed by the following equation:

$$\begin{bmatrix} \text{Lev}_{it} = \alpha + \beta' \text{X}_{it} + \varepsilon_{it} & \text{if the right - hand side} > 0 \\ = \quad 0 & \text{otherwise} \end{bmatrix}$$

Where Lev_{it} is (long term debt-to-equity ratio, debt-to-capital ratio and debt-to-equity ratio), and X_{it} is the column vector of financial variables as defined above.

3.1 Sample Selection

The sample is an updated version of the ICCSR UK Environmental & Financial Dataset, which contains information for UK firms from 1991 to 2002.[2] Financial firms are excluded from the analyses. The sample also excludes any firms with no financial and accounting records on *Datastream* or *Worldscope*. This provides a final sample of 379 non-financial firms for the period from 1991 to 2002 inclusive.

3.2 Measurement of variables

Our capital-structure measures are collected from *Datastream*. Long term debt-to-equity ratio is the total loans divided by equity capital and reserves minus total intangibles (*Datastream* item 733). Debt-to-capital ratio is preference capital plus total debt divided by total capital employed plus short term borrowing minus total intangibles (*Datastream* item 731). Debt-to-equity ratio is calculated as total debts divided by total equity capital and reserves.

[2] The authors thank the International Centre for Corporate Social Responsibility (ICCSR), Nottingham Business School, Nottingham University (UK), for giving them the opportunity to use *Datastream* items 242 and 243 for our research projects.

Our profitability measure is return on capital employed (*Datastream* item 707), which is defined as earnings before interest and tax divided by total capital employed plus short term borrowings minus total intangibles. Business risk measure is beta calculated from *Datastream.* Asset tangibility is the percentage of fixed assets to total assets. Fixed assets variable is calculated by the difference between total assets (*Datastream* item 392) and current assets (*Datastream* item 376). Market-to-book value is the price divided by the book value or net tangible assets per share for the appropriate financial year end, adjusted for capital changes (*Dastastream* item (PTBV). Firm size is the natural logarithm of total assets. This represents the sum of tangible fixed assets, intangible assets investment (including associates), other assets, total stocks and WIP, total debtors and equivalent, and cash equivalents (*Datastream* item 392). Uniqueness variable is research and development (Datastream item 119) divided by total sales (*Datastream* item 104). The percentage of a firm's common stock held by insiders as a proxy for insider power is calculated from *Worldscope* (*Worldscope* item 08021). NEXDR represents the number of board directors employed in non-executive roles (*Datastream* item 243). DRCTR is the number of executive and non-executive directors on the board (*Datastream* item 242).

4. Results

In the regression analysis we used three definitions for capital-structure: long term debt-to-equity ratio, debt-to-capital ratio and debt-to-equity ratio. The reason behind using three definitions is to see if the investigated variables will have the same results across the three definitions of capital-structure. In other words, we aim to study the capital-structure puzzle by investigating whether changing the definition of capital-structure will result in changing the overall interpretation of the theory.

Table 1 shows the long term capital-structure (debt-to-equity) model. The results show that there is a negative relationship between capital-structure and asset tangibility. This result contradicts the positive expected sign in prior research, in which fixed assets can be considered as collaterals. However, this result may be due to the fact that managers are averse to bankruptcy because of its negative impact on their compensation plans and job security. Therefore, firms with lower tangible assets may tend to use more debt to control managerial activity regardless of the cost of issuing debt. Hence, there is a trade-off between agency costs and cost of debt, and thus we expect a negative relationship between capital-structure and tangible assets (Grossman and Hart, 1982; Titman and Wessels, 1988; Jensen and Meckling, 1976; Bhaduri, 2002).

The results also show a positive relationship between growth opportunities and capital-structure. This result contradicts the agency theory, which expects a negative sign between capital-structure and growth opportunities. However, we can explain this positive sign drawing on the fact that high growth UK firms tend to rely on debt financing to pay for their investment opportunities. Another explanation is that these firms have a lower chance of financial distress and hence they can more easily access to debt financing than do low growth firms. This result is consistent with Al-Najjar and Taylor (2008) and Bhaduri (2002). Furthermore, there is a positive relationship between firm size and capital-structure. This result is consistent with transaction cost theory which indicates that large firms tend to be more diversified and have more access to debt financing. Finally, the results show that there is a positive relationship between non-executive directors and capital-structure. This is consistent with Abor and Biekpe (2005). This suggests that UK firms with more non-executive directors on the board of directors are likely to have easier access to credit and consequently pursue high debt policy (Abor and Biekpe, 2005). However, this finding is not consistent with other empirical findings (i.e. Wen et al., 2002).

Based on the results in Table 1, the use of long term debt-to-equity ratio model leads us to accept H3; H4; H5 and H8. We cannot find empirical support for profitability, firm risk, asset uniqueness, insider ownership and board size. As a result, we reject H1; H2; H6; H7 and H9.

Insert Table 1 here

Table 2 shows the debt-to-capital models. Consistent with the previous table, the results show that there is a negative relationship between asset tangibility and capital-structure, and a positive relationship between firm size and capital-structure. In addition, the results show that there is a negative relationship between firm profitability and capital-structure. This result is consistent with the pecking order hypothesis, in which profitable firms prefer internal sources of funds rather than debt financing (Rajan and Zingales, 1995; Booth et al., 2001). Interestingly, the sign of the market-to-book ratio (growth opportunities) is now negative and significant, which is consistent with the agency theory, in which firms with high growth opportunities will tend to have high related agency costs due to their flexibility in future alternative investment opportunities (Titman and Wessels, 1988). Finally, board size is found to be negatively related to capital-structure. This finding is not consistent with other empirical findings reported in Mehran (1992), Berger et al. (1997) and Abor and Biekpe (2005). Negative association between board size and corporate capital-structure decisions might indicate that board size and corporate capital-structure policy are substitute forms of corporate governance mechanisms in reducing agency costs. It also indicates that a larger board size creates pressures on managers to pursue lower debt-to-capital ratio to obtain good performance results (Wen et al., 2002)

Based on the results in Table 2, the use of the debt-to-capital ratio model leads us to marginally accept H1 and H3 (as the coefficients estimates on ROCE and TANG are only

significant in some cases). We also accept H4; H5 and H9. The results in Table 2 lead us to reject H2; H6; H7 and H8.

Insert Table 2 here

Table 3 shows the debt-to-equity model. The results show that there is a negative relationship between firms' risk and capital-structure, and hence firms with high risk will tend to have a higher risk of default and less access to debt financing; this result is consistent with bankruptcy theory of capital-structure (Rajan and Zingales, 1995; Booth et al., 2001). Consistent with Tables 1 and 2, the results show that there is a positive relationship between firm size and capital-structure. In addition, board size has a negative relationship with capital-structure, which is consistent with Table 2. There is limited evidence of a negative relationship between market-to-book ratio and capital-structure; this result is found only in Model 1 and is consistent with the results in Table 2. The results also show that there is no significant relationship between asset uniqueness and cross holder shares. Hence, the study finds no support for the relationship between both asset uniqueness and cross holder shares and capital-structure. Finally, we find that the sign of the non-executive directors is negative, which contradicts the positive sign in Table 1 (Wen et al., 2002). This negative sign is explained in Wen et al. (2002: 76) as follows: "*The outside directors monitor managers more actively, causing these managers to adopt lower leverage to avoid the performance pressure associated with commitments to disgorge large amounts of cash"*.

Insert Table 3 here

In effect, our results show that capital-structure in UK firms can be determined by asset tangibility, market-to-book ratio, firm size, firm risk, firm profitability, non-executive directors and board size. The results show consistency in some variables across the different definitions of capital-structure (such as firm size). Other variables change according to the

definition of capital-structure (such as market-to-book ratio and non-executive directors). In addition, some variables appear only in one of the models (such as firm profitability and firm risk). This change can be explained by the different explanations of the selected capital-structure index. Hence, we argue that we introduce another dimension of the capital-structure puzzle, which is related to the selected definition of the capital-structure and the aim behind such a selection.

5. Summary and overall discussion

This paper aims at investigating capital-structure using UK data. Both fixed effects panel models and random effects tobit models are applied, using around 379 firms across the period from 1991 to 2002. Our results show that the capital-structure of UK firms follows the same determinates as suggested in previous literature; namely, capital-structure in UK firms can be determined by asset tangibility, market-to-book ratio, firm size, firm risk, firm profitability, non-executive directors and board size. In addition, our results show that changing the definition of capital-structure may result in changing the sign and the number of determinants that may affect the capital-structure decision. Hence, we argue that another dimension of the capital-structure can be introduced, which is related to the selected definition of capital-structure used by various studies. It is worth noting that our aim is not to provide an optimal set of factors that may affect the decision of capital-structure, but to highlight the effect of the different definitions of capital-structure that can be used by different studies, which makes the comparison between such studies complicated or even flawed.

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Table (1): Long term debt-to-equity ratio models

Independent Variables	**fixed effects models**		***tobit models***	
	Model (1)	Model (2)	Model (3)	Model (4)
Intercept	**-499.3458**	**-631.2851**	**-212.7555**	**-306.7389**
ROCE	-.0306595	-.0284294	-.0308225	-.0311652
BETA	-4.780761	-10.99034	-10.32946	-14.79026
Tang	**-165.202**	**-180.0296**	**-97.32207**	**-94.09438**
MB	**.4466117**	**.4054884**	**.4862467**	**.4646987**
SIZE	**39.17235**	**55.87437**	**16.74955**	**29.90506**
UNIQ	-.4467004	-.3668198	-.809226	-.3890572
CHS	.000015	.0000211	2.60e-07	8.95e-06
NEXDR	**28.20565**		**23.58943**	
DRCTR		4.732761		2.465717
Observations	3151	3219	3151	3219
F-Value	**6.69**	**6.79**		
Wald chi2(8)			69.19	39.24
Prob > chi2			0.0000	0.0000

Values in **bold** are significant ($p < 0.05$).

Table (2): Debt-to-capital ratio models

Independent Variables	**fixed effects models**		***tobit models***	
	Model (1)	Model (2)	Model (3)	Model (4)
Intercept	**-275.7579**	**-257.1802**	**-111.7611**	**-114.0156**
ROCE	**-.0534979**	-.0548005	**-.0339691**	**-.035382**
BETA	7.785852	9.047373	3.668869	4.458918
Tang	**-73.92528**	**-72.89856**	-14.66566	-16.33828
MB	**-.3317487**	**-.3320453**	**-.2636373**	**-.2673704**
SIZE	**26.76834**	**26.51935**	**11.82764**	**13.62536**
UNIQ	-.1002106	-.0885059	.0439886	.0640925
CHS	-7.82e-06	-8.02e-06	-5.21e-06	-4.73e-06
NEXDR	-2.831139		-.7106937	
DRCTR		**-3.167784**		**-2.683009**
Observations	3147	3215	3147	3215
F-Value	**7.59**	**7.75**		
Wald chi2(8)			45.31	51.12
Prob > chi2			0.0000	0.0000

Values in **bold** are significant ($p < 0.10$).

Table (3): Debt-to-equity ratio models

Independent Variables	**fixed effects models**		***tobit models***	
	Model (1)	Model (2)	Model (3)	Model (4)
Intercept	**-385.9759**	**-284.6684**	**-236.8958**	**-198.2588**
ROCE	.0042651	-.0022339	-.0105555	-.0156764
BETA	**-45.56159**	**-37.67888**	**-40.62063**	**-34.59983**
Tang	35.39766	35.75737	60.09314	53.58344
MB	.0963481	.1089498	.1101107	.1136026
SIZE	**43.72881**	**41.28024**	**29.72092**	**32.04565**
UNIQ	-.1707511	-.1460124	-.1357217	-.2186945
CHS	-.0000203	-.0000221	-.0000208	-.000022
NEXDR	**-20.85164**		**-16.4527**	
DRCTR		**-18.11002**		**-15.57895**
Observations	3022	3095	3022	3095
F-Value	**8.35**	**4.49**		
Wald chi2(8)			26.23	35.51
Prob > chi2			0.0010	0.0000

Values in **bold** are significant ($p < 0.10$).