Indian Journal of Science and Technology, *Vol 9(42), DOI: 10.17485/ijst/2016/v9i42/97812, November 2016*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Dynamic Capital Structure and Factors Influencing the Speed of Adjustment of UK Firms

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Abstract

Objectives: This paper estimates firms' speed of adjustment by measuring the difference between simulated debt levels (target) and actual leverage (observed) levels to the difference between real leverage levels and lag levels based on the unit of observation (firm level) data. We test the impact of endogenous and exogenous factors to speed of adjustment. We find that the interaction of types of factors is statistically significant which would invite a rethink on the current understanding of capital structure decisions.

Keywords: Capital Structure, Speed of Adjustment, System GMM, UK Firms

1. Introduction

Our paper tests the speed of adjustment of UK firms. The hypothesis developed differentiates firms based on the borrowing levels where firms are classified as being under and above target leverage[1]. Our paper distinguishes the interaction of endogenous and exogenous factors to influence speed of adjustment and finds that the empirical results strongly support our hypotheses. Thus, we show that speed of adjustment is dependent on the interplay between endogenous and exogenous factors.

We structure our paper as follows: The following part looks at our empirical priors and motivates our analysis. Next, we entail the data, define the variables and present the model. Next, we document the findings which are presented with a discussion on the relevance to capital structure decisions. Finally, we conclude the paper and provide some indications for future research.

2. Literature Review and Motivation of the Paper

This section discusses previous studies on the rate of adjustment issue where the contention is derived from the dynamic capital structure view stemming from theories of capital structure. Looking at the literature, we find strong contention on the rate at which firms adjust to target levels. Thus motivating our paper to study the differing rates of moment adjustment and distance reduction to target levels.

The literature documents that firms often deviate from target levels. Several factors such as analyst coverage which limits the amount of leverage to be issued as well as other factors which influence adjustment costs act as an impediment to rapid rates of adjustment[2,3]. Furthermore, theoretical views and empirical studies provide evidence that the present value of bankruptcy costs of exceeding target levels far outweigh the costs of having leverage levels which are less than target levels. This would then motivate firms which are above targets to adjust at more rapid levels than firms which are below target[4–6]. We further incorporate into our investigation the impact of endogenous factors[7,8]. Our study looks at the rate of adjustment based on the endogenous factor of financial constraints which is known to impact financial issuing decisions among managers[9–11]. Exogenous factor of equity mispricing is further evaluated in this study[12].

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3. Definition of Variables and Justification of the Methodology

3.1 Sample Description

We start our sample by including all UK firms found in the Datastream (Thomson Reuters) universe. The sample includes observations for 23 years (1993–2015). Dead firms (due to delisting, takeovers/mergers and bankruptcy) are included in the sample to avoid survivorship bias. Furthermore, similar to the literature, we drop all financial firms from the sample. The observations are taken from the financial year-end of individual firms. Furthermore, we eliminate outliers by winsorizing observations for all variables at the 1st and 99th percentile. Given that our study utilizes the two-step system GMM methodology in order to estimate the dynamic model, it will lead to an unavoidable 4-year survivorship bias into the sample. We further drop observations where data is missing. This leads to a final sample of 1,584 firms with 16,824 firm-year observations. Table 1 reports a summary of firm specific characteristics of the sample.

Table 1. Sample descriptive statistics

Variable Name	Sample Mean	Sample Median	Sample StandardDeviation
BLEV	0.1794	0.1587	0.1672
MLEV	0.2163	0.1563	0.2103
SIZE	10.49	9.225	2.035
M/B	1.694	1.412	1.172
TANG	0.3343	0.3367	0.2480
R&D	0.0204	0.0197	0.0601

3.2 Estimating the Model

We opt for unbalanced panel data approach in order to increase efficiency estimates of the model as it leads to econometric efficiency, allows the increase of inference from the model parameters whilst controlling for bias due to omitted variables. This allows the use of sufficient repeated observations of cross sections; allowing us to observe the changing dynamics of shorter time series data. In addition the combination of cross-section with time series enhances the quality and quantity of data in ways which would not be possible from either of these two approaches[13]. In addition the motive of our paper is to study the dynamics of speed of adjustment which is a major benefit of panel data[14].

All variables in this paper use similar definitions as the literature. Firms' SIZE is the natural log of net sales in millions of 1993 pounds. TANG, asset tangibility is plant, property and equipment net of depreciation divided by total assets. To allow comparison between companies, R&D (Research and Development expenses) are also divided by total assets. Similar to the literature, we define the Market-to-Book ratio (M/B) as the ratio of book value of total assets less book value of equity plus market value of equity (M) to book value of total assets (B).

The econometric model for the lead debt (Target Leverage $_{t+1}$) issued to capture the rate of adjustment to target levels based on how far firms deviate from target levels[15,16]. Driven by the literature, our paper uses the model as follows to capture the speed of adjustment[17]:

$$Leveragei_{t+1} - Leverage_{it} = \gamma[Target\ Leverage_{it+1} - Leverage_{it}] + e_{t+1} \quad (1)$$

Where $Leverage_{it+1}$ is the actual debt ratio in period $t+1$ for firm i, and Target $Leverage_{it+1}$ is the simulated ratio in period $t+1$ for unit of observation (firm) i. The variance among the two captures the extent of deviation and thus the extent of adjustment required to be at target levels. We opt for a 2-stage model to allow a better measurement of the speed of adjustment[15,16,18]. The reason for two differing approaches is to allow a more robust analysis as well as tackling the known bias of dynamic panel data[17].

Our approach in the second stage utilizes target leverage ratios which are bifurcated and obtained from Equation (2). The model includes control variables in order to control for characteristics which are firm specific in order to model Target $Leverage_{it+1}$, as they are known determinants of capital structure. In addition, our analysis incorporates both the Book Leverage (BLEV) as well as the Market Leverage (MLEV) ratio. In addition all other control variables are lagged by 1 in order to address endogeneity issues[19,20]. Thus, the model which includes 15 industries dummies (1,0) to capture variations across industries is as follows[17]:

$$Target\ Leverage_{it+1} = \beta_1 CONST_{it} + \beta_2 SIZE_{it} + \frac{\beta_3 M}{B}_{it} + \beta_4 TANG_{it} + \beta_5 R\&D_{it} + \beta_6 RDD_{it} + \beta_7 INDL_{it} + \varepsilon_{it+1} \quad (2)$$

$$Leverage_{it+1} - Leverage_{it} = \beta_1 CONST_{it} + \beta_2 (Target\ Leverage_{it+1} - Leverage_{it}) + \gamma [Explanatory\ Variables]_{it} + \varepsilon_{it+1} \quad (3)$$

The classifications to categorise firms into 15 groups of industries are obtained from Datastream and are presented in Appendix A[12]. Furthermore, our regressions include a binary variable (RDD) which is assigned to be 0 when the values are not available in Dtastream[21]. In addition, we control for target levels specific to each industry by including the median level of industry leverage $INDL_{it}$ for firm *i* at time *t*. We further utilize a dynamic model which is based on the 2-step system GMM estimator[16]. Lastly, the standard errors used in our models correct for heteroscedasticity as well as taking into account the correction for biases arising from finite sample errors[22].

4. Results and Discussion

Our results from regressing the model in Equation (1) is reported in Table 2. The figures reported are the coefficients estimates for the corresponding variables whilst standard errors are in parenthesis[15,23]. The dependent variable for the model reported in Column 1 is book leverage. Column 2 replaces market leverage as the dependent variable.

Table 2. Estimation of target leverage: Utilizing the Fama and French approach

	1	2
CONST	-0.1124***	-0.0484
	(0.0340)	(0.0408)
SIZE	0.0184***	0.0206***
	(0.0012)	(0.0024)
MTB	-0.0052***	-0.0813***
	(0.0019)	(0.0045)
TANG	0.0987***	0.1096***
	(0.0167)	(0.0193)
R&D	0.0030	0.0104
	(0.0080)	(0.0108)
RDD	0.0405***	0.0645***
	(0.0108)	(0.0172)
INDL	0.5658***	0.7865***
	(0.0987)	(0.1944)
Average R^2	0.1624	0.2340
F – Test (p-values)	0.00	0.00
Observations	16,824	16,824
Period	1993 – 2015	1993 – 2015

*Note: ***, ** and * indicates significance at 1%, 5% and 10% respectively.*

Our results are in line with the literature[24]. The results from regressing Equation (2) are reported in Table 3.

We are able to further confirm firms target adjustment behaviour based on the results in Table 3. This is due to the lagged leverage variable being statistically as well as economically significant. We further use modelled figures from the coefficients derived in Tables 2 and 3 to regress the rate of adjustment. This is accomplished by measuring the distance of levels firms deviate from target leverage levels which is therefore expressed as below[18]:

Table 3. Estimation of target leverage: Utilizing the Blundell and Bond approach

	1	2
LEVERAGE	0.5624***	0.7861***
	(0.0160)	(0.0108)
SIZE	0.0219***	0.0349***
	(0.0026)	(0.0062)
MTB	-0.0019	-0.0031
	(0.0022)	(0.0058)
TANG	0.0987***	0.1096***
	(0.0167)	(0.0193)
R&D	0.0016	0.0036
	(0.0104)	(0.0159)
RDD	0.0208	0.0274
	(0.0187)	(0.0231)
INDL	0.4827***	0.6135***
	(0.0705)	(0.1527)
Adjusted R^2	0.5426	0.6944
Wald test (p-values)	0.00	0.00
Sargan test (p-values)	0.26	0.22
Observations	16,82	16,824
Period	1993 – 2015	1993 – 2015

Note: ****, ** and * indicates significance at 1%, 5% and 10% respectively.*

The purpose of the model is to measure the distance of deviation, DIST(Target $Leverage_{it+1}$ - $Leverage_{it}$). This variable captures the change (increase or decrease) in levels of debt in order for firms to approach target levels. Based on this measurement of distance, firms whose debt levels are above target levels will have a negative distance whilst being below target levels will lead to a positive distance. In the event that firms completely adjust to target in the coming financial year, the value of the coefficient of

β_2 will be equal to unity or 1. Zooming into the main notion of the paper, our approach dictates that we split our sample into firm-year observations which are above and below target. We then regress the following:

$$Leverage_{it+1} - Leverage_{it} = \beta_1 CONST_{it} + \beta_2 (DISTANCE) \times UCD \text{ or } CD \times UVALD \text{ or } OVALD + \gamma[Explanatory\ Variables]_{it} + \varepsilon_{it+1} \quad (4)$$

To measure the endogenous factor that influences firms' speed of adjustment the financially Unconstrained Dummy (UCD) is assigned the value of 1 when firms are financially constrained and zero otherwise. We use firms' size to classify financial constraints where the smallest 33th percentile are considered as constrained and the largest third are unconstrained. Use of alternative measures of financial constraints do not materially alter our results and are not reported for the sake of brevity[25]. Furthermore we measure exogenous factors using equity mispricing[18]. The undervaluation (overvaluation) dummy takes the value of 1 when firms' equities are undervalued (overvalued) or zero otherwise. The equity mispricing is using an ex-post valuation methodology[18].

Table 4. Speed of adjustment: Interaction between endogenous and exogenous factors

	1	2	3	4
	Under-levered firms		Over-levered firms	
Panel A: Simulating target leverage$_{t+1}$ using Fama and French framework				
DISTANCE x UCD x UVALD	0.4124***	0.4891***	-	-
	(0.0301)	(0.0403)	-	-
DISTANCE x CD x OVALD	-	-	0.6597***	0.7355***
-			(0.0407)	(0.0908)
Adjusted R^2	0.4897	0.5122	0.6975	0.7244
Wald (p-values)	0.00	0.00	0.00	0.00
Observations	8,824	8,824	7,907	7,907
Period	1993 – 2015			
Simulating target leverage$_{t+1}$ using Blundell and Bond framework				
DISTANCE x UCD x UVALD	0.3244***	0.3423***	-	-
	(0.0106)	(0.0127)	-	-
DISTANCE x CD x OVALD	-	-	0.5428***	0.5877***
	-	-	(0.0309)	(0.0508)
Adjusted R^2	0.3927	0.4644	0.5644	0.6012
Wald (p-values)	0.00	0.00	0.00	0.00
Observations	7,201	7,201	9,645	9,645
Period	1993 – 2015			

Note: ***, ** and * indicates significance at 1%, 5% and 10% respectively.

We report the results obtained from the regression of Equation (4) in Table 4. Our results obtained from looking at the expression in Equation (4) are reported in Table 4 above. We control for unit of observation fixed effects at firm level in order to avoid any potential biases which may occur due to unobservable firms' factors which do not vary across time and may lead to spurious correlation between the speed of adjustment to target leverage and the distance variable.

The aim of this method in our approach is to account for specific differences across the unit of observations (firm level) which are inclined to be invariant across time. The potential biases that may occur throughout the observation period in our sample include talented management particular to a firm or shocks in the economy.

We cluster the standard errors based on a 2-dimensional approach rather than a 1-dimensional approach: By each time unit (year) as well as each observation unit (at firm level) which allows the control of correlation of observations across time (year) for a given firm as well as correlation across firms for a given year. The results reported are robust using standard errors to control for heteroscedasticity although such robust standard errors generally report smaller values leading to more significant values as the p-values would be smaller[26]. Thus, we opt for the two dimensional clustered standard errors which are clustered by unit (firm) level as well as time (year) level over standard errors clustered by one dimension as well standard errors which are robust to control for the likelihood of heteroscedasticity in the regressions[26,27].

The model from the first two columns includes the new term which results from the interaction introduced above. Based on the reported results, we find that the new variable is significant. Furthermore, the results in columns 3 and 4 shows that the interaction terms remains significant. Thus, we are able to conclude that firms are more inclined to adjust to target debt levels only occurs when firms are under levered, unconstrained and equity is undervalued. In addition, when firms are over levered, constrained and its equity is overvalued, firms tend to adjust rapidly to target levels. We report the static approach of the model in Panel B and find that our results hold for both approaches[15,16].

We thus find that speed of adjustment is rapid and slower based on the endogenous and exogenous factors, lending credence to our main hypothesis[28,29]. This indicates the speed of adjustment varies based on the interaction between endogenous and exogenous factors as supported by our findings. Therefore, the predictions provided by the theory is not as straightforward as we would believe it to be given that these factors can act as a catalyst as well as impede adjustment to target levels[30].

5. Conclusion

This paper utilizes the unbalanced panel data based on non-financial UK firms. Our approach allows us to test the speed of adjustment to target levels which is a main theme of research in the capital structure debate. Our main contention as presented in the arguments above is that the rate of adjustment is dependent on endogenous and exogenous factors. Our approach uses the two-stages. The first stage estimates the lead (target) levels whilst the second stage measure the extent of adjustment each firm must make in order to approach the simulated level based on the gap between the actual lead and lag measurements. We document greater speeds of adjustment when firms are below target but not limited by endogenous factors (financial constraints) and motivated by exogenous factors (equity undervaluation). Contrarily, firms above target levels tend to adjust in order to minimize the potential of bankruptcy costs when they are limited by endogenous factors (financial constraints) and exogenous factors are favourable (equity overvaluation). Overall, our results indicate that endogenous and exogenous factors influences speed of adjustment suggesting that firm specific characteristics as well as market characteristics play an important role in speed of adjustment.

Appendix A

Classifications of Industry

Dummy	Types of Industries
1	Automotive, Aviation and Transportation.
2	Beverages, Tobacco.
3	Building and Construction.
4	Chemicals, Healthcare, Pharmaceuticals
5	Computer, Electrical and Electronic equipment.
6	Diversified industry.
7	Engineering, Mining, Metallurgy, Oil and gas exploration.
8	Food producer and processors, Farming and fishing.
9	Leisure, Hotels, Restaurants and Pubs.
10	Other businesses.
11	Paper, Forestry, Packaging, Printing and publishing, Photography.
12	Retailers, Wholesalers and distributors.
13	Services.
14	Textile, Leather, Clothing, Footwear and Furniture.
15	Utilities.
Source: Thomson Reuters Datastream	

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