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Non Linear Speed of Adjustment to Lead Leverage Levels and the Timing Element in Equity Issues: Empirical Evidence from the UK

Research Article

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Abstract. The dynamic trade-off view of capital structure is based on partial adjustment models that find that firms adjust towards target levels. In this paper, we estimate the speed of adjustment based on the first difference of the lead leverage levels (actual lead) and lag leverage levels (actual lag) to the first difference of simulated lead (target) leverage levels and lag levels (actual lag leverage) for UK firms. Consistent with the literature we find that firms adjust the lag (current) leverage levels faster to lead levels when they are above lead levels relative to periods when they are below lead levels. This is due to managerial actions in minimizing present value of bankruptcy costs when firms are over-levered. Bringing in the market timing view of capital structure, we measure deviation of market prices to predicted theoretical values, and find that speed of adjustment is influenced by equity mispricing. We find that firms adjust faster to lead levels when lag levels are above lead levels and the extent of deviation above theoretical values is not excessive relative to when deviations of prices from theoretical levels are too high. Furthermore, looking at firms below lead levels, we find that firms adjust faster to lead levels when equities prices below theoretical values severely deviate; suggesting that firms increase debt issues when equity prices are acutely suppressed. This indicates managers are consistently looking at windows of opportunities when issuing or repurchasing to ensure successful timing attempts. Thus, our findings suggest that although market timing could also work within a trade-off framework where managers are timing based on the deviation from theoretical prices as well as moving towards simulated lead levels, the extent of the integration of both explanations of capital structure remains puzzling.

Keywords. Non-linearity; Speed of adjustment; Timing of equity issues

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1. Introduction

This paper investigates the speed of adjustment to lead (target) leverage levels for UK firms. We empirically test the adjustment levels for firms which are above and under lead levels whilst measuring the extent of deviation of market prices from theoretical prices. Our tests attempt to explain the movement to lead levels at differing speeds whilst incorporating market timing attempts by managers. We assume that managers have superior levels of information and thus are able to exploit windows of opportunity to time the equity market which are in line with targeting behaviour.

The trade-off theory of capital structure posits that managers are trading off the benefits and costs of debt to reach an optimal level. However, empirical studies have shown that firms often deviate from lead levels and do not rapidly adjust to target levels (see Flannery and Rangan, 2006 and Huang and Ritter, 2009). This could be due costs of adjustment impeding firms from reaching target levels. Direct evidence of costs of adjustments impeding firms from reaching target levels is provided in Haas and Peeters (2006) who show that exogenous factors influence speed of adjustment to target levels. In addition, Camara (2012) show differing speed of adjustment for multinational corporations versus domestic corporations who face impediments from reach target levels. Elsas and Florysiak (2011) provide further evidence of non-linear speed of adjustment where firms with high levels of default risk or expected bankruptcy costs and high levels of opportunity costs of deviating from target levels adjust more rapidly to target levels. Oztekin and Flannery (2011) further show that better institutions lower transaction costs which allow firms with access to better institutional factors adjust more rapidly to target levels relative to firms without access. Similar to the findings of Warr et al. (2012), we hypothesize that deviation of market prices from fundamental values which impacts cost of equity as an adjustment cost. However, our paper distinguishes the extent of mispricing and finds strong empirical evidence to support our notion. Managers are acutely aware of the extent of mispricing and react in a distinctive pattern to time issues in order to reach target levels. Our motivation is derived from the evidence of non-linear timing of the equity markets by managers documented in the literature (see Hussain and Jabarullah, 2013 and Hussain, 2014). To the best of our knowledge, we are the first to show that speed of adjustment to target levels although affected by equity mispricing, works in a non-linear manner.

Similar to our expectations and consistent with the literature, we find that firms that are above target levels tend to adjust faster in the presence of overvaluation relative to periods of undervaluation. However distinguishing firms based on the extent of overvaluation, we find that the speed of adjustment to only be significantly faster when the extent of overvaluation is not severe. This indicates that firms do not increase equity issues in the event of severe overpricing. This could be an indication of the signalling effect where managers do not believe that prices can be sustained at these levels if an equity announcement were to be made. Looking at firms below target levels, our findings concur with the literature where firms adjust more rapidly to target levels in periods of undervaluation. Dissecting the sample further, we find that this is only true when equities are severely deflated suggesting that managers are reluctant to rely on debt. It could be that financial flexibility is being preserved.

Our paper proceeds as follows: the next section discusses the relevant literature and the motivation for the study. We then describe the data, provide the variable definitions, discuss the valuation model and detail our empirical model. Following that, we present and discuss our results. Finally we conclude the paper.

2. Literature Review and Motivation of Study

This section looks at the literature on the rate of adjustment to target leverage levels and the equity market timing explanation of capital structure. Although the trade-off theory states that firms have target leverage levels, empirical studies have found that firms may temporarily deviate away from these levels. Adjustments to target levels are often impeded by market imperfections and adjustment costs. Given that there remains contentious debate on the rate of adjustment to target levels in the literature; our paper looks at the extent of deviation of market prices from intrinsic value to and its effect on adjustment costs.

Equity market timing

The equity market timing theory of capital structure argues that the current capital structure of a firm is the cumulative outcome of previous timing attempts by managers (Baker and Wurgler, 2002). Based on this explanation of capital structure, managers tend to favour equity when valuations are high and debt when valuation levels are low. It is assumed that given that managers are acting in shareholders' interests, they are able to identify windows of opportunities where equities are mispriced and hence time security issues to coincide with these periods of mispricing. These windows of opportunity may arise as investors do not fully incorporate information into decision making leading to the possibility of irrational investors making investment decisions (Hirshleifer et al., 2012). Further support for the theory is provided in Hovakimian (2006), who finds that Seasoned Equity Offerings (SEOs) in the US are strongly correlated to equity prices.

The theory is however not without contention. Flannery and Rangan (2006) show that half of the changes in capital structure can be explained by targeting behaviour and attribute only about a tenth to market timing attempts. Alti (2006) further shows that although managers are timing Initial Public Offerings (IPOs), they tend to revert to target levels in a couple o f years after the IPO event. In a more relevant study, Hussain and Jabarullah (2013) show that UK firms tend to only increase reliance on equity issues during periods of slight overvaluation and opt for debt issues during periods of severe undervaluation. Thus, the literature provides no clear distinction on the validity of the market timing explanation of capital structure.

Speed of adjustment

In a survey of UK firms, Brounen et al. (2006) find that managers take into account target levels of leverage when issuing debt indicating that firms do indeed have target leverage levels. However firms often deviate from target levels and are unable to fully adjust back to target levels due to adjustment costs. Leary and Roberts (2005) further use a dynamic duration model to show that financing behaviour is consistent the presence of adjustment costs to target levels. Faulkender et al. (2007) suggest that a possible reason for firms to deviate from target levels would be (although managers have a target level of leverage in mind) to time security issues within a band around the target.

Chang et al. (2006) find that firms that receive less analyst coverage issue equity less frequently and issues are clumped in large issues. The authors show that given this situations, managers would be inclined to time equity issues when market conditions are considered to be favourable. This is due to firms which receive less analyst coverage would face higher levels of information asymmetry and thus their share prices would be subject to greater levels of mispricing. In the event that equity becomes under-valued; firms would be inclined to issue debt and thus be forced to move away from target levels to finance their deficit. Once equity prices have recovered, managers would then be motivated to issue equity and thus reduce the extent of deviation from target levels. Furthermore, even if higher levels of valuations would move firms closer to target market leverage levels, managers would still have the inclination to issue more equity in anticipation of future difficulty in issuing.

In another recent study, Binsbergen et al. (2010) further show that the cost of being over-levered is higher than the cost of being under-levered suggesting that speed of adjustment for firms above target levels would be faster relative to firms below their target levels. This notion is supported in Byoun (2008) who finds that most of the adjustment to target levels occurs if firms have a financing surplus (deficit) and are over-levered (under-levered). Warr et al. (2012) test how equity mispricing affects speed of adjustment. They find that firms adjust faster to target levels when firms are above target levels and equities are overvalued (relative to periods of undervaluation). Looking at firms which are under-levered, the authors provide empirical evidence that firms tend to adjust faster to target levels when equities are undervalued relative to periods of overvaluation. Based on the findings of the authors, we similarly hypothesize that equity mispricing as altering the cost of adjustment to target levels. Drawing from Hussain (2014), we conjecture that the extent of mispricing directly influences managerial actions and hence the speed of adjustment to target levels. Thus speed of adjustment is a function of mispricing, conditional to the extent of mispricing.

3. Material and Methods

Variable definitions and descriptive statistics

We start our sample by including all UK firms that are available in the Datastream Thomson Rueters database to maximize our number of firm-year observations. The time period ranges from 1993-2012 as pre-1993 data is scarcely available. The sample is selected based on data availability and our objective of measuring equity mispricing as well as estimating the speed of adjustment. In order to avoid survivorship and selection bias, we include dead firms in our sample. We exclude all financial firms as is the practice in the literature of capital structure studies in the UK. Furthermore, consistent with the literature, our observations are based on the financial year-end of each individual firm. In line with Faulkender et al. (2012) we winsorize all ratios at the 1st and 99th percentile to eliminate the influence of outliers and the possibility of miscoded observations. Additionally, given that we are using the Blundell and Bond (1998) two-step system GMM to estimate target leverage; as well as the residual income model, the data will have a self-imposed survivorship bias of 4-year continuous observations. Our analysis also excludes observations with missing data. Our final sample comprises of 1.526 firms with 16,246 firm-year observations. The summary statistics of firm specific characteristics and leverage levels are summarized in Table 1.

Table 1. Descriptive statistics of the sample

Variable	Mean	Median	Standard Deviation
BL	0.1794	015870	0.1672
ML	0.2163	0.1563	0.2103
SIZE	10.490	9.2250	2.0340
MTB	1.6940	1.4120	1.1720
TANG	0.3343	0.3367	0.2480
R&D	0.0204	0.0197	0.0601

The table above provides the summary statistics of the variables used in the study. BL is book leverage scaled by total assets, ML is the ratio of book value of total debt to market value of equity plus book value of total debt, SIZE is the natural logarithm of net sales in millions of 1993 pounds, MTB is 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), R&D is research and development expenses divided by total assets and TANG is net plant, property and equipment over total assets.

Our study uses unbalanced panel data to allow us to more accurately capture firms timing behaviour due to econometric efficiency, better inference of model parameters and as a limitation on omitted variable bias which acts as a control for missing or unobservable variables. Variables used in this study are defined based on the literature. Firms' SIZE is the natural logarithm of net sales in millions of 1993 pounds. TANG, asset tangibility is net plant, property and equipment over total assets. R&D (research and development expenses) is scaled by total assets. The market-to-book ratio (MTB) is defined as 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).

Equity mispricing

Our study utilizes the residual income model in order to measure fundamental values of equity (Elliott et al. 2007, 2008). To measure the deviation from fundamental prices, we define the mispricing (MISP) variable as the ratio of intrinsic value of equity to the current market price of a given share (refer to D'Mello and Shroff (2000) for a detailed review of the residual income model). Furthermore, we draw from Rhodes-Kropf et al. (2000) in order to decompose the market-to-book ratio to two components which separate growth and a measure of valuation. This avoids any ambiguity problems (i.e. growth). Thus, the first component (value-to-market) is of particular interest to our study.

Based on the above, we are able to define the intrinsic value of a particular equity based on Elliott et al. (2007, 2008) as follows:

$$IV_0 = BE_0 + \sum_{t=1}^{T}(1+k)^{-t}EE_0[I_t - k] \times BE_{t-1} + \frac{(1+k)^{-T}}{k}TV\,. \tag{3.1}$$

The terminal value, TV from the above expression is calculated as follows:

$$TV = \frac{EE_{i_0}[(I_r - k \times BE_{T-1}) + (I_{r+1} - k \times BET)]}{2}\,, \tag{3.2}$$

where IV_0 is the intrinsic value of the firm's equity at time 0, BE_0 is the book value of equity at time 0, k is the cost of equity, and $EE_0(I_i)$ is the expected earnings for period t at time 0. Time 0 is defined as the previous fiscal year and set T to equal 2 years. Similar to Elliott et al. (2007,

2008) our study incorporates 3 years of future growth earnings. The authors reason that given that the residual income model does not capitalize raw earnings but employs abnormal earnings (similar to the Economic Value Added approach), 3 years is not too short a time period to capture all future potential growth opportunities of a given firm. Drawing further from their study, we utilize the perfect foresight version of the residual income model (see D'Mello and Shroff, 2000). Thus our definition of BE is the book value of equity and I_i is defined as income before extraordinary items.

We further employ a similar approach in using the ex-post realization of earnings in order to maximise sample size. However this approach suffers from several drawbacks, mainly the issue of endogeneity. This issue nonetheless provides a bias against our study of finding any evidence of market timing, given that further debt issues would depress future earnings due to the commitment of interest payments. To estimate the cost of equity capital, k, we use the Fama and French (1997) three factor model. Our results are robust to using a single factor model. We proxy for the risk free rate using short-term treasury bills. The terminal value from expression (3.2) is calculated as the average value of the last 2 years of the finite series and we restrict our sample to positive values, as using negative values would imply that managers are continuously investing in negative NPV projects. In order to proxy for managers more informed expectations relative to investors, we use future realized earnings by assuming perfect and unbiased foresight by managers. Our approach is justified as the purpose of the MISP variable is to measure the extent of deviation from intrinsic value rather than to create a trading rule. Furthermore, to complement and confirm our results, we test for robustness using analyst forecasted earnings (consensus) data obtained from Bloomberg at the beginning of the financial year. Our test of robustness is in line with the approach used in the literature (see Lee et al. 1999, D'Mello and Shroff, 2000 and Elliott et al., 2007). This approach however suffers from the drawback of a reduced sample size due to the limited number of firms covered by analysts.

Target leverage and speed of adjustment

The trade-off theory of capital structure argues for a target level of leverage where firms would continuously issue (retire) securities in order to reach an optimal level of leverage. The speed of adjustment to target levels is dependent on costs of adjustment. The main notion of this paper looks at cost of equity (via equity mispricing) as an adjustment cost towards target levels. Thus we model the lead variable (Target Leverage$_{t+1}$) based on Fama and French (2002) as well as Blundell and Bond (1998). Similar to Warr et al. (2012) we contend that equity mispricing and managerial timing attempts alters the cost of adjustment to target levels. However, given that our main contention lies with the integration of the market timing theory of capital structure, based on previous studies (see Hussain and Jabarullah, 2013 and Hussain 2014) with the trade-off theory; our empirical model is thus aimed at measuring the speed of adjustment to target leverage subject to the extent of equity mispricing. We utilize the following model to measure speed of adjustment as follows (see Flannery and Rangan, 2006 and Warr et al., 2012):

$$\text{Leverage}_{it+1} - \text{Leverage}_{it} = \gamma[\text{Target Leverage}_{it+1} - \text{Leverage}_{it}] + e_{t+1}, \tag{3.3}$$

where Leverage$_{it+1}$ is the debt ratio in period $t+1$ for firm i, and Target Leverage$_{it+1}$ is the target leverage ratio in period $t+1$ for firm i. The difference between the two variables is the amount the debt ratio must change to allow firms to be back on target. Similar to Warr et al (2012) we use a 2-stage model to estimate speed of adjustment. In the initial stage, target leverage (Target Leverage$_{it+1}$) is estimated using the Fama and French (2002) and Blundell and Bond (1998) method. The use of two differing methods for estimating speed of adjustment is for robustness purposes. The literature documents that the Blundell and Bond (1998) method is able to tackle dynamic panel data bias (Flannery and Rangan, 2006). The second stage uses the target l everage ratios which are bifurcated based on the valuation measure to estimate differences in speed of adjustment (based on equation (3.3)). The variables used to estimate in the first stage are firm size, asset tangibility, market-to-book ratio, research and development expenses and industry median leverage for book (MEDBL) and market leverage (MEDML) (similar to Hovakimian et al., 2001 and Hovakimian and Li (2011).

We estimate both book leverage (BL) and market leverage (ML) where BL, is defined as book leverage divided by total assets and (ML), is measured as the ratio of book value of total debt to market value of equity plus book value of total debt. In line with the literature discussed above, to control for endogeneity issues, our estimations are done over the year following the mispricing measure (MISP). Furthermore, we lag all our control variables by 1 to avoid the possibility of reverse causality affecting the results.

Estimation model

In order to estimate target leverage levels at $t+1$ as the lead variable, we utilize two alternative methods as a measure of robustness. As discussed above, the first method is adapted from Fama and French (2002); who in turn utilize the method from Fama and MacBeth (1973). The target leverage levels are based on cross-sectional regressions of annual observations. The model is expressed as follows based on the determinants described above as well as 15 industry dummies with the value of [1,0]:

$$\begin{aligned}\text{Target Leverage}_{it+1} &= \beta_1\,\text{CONST}_{it} + \beta_2\,\text{SIZE}_{it} + \beta_3\,\text{MTB}_{it} + \beta_4\,\text{TANG}_{it} \\ &\quad + \beta_5\,\text{R\&D}_{it} + \beta_6\,\text{RDD}_{it} + \beta_7\,\text{INDL}_{it} + \varepsilon_{it+1}\,. \end{aligned} \tag{3.4}$$

Appendix A details the industry classifications which are similar to Hussain (2014) and based on Thomson Rueters Datastream classifications. Furthermore, we include a dummy variable (RDD) which takes the value of 1 for firms where research and development expenses are not available and 0 otherwise (see Alti, 2006). To further control for specific target levels at industry level, we include the variables which is the industry median leverage at time t for firm i. The second method is based on the Blundell and Bond (1998); utilizing the 2-step system GMM estimator. Consider the basic model based on the autoregressive method:

$$Y_{it+1} = \beta_1\,\text{CONST}_{it} + \beta_2 Y_{it} + \gamma[\text{Explantory Variations}]_{it} + \pi_{it} + \tau_{it} + \varepsilon_{it+1}\,, \tag{3.5}$$

where Y_{it+1} is the lead variable for book and market leverage (target leverage at $t+1$) for firm i, Y_{it} is the lag variable for book and market leverage (actual leverage at t) for firm i, is a vector of explanatory variables as discussed above and similar to equation (3.4) at time t for firm i, are the unobservable firm-specific characteristics which are time invariant such as firm reputation and management ability for firm i at time t, τ_{it} represents the effects which are time specific such as shocks in the economy and inflation rates for firm i at time t which affects all firms and can vary across time and ε_{it} is the error term which is assumed to be serially uncorrelated with mean values of zero and variance σ^2. We utilize 2-step system GMM as OLS estimation of equation (3.5) would result in the coefficients being biased as τ_{it} is not directly observable and has a correlation with the other regressors in the model (Hsiao, 1985). Furthermore, there is a correlation between Y_{it} with π_{it} which would lead to inconsistent coefficients being estimated.

One possible solution would be to take first differences of the variables in order to eliminate fixed effects which are time-invariant (π_{it}). This method would still suffer from inefficiencies due to the correlation between the first difference of the error term ($\Delta\varepsilon_{it}$) and the first difference of the leverage level of firm i at time t (ΔY_{it}). This is due to the assumption of exogeneity of OLS for all explanatory variables. This is a flawed assumption as random effects that affect the dependent variable are also most likely to affect the explanatory variables as well. Another possible solution is proposed by Anderson and Hsiao (1982); which is through the use of the instrument variable technique (IV). However, the IV method can still lead to inefficient estimations as it does not utilize all available moment conditions. Another alternative solution is proposed by Arellano and Bond (1991). The authors suggest that the use of GMM which allows additional instruments. The instruments are obtained by using the orthogonal conditions that are present between the disturbances and the lagged dependent variable. Thus, we are able to find the true parameter for the GMM method by identifying the elements of the parameter space where the linear combinations of the sample cross products are 'as close to zero as possible' (Hansen, 1982). GMM is an advantageous method as it is able to optimally exploit all the linear moment restrictions which are specified in the model. We assume that the error term ($\varepsilon_{it+1};\varepsilon_{it}$) is zero as the consistency of the GMM estimator assumes the absence of second-order correlation in differences and the first-order correlation in levels.

We investigate the Sargan's test to identify the use of over identifying restrictions in order to ensure there is no higher-order serial correlation to have a valid set of instruments independent of the residuals. We do not utilize the one-step GMM estimators given that the error terms are expected to show heteroscedasticity in large sample data with a relatively long time span (see Blundell and Bond, 1998). The two-step approach allows us to use one-step residuals to construct asymptotically matrices which are optimally weighted which leads to efficiency over the one-step approach. Thus, the use of two-step system GMM allows the control of heteroscedasticy over the sample, correlation of errors over observed time, measurement errors due to utilization of orthogonal conditions on the variance-covariance matrix and simultaneity.

Our preference for the two-step system GMM over the first differences GMM method is due to the later having a problem of weak instruments and the use of first-differences in utilizing instruments in levels due to the absence of information regarding parameters in the level-variables. This leads to a l oss of efficiency in the models (Arrellano and Bover, 1995). In addition, Blundell and Bond (1998) show that system GMM has dramatic efficiency gains over the first differences GMM method especially when estimating short sample periods with persistent data. This is especially true if the lagged dependent variable has a coefficient approaching one and the ratio of variances of to increases. Furthermore, the authors document that by including lagged first differences and lagged levels instruments in the instrument set, the method allows for a substantial reduction in finite sample bias due to the ability of the methodology to exploit additional moment conditions. The advantage of the approach chosen in this paper is that the methodology allows estimation in b oth levels and first differences as a result of level equations being estimated simultaneously by utilizing differences of lagged regressors as instruments. Thus we are able to maintain variations among firms in the sample whilst controlling for heterogeneity. In addition the standard errors used to measure significance levels are robust to heteroscedasticity whilst for correcting for finite sample errors based on the suggested approach in Windemeijer (2005) for dynamic linear models.

4. Results and Discussion

We report and discuss our results in this section. Table 2 reports the regression results for equation (3.4). The estimation is done based on a static framework of target leverage levels. The coefficients are reported with standard errors in parenthesis. Regressions results a re done based on the Fama and McBeth (1973) approach. The table reports mean coefficients which is the average slope of the annual regressions. The time series standard errors are as in Fama and French (2002). Column 1 uses book leverage as the dependent variable which is replaced by market leverage in column 2.

Table 2. Estimating target leverage at the lead level based on the Fama and French framework.

	1	2
CONST	$-0.1124^{\dagger}$ (0.0340)	-0.0484 (0.0408)
SIZE	$0.0184^{\dagger}$ (0.0012)	$0.0206^{\dagger}$ (0.0024)
MTB	$-0.0052^{\dagger}$ (0.0019)	$-0.0813^{\dagger}$ (0.0045)
TANG	$0.0987^{\dagger}$ (0.0167)	$0.1096^{\dagger}$ (0.0193)
R&D	0.0030 (0.0080)	0.0104 (0.0108)
RDD	$0.0405^{\dagger}$ (0.0108)	$0.0645^{\dagger}$ (0.0172)
INDL	$0.5658^{\dagger}$ (0.0987)	$0.7865^{\dagger}$ (0.1944)
Average R^2	0.1624	0.2340
F-Test (p-values)	0.0000	0.000
Observations	16,246	16,246
Period	1993-2012	1993-2012

This table provides the results for our initial analysis for target leverage based on a static framework. †, ‡ and * indicates significance at 1%, 5% and 10% respectively. The dependent variable is target leverage $(t+1)$. Column 1 reports results for book leverage while column 2 reports results for market leverage. The mean slope coefficient is the average of the slopes for the 20 annual regressions. Time-series standard error is the time-series standard deviation of the regression coefficient divided by $(20)^{1/2}$, as in Fama and French (2002). All regressions include 15 industry dummies $[0,1]$. SIZE is the natural logarithm of net sales in millions of 1993 pounds. MTB, market-to-book ratio is defined 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). TANG, asset tangibility is net plant, property and equipment over total assets. R&D (research and development expenses) are scaled by total assets. RDD is a dummy variable which takes the value of 1 if R&D expenses are not reported in Datastream and zero otherwise. INDL is the median industry leverage of the firm.

We find that the market-to-book ratio has a negative coefficient and significant for both measures of target leverage. This suggests that firms are trying to protect future growth opportunities and thus choose to lower target levels. Our reports are in line with the literature (see Flannery and Rangan, 2006 and Warr et. al., 2012). Further confirming the findings in the literature, (see Mackie-Mason, 1990 and Flannery and Rangan, 2006), we find that asset tangibility also has a positive and significant coefficient indicating that firms which higher levels of fixed assets tend to have higher depreciation expenses (i.e. tax credits) as well as higher collateral value for securing debt. Thus these firms tend to have higher levels of debt capacity. In addition, we find that firm size has a positive correlation with target leverage which confirms to Hovakimian et al. (2001). This is due to larger firms tending to have higher levels of diversification leading to a less volatile cash flow allowing more security in meeting interest obligations. A more stable cash flow also leads to increased levels of profitability which gives firms the opportunity to further exploit the tax shield of debt leading to lower levels of probability of bankruptcy and thus expected bankruptcy costs (see Hovakimian et al. 2001). Table 3 reports the results for regression for equation (3.5).

Table 3. Estimating target leverage at the lead level based on the Blundell and Bond framework

	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	16,246	16,246
Period	1993-2012	1993-2012

This table provides the results for our initial analysis for target leverage based on a dynamic framework. †, ‡ and * indicates significance at 1%, 5% and 10% respectively. The dependent variable is target leverage ($t+1$). Column 1 reports results for book leverage while column 2 reports results for market leverage. The coefficients are reported based on estimation for the lead variable as the dependent variable and includes a lag measure of leverage as the independent variable. Standard errors robust to heteroscedasticity and based on Windmeijer (2005) finite sample correction. All regressions include 15 industry dummies [0,1] as well as year dummies. SIZE is the natural logarithm of net sales in millions of 1993 pounds. MTB, market-to-book ratio is defined 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).TANG, asset tangibility is net plant, property and equipment over total assets. R&D (research and development expenses) are scaled by total assets. RDD is a dummy variable which takes the value of 1 if R&D expenses are not reported in Datastream and zero otherwise. INDL is the median industry leverage of the firm.

The results from Table 3 further confirm that firms adjust toward target levels as the lagged leverage variable is significant statistically and economically. The simulated values from the results in Table 2 and 3 are then used to estimate the speed of adjustment based on the distance from target leverage and is modelled as (see Warr et al. (2012) for full discussion on the econometric advantage of this approach rather than using baseline speed of adjustment extracted directly from the dynamic model):

$$\begin{aligned}\text{Leverage}_{it+1} - \text{Leverage}_{it} &= \beta_1 \text{CONST}_{it} + \beta_2(\text{Target Leverage}_{it+1} - \text{Leverage}_{it}) \\ &\quad + \gamma[\text{Explanatory Variables}]_{it} + \varepsilon_{it+1}. \end{aligned} \tag{4.1}$$

We measure the distance ($\text{Target Leverage}_{it+1} - \text{Leverage}_{it}$) which is the amount the debt leverage must change in order to allow firms to revert to target leverage levels. In this approach, firms which are above their target levels have a negative distance and firms which are below their target levels have a positive distance. If firms adjust fully to target leverage levels in the following year, the value of β_2 will be 1. We split our sample into firms which are below their target leverage levels and above target levels. Furthermore we interact the distance measure with a LOWOVER (low levels of overvaluation) dummy variable which takes the value of 1 if firms valuation measure is above the median for all overvalued observations and 0 otherwise. Similarly we interact the distance measure with HIUNDER (high levels of undervaluations) dummy variable which takes the value of 1 if valuation levels are below the median level and 0 otherwise. Thus our model will be as follows:

$$\begin{aligned}\text{Leverage}_{it+1} - \text{Leverage}_{it} &= \beta_1 \text{CONST}_{it} + \beta_2(\text{DISTANCE}) \times \text{HIUNDER or LOWOVER} \\ &\quad + \gamma[\text{Explanatory Variables}]_{it} + \varepsilon_{it+1}. \end{aligned} \tag{4.2}$$

The results for regressing the model in equation (4.2) are reported in Table 4.

We report the results for regressing equation (4.2) in Table 4 below. Our regressions control for unit of observation (firm level) fixed effects to allow us to remove any potential omitted firm factors that are time invariant which may lead to spurious correlation between speed of adjustment towards distance and equity mispricing as our models utilizes lead and lag variables. It further allows us to simultaneously control for unit level (firm) specific differences which are also time invariant such as potential bias due to talented management, economic shocks as well as specific customer characteristics to a particular firm. The results in Table 4 report the coefficients and standard errors are reported in parenthesis. The standard errors are clustered based on a 2 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 to using White (1980) 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. 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 (Rogers, 1993) as well robust standard errors controlling for heteroscedasticity (White, 1980).

Column 1 and 2 confirm that firms adjust to target levels as the coefficient of the DISTANCE variable is statistically significant. The results indicate that the speed of adjustment ranges

Table 4. Non-linear speed of adjustment using interaction with distance variable

	1	2	3	4	5	6
			Under-levered firms		Over-levered firms	
Panel A: Estimating target leverage$_{t+1}$ using Fama and French framework						
DISTANCE	0.3648†	0.4261†	-	-	-	-
	(0.0057)	(0.0109)	-	-	-	-
DISTANCE × HIUNDER	-	-	0.4697†	0.5366†	-	-
	-	-	(0.0124)	(0.0265)	-	-
DISTANCE × LOWOVER	-	-	-	-	0.4924†	0.5824†
	-	-	-	-	(0.0621)	(0.1024)
Adjusted R^2	0.4827	0.5244	0.5755	0.6152	0.4644	0.5011
Wald (p-values)	0.00	0.00	0.00	0.00	0.00	0.00
Observations	16,246	16,246	7,503	7,503	8,112	8,112
Period	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012
Panel B: Estimating target leverage$_{t+1}$ using Blundell and Bond framework						
DISTANCE	0.4198†	0.4944†	-	-	-	-
	(0.0308)	(0.0428)	-	-	-	-
DISTANCE × HIUNDER	-	-	0.5255†	0.5828†	-	-
	-	-	(0.0501)	(0.0804)	-	-
DISTANCE × LOWOVER	-	-	-	-	0.5827†	0.6324†
	-	-	-	-	(0.1565)	(0.1819)
Adjusted R^2	0.5618	0.5824	0.6211	0.6726	0.5030	0.5264
Wald (p-values)	0.00	0.00	0.00	0.00	0.00	0.00
Observations	16,246	16,246	7,856	7,856	7,642	7,642
Period	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012

This table provides the results for analysis for adjustment to target leverage. †, ‡ and * indicates significance at 1%, 5% and 10% respectively. The dependent variable is the DISTANCE from target leverage. Column 1, 3 and 5 reports results for book leverage while column 2, 4 and 6 reports results for market leverage. The coefficients are reported based on estimation for the difference between the lead and lag variable as the dependent variable. 2-dimension clustered standard errors are reported in paranteheses which are clustered at unit (firm) and time (year) level. All regressions include 15 industry dummies [0, 1] as well as time (year) dummies and other known determinants of capital structure as discussed in the text above which serve as control variables.

from 36-49%. In columns 3 and 4, we include the interaction term. Our motivation draws from Binsbergen et al. (2010) who argue that firms over target levels adjust more rapidly to target levels than firms below target levels as well as based on Warr et al. (2012), who find that undervalued firms which are below target levels, adjust faster to target levels. Given the main notion of the paper which is motivated in the above text, we include a dummy to capture the effect of high levels of undervaluation. The third and fourth column shows that the interaction term remains significant. Our results confirm the expectations in the literature where firms adjust to target levels at differing speeds (see Oztekin and Flannery, 2012 and Elsas and Florysiak, 2011). In addition our findings contradict the findings from Byoun (2008) as well as Warr et al (2012) who do not distinguish extent of mispricing. Thus, bulk of the adjustment to target level only occurs when firms' equities are severely undervalued. The results are robust to estimating target leverage on both the Fama and French and Blundell and Bond framework. Similarly, motivated by the findings in Warr et al. (2012) as well as the discussion in the text above, we include a different interaction term for firms above target levels in columns 5 and 6. The results indicate that the adjustment to target levels is only significant if equities are slightly overvalued as indicated by the interaction term being significant. Our findings are consistent with the literature which documents firms do not time the equity market in a linear manner (see Hussain and Jabarullah, 2013 as well as Hussain, 2014).

In order to test for robustness of our results, we use consensus analyst forecast values to measure deviation from theoretical values which are obtained from Bloomberg for our sample, although this reduces our sample size. The results are reported in Table 5 below.

Table 5. Robustness of results for non-linear speed of adjustment

	1	2	3	4	5	6
			Under-levered firms		Over-levered firms	
Panel A: Estimating target leverage$_{t+1}$ using Fama and French framework						
DISTANCE	0.4244†	0.4748†	-	-	-	-
	(0.0082)	(0.0104)	-	-	-	-
DISTANCE × HIUNDER	-	-	0.4087†	0.4367†	-	-
	-	-	(0.0074)	(0.0097)	-	-
DISTANCE × LOWOVER	-	-	-	-	0.4644†	0.5154†
	-	-	-	-	(0.0099)	(0.0142)
Adjusted R^2	0.5624	0.5829	0.4725	0.4833	0.5822	0.6127
Wald (p-values)	0.00	0.00	0.00	0.00	0.00	0.00
Observations	8,240	8,240	4,250	4,250	3,852	3,852
Period	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012
Panel B: Estimating target leverage$_{t+1}$ using Blundell and Bond framework						
DISTANCE	0.4842†	0.5243†	-	-	-	-
	(0.0143)	(0.0156)	-	-	-	-
DISTANCE × HIUNDER	-	-	0.4462†	0.5025†	-	-
	-	-	(0.0126)	(0.0145)	-	-
DISTANCE × LOWOVER	-	-	-	-	0.5436†	0.5628†
	-	-	-	-	(0.0206)	(0.0285)
Adjusted R^2	0.6240	0.6508	0.5755	0.5924	0.6523	0.6687
Wald (p-values)	0.00	0.00	0.00	0.00	0.00	0.00
Observations	8,240	8,240	4,624	4,624	3,220	3,220
Period	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012	1993-2012

This table provides the results for analysis for adjustment to target leverage. †, ‡ and * indicates significance at 1%, 5% and 10% respectively. The dependent variable is the DISTANCE from target leverage. Column 1, 3 and 5 reports results for book leverage while column 2, 4 and 6 reports results for market leverage. The coefficients are reported based on estimation for the difference between the lead and lag variable as the dependent variable. 2-dimension clustered standard errors are reported in paranteheses which are clustered at unit (firm) and time (year) level. All regressions include 15 industry dummies [0,1] as well as time (year) dummies and other known determinants of capital structure as discussed in the text above which serve as control variables.

Similar to the conclusion in Table 4, we find that the interaction term is significant. Further confirming our earlier results, columns 5 and 6 show that the interaction term remains significant. Overall, our results indicates that although the market timing element could play a role in adjustment to target levels, the integration of both explanations of capital structure works within a more dynamic and complex framework than otherwise suggested in the literature.

5. Conclusion

Our paper uses unbalanced panel data of UK firms to test the integration of the timing element into the adjustment to target leverage levels. The main notion of the paper is that the integration of the two explanation of capital structure works in a non-linear manner. Drawing from the literature, we utilize a two-stage approach to estimate the speed of adjustment to lead (target) levels. The first stage is further estimated using a static and dynamic approach. The second stage then models the difference between the simulated lead (target) level and the lag (current) level of leverage to the difference between the actual lead (target) level and the actual lag (current) leverage levels. Our initial findings confirm the established evidence in the literature. Further analysis however indicates that the increase in leverage levels when firms are below target levels is only evident when undervaluation levels are excessive. This could be due to information asymmetry reasons, agency considerations as well as managerial actions in preserving debt capacity (financial slack). Conversely, when looking at firms which are above target levels; we find that adjustment to target levels only occur when valuation levels are not severely above theoretical predictions. The findings indicate that the signalling effect as well as expectations of managers on equity prices affects timing affects which in line influences cost of adjustment to target levels. Overall, our results indicate that extent of equity mispricing influences timing decisions in a non-linear manner which affect speed of adjustment to target levels. However, our analysis is limited to the deviation of market prices from theoretical prices and does not consider the interplay between difference factors such as signalling aspect of security issues as well as information asymmetry consideration which are discussed above; providing a plausible direction for future researches in understanding how cost of equity capital influences speed of adjustment and the extent of integration of both explanations of capital structure to explain firms issuing behaviour.

Appendix

Appendix A: Industry classifications

Number	Industry name
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 business

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

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All the authors contributed significantly in writing this article. The authors read and approved the final manuscript.

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