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Industry membership and capital structure dynamics in the UK☆

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ABSTRACT

We examine the impact of industry membership on the capital structure dynamics of UK quoted firms over the period 1968 to 2006 by analysing how the components of common gearing ratios are adjusted in relation to one another. More specifically, if we find evidence of a cointegrating relationship between these components then we argue that this provides us with evidence of target gearing behaviour. Further, employing a novel approach, we test whether firms engage in targeting behaviour in the long-run whilst a hierarchy or pecking order of financing arises in the short-run. The paper is motivated by the conjecture that a synthesis of the pecking-order theory and the trade-off theory is necessary. Arguably, while both theories can explain certain aspects of capital structure setting behaviour, neither provides a satisfactory general explanation of behaviour in the real-world. The results reveal that in the long-run, most firms demonstrate target gearing behaviour, though targeting is restricted to those measures most meaningful to a firm's particular industry. Adjustment towards a given target is rapid, taking on average no more than four years. In the short-run, old economy firms follow a standard pecking order whilst new economy firms choose equity in preference to debt when external financing is required. This provides some evidence in support of a synthesis approach to the determination of gearing while also highlighting the importance of industry membership to capital structure determination.

Keywords: Gearing; Targeting; Pecking order; Trade-off theory; Cointegration

JEL classification: G32

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1. Introduction

The debate regarding whether a firm's capital structure impacts upon its value, which commenced with Modigliani and Miller's 1958 irrelevance proposition, is even today far from over. However, the balance of argument has arguably swung in favour of capital structure relevance, that is, there exists a certain capital structure which will minimise the cost of capital, thereby maximising firm value. An optimal gearing ratio which maximises firm value results from a trade-off of tax shields against financial distress costs (Brealey, Myers and Allen, 2008). Given that the costs and benefits of debt financing will vary across industries, firms most likely set their gearing ratios in relation to the norm for their industry. Indeed, Beattie, Goodacre and Thomson (2006) argue that business risk, asset structure, growth opportunities, and other industry-specific characteristics, drive gearing ratios (see also Aggarwal and Kyaw, 2010, Billett et al., 2007, and Lord and McIntyre, 2003). Whilst we cannot observe directly firm gearing optimisation, we can observe industry norm targeting, and authors such as Lemmon et al. (2008), Kayhan and Titman (2007) and Antoniou et al. (2002), *inter alia,* argue that the existence of an optimal gearing ratio implies the existence of a target ratio. Further, they argue that if it can be shown that debt ratios vary significantly by industry, it will be proved that finance managers have found different optimal gearing ratios that are a function of their firm's business risk. More recently, there is evidence that UK, French and German firms adjust their gearing towards targets at different speeds depending on whether they are manufacturers or service sector firms. If we are to conduct an empirical study of target gearing, then, an industry level study should enable us to not only test for the occurrence of targeting behaviour, but also to examine the speed of adjustment towards targets.

The objective of this paper is to examine the impact of industry membership on the capital structure dynamics of UK firms, the country of study selected on the basis of the length and quality of gearing data available across a wide range of industries. More specifically, we investigate whether industry-optimal gearing ratio targeting behaviour occurs in the long run while a hierarchy of financing arises in the short-run. As the impact of gearing determinants will vary across industries, we expect different gearing ratios to be targeted across those industries. We apply a novel approach by testing for evidence of a cointegrating relationship between the component variables of commonly employed capital structure ratios. This approach is more appropriate than previous cross-sectional studies as it enables the study of capital structure dynamics and allows for the variability of gearing ratios and multi-period adjustment, consistent with, *inter alia,* Elsas and Florysiak (2010), Lemmon et al. (2008), Flannery and Rangan (2006), Hui et al. (2006) and Dissanaike et al. (2001). The approach enables us to consider a synthesis capital structure model where the long-run gearing ratio is determined by the trade-off theory while the short-run variations may be driven by the pecking order theory.

The results show that generally firms target industry gearing norms, though the precise measure targeted varies across industries. Retained earnings are used to close the majority of any deviation from the target in preference to external financing, and when external financing is required, mature-industry firms prefer to employ debt whilst younger-industry firms prefer equity. These results are consistent with the general version of the pecking order theory proposed by Halov and Heider (2008).

This paper proceeds as follows: in Section 2, we briefly review the relevant target capital structure literature. The dataset employed is described and the hypotheses are discussed in Section 3. Section 4 briefly explains the Johansen cointegration methodology and error correction model. In Section 5, the cointegration analysis results are discussed, while Section 6 presents the results of the error correction model. Section 7 summarises the salient findings and concludes.

2. The need for some synthesis

The literature in general provides support for the existence of optimal gearing ratios and, by implication, target gearing behaviour in firms (see, for example, the recent review of literature by Graham and Leary, 2011). Such behaviour is explained well by the trade-off theory whereby an optimal ratio is reached by trading off the debt interest tax shield against financial distress costs or by trading off the agency costs and benefits of debt (see, for example, the classical studies of Jensen, 1986 and Kim, 1978 respectively). Evidence supporting targeting behaviour is provided, *inter alia*, by Lemmon et al. (2008), Flannery and Rangan (2006), Leary and Roberts (2005), Philosophov and Philosophov (2005) and Francis and Leachman (1994) for US firms, and Beattie, et al. (2006), Bunn and Young (2004), Antoniou et al. (2002) and Ozkan (2001) for UK firms. The impact of capital structure determinants is likely to vary significantly across industries, and as a result, optimal ratios will vary across industries not just in terms of magnitude but also in terms of ratio definition.

Lemmon et al. (2008), Flannery and Rangan (2006), Dissanaike et al. (2001) and Fischer et al. (1989) argue that some researchers fail to acknowledge the multiple time periods required by firms to achieve their target capital structure ratios. Estimating target gearing in a simple cross-sectional regression implicitly assumes that firms always attain their target gearing ratios within one time period. However, if adjustment costs are non-trivial, restricting the adjustment speed to unity will bias coefficient estimates. Thus, a functional form that permits partial adjustment of the firm's gearing ratio to its target is essential.

Fischer et al. (1989) develop a model of dynamic optimal gearing choice and demonstrate that debt ratios are characterised by wide swings. Flannery and Rangan (2006) and Bunn and Young (2004) find that US and UK firms, respectively, allow their gearing ratios to vary significantly around a target, suggesting that firms do not identify a strict, single optimal capital structure ratio, but rather a range over which their capital structures are allowed to vary (see also Bhamra et al., 2010, Kurshev and Strebulaev, 2007, Hackbarth et al., 2006 and Goldstein et al., 2001 for other frameworks of target adjustments).

The alternative to the trade-off theory, suggests that firms prefer to use retained earnings to external finance, and that when external funds are required, debt is preferred to new equity (Shyam-Sunder and Myers, 1999). This pecking order to financing could arise due to: the asymmetry in the tax code (Stiglitz, 1973); or asymmetric information and adverse selection (Myers, 2003, Heaton, 2002 and Shyam-Sunder and Myers, 1999). However, Nachman and Noe (1994) note that the standard pecking order implicitly assumes that debt is correctly priced because all firms have the same risk or because uninformed outside investors do not care about risk. However, debt is a concave claim with significant adverse selection costs leading to mispricing if risk matters. Halov and Heider (2008) address this issue and advance a new version of the pecking order theory, arguing that when there is greater asymmetric information about risk rather than value, debt is characterised by a more severe adverse selection problem and hence firms would only issue equity. They show that as asset volatility increases, firms use equity rather than debt to finance their deficits. Moreover, the standard pecking order obtains only when debt is unlikely to be mispriced. Thus, the standard pecking order may be more appropriate in explaining the financing behaviour of mature firms (Brealey, Myers, and Allen, 2008) as these may have lower adverse selection costs for debt. In other words, their debt may be correctly priced, as a result of bond ratings, analysts' coverage and higher transparency. On the other hand, Rampini and Viswanathan (2010) and Fama and French (2002) find that small, high-growth firms tend to make large net issues of new stock and are thus the least levered, even though they would appear to be characterised by higher debt capacity. Hence, Halov and Heider's new version of the pecking order may be more appropriate in explaining the financing behaviour of small, young and/or high-growth firms as these may have higher adverse selection costs for debt. This may be because their lack of bond ratings, lower analysts' coverage and transparency could lead to debt mispricing.

The trade-off theory contrasts sharply with the pecking order theory as the former implies an optimal gearing ratio whereas the latter does not (Barclay, Morellec, and Smith, 2006). However, Beattie et al. (2006) argue that once we introduce the concept of a target range we can reconcile the two competing theories: within an optimal range, the gearing ratio may vary in accordance with investment requirements, earnings generation and external financing opportunities as explained by the pecking order theory. However, when the gearing ratio significantly departs from the optimal range, then firms take steps 'to force' the gearing ratio to mean revert. Since these steps are costly, then firms must believe that the benefits of mean reversion are higher than the costs, and hence maximise firm value as argued by the trade-off theory. Beattie et al. highlight the need for a model combining elements of trade-off and pecking order theories and Kayhan and Titman (2007) and Hovakimian, Opler and Titman (2001) find that firms have target debt ratios whilst also preferring internal financing to external funds. Further, Flannery and Rangan (2006) find strong evidence that firms pursue long-run target capital structures and also that the pecking order variables have some explanatory power in their tests. The implication for empirical testing here is that studies should employ methods capable of modelling the dynamic adjustment of capital structures under such a synthesis model. The approach taken in this study facilitates such testing.

Which ratios should we expect firms in different industries to target? On the basis of the 'control hypothesis' for debt creation, high free cash flow generating firms with low growth prospects have an incentive to have more debt in their capital structures to commit managers to pay out future cash flows, thereby reducing agency costs (Jensen, 1986). Firms with high tangible, fixed assets should target gearing ratios which include either total assets or book equity (Barclay, Morellec and Smith, 2006). Well-established firms with a history of value creation over and above book value should target ratios which include market rather than book value equity (Brealey et al., 2008). Further, as such firms should evidence significant accumulated retained earnings, then gearing ratios which include total equity as opposed to base equity (issued share capital alone) are more likely to be targeted. In terms of debt maturity, firms which are smaller, younger, have cyclical business, or with longer operating cycles should target ratios which include short-term debt (Barclay, Morellec and Smith, 2006), whereas larger firms with higher fixed asset ratios should target gearing ratios with long-term debt as a component, particularly as they enjoy debt issue cost economies (Bevan and Danbolt, 2000). More recently, Welch (2010), Rampini and Viswanathan (2010) and Rauh and Sufi (2010) discuss in detail the construction of gearing ratios, their mismeasurement and the implications for empirical capital structure inference.

3. Data and hypotheses

In this paper we study UK quoted companies over a period of almost four decades, thereby capturing in a comprehensive manner the dynamics of capital structure change. The choice of country is important as Gaud et al. (2007) find, in their study of European company gearing, that the national environment matters as a result of institutional differences across countries such as tax regimes, investor protection and legal rules. The UK presents an interesting case study on a number of levels. It is an efficient G7 economy with large and highly developed debt and equity markets (valued respectively at $4,842 billion and $2,796 billion in 2009 according to the World Federation of Exchanges, 2010), it offers advanced investor protection (Davydenko and Franks, 2008, La Porta et al., 1998), with excellent financial reporting and financial market transparency, significant market depth and liquidity, and genuine exposure to an international investor base. The UK has an equity-orientated market (Kwok and Tadesse, 2006, Ergungor, 2004) rather than a bank-orientated or continental European system as discussed in the study of Spanish gearing in Minguez-Vera and Martin-Ugedo (2007). Most importantly, UK quoted companies span a wide range of industries, thereby enabling a comprehensive testing of the impact of industry membership on capital structure dynamics.

For the purposes of this study we use the Datastream FTAG3 industry classification code, thereby providing us with 10 broad industries. We obtained firm capital structure data for 2,427 firms across ten industries over the period 1968–2006: extraction (84), construction (283), general engineering (402), textiles (272), biotechnology (215), leisure (730), retail (57), utilities (50), real estate (190), and information technology (144 firms). The period of study is 1968–2006, spanning a number of economic cycles, and therefore the cyclical effect whereby companies gear up in advance of an economic upturn and pay down debt thereafter tends to be averaged out to provide a clearer picture of longer term behaviour. The later period within the sample reveals a trend of gearing stability into the late 1990s, followed by a period of increased gearing to the early 2000s, after which gearing is again moderated for the remainder of the sample. The sample excludes the period of accelerated gearing up and the subsequent sharp reversal brought about by the financial crisis from 2007 onwards.

We employ the Johansen (1991) cointegration test[1] as it allows us to study capital structure dynamics in a multi-period framework and thus represents a significant improvement in relation to the tests of the existing literature which are largely cross sectional.[2] Studying targeting at the industry level involves some information loss due to aggregation, though the behaviour of interest occurs at the industry level and our approach enables gains in terms of greater results generalisation.

There is considerable debate concerning how capital structure ratios and their components should be defined. Clearly market value gearing measures are preferable to book value measures as they are more economically meaningful due to their 'forward-looking' nature (Barclay et al., 2006), though a number of studies have found the two measures to be statistically indistinguishable (Bancel and Mittoo, 2002). Some authors argue that short-term debt should be included as its omission would lead to an understatement of financial risk. Rajan and Zingales (1995), Bevan and Danbolt (2000), and Bancel and Mittoo (2002) find evidence of the importance of short-term debt to UK firms. We include in our study book and market value measures, and both short and long-term debt.[3]

Data is measured as falling in the financial reporting year end for a firm, consistent with Dissanaike et al. (2001), and financial firms are omitted due to their atypical capital structures. The data sample thus consists of 12 time series financial statement and market variables over a span of 39 years. Consistent with other empirical studies, such as Bunn and Young (2004) and Leary and Roberts (2005), the econometric analysis is conducted using natural logarithm values rather than levels as the distribution of changes of logarithmic values is closer to normal. Table 1 presents the gearing ratio components, along with their assigned variable labels, Datastream codes and definitions.

[Table 1]

Table 2 presents selected summary statistics. The table clearly confirms the importance of short-term debt as a proportion of total debt. As expected, accumulated retained earnings are a function of a firm's age and an important component of its capital accounts, particularly in high-growth, R&D intensive industries such as IT and biotechnology. The market-to-book ratio, which proxies growth opportunities, is also high for these industries, whilst it is only moderate in the more established real estate and textile industries. Finally, firm size varies significantly across industries.

[Table 2]

In the discussion above, the evidence supporting both the pecking order and trade-off theories was presented. Further, Beattie et al. (2006) argue that while the fundamental approach to financing may be based on the pecking order theory, the firm's short-term financing decision may be determined by trade-off theory drivers, though Sogorb-Mira and Lopez-Gracia (2003) find little evidence to support this for Spanish firms. In this study we argue that although both theories have merit individually, considered together they explain firm financing behaviour more comprehensively in two different time frames and in a particular sequence. Consistent with Beattie et al. (2006), we propose that while the fundamental approach to financing for UK firms may be based on trade-off theory, their short-term financing decisions may be driven by pecking order theory considerations. Table 3 presents the hypotheses of this study. Our central hypothesis, H1, is that UK quoted firms have target capital structure ratios to which they adjust in the long run while in the short run they deviate from these target ratios and that in the adjustment process firms employ the securities with the lowest adverse selection costs. The supporting economic hypotheses, H2 to H5, enable us to be more precise concerning the definition of gearing ratio targeted and the source of finance employed in the adjustment process.

[Table 3]

4. The cointegration methodology

The hypotheses are tested by a methodology which seeks to determine whether the numerator and denominator of a given capital structure ratio are cointegrated. The intuition is straightforward: if, say, the debt-to-assets ratio is targeted, then debt and assets cannot (indefinitely) diverge from each other beyond a certain threshold. This implies that debt and assets are tied together by common stochastic trends and hence will be cointegrated. This approach parallels that employed by Marsh and Merton (1987) who argued that US firms maintain a dividend-price ratio towards which they continually adjust, and that such behaviour implies that prices and dividends are cointegrated. Applying this reasoning to the gearing issue enables the occurrence of targeting behaviour to be tested. In the field of gearing, Francis and Leachman (1994) employ the Johansen methodology to test whether there exists an equilibrium relationship between the gearing ratio and its determinants and find an equilibrium relationship and thus an aggregate optimal gearing ratio. In this paper we employ a more comprehensive cointegration and error correction mechanism (ECM) analysis to a wide range of gearing ratios whilst correcting for some shortcomings inherent in earlier studies. The Johansen (1991) maximum likelihood estimators test for the presence of multiple cointegrating vectors is described below.[4]

For the n-variable first-order VAR given by $x_t = A_1 x_{t-1} + \varepsilon_t$ after subtracting x_{t-1} from each side we obtain:

$$\Delta x_t = (A_1 - I)x_{t-1} + \varepsilon_t$$
$$\Delta x_t = \pi x_{t-1} + \varepsilon_t$$

where x_t and ε_t are (n x 1) vectors; A_1 is an (n x n) matrix of parameters; *I* is an (n x n) identity matrix; and π is defined to be $(A_1 - I)$. The model is easily modified to allow for the presence of a drift term and/or a time trend as well as a higher-order autoregressive process. In this system, the vector x_t contains the time series of gearing ratio components, i.e. debt and equity or debt and assets. Thus, in this case x_t and ε_t are (2 x 1) vectors.

The rank of π equals the number of cointegrating vectors. The number of distinct cointegrating vectors can be obtained by checking the significance of the characteristic roots of π. The test for the number of the characteristic roots that are significantly different from unity can be constructed using the following two test statistics:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (1)$$

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (2)$$

where $\hat{\lambda}_i$ are the estimated values of the characteristic roots (or eigenvalues) obtained from the estimated π matrix. The first statistic tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to *r* against a general alternative, thus $\lambda_{trace} = 0$ when all $\hat{\lambda}_i = 0$. The further the estimated characteristic roots are from zero, the larger the λ_{trace} statistic. The second statistic tests the null hypothesis that the number of the cointegrating vectors is *r* against the alternative of *r+1* cointegrating vectors. Again, if the estimated value of the characteristic root is close to zero, $\lambda_{\max}$ will be small. Although asymptotically the statistics have a χ^2 distribution with (*n*-*r*) degrees of freedom, the critical values depend on the number of nonstationary components under the null hypothesis (i.e. *n*-*r*) and the form of the vector A_0 (i.e. the presence or not of the drift and time trend terms). An advantage of this approach is that it allows simultaneous estimation of the cointegrating vector β and adjustment speed coefficients a as a function of π ($\pi = a\beta^{'}$).

A principal feature of cointegrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. After all, if the system is to return to the long-run equilibrium, the movements of at least some of the variables must respond to the magnitude of the disequilibrium. Thus, the short-term dynamics must be influenced by the deviation from the long-run relationship. The dynamic model implied is one of error correction whereby the short-term dynamics of the variables in the system are influenced by the deviation from equilibrium. A simple, two-variable ECM could be specified:

$$\Delta x_{1t} = \alpha_1 (x_{1,t-1} - \beta x_{2,t-1}) + \varepsilon_{1t} \tag{3}$$

$$\Delta x_{2t} = -\alpha_2 (x_{1,t-1} - \beta x_{2,t-1}) + \varepsilon_{2t} \tag{4}$$

where at least one of the adjustment speed coefficients α_1 and α_2 must be non-zero, otherwise a cointegrating relationship would not exist.[5] The two terms ε_{1t} and ε_{2t} are white noise that may be correlated. More recently, the error correction framework has been employed by Lemmon et al. (2008) while Bhamra et al. (2010) and Hackbarth et al. (2006) present costly adjustment models that can account for the dynamic relation between gearing and macroeconomic characteristics.

The industry-optimal gearing ratio targeting hypothesis, H1, is tested by means of cointegration analysis tests: we test the null hypothesis that gearing ratio components i.e. the numerator (debt) and denominator (equity or assets) are not cointegrated against the alternative that these ratio components are cointegrated. If the null hypothesis of no cointegration is rejected in favour of the alternative, this implies adjustment of gearing ratio components to correct the deviation from the long-run equilibrium representing the target ratio. Therefore, if gearing ratio components are found to adjust to eliminate any deviation that has occurred in the past, then this is interpreted as evidence in favour of the optimal gearing ratio targeting hypothesis. The rationale here is that adjusting one gearing ratio component in relation to the other is an expensive process and would be irrational unless managers believed the adjustment would benefit their firm in the long-run given macroeconomic, industry and firm-specific conditions.

We also model the dynamics of the adjustment process by estimating the ECM. This modelling exercise enables us to consider the occurrence, or otherwise, of a hierarchy of financing when firms correct the deviation from target. For example, we decompose the *TD/TE* ratio into *TD/(BE+RE)* employing the accounting identity total equity = book value of equity + accumulated retained earnings. If the adjustment speed coefficients of the ECM suggest that when the actual ratio deviates from the target, it is retained earnings which closes the majority of the deviation from the target, followed by total debt, then this might indicate a standard pecking order effect. Further, to check the consistency of the ECM results, in addition to the *TD/(BE+RE)* ratio, we also examine the adjustment speed coefficients of the *D/(BE+RE)*, *TD/BE* and *D/BE* ratios. If the adjustment speed coefficients suggest that retained earnings close the majority of the deviation from the target, followed by debt, then this again might indicate a standard pecking order effect. Similarly, in the case of *(T)D/BE* ratios, if (total) debt closes the majority of the deviation from the target, while book equity closes a smaller part of the deviation, then this also might indicate a standard pecking order effect. However, since firms adjust their gearing ratios to the long-run ratio, this should override any pecking order effect and provide evidence in favour of the trade-off theory.

5. Testing for the occurrence of targeting behaviour

Table 4 presents the results of the Johansen cointegration analysis to test whether firms across the 10 industries target different gearing ratios. In the table significant statistics, that is, incidences where the hypothesis of no cointegration is rejected, are presented in bold, thereby indicating which ratios are targeted by firms in a given industry.

[Table 4]

The results show that: whilst targeting behaviour occurs in the majority of industries, the precise gearing ratio targeted varies markedly; gearing measures which include total assets are the most popular; measures which include total equity (including reserves) appear to be more widely employed than those which include base equity alone or those which include the market value of equity. Clearly, gearing ratios including the book value of equity alone, that is, issued share capital, do not adequately capture financial risk for most UK firms. Evidently, the 'equity cushion' enjoyed by debt holders is a far broader concept, and should include accumulated retained earnings and other reserves, hence the greater popularity of the total equity gearing ratios. The popularity of the total debt to total assets ratio emphasises the importance of the balance sheet to financial managers in two respects: firstly, accounting assets are an important consideration in their own right as a stock concept of productive and working capital assets giving rise to the continuity of the firm; and secondly, financial managers are clearly mindful of the balance sheet equation whereby shareholders are residual claimants on the firm's total assets after other claims such as debt have been settled. Finally, given the 'forward-looking' nature of market equity, it is somewhat surprising that gearing ratios containing market value equity are not targeted more across the industries studied. Perhaps firms simply prefer book measures, as the fluctuation of market measures renders their practical use as metrics in strategic financial planning problematic.

Further insights are gained by examining which industries tend to target their gearing ratios. In general, it is evident that 'old industry' firms are more prone to targeting than 'new industry' firms. Older industries such as the extraction, construction and textiles industries tend to target book value gearing measures including either total assets or equity. Interestingly, however, the real estate industry targets only asset-based gearing ratios and the engineering industry shows no evidence of targeting at all. It is possible that the real estate industry is atypical given that certain immutable gearing ratios are industry-bound and deterministic, whilst the engineering industry is atypical given its extremely heterogeneous nature. Newer industries, such as information technology, tend to target a narrower range of ratios than older industries. The exceptions to this are biotechnology which targets a range of ratios and leisure which does not appear to target at all. In common with the older industries, newer industries target book equity or total assets ratios in equal measure, though are more likely to target market equity based measures than older industries.

The results demonstrate that those industries with significant balance sheet assets tend to target gearing measures with totals assets employed as a denominator. Older industries, such as extraction, construction and textiles are fixed asset intensive given their requirement to invest heavily in production facilities, and these assets are then used as collateral to secure borrowing. Further, the real estate industry is, by its very nature, asset-intensive and it makes logical sense to monitor debt in relation to the asset base rather than the balance of equity claims.

All of the industries which evidence targeting behaviour target book equity ratios, whether narrow base (equity) or total (equity capital and reserves), except for the real estate industry which monitors debt in relation to assets. This result reinforces the shareholder focus of financial managers who must monitor the financial risk to which they are exposing them and take corrective action when the firm is becoming too financially risky in relation to its industry norm. Market equity ratios are targeted only in the extraction, biotechnology, and information technology industries. In the extraction industry, financial managers necessarily focus on the value of mineral and oil reserves which are better captured by market than by book values. In the newer economy biotechnology and IT industries, book values are less useful than market values in evidencing the present value of future growth opportunities.

To summarise, hypothesis H1 is clearly supported as all industries except engineering and leisure appear to target at least one form of gearing ratio. In terms of the supporting hypotheses, hypotheses H2 to H5 are supported but only for selected industries as discussed above. Book value equity gearing ratios, particularly those where equity includes both equity capital and reserves, and total asset gearing ratios are popular targeted measures. However, market value equity gearing ratios are targeted far less across the industries of this study. UK quoted firms do in general target gearing ratios, then, though targeting is restricted to those measures appropriate to their industry and their investors.

6. Measuring the speed of adjustment

We can measure the speed of adjustment towards a target gearing ratio within each industry by examining the error correction mechanism. Consistent with Leary and Roberts (2005), we classify industries as either ‘old economy’ or ‘new economy’ in a similar fashion to the distinction applied above. The old economy group includes industries such as extraction, construction, textiles and real estate whereas the new economy group includes biotechnology and IT. Old economy industries are in general fixed assets intensive whereas new economy industries are in general high-growth and R&D intensive.

[Table 5]

Table 5 presents the adjustment speed coefficients of the ECM for the gearing ratio components by industry. The table shows that such adjustment is relatively fast and would appear to take between two and four years on average, consistent with Elsas and Florysiak (2010), Lemmon et al. (2008), Flannery and Rangan (2006), and Leary and Roberts (2005).[6] Further, it would appear that those new economy firms which do target, adjust faster to target gearing than old economy industries, consistent with the findings of Leary and Roberts (2005). This may be because the costs of deviating from the target are higher in the new economy industries than old economy industries, perhaps as the former do not enjoy the reputation effects of the latter.

If we compute adjustment speed coefficients for total debt and both of the components of total equity, thereby giving us separate adjustment speed coefficients for equity capital and reserves, we can infer the nature of pecking order adjustment across the ten UK industries. The final row on the table, TD-BE-RE provides us with this insight. As expected, the adjustment speed coefficients show that retained earnings close the majority of the gap between the target and the actual ratio in both old and new economy industries. However, some interesting differences arise where these industries resort to external finance to correct the deviation from target. Old economy industries generally appear to close the second largest part of the deviation from target with debt whereas new economy industries close the second largest part of the deviation with equity instead. Old economy firms thus follow the standard pecking order whereas new economy firms follow a different pecking order, consistent with the general pecking order theory proposed by Halov and Heider (2008). Small, high growth, R&D intensive firms such as those in the biotechnology and IT industries may have more asymmetric information about risk and hence debt will be severely mispriced. In this case, equity has lower adverse selection costs, 'forcing' new economy firms to issue equity to close the deviation from the target.

The only two old economy industries whose behaviour does not appear consistent with the standard pecking order are utilities and real estate. However, it is unlikely that Halov and Heider's generalised pecking order theory suits such firms since they are normally mature, well-established firms rather than small, fast growing firms. A possible explanation for utility firms is that they are heavily regulated and hence financing outcomes do not represent the deliberate optimising decisions of finance managers. Many researchers, such as Graham and Leary (2010) and Dissanaike et al. (2001), *inter alia*, exclude utility and financial firms due to their atypical financing behaviour: restrictions on the dividend payout/retention ratio, maximum debt levels, and so on, of utility firms may mean that the resulting gearing ratio is not an outcome of deliberate choice for finance managers. With regard to the real estate industry, it might be argued that firms are similar to financial firms in terms of maturity matching and the maintenance of strict solvency and liquidity margins to meet debt covenants, and as such should be excluded from the analysis.

In sum, adjustment towards a target gearing ratio is fairly rapid for UK firms, taking between two and four years on average. The speed of adjustment coefficients for retained earnings, debt and equity when taken together suggest that old industry firms tend to follow the standard pecking order whilst new economy firms tend instead to resort to equity before debt when external financing is required.

7. Conclusion

This paper sought to examine the impact of industry membership on the capital structure dynamics of UK firms, and in particular to investigate whether industry-optimal gearing ratio targeting behaviour occurs in the long-run while a hierarchy of financing arises in the short-run. The capital structure debate has over many decades arrived at something of a theoretical and empirical impasse – either firms trade-off the costs and benefits of gearing to arrive at an optimal gearing ratio or they avoid the optimality issue and simply select the most advantageous form of finance on an incremental basis. This paper, investigating the conjectures of Beattie et al. (2006), argues that some synthesis is required to reconcile the two theoretical camps and further that firms might in fact pursue an optimal or target gearing ratio in the long-run whilst accepting a pecking order of financing in the short-run.

The paper employed a novel approach by testing for evidence of a cointegrating relationship between the component variables of capital structure ratios commonly employed by finance managers, testing for the occurrence of targeting and/or pecking order behaviour in UK quoted companies grouped by 10 broad industries over almost four decades. The results suggest that most firms demonstrate target gearing behaviour, though such targeting is restricted to those measures most appropriate to their industry and their investors. Adjustment towards a given target is fairly rapid, taking between two and four years. Further examination of the speed of adjustment coefficients suggests that old economy firms tend to follow the standard pecking order, whilst new economy firms tend instead to resort to equity before debt when external financing is required. Therefore, the paper builds on previous studies by showing that synthesis between the trade-off and pecking order theories is not only theoretically desirable but is readily observable, at least at industry level.

The implications of this research for the current economic and financial environment are many, though we focus here on the effect on three groups of stakeholders: companies, their investors, and investment analysts. Firstly, following the financial crisis, many companies have re-examined the adequacy of their solvency and liquidity ratios, resulting in the paying down of debt and the movement towards a lower geared financial environment. Companies will therefore gradually adjust their gearing targets downwards over the subsequent two to four years, though the precise ratio adjusted and the speed of adjustment will depend on the industry concerned. Secondly, from an investor perspective, following the crisis the cost of corporate debt has increased markedly as banks rebuild their balance sheets through spread expansion, and debt investors remain concerned about the risks inherent in corporate debt. At the same time, the UK equity market has recovered well. Taken together, this leads to lower equilibrium target gearing ratios across the industrial base. Whilst we expect that new economy companies will adjust their gearing ratios downwards by issuing equity when new external financing is required, in the more buoyant post-crisis equity market there may also be a greater propensity for older economy companies to depart from expectations and issue equity rather than debt at the margin, at least until the UK market has adjusted fully to the new balance sheet conservatism. Thirdly, given the uncertainty during the recovery phase regarding the growth path of the economy, investment analysts will revise downwards their benchmarks for acceptable corporate financial risk in the equities that they follow, even in the face of strong cash flow recovery in many industries. On the debt side, covenant restrictions are likely to remain tight. In this new valuation paradigm, and consistent with the implications above, gearing ratio norms and ranges will moderate downwards, at least until consensus expectations regarding the longer term growth path of the economy are more stable. Extensions to this study might include an examination of capital structure dynamics at firm-level, particularly as it is clear that certain industries are far from homogeneous, or a study for a bank-based country where institutional influences may differ.

Notes

1. We also employ the Engle-Granger (1987) cointegration test. However, for efficiency of presentation we do not report these results. They are available upon request.

2. We also employ the Kruskal-Wallis and Analysis of Variance (ANOVA) techniques which test the hypothesis that gearing ratios vary more across industries than they do within industries (see, for example, Bradley, Jarrell and Kim, 1984). The results confirm the industry norm targeting hypothesis. To preserve space, we do not present these results. They are available upon request.

3. We conduct the cointegration analysis and estimate the error correction mechanism (ECM) for total as well as long-term debt and find that they generally lead to the same inferences. For efficiency of presentation, we do not report the results for ratios with long-term debt as a component. They are available upon request.

4. Cointegration analysis requires that variables be integrated of the same order. The Augmented Dickey-Fuller (ADF) and Philip-Perron (PP) unit root tests reveal that each gearing ratio component for each of the ten industries is integrated of order one (I(1)). For efficiency of presentation we do not report the results. They are available upon request.

5. From the estimated adjustment speed coefficients we compute also the half-life, i.e. the time required by the process to return halfway to the equilibrium state after a shock which is given by $t = \ln(0.5) / \alpha_i$ $i = 1,2$ (see, for example, Leary and Roberts, 2005). However, since we are more interested in the relative magnitude of the adjustment speed coefficients, we do not report the half-life estimates. They are available upon request.

6. We reach this conclusion based on the half-life estimates computed as outlined in footnote 5.

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Table 1: Gearing ratio constituents

Variable	Label	Datastream code	Definition
Book value of equity	BE	301	(Ln of) Book value of equity at balance sheet date
Market value of equity	ME	HMV	(Ln of) Market value of equity at balance sheet date
Total assets employed	A	391	(Ln of) The sum of all assets less current liabilities
Book value of equity plus reserves	TE	305	(Ln of) Book value of equity and reserves at balance sheet date
Long-term debt	D	321	(Ln of) All loans repayable in more than one year
Short-term debt	SD	318	(Ln of) All loans payable in one year or less
Total debt	TD	–	(Ln of) The sum of long-term and short-term debt
Book value of total capital employed	TDBE	–	(Ln of) The sum of total debt and book value of equity
Book value of total capital employed and reserves	TDTE	–	(Ln of) The sum of total debt and total equity
Market value of total capital employed	TDME	–	(Ln of) The sum of total debt and market value of equity

Notes: This table presents the gearing ratio components taken from Datastream in January 2007 for the UKQI and UKQI plus Dead firms list. Also presented are variable labels, Datastream codes and definitions. All variables are expressed as natural logarithm (Ln) values.

Table 2: Mean and interval of variation for selected financial ratios

Industry	SD/TD Mean (%)	SD/TD Lo-Hi (%)	RE/BE Mean (%)	RE/BE Lo-Hi (%)	ME/BE Mean (times)	ME/BE Lo-Hi (times)	Mean Market Cap (£m)
Extraction	31	22 - 35	64	6 – 143	1.5	0.33 – 2.5	1,393
Construction	29	12 - 40	62	10 – 90	1.2	0.5 – 2.04	196
Engineering	30	8 - 36	73	-2 – 92	1.8	0.8 – 3.16	120
Textiles	30	10 - 44	18	1.6 – 64	1.1	0.44 – 2.15	56
Biotech	30	8 – 44	76	9.2 – 146	2.7	1.6 – 6.6	108
Leisure	28	11 – 37	68	10.3 – 142	1.9	0.8 – 3.86	193
Retail	23	11 – 35	62	20 – 123	1.3	0.76 – 2.7	1,764
Utilities	20	0 - 44	68	18 –180	1.3	0.66 – 2.37	603
Real Estate	26	0 – 40	70	0 – 127	0.8	0.55 – 1.1	512
Info. Tech	29	2 – 47	80	-21 – 191	3.6	0.83 – 7.22	211

Notes: This table presents the mean and the lowest and highest values for the short-term debt to total debt (SD/TD), accumulated retained earnings to book value of equity (RE/BE), and market-to-book ratios (ME/BE). These ratios show the relative importance of short-term debt and retained earnings as a source of funds whereas the market to book ratio may be interpreted as a measure of growth opportunities. The mean market capitalisation is useful as a measure of the size of typical firms in the different industries of this study.

Table 3: The hypotheses tested

Hypothesis	Central Economic Hypothesis
H1	UK quoted firms have target capital structure ratios to which they adjust in the long run while in the short run they deviate from these target ratios and in the adjustment process firms employ the securities with the smallest adverse selection costs.

Hypothesis	Supporting Economic Hypotheses	Definition of Gearing Ratios to be tested
H2	UK firms have long-run or total debt to book equity target ratios from which they deviate in the short run. In the adjustment process mature (young) firms employ total debt (book equity).	*TD/BE; TD/(TD+BE)*
H3	UK firms have long-run or total debt to total assets target ratios from which they deviate in the short run and in the adjustment process firms employ total debt rather than total assets.	*TD/A*
H4	UK firms have long-run or total debt to market equity target ratios from which they deviate in the short run and in the adjustment process firms employ total debt*.	*TD/ME; TD/(TD+ME)*
H5	UK firms have long-run or total debt to total equity target ratios from which they deviate in the short run. In the adjustment process mature (young) firms employ retained earnings rather than total debt (book equity).	*TD/TE;* *TD/(TD+TE)***

Notes: This table presents the hypotheses tested for UK firms in the 10 industries. In addition to total gearing ratios (i.e. long-term plus short-term debt in the numerator and denominator), we also tested the equivalent hypotheses employing the long-term gearing ratios (i.e. long-term debt in the numerator and denominator).
* This is more of a restriction than a deliberate choice. Firms can influence but not control market values of equity and hence when (total) debt and market equity diverge beyond a certain threshold, the only option firms have to reach the target ratio is to reduce or increase borrowing.
**To distinguish between the adjustment speed coefficients of retained earnings and book equity, we decompose these ratios into *TD/(RE+BE)* and *TD/(TD+RE+BE)* respectively.

Table 4: Johansen cointegration test results of gearing ratio components by industry

Ratio components	Extraction		Construction		Engineering		Textiles		Biotech		Leisure		Retail		Utilities		Real Estate		Info. Tech	
	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}	$\lambda_{\max}$	λ_{Trace}
TD-BE	12.21	16.95	**16.51**	**18.43**	6.39	8.27	**15.03**	**18.13**	8.28	11.83	10.28	12.54	9.49	14.51	12.07	16.76	10.12	13.73	**18.73**	**22.03**
TD-ME	**13.46**	**18.19**	13.89	15.88	10.64	12.60	10.64	12.60	**14.13**	**18.01**	10.25	11.39	14.69	17.55	10.66	13.32	10.25	14.36	**19.64**	**22.38**
TD-TE	**11.08**	**17.89**	**16.62**	**19.08**	11.43	13.80	**18.28**	**26.10**	**15.94**	**18.71**	10.63	10.70	**12.83**	**17.98**	12.00	16.72	10.28	14.66	10.29	16.04
TD-A	**11.48**	**17.79**	**16.34**	**18.81**	10.43	13.82	**18.01**	**25.18**	8.55	13.07	10.42	11.82	**13.06**	**18.71**	**10.92**	**18.15**	**17.39**	**19.09**	11.34	15.58
TD-TDBE	11.02	17.31	9.71	14.55	9.56	15.82	**17.24**	**25.56**	9.56	16.01	9.53	10.54	8.99	14.18	9.72	15.51	8.31	9.82	7.06	9.59
TD-TDME	**13.62**	**18.94**	11.84	14.40	9.23	10.44	8.74	14.72	10.74	13.54	9.87	11.63	12.40	15.19	10.62	12.12	9.52	14.11	7.25	10.93
TD-TDTE	10.98	17.29	**16.35**	**18.82**	12.63	15.74	**17.22**	**25.49**	10.35	16.47	9.09	13.93	11.17	14.23	**13.41**	**19.58**	8.84	10.43	8.67	12.24
TD-BE-RE	**24.47**	**36.78**	18.86	27.79	20.33	31.68	**29.48**	**34.75**	**21.67**	**32.15**	15.09	30.47	13.41	27.38	14.90	28.77	20.38	31.14	14.03	27.31

Notes: This table presents the results of Johansen cointegration test for the components of different gearing ratios for the ten industries $\beta_0 + \ln \bar{D}_t + \beta_1 \ln \bar{E}_t + \tilde{\varepsilon}_t = 0$ (a) and $\beta_0 + \ln \bar{D}_t + \beta_1 \ln \bar{BE}_t + \beta_2 \ln \bar{RE}_t + \tilde{\varepsilon}_t = 0$ (b). The gearing ratio components (i.e. the sample series in column one) are adjusted for inflation and then the natural logarithm is computed. $\lambda_{\max}$ and λ_{Trace} are the Johansen test statistics and the 10 percent critical values are 10.29 and 17.79 for equation (a) and 14.09 and 31.88 for equation (b). Significant statistics are presented in bold.

Table 5: The adjustment speed coefficients of the error correction for the gearing ratio components by industry

Ratio components	Industries																			
	Extraction		**Construction**		**Engineering**		**Textiles**		**Biotech**		**Leisure**		**Retail**		**Utilities**		**Real Estate**		**Info. Tech**	
	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat	α_D, α_E, (α_{RE})	α t-stat
TD-BE	-0.41	-3.39	**-0.36**	**-1.99**	-	-	**-0.19**	**-2.34**	-	-	0.14	2.92	-	-	-0.15	-1.35	-0.06	-1.21	**-0.10**	**-1.26**
	0.03	0.44	**0.06**	**1.83**			**0.10**	**1.66**			-0.05	-0.52			0.22	2.89	0.09	1.94	**0.38**	**4.05**
TD-ME	**0.05**	**0.58**	-0.43	-4.09	-0.19	-3.40	-0.19	-3.39	**-0.49**	**-3.57**	-	-	-0.50	-2.09	-0.85	-3.53	-0.12	-1.99	**-0.26**	**-3.88**
	-0.35	**-3.72**	0.08	0.48	0.02	0.26	0.02	0.26	**0.25**	**1.17**			0.19	1.21	0.13	0.16	0.17	1.96	**0.18**	**2.76**
TD-TE	**0.08**	**1.64**	**-0.10**	**-1.19**	-0.01	-0.97	**0.07**	**1.09**	**-0.12**	**-2.19**	-	-	**-0.10**	**-1.09**	0.15	1.35	-0.06	-1.19	-0.08	-1.29
	-0.22	**-2.41**	**0.20**	**2.92**	0.20	2.35	**-0.26**	**-2.69**	**0.28**	**2.31**			**0.28**	**1.93**	0.21	2.88	-0.10	2.06	-0.37	-3.50
TD-A	**-0.43**	**-2.41**	**0.06**	**0.29**	-0.04	-0.44	**0.19**	**1.67**	-	-	0.26	2.86	**-0.30**	**-2.11**	**0.08**	**0.28**	**-0.24**	**-1.72**	0.20	2.81
	0.03	**0.30**	**0.30**	**2.39**	0.13	1.77	**-0.50**	**-4.87**			0.17	1.18	**0.29**	**1.78**	**0.31**	**1.53**	**0.12**	**0.96**	-0.13	-3.37
TD-BE-RE	**-0.02**	**-1.53**	-0.29	-1.77	-0.02	-1.31	**-0.10**	**-2.15**	**-0.11**	**-1.23**	-0.04	-1.25	-	-	-0.20	-2.18	-0.13	-1.71	**-0.15**	**-1.75**
	0.01	**1.09**	0.15	2.19	0.00	0.22	**-0.01**	**-0.73**	**0.21**	**1.99**	0.63	2.68			0.23	3.77	0.18	2.54	**0.32**	**2.06**
	0.25	**4.22**	0.42	3.05	0.13	4.95	**0.24**	**2.70**	**0.38**	**2.36**	0.32	1.88			0.40	3.19	0.26	1.96	**0.46**	**2.41**

Notes: This table presents the results of the Error Correction Mechanism for the cointegrated components of different gearing ratios for the ten industries. α_D is the adjustment speed coefficient for *TD* and α_E is the adjustment speed coefficient for *BE, ME, TE* and *A*, and α_{RE} is the adjustment speed coefficient for *RE*; α t-stat is the t-statistic of the associated adjustment speed coefficient. Significant coefficients are presented in bold.