TESTING THE TRADE-OFF AND PECKING ORDER THEORIES: SOME UK EVIDENCE

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Abstract

In this paper, we conduct empirical tests for the two leading but contradicting theories of capital structure: the trade-off and the pecking order theories. To examine former theory, we use a partial adjustment model, and an error correction model as a generalised specification of the partial adjustment process. This framework allows us to nest the cash flow deficit variable necessary to examine the pecking order theory. The empirical models are estimated by IV and GMM methods, which are argued to yield consistent estimates for dynamic panel data. The finding suggests that the trade-off theory holds well and consistently outperforms the pecking order theory.

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***Keywords*:** Capital structure, Trade-off theory, Pecking order theory, Partial Adjustment, Dynamic panel data.

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I. INTRODUCTION

The modern theory of capital structure began with the path-breaking Modigliani and Miller's (1958) (hereafter MM) propositions, which state that in a world with perfect capital markets, the firm value is independent of its financing decisions. While these irrelevance propositions offer important insights, they only provide benchmarks, not end results (Myers, 2001). The main result of the MM theory is to show under what conditions the capital structure choice becomes irrelevant. Implicitly, it raises an important question as under what conditions corporate financing matters (Harris and Raviv, 1991). Over the last forty years, a vast body of research on capital structure has advanced useful theoretical and empirical models by explicitly relaxing some of the key assumptions underlying the MM's theorems. These attempts have led to two predominant but competing theories of capital structure, known as the trade-off theory and the pecking order theory.[1]

The (static) trade-off theory, derived from the models based on taxes (e.g. Modigliani and Miller, 1963; DeAngelo and Masulis, 1980) and agency costs (e.g. Jensen and Meckling, 1976), suggests the firm has a well-defined optimal capital structure, which is determined at the point where the marginal benefit equates the marginal cost of using debt.[2] This framework posits that the debt ratio is mean reverting as the firm seeks to achieve the optimum. An extensive body of empirical research has documented evidence supporting the theory prediction. Early US papers by Taggart (1977), Jalilvand and Harris (1984) and Auerbach (1985) find the firm debt ratio exhibits a mean revering behaviour. Recent studies by Miguel and Pindado (2001), and Fama and French (2002) report mixed results, while research by Ozkan (2001), Bhaduri (2002) and Loof (2003), Flannery and Rangan (2004), offers consistent evidence, lending support to the partial adjustment model as predicted by the trade-off framework. In other approaches, Marsh (1982) and Hovakimian *et al*. (2001) estimating a logit model observe that the debt equity

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[1] Two recent theoretical developments in the literature include the market-timing hypothesis (Baker and Wurgler, 2002) and managerial inertia theory (Welch, 2004). Frank and Goyal (2005) review the theories and their criticisms (e.g. Leary and Roberts, 2004a; Kayhan and Titman, 2004) .

[2] Some recent theoretical work on the trade-off framework has focused on developing dynamic structural models (e.g. Strebulaev, 2004; and Hennessy and Whited, 2005).

choice reflects a tendency towards the optimum, which is supportive of the trade-off theory.

The pecking order theory argues that the firm does not have an optimal mix of debt and equity (e.g. Myers, 1984; Myers and Majluf, 1984). The observed amount of debt reflects a cumulative result of financing decisions overtime. Due to asymmetric information, the capital structure choice follows a pecking order: where internal finance is preferred to external finance, in which debt is preferred to equity. Past empirical evidence for the pecking order theory has been rare, due to inherent difficulties in devising a test for the theory prediction. The earliest direct empirical test is due to Baskin (1989), who finds the result consistent with the theory. Using a logit model, Helwege and Liang (1996) provide a mixed conclusion, while Haan and Hinloopen (2003) document strong evidence supporting the pecking hierarchy.

A recent strand of the literature is interested in an empirical model that embeds both the pecking order and the trade-off theories. In an important paper, Shyam-Sunder and Myers (1999) propose a simple test for a strict interpretation of the pecking order hypothesis, which models net debt issues using the cash flow deficit variable. The specification also allows them to nest the trade-off theory in a single framework. Their finding conforms to the pecking order theory and simultaneously leads to the rejection of the trade-off framework. Frank and Goyal (2003) extend the Shyam-Sunder and Myers approach by examining a broader sample of US firms for a longer time-period. They however fail to find evidence in favour of the pecking order theory. Most recent papers provide further mixed evidence to the debate on the applicability of the pecking order's hierarchy. Among others, Chen and Zhao (2004), and Lemmon and Zender (2004) find new evidence supporting the modified version of the pecking order theory (e.g. in consideration of the role of debt capacity). Nonetheless, Leary and Robert (2004a) report that the pecking order's predictions fail to explain the data well. More importantly, Fama and French (2005) show that the evidence on equity issuance strongly violates the pecking order theory. In general, the conclusion from past research remains inconclusive. Such mixed results show the importance of further empirical research in this area.

With the current empirical literature dominated by US-based research, there have been a few UK studies investigating the trade-off and the pecking order theories. Most of the UK research examines the explanatory power of various determining factors of the debt-equity ratio on a conventional cross-sectional basis (Bennett and Donnelly, 1993; Lasfer, 1995; Michaelas *et al*, 1996; Walsh and Ryan, 1997; Jordan *et al.*, 1998; Hall *et al.*, 2000; Short *et al.*, 2002; Bevan and Danbolt, 2002; Bevan and Danbolt, 2004). Recent studies by Ozkan (2001) and Antoniou *et al.* (2002) develop a test for the trade-off theory, while Adedeji (2001) and Watson and Wilson (2002) investigate the pecking order theory. Nonetheless, there have been no UK attempts to examine the power of the two theories simultaneously. [3]

The main aim of this paper is to test the two leading but competing theories of capital structure against a sample of UK firms. To this end, we develop some econometric models that nest the two theories in a single framework, along the lines of Shyam-Sunder and Myers (1999), and Frank and Goyal (2003). We also employ recent econometric techniques to examine an unbalanced panel data set of about 5,500 year-observations and 860 UK firms, over the period 1996-2003. Our analysis makes three contributions to the current empirical literature.

First, in testing the mean-reversion of the debt ratio, the study adopts an error correction model, as a generalised version of the partial adjustment model that has been widely exploited in prior research. An error correction equation explicitly models the past deviation of the actual debt-equity ratio from the target one, as well as the change in the target ratio over time. The use of this model is important because it allows us to test the robustness of the results, particularly for the trade-off theory, to an alternative but a more general specification.

In terms of methodologies, we employ appropriate testing procedures based on recent advances in the econometrics of dynamic panel data to improve the robustness of the estimation results. The Anderson and Hsiao (1981, 1982)

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[3] In a recent working paper, Benito (2003) examines the trade-off theory using the UK and Spain panel data. His empirical model does not use the deficit cash flow variable, so it does not capture the pecking order hypothesis. His UK data set is also limited to a sample of quoted firms in the London Stock Exchange.

instrumental variable estimator and the Arellano and Bond (1991) and Blundell and Bond (1998) Generalised Methods of Moments (hereafter GMM) estimators are adopted to provide a basis for our dynamic panel data analysis.

The paper can be considered as one of the first UK attempts to formally investigate the trade-off theory, against the pecking order theory. The results will shed light on the dominant financing behaviour of UK firms, which can be compared to non-UK studies. In this respect, unlike the mixed results reported in US research (e.g. Shyam-Sunder and Myers (1999), and Frank and Goyal (2003)), our study provides consistent evidence to suggest that the trade-off theory holds well and consistently outperforms the pecking order theory. Furthermore, it also finds significant relationships between debt ratio and some important determinants including collateral value of assets, non-debt tax shields and growth, as predicted by the trade-off theory.

The remainder of the paper is organised as follows. The first section briefly surveys the trade-off and pecking order theories. Next, the paper develops the empirical models and econometric methodologies. We then summarise the data and sample. The next section presents and interprets the estimation results. Finally, we offer some concluding remarks.

II. THEORETICAL FRAMEWORK

1. Trade-off Theory

The (static) trade-off theory states that each firm has a well-defined optimal capital structure, which balances the benefits and costs associated with debt financing. The main benefits of debt include (i) tax deductibility gained by tax-paying firms (Modigliani and Miller, 1963), and (ii) advantages of using debt to mitigate the agency costs of equity and the free cash flow problem (e.g. Jensen and Meckling, 1976; Jensen, 1986). The costs of debt can be identified as (i) non-debt tax shields (DeAngelo and Masulis, 1980), and (ii) agency costs of debt due to suboptimal investment behaviour (Jensen and Meckling, 1976), or underinvestment problem (Myers, 1977).

1.1. Models Based on Taxes

In their corrected version of the classic MM's propositions, Modigliani and Miller (1963) show that when corporate tax is taken into consideration, the firm value becomes an increasing function of debt. Debt financing is viewed as more advantageous than equity because using more debt reduces the expected tax liability and increases the after tax cash flow. This result also implies that, given the existence of bankruptcy costs or reorganisation costs due to debt usage, there should be an optimal capital structure that equates debt tax shields and the cost of financial distress.

The analysis in Modigliani and Miller (1963) considers the impact of corporate tax while ignoring the effect of personal income tax. Miller (1977) explicitly takes into account the effect of the latter tax code and demonstrates that in equilibrium, the total amount of tax saving will be equal to zero. In other words, the advantage of the corporate tax is cancelled by the disadvantage of the personal tax. The author further suggests that there should be no optimal debt ratio for any individual firms.

DeAngelo and Masulis (1980) generalise the models developed in Modigliani and Miller (1963) and Miller (1977) by considering the impact of non-debt tax shields. Their overall finding suggests that when corporate tax shield substitutes for debt such as depreciation or investment tax credits are accounted, there is some interaction between the firm' advantages of debt tax shields and non-debt tax shields. That results in a unique optimal debt ratio in equilibrium, regardless of the presence of bankruptcy and agency costs.[4] In rejecting the irrelevance theorems of Modigliani and Miller (1958) and Miller (1977), the DeAngelo and Masulis (1980) model offers a plausible taxes-based argument for the trade-off framework.

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[4] DeAngelo and Masulis also maintain that even without the non-debt tax shields, the size of default costs would be enough to yield a unique optimal debt-equity choice.

1.2. Models Based on Agency Costs

The developments in the modern theory of capital structure in the last thirty years or so have been devoted to the consideration of principal-agent problems (e.g. Jensen and Meckling, 1976; Jensen, 1986; Slutz, 1990; Harris and Raviv, 1990). These models have provided insights into the potential benefits and costs associated with debt financing.

In the juncture between shareholders and managers, the fact that the fractional-owner manager only bears a fraction, but not full costs of perquisites, gives rise to a typical principal-agent problem. In particular, the former party has an incentive to increase the non-pecuniary costs, thereby reducing the firm value and generating the agency costs of outside equity (Jensen and Meckling, 1976). One possible measure to mitigate these agency costs requires the firm to increase the proportion financed by debt, which reduces the cash flow available that otherwise would be spent at the discretion of the manager (Jensen, 1986). [5]

With respect to the relationship between debt-holders and equity-holders/managers, it is argued that debt can generate a different type of incentive problems. Jensen and Meckling (1976) argue that an asset substitution effect is possible as the owner/manager has an incentive to invest in risky projects when they have negative expected returns. This overinvestment problem arises because even when the value-decreasing investment fails, due to limited liability, it is the debt-holder, not the owner/manager, who bears the consequences. From another perspective, Myers (1977) contends that firms issuing risky debt to outsiders may reduce equity-financed capital investment. As debt becomes more risky, the better-protected debt-holders will be able to capture more gain from additional investment. Consequently, the owner/manager will have no incentive to commit new capital, even to invest in value-increasing projects. That results in another agency problem, known as the underinvestment or debt overhang problem.[6]

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[5] In addition to the free cash flow theory by Jensen (1986), Slutz (1990) and Harris and Raviv (1990) consider different aspects of the benefits of debt in reducing agency costs.

[6] In fact, as argued in Myers (2001, p. 97), this gain in the market value of debt can be considered as a tax on new investment and as that tax is high enough, the manager may even forgo positive NPV projects: “the greater the risk of default, the greater benefit to existing debt from additional investment”.

2. Pecking Order Theory

An implicit assumption underpinning the MM theory concerns the way in which information is possessed and distributed within the firm and the market. In this respect, the introduction of asymmetric information from economics into finance has given rise to recent advances in the theory of capital structure.

In their seminal paper, Myers and Majluf (1984) develop a model in which the capital structure choice is designed to limit inefficiencies caused by informational asymmetries.[7] The asymmetric information assumption states that the manager knows more about the value of the existing assets and the new growth opportunities than the outside investor does. A potential adverse selection problem arises as firms with lower value opportunities have an incentive to issue securities that imitate firms with higher value opportunities. This behaviour results in a situation where securities of the former firms can be overvalued while those of the latter firms undervalued. To avoid loss of wealth, only share-holders/managers with overvalued assets in place will issue outside financing instruments.[8] Consequently, investors will predict a decision not to issue securities to signal good news and vice versa. This problem leads to a pooling market equilibrium in which new shares can only be offered at a marked-down price.

This adverse selection problem can be mitigated if capital structure follows a particular hierarchy (Myers, 1984). The financing choice should be in favour of the financing instruments that are less risk and less sensitive to mis-pricing and valuation errors. First, internally generated funds with no risks are preferred to external financing. Between the two external financing sources, debt with its prior claim and lower risks than equity is preferred. The argument leads to the well-

[7] Another strand of the literature includes signalling models (e.g. Ross, 1977; Leland and Pyle, 1977; Heinkel, 1982), which consider the use of capital structure as a signal of private insider information under the asymmetric information framework (i.e. managers possess private information about the characteristics of the firm that investors do not).

[8] The argument is put forward under the assumption that managers act in the interest of existing shareholders. This can be however a shortcoming of the approach (Watson and Wilson, 2002). As demonstrated in the models based on agency costs, the managers may have the discretion to exploit their informational advantage to the expense of the shareholders.

known pecking order theory, which holds that internal finance is preferred to external finance, in which debt is preferred to equity (Myers, 1984).[9]

The pecking order theory is in contrast with the trade-off theory since it does not envisage that the firm has a well-defined optimal capital structure. The theory suggests that the mix of debt and equity should be the cumulative result of hierarchical financing decisions overtime (Shyam-Sunder and Myers, 1999). To avoid mis-pricing of new securities, the firm always uses up all the retained earnings to fund new investments. When this internal financing is insufficient, debt will be preferred to outside equity. The latter financing instrument will be issued as the last resort, when the firm exceeds its debt capacity.

III. EMPIRICAL MODELS AND METHODOLOGIES

1. Empirical Specifications for Trade-off Theory

The trade-off framework implies each firm attempts to achieve the optimal capital structure through strategic financing decisions. In reality, however, random events or costs can prevent the firm from maintaining the actual debt ratio at, or even close to, its target one. If the theory holds, the debt ratio will reverse to its target in the long-term. Testing the trade-off theory is therefore a test of mean-reversion of the debt ratio.

1.1. Partial Adjustment Model

The conventional econometric model to test the mean reverting interpretation of the trade-off theory takes the form of a partial adjustment process (e.g. Jalilvand and Harris, 1984; Shyam-Sunder and Myers, 1999; Ozkan, 2001 and Fama and French, 2002):

$$D_{it} - D_{it-1} = \delta (D_{it}^{*} - D_{it-1}) + v_{it} \qquad \text{(III-1)}$$

or:

[9] Titman and Wessels (1988) argue that transaction costs of new equity issue can also be an additional reason to explaining why firms follow the pecking order preference.

$$D_{it} = \delta D_{it}^{*} + (1-\delta) D_{it-1} + v_{it} \quad \text{(III-2)}$$

where D_{it} and D_{it}^{*} denote the actual and target debt ratio for firm *i* at time *t*, respectively, $v_{it} \sim IDD(0, \sigma_v^2)$. In both equations (III-1) and (III-2), δ is the speed of adjustment, which shows how fast the firm reverses to its target debt ratio. If a firm could adjust to its optimal capital structure fully, the coefficient would be equal to 1. Due to adjustment costs, δ is expected to be between 0 and 1, with higher δ implying higher speed of adjustment.

Estimating equations (III-1) and (III-2) requires the knowledge of the actual observable debt ratio and the target one, which is unobservable. A number of solutions are available. First, the target debt ratio can be calculated using (i) the historical mean of the debt ratio, or (ii) the (three-year) moving average, (Marsh, 1982; Jalilvand and Harris, 1984). A limitation of this approach is the dependence upon historical data. Theoretically, it is difficult to justify why the target debt ratio should remain constant over a period of time (Jalilvand and Harris, 1984; Shyam-Sunder and Myers, 1999).

Second, the target debt-equity ratio can be viewed as a unique ratio, which is determined by the firm individual characteristics. Two issues arise from this approach. The first is the selection of the explanatory variables of the target debt ratio. Given the fact that quite a few determining factors have been suggested in the literature, an exhaustive list will not be attempted here.[10] In order to facilitate comparisons with previous conventional cross-sectional studies, five important determinants including collateral value of assets, non-debt tax shields, profitability, growth opportunities and firm size are chosen (see Appendix 1 and 2 for further discussions on these determinants).

The second issue concerns the appropriate econometric specification for dynamic panel data analysis. Following recent studies (Ozkan, 2001; Miguel and Pindado, 2001), we adopt a two-way-error-component regression model. The unobservable firm effects capture the firm and industry characteristics (e.g.

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[10] For a comprehensive list of the potential determinants of debt ratios, see Harris and Raviv (1991), and Frank and Goyal (2003).

managerial ability and skills; level of competition in the industry, life cycle of products and so on).[11] The time effects capture macroeconomic variables, including changes in the state of the economy, interest rates and prices, accounting standard and other regulations, etc. Both the time and firm effects are treated as fixed effects. According to Baltagi (1995), this specification is required when the purpose of the test is to examine a specific set of firms and make inference within this set.

The econometric specification of the target debt ratio is:

$$D_{it}^{*} = \sum_{k=1}^{n} \beta_k x_{kit} + \mu_i + \lambda_t + v_{it} \qquad \text{(III-3)}$$

where x_{kit} denotes the k*th* determining factor and β_k the coefficient;. μ_i represents time-invariant unobservable firm and/or industry-specific fixed effects; λ_t represents firm-invariant time-specific fixed effects, and v_{it} is the error term $v_{it} \sim IDD(0, \sigma_v^2)$.

Estimation of (III-2) given (III-3) can be conducted in two ways. First, one can adopt a two-stage procedure, along the lines of Shyam-Sunder and Myers (1999) and Fama and French (2002). The first stage involves estimating (III-3) using the actual ratio, and subsequently deriving the fitted values for the target debt ratio. In the second stage, the fitted values obtained from the first regression are used as a proxy for the target debt ratio in estimation of equations (III-1) and (III-2), respectively. While this procedure is easy to implement, it has limitations. In practice, the regression model in (III-3) tends to have a low "goodness of fit" and any estimation errors can be carried into the second stage when equations (III-1) or (III-2) are estimated.

The alternative option is a one-step procedure (e.g. Ozkan, 2001; Wanzenried, 2001), in which equation (III-3) is substituted into (III-2) to yield a single equation:

[11] Bennett and Donnelly (1993) and Hall *et al.* (2000) all document the impact of industry characteristics on the UK firm capital structure.

$$D_{it} = \varphi_0 D_{i,t-1} + \sum_{k=1}^{n} \varphi_k x_{kit} + \eta_i + \tau_t + \varepsilon_{it} \qquad \text{(III-4)}$$

where $\varphi_0 = 1-\delta$, $\varphi_k = \delta\beta_k$, $\eta_i = \delta\mu_i$, $\tau_t = \delta\lambda_t$ and $\varepsilon_{it} = \delta v_{it}$. Note that in estimation of equation (III-4), both the time and firm effects, and the error term retain their properties.

Using the *OLS* estimator to estimate (III-4) is likely to result in biased and inconsistent coefficients because both D_{it} and D_{it-1} are correlated with η_i. The econometric literature offers a number of estimation procedures that can overcome this limitation. First, according to the Anderson and Hsiao (1981 and 1982) procedure (hereafter AH), equation (III-4) can be transformed using first differences as follows:

$$\Delta D_{it} = \varphi_0 \Delta D_{i,t-1} + \sum_{k=1}^{n} \varphi_k \Delta x_{kit} + \Delta\tau_t + \Delta\varepsilon_{it} \qquad \text{(III-5)}$$

The individual effects have been eliminated in (III-5), hence no correlation between D_{it-1} and η_i. Nonetheless, it is likely that the two terms ΔD_{it-1} and $\Delta\varepsilon_{it}$ will be correlated via the correlation between D_{it-1} and ε_{it-1}. Anderson and Hsiao (1981 and 1982) propose to use an instrumental variable (IV) estimation method, in which either ΔD_{it-2} or D_{it-2} can be adopted as an instrument for ΔD_{it-1}. This IV estimator is consistent since the instruments are correlated with ΔD_{it-1} (via D_{it-2}) but they have no correlation with $\Delta\varepsilon_{it}$.

The AH IV estimator is potentially inefficient because it does not take into account all the moment conditions available in equations (III-4) and (III-5). Recent developments in literature have focused on the Generalised Method of Moments (hereafter GMM) and their application in dynamic panel data analysis. Arellano and Bond (1991) (hereafter AB) suggest the use of a GMM estimator that exploits all the linear restrictions under the assumption of no serial correlation. They argue that additional instruments can be created using the orthogonality conditions between lagged values of the dependent variable and the error term. Considering equation (III-5), for example, the GMM instruments for D_{it-1} include a set of *t*-2 elements $(D_{it-2}, D_{it-3}, ..., D_{i1})$, rather than a single instrument D_{it-2} (ΔD_{it-2}) as in the AH procedure (see also Appendix 3).

Blundell and Bond (1998) (hereafter BB) maintain that for short sample periods and persistent series, the standard GMM estimator can be inefficient. They extend the AB procedure by considering additional moment conditions that have not yet been utilised. Under the condition of no correlation between ΔD_{it-1} and η_i, the former term can become a valid instrument in the levels equation. This GMM system estimation involves estimating both the differenced and levels equations.

1.2. Error Correction Model

Although the partial adjustment model has been widely used in the finance literature to test the trade-off framework, it is criticised in the econometrics literature as being *ad hoc* or as depending on overly restricted assumptions (see Maddala, 2001, p. 408). Attempts to extend the partial adjustment model may involve (i) specifying the speed of adjustment (δ) as a function of other explanatory variables or (ii) generalising it to an Error Correction Model (hereafter ECM).[12] In this study, we focus on the latter approach.

Formally, an ECM for the debt ratio is:

$$D_{it} - D_{it-1} = \delta(D_{it}^{*} - D^{*}_{it-1}) + \gamma(D^{*}_{it-1} - D_{it-1}) \qquad \text{(III-6)}$$

or:

$$D_{it} = (1-\gamma)D_{it-1} + \delta D_{it}^{*} + (\gamma - \delta)D^{*}_{it-1} \qquad \text{(III-7)}$$

where 0<δ, γ <1. The first term on the right hand side of (III-6) is the change in the target debt ratio, and the second term the past deviation of the actual debt ratio from the target one. Unlike a partial adjustment model, an ECM explicitly models the target change of the dependent variable. In fact, the ECM in (III-6) is a generalised version of the partial adjustment specification in (III-1). The former model is reduced to the latter when $\delta = \gamma$.

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[12] Davidson *et al.* (1978) were among the first to use an ECM specification. Since then it has become a widely used model in dynamic econometrics (see Hendry, 1995 for a discussion of ECM).

As with the partial adjustment model, we can proceed in one or two steps. The two-stage procedure involves estimating equations (III-3) and obtaining the fitted values of the target debt ratio, which will be used in estimation of equation (III-6). In the one-stage procedure, we only estimate a single equation, which is derived by substituting (III-3) into (III-7):

$$D_{it} = \varphi_0 D_{it-1} + \sum_{k=1}^{n} \varphi_k x_{kit} + \sum_{k=1}^{n} \phi_k x_{kit-1} + \eta_i + \tau_t + \varepsilon_{it} \qquad \text{(III-8)}$$

where $\varphi_0 = 1 - \gamma$, $\varphi_k = \delta\beta_k$, $\phi_k = (\gamma - \delta)\beta_k$, $\eta_i = \gamma\mu_i$, $\tau_t = (\delta + \gamma)\lambda_t - \delta\lambda_{t-1}$ and $\varepsilon_{it} = \delta v_{it} + (\gamma - \delta) v_{it-1}$.

It can be seen from equation (III-8) that there is a potential correlation between D_{it-1} and the disturbance (via the term v_{it-1}), as well as between D_{it-1} and the fixed effects η_i. The *OLS* estimator is thus not an appropriate one. To address this issue, one can take the first differences of (III-8) and adopt the Anderson and Hsiao IV, Arellano and Bond GMM or Blundell and Bond GMM system estimators.

2. Empirical Specifications for Pecking Order Theory

A recent strand of the empirical literature attempts to design a test for the pecking order theory (Shyam-Sunder and Myers, 1999; Frank and Goyal, 2003; Watson and Wilson, 2002; Lemmon and Zender, 2003). Shyam-Sunder and Myers (1999) develop a simple model for a strict version of the pecking order hypothesis, which holds that when the firm needs external finance, it will only issue debt, not equity. After an IPO, equity financing is used under extreme circumstances, especially when the cost of financial distress is high. The empirical specification for the test takes the following form:

$$\Delta D_{it} = \alpha + \beta_{PO} DEF_{it} + \varepsilon_{it} \qquad \text{(III-9)}$$

where ΔD_{it} denotes net debt issued, DEF_{it} cash flow deficit in year *t* (all variables in levels) and ε_{it} the well-behaved error term. In equation (III-9), the strict version of the pecking order theory holds if $\alpha = 0$ and $\beta_{PO} = 1$, i.e., when the deficit in cash flow is entirely offset by the change in debt.

In order to estimate equation (III-9), we must adopt appropriate proxies for the dependent and independent variables. First, DEF_{it} is defined as follows:

$$DEF = -CF + I + DIV + \Delta C = (\Delta D + \Delta E) \quad \text{(III-10)}$$

where CF denotes Cash flow after tax and interest (i.e. CF = Cash flow from Operating activities (*Datastream item* 1015) - Investment return and servicing of finance (1117) – Taxation (433)). I: Net investment (i.e. I = Capital Expenditures (1122) + Acquisitions and Disposals (1128)). DIV: Equity dividends paid (1129). ΔC : Net change in cash (1134). ΔE : Net equity issued (429).[13]

As in Shyam-Sunders and Myers (1999) and Frank and Goyal (2003), proxies for ΔD_{it} include: (i) total debt ratio in first differences, (ii) net debt issued and (iii) gross debt issued scaled by the firm value. Finally, note that equation (III-9) is in levels but the conventional procedure requires scaling the variables by a common factor such as the market value of the firm.[14]

3. Models Nesting Trade-off and Pecking Order Theories

In order to compare the performance of the trade-off against pecking order theories, a unified framework that embeds both theories is required. Shyam-Sunder and Myers (1999), and Frank and Goyal (2003) both propose to include the cash flow deficit in the partial adjustment model (III-1) to nest the pecking order theory,

$$D_{it} - D_{it-1} = \alpha + \delta (D_{it}^{*} - D_{it-1}) + \beta_{PO} DEF_{it} + v_{it} \quad \text{(III-11)}$$

The pecking order hypothesis holds if $\alpha = 0$ and $\beta_{PO} = 1$. Moreover, if $\delta = 0$ (i.e. the speed of adjustment not statistically different from zero) then one can reject the trade-off theory in favour of the pecking order theory. Again, estimating (III-11) can proceed in either one or two steps. The two-step procedure is similar to the one adopted in estimating the partial adjustment and error correction specifications. The

[13] For some UK firms, *DEF* also includes Management of liquid resources (Datastream item 1133).
[14] It can be seen that while scaling is useful as it allows for comparisons, one should take caution in interpretation since the coefficients may be strongly affected if the scale is correlated with the variables in the equation.

one-step method involves adding the variable DEF_{it} in the partial adjustment specification (equation (III-5)), yielding an important equation as follows:

$$\Delta D_{it} = \varphi_0 \Delta D_{i,t-1} + \sum_{k=1}^{n} \varphi_k \Delta x_{kit} + \Delta\tau_t + \beta_{PO} DEF_{it} + \Delta\varepsilon_{it} \qquad \text{(III-12)}$$

A similar modification can be also done for an ECM (as specified in (III-8)) to nest the pecking order hypothesis.

$$\Delta D_{it} = \varphi_0 \Delta D_{it-1} + \sum_{k=1}^{n} \varphi_k \Delta x_{kit} + \sum_{k=1}^{n} \phi_k \Delta x_{kit-1} + \beta_{PO} DEF_{it} + \Delta\tau_t + \Delta\varepsilon_{it} \qquad \text{(III-13)}$$

Given equation (III-12) and (III-13), one can proceed by adopting the Anderson and Hsiao (IV), the Arellano and Bond GMM method or the Blundell and Bond GMM system estimators, as detailed in the preceding subsection.

IV. DATA

The data set is a large sample of UK firms collected from *Datastream*, a database that maintains both times series and cross-sectional company data. The initial sample is the UK research list constructed by the database itself, which includes approximately 1,680 firms. The accounting data for all the firms was collected from the earliest possible year (which depends upon the individual firms) up to January 2004, creating an unbalanced panel data set of nearly 20,000 year-observations.

Following previous UK research by Lasfer (1995), Walsh and Ryan (1997), Ozkan (2001), Short *et al.* (2002), a number of conventional restrictions are imposed on the initial data set. First, firms operating in the financial sector (banks, insurance and life assurance companies and investment trusts) and in utilities sector (electricity, water and gas distribution) are excluded because they are subject to different regulatory accounting and taxation considerations.[15] Second, in order to adopt the IV and GMM estimators, only the companies that have five-year or more

[15] About 3,000 year-observations were removed after this restriction was imposed.

observations are retained in the data set.[16] Last, any observations that have missing data for the variables of interest are removed.[17] That results in a final sample of 859 companies and 5,393 year-observations, with the longest time series of 8 years over the period 1996-2003. The structure of the sample is summarised in appendix 4 and descriptive statistics presented in appendix 5. In appendix 2, we discuss the definition and measurements of all the variables used in the paper.

V. RESULTS

In this section, we present and interpret the estimation results. [18] Apart from the coefficients and the asymptotic standard errors robust to heteroscedasticity, the *R*-squared and *RSS*, we report five important statistics. These include (i) *Wald test 1*, which is a test for joint significance of the estimated coefficients under the null of no relationship; (ii) *Wald test 2* for the join significance of the time dummies; (iii) *AR(1)* and (iv) *AR(2)*, which are tests for first-order and second-order serial correlation, asymptotically distributed as $N(0,1)$ under the null of no first-order serial correlation, and (v) *Sargan test*, which is a test for over-identifying restrictions, asymptotically distributed as χ^2, under the null of the validity of the instruments (see Doornik *et al.*, 2002).

1. Trade-off Theory

1.1. Partial Adjustment Model

Table 1 presents the results for the estimation of the trade-off theory, modelled by a partial adjustment process in equation (III-5). In columns (1) and (2), the AH procedure is employed, with the instruments being ΔD_{t-2} and D_{t-2},

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[16] Of about 16,700 observations left after the first restriction, a further 1,000 observations were excluded when the minimum five-year time series criteria was used. The remaining sample includes about 15,850 year-observations.

[17] A large number of observations were lost because of the use of the cash flow deficit variable, which is computed using some items in the cash flow statement. Our final sample would be more than 12,800 year-observations if this single variable were not taken into consideration.

[18] The analysis was conducted using *DPD* statistical package (integrated in GiveWin 2.10) written in Ox code (see Doornik *et al.*, 2002).

respectively.[19] Of the two AH estimations, the one using D_{t-2} as the instrument is more appropriate. In column (2), the *AR*(2) test result is satisfied, while in column (1) one can reject the null of no second-order autocorrelation of the (differenced) residual at 10%. In addition, there appears to be an upward bias on the coefficient estimates and standard errors in column (1), as compared to the results in column (2). This finding is consistent with the previous remark by Arellano (1989) that the IV estimator that uses the differences for instruments has larger variances.

[Insert Table 1 about here]

The last two columns of Table 1 present the results for GMM estimation of the partial adjustment model. In column (3), it can be seen that the results for the AB GMM estimation are appropriate. Both the *AR*(2) and Sargan tests suggest that the absence of second-order autocorrelation and lack of over-identifying restrictions cannot be rejected. This finding is in line with previous studies using GMM methods by Ozkan (2001), and Miguel and Pindado (2001), who all document that the estimation method provides satisfactory results. Unlike Ozkan (2001), however, our observation does not to show that the GMM estimation results in column (3) can improve considerably from the Anderson-Hsiao estimation in column (2). The estimated coefficients are broadly similar, in terms of the sign, level of significance and magnitude.

We also perform Blundell and Bond (1998) GMM system estimation, which is postulated to be appropriate for short sample periods and persistent series. The results are presented in column (4). First, the *AR*(2) and Sargan tests show that the instruments are valid. However, in terms of magnitude, the results for coefficients and standard errors obtained by using the GMM system estimator differ considerably from the results obtained by using the GMM estimator. Most noticeably, the coefficient on the lagged debt ratio (ΔD_{t-1}) is found to be .791, substantially higher than any other estimated values reported in the table. This finding should be treated with caution, as further experiments reveal that the

[19] Our experiment (not reported here) shows that, expectedly, the *OLS* estimation using first differences transformation is inappropriate, resulting in clearly biased coefficients on the lagged debt ratio.

coefficient on lagged variables obtained by using the GMM system estimator is consistently large.

To summarise, our finding suggests that the Arellano and Bond GMM (column (3)) estimator be an appropriate basis for estimation of the partial adjustment process (see Appendix 6). The Anderson and Hsiao estimation using D_{t-2} as the instrumental variable (column (2)) also provide satisfactory results. More importantly, the finding shows that the adjustment process takes place quickly with the speed significant and above .50.

1.2. Error Correction Model

In this section, we interpret the estimation results for the ECM specified in equation (III-8). Columns (1), (2), (3) of Table 2 report the results for the two AH IV and the AB GMM estimations (all in first differences), respectively. Like in Table 1, the first AH estimator has relatively larger standard errors than the second does. The second AH estimation results are generally similar to those obtained by using the AB GMM estimator (see columns (2) and (3)). According to the *AR*(2) and Sargan test results, both the AH IV and AB GMM estimators satisfy the assumptions of valid instruments.

[Insert Table 2 about here]

In the last column, the GMM system estimation is performed. The instruments for the differenced equations are restricted to $(D_{it-2}, D_{it-3},..., D_{it-5})$, in order to avoid over-identifying restrictions (in Table 1, the instruments are $(D_{it-2}, D_{it-3},..., D_{i1})$). It can be seen that in column (4), the Sargan test suggests instrument validity. In other respect, comparing the results in columns (3) and (4), one can notice that the coefficients on the explanatory variables only differ marginally and so do the standard errors. The sign and level of significance of these coefficients are broadly similar in two the models. Nonetheless, the coefficients on ΔD_{t-1} are considerably different (.391 and .768). This result indicates that the GMM system estimation results need treating with care.

In short, it has been shown that the two regressions using the Anderson and Hsiao instrumental variable or Arellano and Bond GMM estimator are the appropriate ones. With respect to the speed of adjustment, it can be seen from equation (III-7), that the one-stage procedure only allows us to make inference about γ (which could be interpreted to be the speed of adjustment of the past disequilibrium to the target debt ratio). In both columns (2) and (3), γ is found to be statistically significant and greater than .50 (as $1-\gamma$ is estimated to be .460 and .391, respectively).

1.3. Two-stage Estimation of Partial Adjustment and Error Correction Model

The one-stage procedure adopted in the previous subsections does not estimate the speed of adjustment directly. In what follows, our analysis considers the two-stage procedure.[20]

[Insert Table 3 about here]

Columns (1) and (2) in Table 3 report the pooled *OLS* estimation results for the partial adjustment and ECM, respectively. Consistent with the results obtained by implementing the one-stage procedure, our overall examination shows that the two model specifications are satisfactory with relatively high R^2 (.350 and .352, respectively). More importantly, the speeds of adjustment are found to be significant, lending further support for the trade-off theory. In column (1), δ is found to be strongly significant and equal to .671.[21] In column (2), both the change in the target debt ratio (ΔD^*_t), and the deviation of the past actual ratio from the past target one $(D^*_{t-1} - D_{t-1})$ have significant effects upon the adjustment to the actual target ratio. In terms of the magnitude, δ and γ are found to be .842 and .649, respectively. This finding provides further evidence to suggest that the trade-off theory holds well. Furthermore, the ECM as a general version of the standard

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[20] As discussed, the two-stage procedure involves estimating equation (III-3) using Within-group transformation, then obtaining the fitted values for the debt ratio and using them as the target debt ratio to estimate equations (III-1) and (III-2) under the partial adjustment framework, or equations (III-6) and (III-7) under the error correction framework

[21] This finding is slightly higher than the result obtained by using one-stage testing procedure (where δ is between .50 and .60).

partial adjustment process is an appropriate specification, which explains well the mean-reverting behaviour of the debt ratio.

2. Pecking Order Theory

In this section, we perform a test for the pecking order hypothesis, which has been confined to a single regression in equation (III-9). The last three columns of Table 3 present the regression results, which are obtained by using pooled *OLS*. We adopt three proxies for the dependent variable, including (i) the first differenced debt ratio, (ii) net debt issued and (iii) gross debt issued ratio, all measured in market values.

A general examination of the results shows that in all there models, the estimated coefficient on the cash flow deficit variable (DEF_t) is significant but small in magnitudes. It can be seen that the coefficient on DEF_t in column (4), where the dependent variable is net debt issued ratio, is the relatively high (.322), compared to other results in the table.[22] This finding suggests that the firm net debt issued be strongly related to the amount of cash flow deficit. It is interesting to note that this result is in line with Shyam-Sunders and Myers (1999), and Frank and Goyal (2003), who find that using net debt issued as the dependent variable generally yields a better good fit.

All of the estimation results fail to support the simple interpretation of the pecking order hypothesis, which would require the coefficient β_{PO} to be equal to unity and the estimated constant equal to zero. Regarding previous empirical evidence, this finding is not consistent with by Shyam-Sunder and Myers (1999), who observe that most of the cash flow deficit is offset by the change in debt (as they find β_{PO} to be close to unity). Our result is in line with Frank and Goyal (2003), who generally document the evidence against the pecking order hypothesis for a US sample in the 1990s. In short, our finding suggests that the simple model of the pecking order hypothesis does not explain the UK data.

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[22] These two specifications also have a relatively high R^2 in comparison with the rest (0.320 and 0.197, respectively).

3. Trade-off and Pecking Order Theories

The failure of the pecking order theory to explain the data leads to an interesting question as how it works in a model that also nests the competing trade-off theory. In Table 4, the two theories are nested in a single equation, under both the PA framework and ECM. Like in the last three columns of Table 3, three measures of the dependent variable are used.

[Insert Table 4 about here]

In columns (1) and (4), where the dependent variable is measured by the change in market value-based debt ratio, the results have improved considerably, in comparison with column (3) of Table 3. In both columns, the "goodness of fit" indicator increases to .369 from .064. The adoption of the partial adjustment and error correction framework has made the model more fit. On the contrary, in comparing the results with those in columns (1) and (2) of Table 3, one can notice that the presence of the cash flow deficit variable does not add any significant amount of explanatory power. More importantly, the coefficient β_{PO} remains relatively small. The estimates of the speed of adjustment reported in Table 3 and Table 4 are relatively unchanged, with or without the cash flow deficit variable. Under the partial adjustment framework, δ is found to be .671 and .640, respectively (see column (1) of Table 3 and column (1) of Table 4). Similarly, the estimates of two speeds of adjustment of the ECM do not change considerably (see column (2) of Table 3 and column (4) of Table 4). In the former table, δ and γ are found to be .842 and .649, while in the latter, the estimates are .730 and .629, respectively.

In columns (2) and (5) of Table 4, the pecking order theory appears to perform relatively well, in comparison with the trade-off theory. The coefficient estimates of DEF_t are higher than any other alternative estimates of this variable. Furthermore, due to the additional effect of the cash flow deficit variable, the estimates of δ and γ have decreased considerably from the results in Table 3 (R^2 remain relatively unchanged). This is consistent with our previous result that net debt issued and cash flow deficit exhibit a very strong relationship.

Nevertheless, the evidence does not suggest that the pecking order theory holds because the estimates of β_{PO} remain significantly less than unity. This finding cannot undermine the power of the trade-off theory, which is meant to explain the change in debt ratio rather than net debt issued ratio (see Shyam-Sunder and Myers, 1999).

Further examination of the results reported in columns (3) and (6) shows that none of the theories performs well. This finding for the trade-off framework is not surprising, given the fact that the theory is little concerned with gross debt issued. According to Shyam-Sunder and Myers (1999), one would expect the pecking order theory to explain gross debt issued better than it does to other measures such as the change in debt ratio, or even net debt issued. The results in Table 4 reveal that β_{PO} remains small (.161 and .165, respectively), broadly similar to the finding in column (5) Table 3. This provides additional evidence against the pecking order hypothesis.

Finally, we examine the power of the trade-off and pecking order theories by using the one-stage testing procedure. The estimation results are presented in Table 5. The econometric models are based on the partial adjustment or error correction framework that have been modified to include an additional variable (DEF_t) to nest the pecking order theory (see equation (III-12) and (III-13). The results, which are obtained by adopting the AH IV and AB GMM estimator show that the estimates of β_{PO} are significant but small and far from unity. The coefficient on D_{it-1} (or ΔD_{it-1}) in all of the models only changes slightly in magnitudes. In particular, it can be seen from the estimations in columns (2) and (3), and (4) and (5), that the speed of adjustment (δ) is significant and remains around .60, which is consistent with the evidence in the preceding subsections. With respect to the conventional explanatory variables of debt ratio, their sign and level of significance are unaffected by the inclusion of the cash flow deficit variable. There are some changes in magnitudes but these are too small and can be neglected. In short, the cash flow deficit variable does not have any significant additional explanatory effects upon the model.

[Insert Table 5 about here]

In sum, our results suggest that the pecking order theory does not perform as well as the trade-off theory. Although the cash flow deficit and some measures of debt (particularly net debt issued ratio) have a strong relationship, there has been little evidence that the former variable is fully offset by debt, as predicted by the strict version of the pecking order hypothesis. On the contrary, it has been shown that the trade-off theory, modelled by the partial adjustment or error correction framework, explains the firm financing behaviour well.

4. On the Determinants of Capital Structure

The results of the previous section are relatively supportive of the trade-off theory, and unfavourable to the pecking order theory. In this section, we further examine the implications of the two theories for the standard explanatory variables of the debt ratio. In general, the evidence lends further support to the hypotheses developed within the trade-off framework. Our discussion is based on the results for the satisfactory specifications in columns (2) and (3) of Tables 1 and 2.

The trade-off framework contends that *CVAS* and debt ratios have a significant relationship, although it is not indicative as to whether the relationship should be positive or negative. In line with the major body of prior empirical results, the study reveals very strong and consistent evidence that *CVAS* have a significant and positive relationship with the total debt ratio. This finding lends support to the view that firms with more collateralisable assets issue more debt. Under the principal-agent framework, collateral can be used as a security to reduce the agency costs of debt, as well as to avoid the asset substitution problem. However, the finding does not support the proposition developed by Titman and Wessels (1988) that firms with less collateralised assets should employ more debt in order to limit the managers' discretion over the use of fund. Monitoring may not be a serious problem for the firms selected in our sample, which seem to be large and may have an effective control system. Empirically, the finding is in line with previous UK evidence by Bennett and Donnelly (1993), and Bevan and Danbolt (2002), while it is inconsistent with Short *et al.* (2002), who fail to find the relationship to be significant. Our evidence is also consistent with other US research by Long and Malitz (1985), Friend and Lang (1988) and Rajan and Zingales (1995).

The trade-off theory predicts that firms with high level of non-debt tax shields use less debt since they can substitute for debt tax shields (DeAngelo and Masulis, 1980). Despite the potential correlation between the measure of *NDTS* and that of *CVAS* (via the correlation between depreciation and fixed assets), most of the results reveal that the coefficient on *NDTS* is negative and significant. There is also some evidence that past values of *NDTS* have a negative impact on debt ratio (Table 5 columns (3) and (4)). All these results are supportive of the trade-off framework. This finding is consistent with the results in two UK studies by Bennett and Donnelly (1993) and Ozkan (2001) with the latter study using the same proxy as ours. However, our evidence is not in line with what found in Michealas *et al.* (1996) and other non-UK studies by Bradley *et al.* (1984) and Boyle and Eckhold, (1997).

The models based on agency costs argue that firms with high growth have more investment schedules available, which give rise to a potential suboptimal investment problem. It is hypothesised that firms with available growth opportunities should have a lower debt ratio in order to prevent managers from investing in value-decreasing projects. The results in our study support the proposition that growth opportunities have an inverse effect upon gearing. The coefficients on *GRTH* (measured by market to book ratio) and the lagged variable are negative and significant, although they are relatively small in magnitude.[23] Empirically, the finding is in line with the well-documented evidence in US studies by Rajan and Zingales (1995), and Frank and Goyal (2003). This is however inconsistent with the results for UK data by Wald (1999), and only partially in line with the evidence in Ozkan (2001), who fails to find a negative coefficient on the lagged growth.

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[23] While a negative relationship between *GRTH* and gearing can be considered as compelling evidence of the agency theory and hence the trade-off framework, this finding could well conform to different views. Rajan and Zingales (1995) argue that finding may support the contention that firms with high market to book value are tempted to issue equity and reduce gearing. Furthermore, the finding may also be consistent with the argument that firms with high gearing ratio have higher financial distress and discounted rate, and hence lower market value. All these indicate that our interpretation of the finding should be taken with care.

It is postulated that under the assumption of information asymmetries, firms with high profitability are likely to have more retained earnings, which allow them to use internal finance instead of external debt, consistent with the pecking order theory prediction. This argument suggests that profitability and gearing have a negative relationship. Alternatively, one can also expect a positive association between debt ratio and profitability given the latter can be considered as a proxy for the firm cash free flow. The latter proposition is based on the principal-agent argument by Jensen (1986) that firms use debt financing as a disciplinary device to prevent managers from consuming the available free cash flow. Our estimation results reveal that *PRFT* (measured by EBIT to total assets) is significantly and inversely related gearing ratio.[24] This finding is in line with the empirical evidence reported in Titman and Wessels (1988), Rajan and Zingales (1995), Fama and French (2002), Frank and Goyal (2003), as well as in recent UK research by Ozkan (2001), Short *et al.* (2002), Bevan and Danbolt (2002, 2004). Note that the negative coefficient on profitability is relatively in favour of the pecking order hypothesis. Given the fact that our test for the strict version of the pecking order theory suggests the opposite, this present finding is difficult to interpret. It is possible that for our data, profitability may proxy for an unknown underlying factor other than the pecking order or the free cash flow hypothesis.

The consensus of the literature on capital structure suggests that the relationship between size and gearing ratio should be a positive one. Our results show that the coefficients on lagged size are negative and insignificant while those on size are strongly significant and positive. Although the first observation remains difficult to explain, the second finding is consistent with previous UK evidence in favour of the size effect by Bennett and Donnelly (1993) and Short *et al.* (2002). Yet it remains difficult to suggest which theory this finding is in supportive of, since both the trade-off and pecking order theories have the same prediction. Larger firms may face lower bankruptcy costs (as they are regarded as “too big to fail” – Bevan and Danbolt, 2002), agency costs and transactions costs, while may be less

[24] In other respect, unlike Ozkan (2001), our estimation results in Table 5, columns (3) and (4) also show that the coefficients on the lagged profitability variable are significant and negative. Since it has been argued that past profitability can proxy future growth, this latter observation further confirms the previous results regarding the relationship between growth opportunities and gearing.

vulnerable to informational asymmetries and adverse selection problems, which allow them to rely more heavily on debt financing, as compared to smaller firms.

VI. CONCLUSIONS

The study has examined the performance of two influential but contradicting theories of capital structure, known as the trade-off and pecking order theory. In general, our finding suggests that the trade-off theory holds well under both a partial adjustment and an error correction framework. In specifications that nest both theories, the former theory outperforms the latter theory. The introduction of the cash flow deficit variable has added little amount of additional explanatory power to the trade-off framework. Furthermore, the estimated coefficient on that variable is not found to be statistically equal to unity as it would be if the strict interpretation of the pecking order theory were to hold. The results consistently show that the adjustment process prevails with the speed of adjustment coefficient significant and relatively high (above .50). There has been also some compelling evidence in favour of the relationships between gearing and the conventional determining factors (except profitability), as predicted by trade-off framework. Non-debt tax shields and growth opportunities are reported to be inversely related to debt ratio, while collateral value of assets and size are found to have positive effects upon gearing.

In terms of methodologies, our study shows that the use of an ECM as a generalised version of the partial adjustment process has improved our understanding of the firm financing behaviour. Unlike the partial adjustment model, an ECM allows the target debt ratio to vary overtime and the evidence has shown that the change in the optimal ratio has a significant impact upon the adjustment process. In other respect, our results also conform to Ozkan (2001) and Miguel and Pindado (2001) in that the use of appropriate econometric techniques for dynamic panel data such as the Anderson and Hsiao IV and the Arellano and Bond GMM estimators has improved our estimation results.

Finally, some issues remain for further research. Apart from using an ECM, another way to general the partial adjustment process is to model the speed of adjustment as a function of the firm characteristics (see Loof, 2003 for this research direction). In other respect, our study has posed serious questions on the empirical validity of the pecking order theory. However, given the simplicity of the empirical model, it is impossible to reject the pecking order theory prediction completely (e.g. see critiques in Chirinko and Singha, 2000, Lemmon and Zender, 2004, Leary and Roberts, 2004a). A more shaper and less restrictive model would also be a matter of future study.

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APPENDICES

Appendix 1. On the determinants of capital structure

The following table summaries the prior theoretical prediction and empirical evidence on the determinants of capital structure.

Table A-1.1. Determining factors of capital structure: theoretical prediction and empirical evidence

No	Factors determining capital structure	Trade-off theory	Pecking order theory	Prior empirical results
1	Collateral value of Assets	+/-		(+) BD, BDa, SKDx, RZ, TWx (-) BDb
2	Non-debt tax shields	-		(+) BJK (-) BD, O, TWx, W
3	Growth	-		(+) SKDx, W (-) BDa, BDbx, O, RZ, TWx
4	Profitability	+	-	(+) LMx, (-) BDa, BDb, O, SKD, RZ, TW, W
5	Size	+	+	(+) BD, BDax, BDb, SKD, RZx, W (-) Ox, TWx

Notes:

1. Symbol + indicates the significant and positive relationship between the factor and debt ratios. On the contrary, symbol – indicates the significant and negative relationship. Symbol x indicates the result (i.e. the relationship in question) was found not statistically significant.
2. The empirical results reported are summarised from well-cited US studies by Bradley *et al.* (1984) (denoted **BJK**); Titman and Wessels (1988) (**TW**); UK results from cross-country studies by Rajan and Zingales (1995) (**RZ**); Wald (1999) (**W**); and UK studies by Bennett and Donnelly (1993) (**BD**); Ozkan (2001) (**O**); Short *et al.* (2002) (**SKD**); Bevan and Danbolt (2002) (**BDa**); Bevan and Danbolt (2004) (**BDb**). (In studies that have many results, only the result with relevant measures is included),
4. It should be noted that all the studies surveyed in the table might use different measures of debt ratios as well as determining factors. They also use different time-periods and different methodologies.

Appendix 2. Measurements of variables

Measures of dependent variables - Deb ratios: Consistent with previous UK research by Bennett and Donnelly (1993) and Short *et al.* (2002), the main proxy employed in this study is the total debt (*Datastream item 1301*) scaled by the total market value of equity and debt. The market value of equity plus debt is preferred to book value one, since the theoretical framework has so far considered capital structure in terms of market values (Bennett and Donnelly, 1993). Moreover, Short *et al.* (2002) contend that book values of equity are highly subject to manipulation from the use of various creative accounting techniques, which make it difficult to compare among firms on a cross-sectional basis. It should be noted also that, in principle, the market value is the sum of the market value of equity (i.e. market capitalisation – *Datastream item MV*) and that of debt. However, due to the lack of the market data of debt, the book value of debt (i.e. total debt - *Datastream item 1301*) is used instead. According to Titman and Wessels (1988), this should not be regarded as a serious limitation because the market value and book value of debt can be highly correlated.

Measures of determining factors

Collateral value of Assets (CVAS): This study follows the major body of the past empirical literature that applies Fixed Assets (*Datastream item 339*) scaled by Total Assets (all in book values) as the measure of this variable (e.g. Chung, 1993; Boyle and Eckhold, 1997; Short *et al.*, 2002).

Non-Debt Tax Shields (NDTS): The most widely-used measure for *Non-Debt Tax Shields* (NDTS) in past research is Depreciation (*Datastream item 136*) divided by Total Assets (e.g. Titman and Wessels, 1988; Michaelas *et al.*, 1998; Ozkan, 2001). This measure is employed in our study, although caution should be taken due to its potential correlation with the measure of *CVAS* (see Bennett and Donnelly, 1993) as well as with the proxy for *Growth* (Ozkan, 2001).

Profitability (PRFT): Prior research generally agrees on the measurement of *Profitability* (PRFT) with the common proxy being Profit to Total assets ratio. Differences are only concerned with what specific measure of profit should be used, be it trading profit, *EBIT*, *EBITDA* or retained earnings. This study uses *EBIT* to Total assets as the proxy for profitability because of the high availability of data for *EBIT* (*Datastream item 1300*).

Growth (GRTH): According to previous studies, there are two popular proxies for Growth, including (i) the change in Total assets (e.g. Titman and Wessels, 1988; Short *et al.*, 2002) or (ii) the firm market to book value ratio (e.g. Myers, 1977; Rajan and Zingales, 1995; Barclay *et al.*, 1995; Frank and Goyal, 2003). Since former measure tends to capture the past growth rather than the expected growth, our study employs the latter measure.

SIZE (SIZE): There is a considerable consensus among previous research regarding the measurement of size. In general, the factor is proxied by either (i) the natural logarithm of *total assets* (e.g. Michaelas *et al.*, 1998; Hall *et al.*, 2000) or (ii) the natural logarithm of *total sales* (Ozkan, 2001; Short *et al.*, 2002). This study adopts the former measure.

Appendix 3. Definition of GMM instruments

The standard GMM instruments for the lagged values of the dependent variable can be therefore generalised by the following matrix:

$$Z = [Z_1',...,Z_N']$$

where Z_i is the matrix including all the GMM for individual *i* ($n = 1,..., N$):

$$Z_i = [diag(D_{it-2}, D_{it-3},..., D_{i1})]$$

where $t = 3,..., T$ (*T* is length of the time series).

The GMM system instruments include the standard GMM instruments defined above, and further instruments for the lagged values of the dependent variable in levels equations: Z_i^+, where $Z_i^+ = [diag(D_{it-2}, D_{it-3},..., D_{i1})]$.

Appendix 4. Sample Description

Table A-4.1 and A-4.2 summaries the data set employed in this study.

Table A-4.1. Summary of the structure of the unbalanced panel data set

Year	Number of companies
1996	167
1997	742
1998	833
1999	859
2000	859
2001	858
2002	833
2003	241
Total	**859**

Table A-4.2. Summary of the structure of the unbalanced panel data set

Number of year observations	Number of Companies
5	80
6	463
7	313
8	3
Total	**859**

It should be noted that a number of limitations can arise due to our sample selection procedure. First, it can be seen that the initial sample is not selected entirely randomly, but rather it is a research sample constructed by *Datastream* with potential monitoring bias. It is possible that the list could be biased to large and public firms whose data may be more available and easy to supervise. In addition, this problem can become more pronounced due to our exclusion of the observations that have missing data. The requirement of some cash flow statement items, for example, could also exclude many small firms that typically do not make this type of data available. All these issues may consequently limit the ability of the study to generalise its results. Nonetheless, given the fact that the final sample of 859 companies includes most of the firms in the *FTSE All share index,* that is estimated to represents 98-99% of the UK capitalisation, the results produced by this study are still expected to exhibit the behaviour of a large proportion of the UK economy.

Appendix 5. Descriptive analysis

Table A-5.1. Descriptive analysis for variables

Variables		**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
MTD	Mean	***0.1672***	***0.1545***	***0.1818***	***0.1845***	***0.1951***	***0.2315***	***0.2464***	***0.2387***
	Std E	0.0122	0.0059	0.0064	0.0062	0.0067	0.0072	0.0078	0.0151
CVAS	Mean	***0.3361***	***0.3187***	***0.3230***	***0.3215***	***0.3004***	***0.3023***	***0.2979***	***0.2996***
	Std E	0.0178	0.0087	0.0083	0.0082	0.0082	0.0085	0.0086	0.0169
NDTS	Mean	***0.0381***	***0.0367***	***0.0383***	***0.0414***	***0.0378***	***0.0386***	***0.0413***	***0.0449***
	Std E	0.0021	0.0010	0.0010	0.0019	0.0010	0.0011	0.0012	0.0025
PROF	Mean	***0.0748***	***0.0531***	***0.0345***	***0.0370***	***0.0164***	***-0.0463***	***-0.0418***	***-0.1183***
	Std E	0.0123	0.0095	0.0138	0.0113	0.0130	0.0156	0.0117	0.0375
GRTH	Mean	***2.0334***	***2.1979***	***2.1787***	***2.5280***	***2.7064***	***1.7033***	***1.4848***	***1.7585***
	Std E	0.1081	0.0949	0.0838	0.1432	0.2398	0.0562	0.0465	0.1520
SIZE	Mean	***11.9977***	***11.0320***	***11.0288***	***11.0793***	***11.3073***	***11.3813***	***11.3389***	***10.6907***
	Std E	0.1677	0.0778	0.0717	0.0712	0.0703	0.0709	0.0725	0.1282

Notes: MTD denote total debt to the firm book value and market value. CVAS denotes Collateral values of Assets, measured by Fixed assets scaled Total assets. NDTS denotes Non-debt Tax shields, measured by Depreciation scaled Total assets. PRFT denotes Profitability, measured by EBIT scaled Total assets. GRTH denotes Growth, measured by market value scaled by book value. SIZE denotes Size itself, measured by natural logarithm of Total assets.

Summary statistics for the dependent variable and five determining factors of debt ratios are presented in Table A-3. Some interesting results are in order. First, it can be seen that the market value based debt ratio experienced a decrease from 1996 to 1997, before rising steadily up to 2001 with the market value based measures showing the most pronounced increase. After reaching the top in 2002, however, the ratio has shown a trend of a decline. In general, this pattern suggests there could be some adjustment process, taking place over time. In terms of the explanatory variables, the mean of *CVAS* has been fluctuating around .30 over the period, smaller than the 1991-1997 figure of .35 reported in Bevan and Danbolt (2004). Without taking into account the differences of their sample and ours, this finding shows there has been probably a shift in the asset structure of UK firms since the year 1996. In terms of *NDTS*, the mean has varied from .036 to .044 over the period, consistent with, if not slightly higher than, the reported mean of .036 in Ozkan (2001). The proxy for profitability (*PRFT*) saw its mean decreasing gradually over the period, to -.1183 in 2003 from .0748 in 1996, suggesting that the UK businesses have suffered a decline in recent years. In other respect, there have been some fluctuations in the market to book value ratio - our measure for growth opportunities (*GRTH*), although they have remained significantly higher than unity. The latter observation also indicates that book values may fail to reflect the value of UK firms, hence the need to use market value based debt ratio as the main measure of the dependent variable.

Appendix 6. Other specifications

Table A-6.1 Regression results for the standard static model

Dependent variable: Debt ratios			
Independent variables	**MTD**	**MTD**	**MTD**
	(1)	**(2)**	**(3)**
	Pooled OLS	***Differences***	***Within-group***
$CVAS_t$	0.226***	0.216***	0.210***
	(0.026)	(0.034)	(0.042)
$NDTS_t$	-0.329***	-0.152*	-0.053
	(0.117)	(0.087)	(0.1627)
$PRFT_t$	-0.063***	-0.044***	-0.052***
	(0.013)	(0.012)	(0.011)
$GRTH_t$	-0.010***	-0.002***	-0.003***
	(0.003)	(0.000)	(0.000)
$SIZE_t$	0.015***	0.054***	0.050***
	(0.002)	(0.007)	(0.006)
Instruments	None	None	None
No of obs	5393	4534	5393
R-squared	0.177	0.076	0.165
RSS	174.896	63.533	61.22
Wald test 1	191.0(5)***	85.57(5)***	98.51(5)***
Wald test 2	113.2(8)***	151.9(7)***	129.8(7)***
AR(1) test	15.49***	-5.098***	10.34***
AR(2) test	13.22***	-4.161***	-9.861***
Sargan test	-	-	-

Notes:
1. *, ** and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively. 2. Year dummies are included in all specifications except the first one.

Columns (1), (2) and (3) reveal the regression results of the *pooled OLS* (without the individual effects), *first differences* and *within-group* estimation (both including the individual effects), respectively. Of the two transformation methods used in columns (2) and (3), the within-group is preferred to first differences since it yields a higher "goodness of fit" measure (i.e. .165>.076). Moreover, unlike the first differences estimation, the within-group one can avoid losing one-year observation for all the individuals. Hence, it can be argued that the latter estimation method may be the most appropriate specification for our cross-sectional standard static model. On this basis, the target debt ratio to be adopted in the two-stage procedure in the study are computed using the results obtained from this specification (i.e. the target debt ratio will be set equal to the fitted values obtained from column (3)).

Table A-6.2 Regression results for other specifications

Dependent variable: Debt ratios				
Independent Variables	MTD (1)	MTD (2)	MTD (3)	MTD (4)
	GMM1/Diff	*OLS/Diff*	*GMM/Diff*	*GMM/Diff*
D_{t-1}	0.425***	-0.102***	0.328***	0.253*
	(0.072)	(0.023)	(0.111)	(0.150)
$CVAS_t$	0.244***	0.230***	0.507**	0.794*
	(0.044)	(0.040)	(0.248)	(0.467)
$NDTS_t$	-0.375***	-0.136	0.058	1.917
	(0.076)	(0.089)	(0.305)	(1.649)
$PRFT_t$	-0.053***	-0.043***	0.008	-0.073
	(0.016)	(0.012)	(0.022)	(0.096)
$GRTH_t$	-0.003***	-0.002***	0.001	-0.006
	(0.001)	(0.001)	(0.002)	(0.005)
$SIZE_t$	0.063***	0.049***	0.101**	0.080
	(0.010)	(0.008)	(0.041)	(0.193)
Instruments	*GMM*	None	*GMM*, Δx_{t-1}	*GMM*, 0 Δx_{t-2}
No of obs	3675	3675	3675	2816
R-squared	-	0.086	-	-
RSS	67.414	52.886	67.737	71.23
Wald test 1	110.3(6)***	101.8(6)***	70.90(6)***	46.51(6)***
Wald test 2	59.31(6)***	121.7(6)***	68.12(6)***	17.87(5)***
AR(1) test	-5.855***	-1.414	-3.20***	-2.688***
AR(2) test	-1.216	-3.276***	-1.677*	-0.389
Sargan test	21.74(20)	-	26.86(19)	16.86(19)

Notes: 1. See description of the measures of variables in Table 1 Notes. 2. Column (2) adopts the two-step Arellano and Bond (1991) GMM estimation method, using instruments: $(D_{it-2}, D_{it-3},..., D_{i1})$ and Δx_t. 3. Columns (2) adopt *OLS* estimation method (in first differences). 4. Columns (3) and (4) assume the explanatory are pre-determined, and thus adopt $(D_{it-2}, D_{it-3},..., D_{i1})$ and Δx_{t-1}, and $(D_{it-2}, D_{it-3},..., D_{i1})$ and Δx_{t-2} as the instruments, respectively. 5. Year dummies variables are included and first differences used in all specifications. 6. *, ** and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively.

Comparing the two specifications in columns (1) and (2) with the former being selected and reported in the study, one can clearly see that the *OLS* estimation using differences transformation is inappropriate. As discussed earlier, the likelihood that ΔD_{t-1} is correlated with the error term can lead to the biasedness of the estimated coefficients. Our results actually show that the coefficient on the lagged debt ratio (-.102) is negative and significantly different from the ones estimated using the GMM estimation method reported column (1).

Throughout the study, all the explanatory variables are assumed to be exogenous. In columns (3) and (4), as an experiment, they are treated as endogenous, in which case the lagged independent variables in first differences Δx_{t-1} are used as the instruments for Δx_t in column (3) and Δx_{t-2} for Δx_t in column (4) . Unexpectedly, and inconsistent with previous research (e.g.

Ozkan, 2001), our finding in column (3) shows that there is some evidence of not only first-order but also second-order autocorrelation, which violate the vitally important assumption of the GMM estimator (although note that the Sargan test is indeed satisfactory). In column (4), although this AR(2) problem has been eliminated, like in column (3) the coefficient estimates are found to be considerably different from those reported in column (1) and (2), in respect of the sign, level of significance and magnitude. This finding does not lend support to the assumption of endogeneity. On this basis, all the explanatory variables in this study are treated as strictly exogenous.

Table 1. Regression results for Partial Adjustment Model

Dependent variable: Debt ratios				
Independent Variables	MTD	MTD	MTD	MTD
	(1)	(2)	(3)	(4)
	AH1/Diff	*AH2/Diff*	*GMM/Diff*	*GMMsys/Diff*
D_{t-1}	0.676***	0.480***	0.425***	0.791***
	(0.198)	(0.068)	(0.072)	(0.031)
$CVAS_t$	0.217***	0.238***	0.244***	0.092***
	(0.054)	(0.044)	(0.044)	(0.012)
$NDTS_t$	-0.519***	-0.409***	-0.375***	-0.459***
	(0.188)	(0.085)	(0.076)	(0.058)
$PRFT_t$	-0.065***	-0.058***	-0.053***	-0.040***
	(0.023)	(0.017)	(0.016)	(0.013)
$GRTH_t$	-0.003***	-0.003***	-0.003***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
$SIZE_t$	0.071***	0.064***	0.063***	0.008***
	(0.013)	(0.009)	(0.010)	(0.001)
Instruments	ΔD_{t-2}	D_{t-2}	*GMM*	*GMM system*
No of obs	2816	3675	3675	4534
R-squared	-	-	-	-
RSS	65.118	70.533	67.414	61.001
Wald test 1	60.81(6)***	130.7(6)***	110.3(6)***	2049(6)***
Wald test 2	32.04(5)***	60.31(6)***	59.31(6)***	46.04(7)***
AR(1) test	-4.100***	-7.135***	-5.855***	-12.26***
AR(2) test	-1.677*	-1.198	-1.216	-1.122
Sargan test	-	-	21.74(20)	37.44(26)

Notes: 1. *MTD* denote total debt scaled by the market value of equity plus the book value of debt. *CVAS* denotes Collateral values of Assets, measured by Fixed assets scaled by Total assets. *NDTS* denotes Non-debt Tax shields, measured by Depreciation scaled by Total assets. *PRFT* denotes Profitability, measured by EBIT scaled by Total assets. *GRTH* denotes Growth, measured by the firm market value scaled by book value. *SIZE* denotes Size, measured by natural logarithm of Total assets. 2. Columns (1) and (2) adopt Anderson and Hsiao (1981, 1982) estimation method, using ΔD_{t-2} and D_{t-2} as the instrumental variable for ΔD_{t-1}, respectively. 3. Column (3) adopts the two-step Arellano and Bond (1991) GMM estimation method, using instruments: $(D_{it-2}, D_{it-3}, ..., D_{i1})$ and Δx_t. 4. Column (4) adopts the two-step Blundell and Bond (1998) GMM system estimation method, using instruments: $(D_{it-2}, D_{it-3}, ..., D_{i1})$ and Δx_t in the differenced equations and ΔD_{t-1}, x_t in the levels equations. 5. Year dummies variables are included and first differences used in all specifications. 6. *, ** and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively.

Table 2. Regression results for Error Correction Model

Dependent variable: Debt ratios				
Independent variables	MTD	MTD	MTD	MTD
	(1)	(2)	(3)	(4)
	AH1/Diff	*AH2/Diff*	*GMM/Diff*	*GMMsys/Diff*
D_{t-1}	0.626***	0.460***	0.391***	0.768***
	(0.225)	(0.081)	(0.093)	(0.043)
$CVAS_t$	0.220***	0.250***	0.245***	0.214***
	(0.052)	(0.043)	(0.043)	(0.034)
$CVAS_{t-1}$	-0.034***	-0.009	0.004	-0.130***
	(0.054)	(0.035)	(0.036)	(0.035)
$NDTS_t$	-0.538***	-0.472***	-0.429***	-0.339***
	(0.187)	(0.085)	(0.077)	(0.074)
$NDTS_{t-1}$	-0.213**	-0.225***	-0.215***	-0.002
	(0.086)	(0.079)	(0.079)	(0.070)
$PRFT_t$	-0.077***	-0.075***	-0.067***	-0.056***
	(0.022)	(0.017)	(0.016)	(0.015)
$PRFT_{t-1}$	-0.025**	-0.032**	-0.032**	0.006
	(0.012)	(0.013)	(0.013)	(0.012)
$GRTH_t$	-0.004***	-0.004***	-0.004***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
$GRTH_{t-1}$	-0.001**	-0.002***	-0.002***	-0.001**
	(0.001)	(0.000)	(0.001)	(0.001)
$SIZE_t$	0.077***	0.072***	0.067***	0.053***
	(0.014)	(0.009)	(0.010)	0.009
$SIZE_{t-1}$	-0.018	-0.016*	-0.013	-0.045
	(0.017)	(0.010)	(0.010)	(0.009)
Instruments	ΔD_{t-2}	D_{t-2}	*GMM*	*GMM System*
No of obs	2816	3675	3675	4534
R-squared	-	-	-	-
RSS	61.685	68.728	64.992	59.70
Wald test 1	173(11)***	235(11)***	193(11)***	1880(11)***
Wald test 2	33.17(5)***	62.18(6)***	59.45(6)***	61.47(7)***
AR(1) test	-3.369***	-6.611***	-4.740***	-9.257***
AR(2) test	-1.815	-1.303	-1.355	-0.9202
Sargan test	-	-	24.71(20)	21.35(19)

Notes:

1. See description of the measures of variables in Table 1 Note 1. 2. All the instruments used in columns (1), (2), (3) and (4) are exactly the same as those used in columns (1), (2), (3), (4), in Table 1. In column (5), the GMM system instruments include: $(D_{it-2}, D_{it-3},..., D_{it-5})$ and Δx_t in the differenced equations and ΔD_{t-1}, x_t in the levels equations. 3. Year dummies are included and first differences used in all specifications. 4 *, ** and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively.

Table 3. Regression results for Trade-off, and Pecking Order Theory

Dependent variable: specified below					
Independent variables	**Δ MTD**	**Δ MTD**	**Δ MTD**	**Net debt issued ratio**	**Gross debt issued ratio**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	OLS	***OLS***	***OLS***	***OLS***	***OLS***
Constant	0.006***	0.002	0.018***	-0.013***	0.043***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
DEF_t	-	-	0.146***	0.322***	0.161***
	-	-	(0.029)	(0.053)	(0.025)
$(D^*_t - D_{t-1})$	0.671***	-	-	-	-
	(0.021)	-	-	-	-
ΔD^*_t	-	0.842***	-	-	-
	-	(0.069)	-	-	-
$(D^*_{t-1} - D_{t-1})$	-	0.649***	-	-	-
	-	(0.022)	-	-	-
Instruments	None	None	None	None	None
No of obs	4534	4534	4534	5393	5393
R-squared	0.350	0.352	0.064	0.320	0.089
RSS	44.681	44.51	64.36	49.21	58.62
Wald test 1	1033(1)***	1039(2)***	26.21(1)***	36.52(1)***	40.52(1)***
Wald test 2	31.94(1)***	1.953(1)	150.7(1)***	51.21(1)***	390.6(1)***
AR(1) test	5.535***	5.073***	-4.462***	-0.220	2.437**
AR(2) test	-7.985***	-7.570***	-3.850***	0.839	2.735***

Notes:

1. Columns (1) and (2) adopt the two-stage estimation procedure to test the trade-off theory, under the partial adjustment and ECM framework, respectively. Columns (3), (4) and (5) test the pecking order theory.
2. The dependent variable in each specification is defined as follows: In columns (1), (2) and (3), the dependent variable is the first differenced market value-based total debt ratio. In columns (4) and (5), the dependent variable is (i) the net debt issued and (ii) gross debt issued, both scaled by the sum of the market value of equity plus book value of total debt, respectively.
3. D^*_t is the fitted value of the dependent variable when estimating (III-3) using Within-group transformation method.
4. DEF_t is computed using equation (III-10) and then scaled by either the sum of market value of equity plus book value of total debt.
5. Year dummies are not included in any specifications.
6 *, ** and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively.

Table 4. Regression results for Trade-off vs. Pecking Order Theory

Dependent variable: specified below						
Independent variables	Δ MTD	Net debt issued ratio	Gross debt issued ratio	Δ MTD	Net debt issued ratio	Gross debt issued ratio
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	*OLS*	*OLS*	*OLS*	*OLS*	*OLS*
Constant	-0.005***	-0.017***	0.046***	0.003**	-0.012***	0.049***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
DEF_t	0.081***	0.313***	0.161***	0.078***	0.320***	0.165***
	(0.012)	(0.055)	(0.030)	(0.012)	(0.056)	(0.031)
$(D^*{}_t - D_{t-1})$	0.640***	0.234***	0.038	-	-	-
	(0.021)	(0.022)	(0.036)	-	-	-
$\Delta D^*{}_t$	-	-	-	0.730***	-0.017	-0.123
	-	-	-	(0.065)	(0.063)	(0.100)
$(D^*{}_{t-1} - D_{t-1})$	-	-	-	0.629***	0.264***	0.058*
	-	-	-	(0.022)	(0.022)	(0.031)
Instruments	None	None	None	None	None	None
No of obs	4534	4534	4534	4534	4534	4534
R-squared	0.369	0.390	0.092	0.369	0.395	0.09
RSS	43.39	40.760	54.686	43.347	40.42	54.55
Wald test 1	1193(2)***	172.5(2)***	92.43(2)***	1192(3)***	245(3)***	97.58(3)***
Wald test 2	23.55(1)***	89.17(1)***	330.7(1)***	4.390(1)**	26.05(1)***	230.5(1)***
AR(1) test	4.534***	-0.155	2.235**	4.458***	-0.075	2.182**
AR(2) test	-7.366***	-0.184	2.589**	-7.141***	0.259	2.605***

Notes:

1. The dependent variable in each specification is defined as in Table 3, see its notes for more detail.
2. Columns (1), (2) and (3) nest the partial adjustment model and pecking order model, using equation (III-11):

$$D_{it} - D_{it-1} = \alpha + \delta (D_{it}{}^* - D_{it-1}) + \beta_{PO} DEF_{it} + v_{it}$$

3. Columns (4), (5) and (6) nest the ECM and pecking order model, using the following equation:

$$D_{it} - D_{it-1} = \delta (D_{it}{}^* - D^*{}_{it-1}) + \gamma (D^*{}_{it-1} - D_{it-1}) + \beta_{PO} DEF_{it} + v_{it}$$

4. Year dummies are not included in any specifications.

5 *, ** and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively.

Table 5. Regression results for Trade-off vs. Pecking Order Theory

Dependent variable: Debt ratios						
Independent variables	**MTD**	**MTD**	**MTD**	**MTD**	**MTD**	**MTD**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	AH1/Diff	***AH2/Diff***	***GMM/Diff***	***AH1/Diff***	***AH2/Diff***	***GMM/Diff***
Constant	-0.045***	0.043***	0.044***	-0.040***	0.049***	0.045***
	(0.015)	(0.011)	(0.009)	(0.015)	(0.010)	(0.009)
ΔD_{t-1}	0.610***	0.410***	0.350***	0.566***	0.396***	0.295***
	(0.189)	(0.073)	(0.084)	(0.211)	(0.085)	(0.105)
DEF_t	0.146***	0.117***	0.120***	0.145***	0.114***	0.132***
	(0.045)	(0.035)	(0.034)	(0.043)	(0.034)	(0.035)
$\Delta CVAS_t$	0.207***	0.223***	0.230***	0.209***	0.233***	0.231***
	(0.052)	(0.042)	(0.043)	(0.049)	(0.041)	(0.042)
$\Delta CVAS_{t-1}$	-	-	-	-0.042	-0.005	0.016
	-	-	-	(0.052)	(0.035)	(0.036)
$\Delta NDTS_t$	-0.513***	-0.408***	-0.372***	-0.525***	-0.470***	-0.426***
	(0.187)	(0.080)	(0.070)	(0.185)	(0.078)	(0.070)
$\Delta NDTS_{t-1}$	-	-	-	-0.190**	-0.210***	-0.208***
	-	-	-	(0.087)	(0.075)	(0.069)
$\Delta PRFT_t$	-0.053***	-0.050***	-0.046***	-0.061***	-0.065***	-0.057***
	(0.020)	(0.015)	(0.015)	(0.020)	(0.016)	(0.015)
$\Delta PRFT_{t-1}$	-	-	-	-0.018	-0.026**	-0.028**
	-	-	-	(0.012)	(0.013)	(0.013)
$\Delta GRTH_t$	-0.003***	-0.003***	-0.003***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\Delta GRTH_{t-1}$	-	-	-	-0.001***	-0.001***	0.002***
	-	-	-	(0.000)	(0.000)	(0.000)
$\Delta SIZE_t$	0.042***	0.0043***	0.041***	0.047***	0.050***	0.041***
	(0.014)	(0.011)	(0.011)	(0.014)	(0.010)	(0.011)
$\Delta SIZE_{t-1}$	-	-	-	-0.018	-0.016*	-0.012
	-	-	-	(0.016)	(0.008)	(0.009)
Instruments	ΔD_{t-2}	D_{t-2}	*GMM*	ΔD_{t-2}	D_{t-2}	*GMM*
No of obs	2816	3675	3675	2816	3675	3675
R-squared	-	-	-	-	-	-
RSS	59.190	64.748	61.728	56.42	63.48	58.82
Wald test 1	71.53(7)***	159.8(7)***	144.2(7)***	151(12)***	246(12)***	213(12)***
Wald test 2	34.27(5)***	66.66(6)***	68.43(6)***	36.90(5)***	69.14(6)***	70.62(6)***
AR(1) test	-3.893	-5.989***	-4.599***	-3.282***	-5.463***	-3.431***
AR(2) test	-1.911*	-1.200	-1.201	-1.966**	-1.293	-1.362
Sargan test	-	-	25.56(20)	-	-	30.09(20)*

Notes: 1. Year dummies are not included in any specifications. 2. *, ** and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively.