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TESTING CAPITAL STRUCTURE THEORIES USING ERROR CORRECTION MODELS: EVIDENCE FROM THE UK, FRANCE AND GERMANY

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EVIDENCE FROM THE UK, FRANCE AND GERMANY**

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**TESTING CAPITAL STRUCTURE THEORIES USING ERROR CORRECTION MODELS:
EVIDENCE FROM THE UK, FRANCE AND GERMANY**

Abstract

We employ an error correction model of leverage to test the trade-off and pecking order theories of capital structure for firms in the UK, France and Germany. The error correction framework extends the partial adjustment model by explicitly modelling changes in target leverage and past deviations from such target as determinants of firms' dynamic leverage adjustment process. We also augment our empirical models to test the pecking order theory. Using appropriate and advanced dynamic panel data methods, we find that UK, French and Germany firms adjust towards target leverage quickly in both the partial adjustment and error correction models, which is consistent with the trade-off theory. We further show that the trade-off theory explains these firms' capital structure decisions better than the pecking order theory in the models nesting the two theories.

JEL Classification: G32.

Keywords: Capital structure, Trade-off theory, Pecking order theory, Partial adjustment, Error correction model.

Peer Review

1. Introduction

Since Modigliani and Miller's (1958) (hereafter MM) irrelevance theorem, the major body of capital structure research has attempted to examine whether firms' financing decisions matter by relaxing MM's restrictive assumptions and considering market frictions and imperfections such as financial distress, taxes, agency problems and asymmetric information (see Harris and Raviv, 1991; Myers, 2001; Frank and Goyal, 2007 for reviews). In particular, this research agenda has advanced two dominant theories of capital structure, namely the trade-off and pecking order theories.¹ In this paper, we provide new international evidence on these two theories using novel empirical models.

The trade-off theory considers the benefits and costs of debt financing in the presence of taxes, costly bankruptcy (e.g., Kraus and Litzenberger, 1973; Bradley et al., 1984) as well as incentive problems (Jensen and Meckling, 1976). Debt is financially beneficial because it has a tax advantage treatment (i.e., debt tax shields) that allows firms to reduce their expected tax bill and increase their after-tax cash flows (Modigliani and Miller, 1963). Another potential benefit of debt is its disciplining role to help mitigate agency costs associated with the risk-shifting problem, the asset substitution effect (Jensen and Meckling, 1976) as well as the free cash flow problem (Jensen, 1986). The disadvantages of debt are due to costly financial distress and bankruptcy as well as agency problems such as overinvestment (Jensen and Meckling, 1976) or underinvestment incentives (Myers, 1977). Overall, the trade-off theory predicts that firms should balance the benefits against the costs of debt and, thus, should have optimal capital structure.

Empirical studies testing the trade-off theory focus on its key prediction that firms have an optimal debt ratio (i.e., target leverage) but due to transaction costs, may temporarily deviate from such target and seek to adjust towards it. To examine this dynamic adjustment behaviour, most studies have employed a partial adjustment model of leverage that captures the actual leverage change as a fraction of the desired change towards target leverage. Early studies using this model provide mixed evidence for active dynamic adjustment of leverage. While Ozkan (2001) shows that UK firms have a relatively fast speed of adjustment (above 50%), Fama and French (2002) find that US firms adjust towards their target leverage at a very slow speed ranging from 7% to 18%. However, recent empirical studies using advanced

¹ Recent research has also developed two alternative hypotheses, namely the market-timing hypothesis (Baker and Wurgler, 2002) and managerial inertia hypothesis (Welch, 2004), in which capital market conditions are of first-order importance to firms' external financing decisions (see Frank and Goyal, 2007 for a review). Nevertheless, these two hypotheses are not the focus of this paper.

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econometric techniques for dynamic panel data models provide stronger support for the trade-off theory. Flannery and Rangan (2006) find that US firms adjust towards target leverage quite actively at an annual adjustment speed of over 30%.² Antoniou et al. (2008) show that firms in France, the US, the UK and Germany all undertake partial adjustment towards their target leverage at relatively quick speeds.

The pecking order theory considers the problem of information asymmetries in which the shareholders/managers of a firm know more about the value of its assets in place and future growth prospects than do the outside investors (Myers, 1984; Myers and Majluf, 1984). Under this framework, it is difficult for investors to distinguish between securities of high-quality and those of low-quality firms. Therefore, high-quality firms have little incentive to issue new securities that are susceptible to under-pricing, leading to an adverse selection problem and partial market failure in the capital market.³ To mitigate this problem, firms prefer to rely on the source of financing that is less risky and sensitive to valuation errors. This behaviour consequently leads to a pecking order of financing choice in which internal funds are preferred to external finance and debt is preferred to equity. In contrast with the trade-off theory, the pecking order theory does not predict that firms have well-defined target leverage.

The existing empirical evidence for the pecking order theory is far from conclusive. Shyam-Sunder and Myers (1999) were the first to propose a direct test for the second rung of the pecking order of financing in which debt is a preferred source of external finance to equity. Specifically, they examined the relation between firms' net debt issues and financing deficit (or surplus) and found that firms mainly used debt policies to offset their financing deficit (or surplus), which was consistent with their interpretation of the pecking order theory. Frank and Goyal (2003) examine a broader sample of US firms over a longer period and document inconclusive evidence for Shyam-Sunder and Myers' (1999) model. Seifert and Gonenc (2008) estimate a series of similar models for a sample of firms in the UK, the US and Germany and find little support for the pecking order theory. Most recently, however,

² Recent US evidence documents a slower speed of adjustment, in the range between 17% and 25% (see, for example, Lemmon et al., 2008; Huang and Ritter, 2009). Hence, the question of whether US firms do undertake active and fast adjustment towards target leverage is not yet settled.

³ Note, however, that high-quality firms may signal their type to the market through capital structure decisions. See a series of signalling models by Ross (1977), Leland and Pyle (1977) and Heinkel (1982).

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3 Lemmon and Zender (2010) provide some empirical support for a “modified” version of the
4 pecking order theory that incorporates the concept of debt capacity.⁴
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7 The above review suggests that past empirical studies tend to test the trade-off or
8 pecking order theories in isolation. However, a recent trend of research has attempted to
9 examine both theories simultaneously. Shyam-Sunder and Myers (1999), for example,
10 augment their pecking order model to nest the trade-off theory in a single specification; they
11 subsequently find that the pecking order theory outperforms the trade-off theory in this nested
12 model. However, recent studies have provided mixed evidence for the pecking order and the
13 trade-off theories. Leary and Roberts (2005) show that US firms dynamically rebalance their
14 capital structure, which is more consistent with the trade-off theory. Flannery and Rangan
15 (2006) find that US firms’ financing behaviours follow the trade-off framework more closely
16 than alternative views of capital structure, including the pecking order theory. Dang (2010)
17 further shows that the trade-off theory explains UK firms’ capital structure decisions much
18 better than the pecking order theory. Most recently, however, de Jong et al. (2011) find that
19 the trade-off and pecking order theories are respectively relevant to firms’ decisions to
20 repurchase and issue new securities. Overall, the question of whether the trade-off and
21 pecking order theories can better explain firms’ actual financing decisions remains an
22 interesting and relevant one that deserves further research.
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35 In this paper, we contribute to the empirical capital structure literature in the
36 following ways. First, we employ an empirical model that better captures the trade-off
37 theory’s prediction about firms’ dynamic adjustment towards target leverage than existing
38 models. Specifically, we extend the widely-used partial adjustment model of leverage into a
39 more general specification, namely an error correction model. The latter framework explicitly
40 models target leverage change and past deviations from target leverage over time as the
41 driving forces underlying firms’ dynamic adjustment behaviour. In testing the trade-off
42 theory, it is important to control for changes in target leverage for the following reasons.
43 Theoretically, target leverage must balance the benefits (e.g., debt tax shields) and costs (e.g.,
44 financial distress and/or agency problems) of debt, both of which depend on the time-varying
45 firm characteristics.⁵ In addition, in most empirical studies, target leverage is proxied by the
46 fitted values from a regression of leverage on a set of firm characteristics. Thus, any changes
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58 ⁴ See also Fama and French (2005), who reveal some patterns of corporate equity issues that are in stark contrast
59 with the pecking order theory.

60 ⁵ For example, a firm’s probability of financial distress and the associated costs are determined by its size,
profitability, earnings’ volatility and credit ratings etc, which do not remain constant overtime.

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3 in the latter factors will also lead to changes in target leverage. As another contribution in
4 terms of modelling, we further augment the partial adjustment and error correction models of
5 leverage to nest the pecking order theory in unifying specifications that allow us to examine
6 the trade-off and pecking order theories jointly.
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11 Second, we employ appropriate and advanced dynamic panel data estimators to
12 estimate the speed of leverage adjustment in the partial adjustment and error correction
13 models. Existing research studies employing a two-stage procedure to estimate the partial
14 adjustment model of leverage use traditional methods such as the Fama-MacBeth (1973),
15 pooled OLS and/or fixed effects estimators (e.g., Shyam-Sunder and Myers; 1999; Fama and
16 French, 2002; Frank and Goyal, 2003; Byoun, 2008).⁶ However, it is well-established in the
17 econometrics literature that these methods provide biased estimates in dynamic panel data
18 models, especially in the likely presence of individual firm fixed-effects and short panel
19 lengths (see Baltagi, 2008). Simply put, they may produce estimated speeds of adjustment
20 that are unreliable, thus potentially leading to misleading evidence for the trade-off theory. In
21 this paper, we adopt Anderson and Hsiao's (1982) instrumental variable estimator (hereafter
22 AHIV), Arellano and Bond's (1991) and Blundell and Bond's (1998) generalised methods of
23 moments estimators (hereafter GMM and SYSGMM, respectively) to improve the
24 consistency and efficiency of our estimates of the speed of leverage adjustment.
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35 Finally, our proposed empirical framework will be tested against a comprehensive
36 sample of firms in the UK, Germany and France between 1980 and 2007. While recent
37 empirical studies have started to examine capital structure decisions using international data
38 (see, among others, Rajan and Zingales, 1995; Wald, 1999; de Jong et al., 2008; Antoniou et
39 al., 2008), very few of them have tested both the trade-off and pecking order theories jointly
40 using non-US data.^{7,8} This is a significant omission because it is of interest to examine
41 dominant capital structure theories in other macroeconomic environments. We focus on firms
42 in the UK, Germany and France for two main reasons. First, these countries represent the
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52 ⁶ The two-stage procedure involves estimating target leverage before estimating the partial adjustment and error
53 correction models. It is different from the one-stage approach where target leverage is not estimated but is
54 substituted into the latter models to be estimated in one step. We discuss this procedure in detail in Section 2.1.

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56 ⁷ There is a growing literature examining UK firms. See, for example, Bennett and Donnelly (1993), Ozkan
57 (2001), Bevan and Danbolt (2002, 2004), Watson and Wilson (2002). However, these studies have only
58 examined the determinants of capital structure, or either the trade-off theory or the pecking order theory.

59
60 ⁸ An exception is Dang (2010), who also develops an error correction model of leverage to investigate the trade-
off and pecking order theories jointly. However, his sample is limited to a small sample of UK firms over a
short period between 1996 and 2003 while, methodologically, his two-stage model is estimated using the OLS
or the fixed-effects estimators as in prior research, which are most likely to produce biased estimates.

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3 most developed economies outside the US and, thus, are the most natural testing ground for
4 modern capital structure theories. Second, these countries also represent two distinct
5 economic systems with the UK being another market-based economy with similar
6 macroeconomic characteristics to the US and Germany and France being typical bank-based
7 economies with different financial and institutional differences to those of the US and UK
8 (Antoniou et al., 2008). Hence, our results are expected to provide new and important
9 evidence on capital structure theories in different markets and macroeconomic systems.

10
11 As a preview of our results, we first find that target leverage and firm characteristics
12 (e.g., collateral value of assets, growth opportunities and firm size) have significant relations
13 as predicted by the trade-off theory. Second, we show that UK, German and French firms
14 adjust relatively quickly towards their target leverage in both the partial adjustment and error
15 correction models. Third, we show that the error correction model is a better specification to
16 test firms' dynamic adjustment towards target leverage. In particular, the results reveal that
17 firms adjust towards target leverage the most quickly in response to target leverage change, at
18 a speed of adjustment ranging between 0.776 and 0.933. The speed of adjustment in response
19 to past deviations from target leverage is significantly slower, ranging from 0.390 to 0.454.
20 Taken together, these findings are strongly in line with the trade-off theory. Finally, we show
21 that pecking order considerations are of minor importance to UK, German and French firms.
22 Our results suggest that the trade-off theory consistently outperforms the pecking order
23 theory in nested models that capture the predictions of the two theories.

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25 The remainder of the paper is organised as follows. Section 2 develops the empirical
26 models and discusses the econometric methods used. Section 3 describes the data and
27 provides the summary statistics. Section 4 reports and interprets the empirical results. Section
28 6 concludes the paper.

26 27 28 **2. Empirical Models and Methods**

29 30 **2.1. Partial Adjustment Model**

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32 We first follow the convention of previous research (e.g., Ozkan, 2001; Fama and
33 French, 2002; Flannery and Rangan, 2006) and adopt a dynamic, partial adjustment model of
34 leverage to test the prediction of the trade-off theory that firms move partially towards their
35 target leverage. Formally, this partial adjustment model is specified as follows:

$$36 \Delta D_{it} = \alpha + \lambda(D_{it}^* - D_{it-1}) + u_{it}, \quad (1)$$

37
38 or

$$\Delta D_{it} = \alpha + \lambda TLD_{it} + u_{it}, \quad (2)$$

where D_{it} and D_{it}^* represent the actual and target leverage for firm i at time t , respectively. TLD_{it} is the deviation from target leverage such that $TLD_{it} = D_{it}^* - D_{it-1}$. u_{it} is the well-behaved error term. λ is the speed of adjustment, which measures the proportion of the actual leverage change, ΔD_{it} , to the desired leverage change, TLD_{it} . The speed of adjustment would be equal to unity if firms could adjust to their target leverage instantaneously. In the presence of leverage adjustment costs, however, it is expected to be between 0 and 1.⁹ Empirically, a coefficient estimate in the range of 0.30 and above is interpreted as a relatively quick speed of adjustment and one that is consistent with the trade-off theory (see, for example, Flannery and Rangan, 2006). Firms in bank-based economies such as Germany and France may face lower adjustment costs thanks to close business relationships with their banks, suggesting the adjustment speed for these firms may be faster than that for firms in a market-based economy such as the UK.

In order to estimate Equation (2), we need to find a proxy for target leverage, D_{it}^* . Following the conventional approach adopted in literature (e.g., Byoun, 2008), we model target leverage as a function of firm characteristics, as follows:

$$D_{it}^* = \beta' \mathbf{x} + w_{it}, \quad (3)$$

where \mathbf{x} is a vector of firm characteristics and β is the associated vector of the parameters. w_{it} is an error component that includes firm and/or industry fixed-effects, μ_i , such that $w_{it} = \mu_i + u_{it}$, where u_{it} is the *i.i.d* error term. The firm and or industry fixed-effects control for time-invariant unobservable, unique firm and/or industry characteristics, such as managerial skills, the life cycle of products and firm competitiveness etc, which cannot be captured by \mathbf{x} (Ozkan, 2001). We will discuss the firm characteristics included in \mathbf{x} in detail in Section 2.3.

Our estimation strategies can be described as follows. We adopt a two-stage estimation procedure (Shyam-Sunder and Myers, 1999; Fama and French, 2002; Byoun, 2008), in which we first estimate Equation (3) and obtain the fitted values, $\hat{D}_{it} = \hat{\beta}' \mathbf{x}$ (where

⁹ See also Fischer et al. (1989) and Leary and Roberts (2005) for models with costly adjustment.

$\hat{\beta}$ is a consistent estimate of β), as a proxy for target leverage (D_{it}^*) before estimating Equation (2).¹⁰

In terms of econometric techniques, we only consider recently developed estimators for dynamic panel data models when estimating Equation (2). It is well-established in the literature that applying traditional methods such as the pooled *OLS* and fixed-effects estimators to a dynamic panel data model such as (2) will produce biased estimates due to the correlation between TLD_{it} (via D_{it-1}) and u_{it} , especially in short panels with unobserved individual firm fixed-effects (e.g., Nickell, 1981; Baltagi, 2008). Importantly, such biases may lead to inaccurate and unreliable estimates of the speed of adjustment, hence invalidating tests of the trade-off theory.

To overcome the drawback of the pooled *OLS* and fixed-effects estimators, we employ the following methods: Anderson and Hsiao's (1982) instrumental variable estimator (AHIV), Arellano and Bond's (1991) GMM (GMM) and Blundell and Bond's (1998) system GMM (SYSGMM). These estimators apply the first-differencing transformation to Equation (2) to yield:

$$\Delta^2 D_{it} = \lambda \Delta TLD_{it} + \Delta u_{it}. \quad (4)$$

Next, to adopt the AHIV estimator, we use the (first) lagged value, TLD_{it-1} as an instrument for ΔTLD_{it} . Although the AHIV approach provides consistent estimates of the adjustment speed, it is potentially inefficient for not taking into account all the moment conditions available in (2). Hence, we also adopt the more efficient GMM estimator that exploits all the linear restrictions in (2) under the assumption of no serial correlation.¹¹ Specifically, based on the orthogonality conditions between the lagged values of TLD_{it} and the error term, Δu_{it} , we follow Arellano and Bond (1991) and use all these lagged values, i.e., $(TLD_{it-1}, TLD_{it-2}, \dots, TLD_{i1})$ as instruments for ΔTLD_{it} . Finally, we also employ the SYSGMM estimator that considers additional moment conditions in the level equation (2) where it adopts $(\Delta TLD_{it-1}, \Delta TLD_{it-2}, \dots, \Delta TLD_{i1})$ as instruments for TLD_{it} under the orthogonality conditions between these instruments and u_{it} (Blundell and Bond, 1998). This SYSGMM

¹⁰ While this procedure is intuitive and easy to implement, it has a potential limitation in that any estimation errors in the first stage will be carried into the second stage when Equation (2) is estimated. An alternative procedure involves substituting (3) directly into (2), yielding a dynamic panel data model that can be estimated in one-stage (see, among others, Ozkan, 2001; Flannery and Rangan, 2006).

¹¹ This is equivalent to having no second-order correlation in the first-differenced equation (4). Hence, the consistency of the GMM depends on the absence of second-order correlation.

estimator is supposed to improve the consistency and efficiency of Arellano and Bond's GMM estimator, especially in short panels when the data are highly persistent (Blundell and Bond, 1998). Finally, we follow Arellano and Bond (1991) and employ (1) the AR2 test to check the important condition of no second-order correlation in the (differenced) error term and (2) the Sargan test to check the validity of the instruments used.

2.2. Error Correction Model

While the partial adjustment model of leverage specified by Equation (2) has been used widely in the corporate finance literature to investigate firms' dynamic adjustment towards target leverage (e.g., Ozkan, 2001; Flannery and Rangan, 2006; Byoun, 2008), it is based on the assumption that the costs of adjusting leverage is independent of target leverage change. An alternative and more reasonable assumption is, however, that the adjustment costs can also be partially reduced when there is movement towards target leverage (Maddala, 2001). A natural extension of the partial adjustment model, therefore, involves explicitly modelling target leverage changes as well as their effect on the dynamic leverage adjustment process through a more general specification, namely an error correction model (see also Dang, 2010).

Formally, the error correction model of leverage can be specified as follows:

$$\Delta D_{it} = \alpha + \lambda(D_{it}^* - D_{it-1}^*) + \gamma(D_{it-1}^* - D_{it-1}) + u_{it}, \quad (5)$$

or

$$\Delta D_{it} = \alpha + \lambda TLC_{it} + \gamma LECM_{it} + u_{it}, \quad (6)$$

where λ and γ are the speeds of leverage adjustment towards the target. The first term on the right hand side of (6), TLC_{it} , represents the change in target leverage over time and the second term, $LECM_{it}$, is the deviation of actual leverage from target leverage in the last accounting period. Unlike the partial adjustment model (2), the error correction model (6) explicitly controls for the change in target leverage caused by shocks to its determining factors (i.e., firm characteristics) and its effects on leverage adjustment costs and adjustment process. Note that the error correction model is a generalised version of the partial adjustment model; the former model effectively becomes the latter when the two speeds of adjustment are equal, i.e., $\lambda = \gamma$.

In estimating the error correction model (6), we adopt the same two-stage procedure proposed for estimating the partial adjustment model (2). Specifically, we proxy for target leverage in (6) by using the fitted values from the first-stage estimation of Equation (3). In terms of the econometric methods, we only use the AHIV, GMM and SYSGMM estimators

to obtain consistent and efficient estimates of the adjustment speeds. These methods first involve first-differencing Equation (6), as follows:

$$\Delta^2 D_{it} = \lambda \Delta TLC_{it} + \gamma \Delta LECM_{it} + \Delta u_{it}. \quad (7)$$

Next, we employ the AHIV estimator by using TLC_{it-1} and $LECM_{it-1}$ as instruments for ΔTLC_{it} and $\Delta LECM_{it}$ in (7), respectively. Regarding the GMM estimator, we use the vectors $(TLC_{it-1}, TLC_{it-2}, \dots, TLC_{i1})$ and $(LECM_{it-1}, LECM_{it-2}, \dots, LECM_{i1})$ as instruments for ΔTLC_{it} and $\Delta LECM_{it}$, respectively. Finally, we apply the SYSGMM estimator by employing the same instruments as the GMM estimator as well as two additional sets of instruments $(\Delta TLC_{it-1}, \Delta TLC_{it-2}, \dots, \Delta TLC_{i1})$ and $(\Delta LECM_{it-1}, \Delta LECM_{it-2}, \dots, \Delta LECM_{i1})$ for TLC_{it} and $LECM_{it}$ in the level equation (6), respectively.

2.3. Target Leverage and its Determinants

To specify \mathbf{x} in the estimation of target leverage in (3), we follow the literature (Titman and Wessels, 1988; Rajan and Zingales, 1995; Frank and Goyal, 2009) and consider the five most commonly-used determinants of leverage, namely, (1) the collateral value of assets, (2) non-debt tax shields, (3) profitability, (4) growth opportunities and (5) firm size. The following subsection discusses these factors and the expected relations between them and target leverage.

Collateral value of assets. The trade-off view suggests that firms with more collateral can borrow more debt as they face lower financial distress/bankruptcy costs. In addition, collateral can be used as a security to mitigate the risk-shifting and asset substitution problem (Jensen and Meckling, 1976), thus reducing the agency costs of debt. In short, under the trade-off framework, the collateral value of assets and target leverage should have a positive relation. However, the pecking order theory predicts that firms with less collateral face higher information costs and, thus, prefer debt to equity (see Harris and Raviv, 1991). In other words, collateral and target leverage are negatively related. We measure the collateral value of assets by the ratio of fixed assets to total assets.

Non-debt tax shields. Firms that can benefit from non-debt tax shields have less incentive to exploit the tax advantage of debt financing (DeAngelo and Masulis, 1980). Since non-debt tax shields may substitute for debt tax shields, the trade-off theory predicts that non-debt tax shields and target leverage have a negative relation. In the empirical analysis, we use the ratio of depreciation to total assets as a proxy for non-debt tax shields.

Profitability. The trade-off theory predicts a positive relation between profitability and leverage as profitable firms have strong incentive to raise debt capital to exploit the tax

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3 advantage of debt, i.e., debt tax shields (Modigliani and Miller, 1963). In addition, under the
4 agency framework, profitable firms may experience the free cash flow problem, which they
5 can mitigate by using debt as a discipline device (Jensen, 1986). In contrast, the pecking
6 order theory has a conflicting prediction: profitability and leverage should be negatively
7 associated (Myers and Majluf, 1984). Profitable firms are likely to have sufficient retained
8 earnings to fund future investment opportunities so they can rely less on external financing
9 sources, including debt. In this paper, profitability is measured by the ratio of *EBITDA* to
10 total assets.
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17 *Growth opportunities.* Firms with high growth opportunities are likely to suffer from
18 financial distress and the debt overhang problem (Myers, 1977). As a result, these firms have
19 strong incentive to rely more on equity than on debt finance. On the other hand, low-growth
20 firms operating in mature industries may use debt as a discipline device to alleviate the free
21 cash flow problem (Jensen, 1986). Thus, under the trade-off framework, growth opportunities
22 and leverage should have a negative relation. We use the market-to-book ratio as a proxy for
23 growth opportunities.
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30 *Firm size.* The trade-off theory suggests that large firms face lower financial distress
31 and agency costs and, thus, are able to borrow more than small firms. The implication follows
32 that firm size has a positive effect on target leverage. However, the former firms face lower
33 information costs and can raise equity capital more easily than the latter firms (see Frank and
34 Goyal, 2009). Thus, in the presence of asymmetric information, firm size and target leverage
35 may have a negative relation. We measure firm size by the natural logarithm of total assets,
36 adjusted for inflation.
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39 40 41 42 **2.4. Pecking Order Model**

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44 In one of the first direct tests of the pecking order theory, Shyam-Sunder and Myers
45 (1999) develop a simple empirical framework that captures the second rung of the pecking
46 order of firms' financing choice. Their model tests the prediction that when a firm raises
47 external finance, it will mainly use debt but not equity. After having an initial public offering
48 (IPO), the firm rarely issues additional equity unless it has used up its debt capacity or faces
49 extremely high bankruptcy costs that make borrowing impossible. Formally, Shyam-Sunder
50 and Myers' (1999) empirical model takes the following form:
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$$53 \Delta D_{it} = \alpha + \beta DEF_{it} + \varepsilon_{it}, \quad (8)$$

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where ΔD_{it} is the change in market leverage,¹² ε_{it} is the *i.i.d* error term. DEF_{it} represents the financing deficit or surplus for firm i in year t . We follow Shyam-Sunder and Myers (1999) and Frank and Goyal (2003) and define this variable as follows:

$$DEF = -CF + I + DIV + \Delta C, \quad (9)$$

where CF is cash flow from operating activities less investment return and servicing of finance as well as taxation, I is net investment, DIV is dividends paid, and ΔC is the net change in cash. Finally, since Equation (8) is a static model, it will be estimated using the fixed-effects estimator, rather than dynamic panel data methods outlined in previous sections.

Shyam-Sunder and Myers (1999) argue that the pecking order theory holds if and only if $\alpha = 0$ and $\beta = 1$, i.e., when firms only raise (retire) debt to offset by their financing deficit (surplus).^{13,14} According to Seifert and Gonenc (2008), firms in Germany and France (bank-based economies) may face a more severe asymmetric information problem than firms in the UK (market-based economy) so we expect the pecking order theory to hold better for firms in the former countries than for those in the latter country.

2.5. *Augmented Partial Adjustment and Error Correction Models*

The empirical models developed in the previous sections can only be used to test the trade-off and pecking order theories separately. In this section, we consider a nested model that embeds both theories and allows us to test them jointly. We follow the spirit of Shyam-Sunder and Myers (1999) and Frank and Goyal (2003) and augment the partial adjustment model (2) by adding the financing deficit/surplus variable, DEF_{it} , defined in (9), to derive the following nested model:

$$\Delta D_{it} = \alpha + \delta TLD + \beta DEF_{it} + u_{it}. \quad (10)$$

In this model, the pecking order theory holds and explains firms' capital structure better than the trade-off theory if firms offset their financing deficit or surplus mainly by debt policies, i.e., $\alpha = 0$ and $\beta = 1$, and that they do not make active leverage adjustment towards the target, i.e., $\delta = 0$. In contrast, if the adjustment speed is relatively fast (e.g., $\delta \geq 0.3$) and that

¹² Shyam-Sunders and Myers (1999) and Frank and Goyal (2003) consider three main proxies for the dependent variable in Equation (8), including total leverage change, net debt issued and gross debt issued, all scaled by the firm value. We focus on the first proxy in our empirical analysis because it allows us to develop the augmented partial adjustment and error correction models that nest both the trade-off and pecking order theories. However, the (unreported) results for the pecking order theory are qualitatively similar when we use the other two proxies.

¹³ Recent research shows that the coefficient on DEF , β , may be asymmetric, depending on whether there is a financing deficit ($DEF > 0$) or surplus ($DEF < 0$). See, for example, de Jong et al. (2010).

¹⁴ Shyam-Sunder and Myers' (1999) pecking order model has been criticised for having a low power in rejecting alternative theories. See Chirinko and Singha (2000).

the financing deficit coefficient is significantly less than 1, $\beta < 1$, then the trade-off theory can be said to outperform the pecking order theory. Note that in estimating (10), we follow the same two-stage procedure and use the AHIV, GMM and SYSGMM estimators detailed above.

Finally, we augment the error correction model (6) by incorporating the financing deficit/surplus variable as follows:

$$\Delta D_{it} = \alpha + \lambda TLC + \gamma LECM + \beta DEF_{it} + u_{it}. \quad (11)$$

The pecking order theory holds that $\alpha = 0$, $\beta = 1$ and $\lambda = \gamma = 0$ while the trade-off theory predicts the opposite. Finally, Equation (11) will be estimated using the same two-stage procedure mentioned above.

3. Data, Sample Selection and Descriptive Statistics

We investigate a large panel of firms in the most advanced economies in Europe, namely the UK, France and Germany. These three countries also represent two main types of economic systems, namely market-based (the UK) and bank-based economies (France and Germany). We collected our data from the *Worldscope* database over the period 1980–2007. We follow the standard practice in the literature (e.g., Ozkan, 2001) and apply a number of data restrictions. First, we remove financial and utility firms because they are subject to different regulatory accounting considerations. Second, we only retain firms that have five-years or more of observations in order to use the AHIV, GMM and SYSGMM estimators that require the use of lagged variables as instruments. Third, we remove firm-year observations that have missing data for the variables of interest. Fourth, we winsorise all the variables at the 1% and 99% to mitigate the impact of outliers in our empirical analysis. Our final sample comprises 2,102 firms with 17,778 firm-year observations. Specifically, it consists of 1,340 firms in the UK (with 11,635 observations), 446 firms in Germany (with 3,640 observations) and 316 firms in France (with 2,503 observations).

[Insert Table 1 about here]

Panels A, B and C of Table 1 report the descriptive statistics for UK, German and French firms, respectively. A general examination of these statistics reveals several interesting empirical facts. First, firms in the UK have substantially lower (market) leverage ratio (0.191) than firms in Germany (0.278) and France (0.294). This finding is consistent with previous international evidence (Rajan and Zingales, 1995; Antoniou et al., 2008) that firms in market-based economies (e.g., the UK) use debt more conservatively than firms in bank-oriented economies (e.g., Germany and France). Firms in market-based economies have

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3 dispersed share ownership and hence a preference for equity capital. On the contrary, firms in
4 bank-based economies have strong incentive to use debt finance because, thanks to their close
5 banking relationships, they are able to borrow at low costs.
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9 The mean collateral value of assets (i.e., tangibility) is higher for UK firms (0.296)
10 than for German firms (0.249) and French firms (0.194). This finding is plausible because
11 UK firms have looser ties with their banks and so they have to satisfy stricter collateral
12 requirements than those in bank-oriented economies.
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16 UK firms have substantially more growth opportunities than German and French
17 firms. High-growth firms face potentially high costs of financial distress and underinvestment
18 incentives so they may prefer equity to debt finance, which is consistent with the above
19 finding that UK firms have lower leverage ratios than other firms in the sample. In addition,
20 since growth opportunities are measured by the market-to-book ratio, high-growth firms may
21 be overvalued and, thus, have incentives to take advantage of this misvaluation by tapping in
22 cheaper equity (i.e., market timing).
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28 Finally, the descriptive statistics for firm size reveal that German and French firms
29 have a tendency to remain private until they are sufficiently large and need to access
30 additional sources of capital. In contrast, in market-based economies with favourable capital
31 market conditions (e.g., the UK), firms with smaller size are able to access the equity market
32 and source capital more easily.
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37 **4. Empirical Results**

38 **4.1. Target Leverage Estimations**

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40 Table 2 reports the empirical results from our estimations of target leverage, modelled
41 by Equation (3). An overall assessment suggests that the results are comparable for UK,
42 German and French firms. Moreover, they are statistically significant and most consistent
43 with the predictions of the trade-off theory.
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48 [Insert Table 2 about here]

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50 The results show that the collateral value of assets has a positive effect on leverage.
51 This finding is consistent with the trade-off view that firms with more collateralised assets
52 face lower bankruptcy costs and, thus, are able to borrow more. It is also in line with the
53 agency framework that predicts firms use their collateral to mitigate the asset substitution
54 effect and the agency costs of debt. Empirically, our finding is consistent with previous
55 empirical evidence (e.g., Rajan and Zingales, 1995; Antoniou et al., 2008; de Jong et al.,
56 2008).
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The results regarding non-debt tax shields are mixed and inconsistent with the trade-off theory. Specifically, this variable is significantly positive for UK and French firms but is insignificant for German firms. Unlike the existing evidence in the literature (e.g., Antoniou et al., 2008), these findings suggest that firms in the sample countries do not use non-debt tax shields as a substitute for debt tax shields as predicted by the trade-off framework (DeAngelo and Masulis, 1980).

The results show that profitable firms in the UK, Germany and France have lower leverage than less profitable firms. This finding appears to be most consistent with the pecking order theory's prediction that firms with large profits and sufficient retained earnings are less likely to rely on debt financing. It is often interpreted to be inconsistent with the static trade-off theory that predicts profitable firms should use more debt to shelter from corporate taxes. However, profitability may also proxy for growth opportunities such that a negative relation between profitability and leverage is also in line with the trade-off view (Frank and Goyal, 2007). Further, in dynamic trade-off settings, profitable firms may choose to hold on to their retained earnings to take advantage of future investment opportunities, thus resulting in lower leverage (e.g., Hennessy and Whited, 2006; Strebulaev, 2007). Empirically, our results are consistent with the well-documented international evidence on the relation between leverage and profitability (e.g., Rajan and Zingales, 1995; Antoniou et al., 2008).

Growth opportunities have a negative and significant effect on leverage across firms in our sample countries, which is consistent with the trade-off view. Specifically, under the agency framework, firms with high (low) growth options are more likely to use less (more) debt to mitigate the underinvestment (overinvestment) problem. This finding is strongly in line with previous empirical evidence (e.g., Rajan and Zingales, 1995; de Jong et al., 2008; Antoniou et al., 2008).

The results for UK, German and France firms show that target leverage is significantly and positively associated with firm size. This finding is consistent with the trade-off argument that large firms face lower financial distress and bankruptcy costs as well as agency and transaction costs, hence having stronger incentives to lever up to exploit debt tax shields. Empirically, our results are broadly in line with the previous empirical evidence (e.g., Antoniou et al., 2008).

In sum, the regression results for target leverage are both theoretically and empirically plausible for firms in the sample countries. Moreover, they are consistent with the predictions of the trade-off theory about the relations between target leverage and its determinants. The

latter finding is important because it suggests target leverage is well-defined such that it is appropriate to test how firms adjust towards such target.¹⁵

4.2. Results for the Partial Adjustment Model

Table 3 contains the results for the trade-off theory, modelled by the partial adjustment model (2). Columns (1)–(3), (4)–(6) and (7)–(9) report the results for UK, German, and French firms, respectively. Columns (1), (4) and (7) use the AHIV estimator. Columns (2), (5) and (8) adopt the GMM estimator and columns (3), (6) and (9) adopt the SYSGMM estimator. We further report the AR2 and Sargan test statistics to evaluate the validity of the dynamic panel data methods used.

[Insert Table 3 about here]

Overall, all the estimation results are satisfactory. The AR2 test results show no evidence of second autocorrelation, suggesting the instruments used in estimating the panel dynamic data model (2) are appropriate. However, the Sargan test is rejected at the 1% significance level in the GMM and SYSGMM models for UK firms; it is also rejected in the SYSGMM model for German firms. This suggests that these specific GMM and SYSGMM results may suffer from the over-identification problem and, therefore, should be treated with caution.

The coefficient on TLD_{it} , which represents the speed of adjustment, is statistically and economically significant in all models. A general observation of the results shows that the AHIV estimates of the adjustment speed are the smallest, followed by the GMM and SYSGMM estimates, both of which are nevertheless fairly similar in magnitude (except for German firms). This finding suggests that using GMM and SYSGMM can potentially overcome the (downward) bias of the AHIV results. In economic terms, UK firms adjust their leverage towards the target at a speed ranging between 0.425 and 0.434. German firms have a relatively higher speed of adjustment, in the range of 0.455–0.495. French firms appear to adjust towards their target leverage the most quickly: their estimated adjustment speed varies between 0.442 and 0.517.

Empirically, our estimated speeds of adjustment are strongly consistent with the trade-off theory's prediction that firms should adjust towards target leverage actively and frequently. With an adjustment speed of above 0.40, UK, German and French firms make full

¹⁵ Note that if the relations between leverage and its determinants are inconsistent with the trade-off theory then target leverage is not well-defined, at least empirically, and so testing adjustment towards target leverage is likely to capture mechanical mean reversion behaviours (see Chang and Dasgupta, 2009).

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3 adjustment towards their target leverage in less than two and a half years. Further, this
4 adjustment speed range is relatively quicker than the previous evidence documented in the
5 literature. Antoniou et al. (2008), for example, employ a one-stage procedure to estimate the
6 partial adjustment model analogous to (2) and report that French firms adjust towards the
7 target the most quickly at a speed of 0.40, followed by UK firms (0.32) and German firms
8 (0.24). Thus, their estimated adjustment speeds are clearly slower than ours. Further, unlike
9 Antoniou et al. (2008), we find that German firms adjust towards target leverage at a quicker
10 speed than do UK firms.¹⁶ Our finding suggests that thanks to closer banking relationships,
11 German and French firms may face lower adjustment costs and, therefore, find it easier to
12 borrow or retire debt than their UK counterparts. Consequently, these firms may undertake
13 faster leverage adjustments than firms in a market-based economy such as the UK. Finally,
14 compared to previous US studies, we show that firms in the UK, Germany and France have
15 considerably faster speeds of leverage adjustment. Fama and French (2002) show that US
16 firms have slow adjustment speeds, ranging between 7–10% for dividend payers and 15–18%
17 for non-payers. Byoun (2008), however, reports significantly faster speeds of adjustment in
18 the range of 0.22–0.32 for a more recent and comprehensive sample of US firms. Flannery
19 and Rangan (2006) and Antoniou et al. (2008) also show that US firms adjust towards their
20 target leverage at a speed of more than 0.30, which is again slower than the speed with which
21 the European firms in our sample undertake leverage adjustment.

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37 In sum, we find that the estimated speeds of adjustment for our sample of UK,
38 German and French firms are statistically and economically significant, which is strongly
39 supportive of the trade-off theory.

40 41 42 **4.3. Results for the Error Correction Model**

43
44 Table 4 reports the estimation results for the error correction model of leverage
45 specified by Equation (5). As in Table 3, Columns (1)–(3), (4)–(6) and (7)–(9) contain the
46 results for firms in the UK, Germany and France, respectively. We adopt the AHIV estimator
47 in Columns (1), (4) and (7), the GMM estimator in Columns (2), (5) and (8), and the
48 SYSGMM estimator in Columns (3), (6) and (9). We report the statistics for the AR2 and
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¹⁶ There are two potential reasons why our results differ from Antoniou et al. (2008). First, we adopt a two-stage estimation procedure in which we first estimate target leverage in (3) before estimating the partial adjustment model in (2), while Antoniou et al. (2008) substitute (3) into (2) and estimate the resulting model in one stage. Second, Antoniou et al. (2008) examine a sample of UK, German and French firms over a relatively short period 1987–2000, which is a subset of the longer sample period between 1980 and 2007 used in our paper.

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3 Sargan tests as well as the statistics for the F-test under the null that the coefficients on TLC_{it}
4 and $LECM_{it}$ are equal.
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7 [Insert Table 4 about here]

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9 In terms of model specification, the AR2 test results reveal that no models suffer from
10 the problem of second-order serial correlation. However, the Sargan test is rejected at the 1%
11 significance level in the GMM and SYSGMM models for UK firms, suggesting the
12 corresponding estimation results may contain an over-identification bias and, thus, they
13 should be treated with caution. As in Table 3, the AHIV estimates of the speeds of adjustment
14 (i.e., the coefficients on TLC_{it} and $LECM_{it}$) appear to be downward biased compared to the
15 GMM and SYSGMM estimates, which are theoretically more consistent and efficient. Hence,
16 the following discussions will be focused on the GMM and SYSGMM estimation results.
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23 The results show that the coefficients on target leverage change, TLC_{it} , and the past
24 deviation from target leverage, $LECM_{it}$, are both statistically and economically significant.
25 By definition, the deviation from target leverage, TLD_{it} , consists of the change in target
26 leverage, TLC_{it} , and the deviation from target leverage in the last accounting period, $LECM_{it}$;
27 our results reveal that both of these factors have significant effects on firms' dynamic
28 leverage adjustment towards the target. Further, these effects are significantly differential as
29 the F-test is rejected at the 1% significance level. Specifically, the speed of adjustment
30 corresponding to target leverage change is significantly faster than the speed corresponding to
31 the past deviation from target leverage. UK firms adjust towards their target leverage in
32 response to any changes in such target at a speed ranging between 0.759 and 0.776. Firms in
33 Germany and France make even more rapid adjustment in response to any movements
34 towards target leverage; their respective adjustment speeds are estimated at 0.844–0.863 and
35 0.931–0.933. On the contrary, firms undertake leverage adjustment at a much more moderate
36 speed in response to the past deviation from the target; the adjustment speed is in the range of
37 0.390–0.397 for UK firms, 0.428–0.454 for German firms and 0.439–0.440 for French firms.
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50 In sum, the results for the error correction model suggest that firms in the UK,
51 Germany and France undertake dynamic but otherwise asymmetric adjustment towards target
52 leverage. Firms react the most strongly to target leverage change with the corresponding
53 speed of adjustment ranging between 0.776 and 0.933. However, the speed of adjustment
54 corresponding to the past deviation from target leverage is much slower, ranging from 0.390
55 to 0.454. This pattern is consistent across firms in our sample countries. In terms of
56 methodology, our finding highlights the advantage of employing the error correction model
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as a more general specification over the simple partial adjustment model in studying firms' dynamic adjustment towards target leverage. Finally, our results provide further support for the trade-off theory as we show that UK, German and French firms react strongly and actively to changes in and (past) deviations from target leverage when making adjustment towards such target.

4.4. *Results for the Pecking Order Theory*

Table 5 reports the estimation results for the pecking order model specified by Equation (8). Columns (1), (2) and (3) contain the results for UK, German and French firms, respectively. As mentioned, all models are static and therefore are estimated using the fixed-effects estimator.

[Insert Table 5 about here]

An overall examination of the results suggests that these models have a very low explanatory power with their respective R-squared varying between 0.061 and 0.106. The constant term is insignificant in all models as predicted by the pecking order model. However, the estimated coefficient on the financing deficit/surplus variable, β , is statistically significant but relatively small in magnitude. For firms in the UK and France, this coefficient is estimated at 0.171 and 0.135, respectively, suggesting a weak economic relation between these firms' financing deficit (surplus) and changes in debt levels. The highest coefficient estimate is 0.424 in Column (2), suggesting German firms offset nearly a half of their financing deficit (surplus) with debt policies. This latter finding is weakly consistent with the argument that firms in bank-based economies (e.g., Germany) face more information problems and should follow the pecking order style of financing more closely than firms in market-based economies (e.g., the UK).

More importantly, however, the F-test results show that the coefficient on the financing deficit/surplus variable, β , is statistically less than unity at the 1% significance level in all models. This finding is not in line with the second rung of the pecking order of financing, which requires that not only the constant term equal zero and but also β equal unity. Finally, our empirical results are in contrast with the original US evidence by Shyam-Sunder and Myers (1999), but are consistent with recent US and international evidence against the pecking order theory (e.g., Flannery and Rangan, 2006; Seifert and Gonenc, 2008).

4.5. *Results for Augmented Partial Adjustment and Error Correction Models*

In Table 6, we report the results for the augmented partial adjustment model of leverage based on (10) that captures the predictions of both the trade-off and pecking order theories. In constructing this table, we employ the same format used in Tables 3 and 4. As in Table 5, we report the F-test statistics under the null that the coefficient on the financing deficit/surplus variable is equal to unity.

[Insert Table 6 about here]

An overall examination of the diagnostic tests suggest that all the models are well-specified and adopt valid instruments with the only exception being the GMM and SYSGMM models for UK firms where the Sargan test is rejected at the 1% significance level. As in Table 3, the AHIV estimates of the adjustment speed appear to carry a small downward bias, compared to the GMM and SYSGMM estimates. Hence, in what follows, we will focus our discussions on the latter estimates.

The results show that the trade-off theory clearly outperforms the pecking order theory in explaining corporate capital structure in the UK, Germany and France. The presence of the financing deficit/surplus variable does not affect the statistical and economic significance of the estimated speed of adjustment, which is still very fast, varying in the range between 0.405 and 0.514. Note that these estimates are broadly similar to those estimated for the stand-alone partial adjustment model without the financing deficit/surplus variable (see Table 3). On the other hand, the coefficient on the financing deficit/surplus variable is significantly less than unity as revealed by the F-test. Specifically, this coefficient varies between 0.115 and 0.145 for UK firms and between 0.251 and 0.271 for German firms. Note that these estimates are slightly smaller than those estimated for the pecking order model in Table 5. Finally, for French firms, this coefficient even becomes insignificant in both statistical and economic terms. These findings suggest that in the present nested framework, the pecking order theory is dominated by the trade-off theory such that the former theory's relevant coefficient decreases in magnitude. In sum, the results for the augmented partial adjustment model are strongly favourable to the trade-off theory.

In Table 7, we report the estimation results for our most general model specification, namely the augmented error correction model of leverage that captures the pecking order theory's prediction. Overall, the results for this augmented error correction model are consistent with the trade-off theory but inconsistent with the pecking order theory. The two speeds of adjustment, i.e., the coefficients on TLC_{it} and $LECM_{it}$, are statistically and economically significant; they are unaffected by the presence of the financing deficit/surplus

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3 variable. Furthermore, they have the same magnitude as those estimated for the stand-alone
4 error correction model in Table 4. Finally, the coefficient on the financing deficit/surplus
5 variable is statistically insignificant for French firms and economically insignificant (less
6 than unity) for UK and German firms.
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10 [Insert Table 7 about here]
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12 In summary, our augmented partial adjustment and error correction models provide
13 consistent and strong support for the trade-off theory but little support for the pecking order
14 theory. Although the financing/surplus deficit variable is significant for UK and German
15 firms, the evidence does not suggest that these firms rely mainly on debt finance to offset
16 their financing deficit/surplus as predicted by the pecking order theory. Our finding clearly
17 shows that in nested empirical models, the trade-off theory explains firms' financing
18 decisions better than the pecking order theory.
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24 **4.6. Robustness Checks** 25

26 Thus far in our paper, we have used a market-based measure of leverage, which is
27 consistent with the trade-off view and is adopted in many previous empirical studies (e.g.,
28 Titman and Wessels, 1988; Welch, 2004). However, some studies argue that managers in
29 practice often prefer using book-based measures of leverage (Myers, 1984; Shyam-Sunder
30 and Myers, 1999). Hence, in this subsection, we examine the robustness of our results to an
31 alternative measure of leverage, namely book leverage, defined as the ratio of the book value
32 of total debt to the book value of total assets. We follow the same estimation procedure
33 detailed in Section 2.1. We report our first-stage regression results for the model of target
34 leverage in Table 8 and second-stage results for the augmented error correction model in
35 Table 9.
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44 [Insert Table 8 and Table 9 about here]
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46 The results for book leverage reported in Table 8 are slightly less significant than
47 those for market leverage reported in Table 2. In particular, growth opportunities now
48 become insignificant in Columns (2) and (3) while carry a positive sign in Column (1). The
49 latter finding is inconsistent with our results for market leverage, but is, nevertheless, in line
50 with the trade-off theory. The remaining variables are generally significant and have the
51 expected signs, which is consistent with our results for market leverage.
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56 The results in Table 9 show that the speeds of adjustment still maintain their statistical
57 and economic significance; firms react significantly differently in response to changes in or
58 deviations from target (book) leverage. The coefficient on the financing deficit/surplus
59 variable is significant but considerably less than unity. These results are qualitatively similar
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3 to those obtained using market leverage in the previous sections. Hence, the main finding of
4 the paper is robust to the choice of the leverage measure.
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7 **5. Conclusions**

9 In this paper, we have examined the trade-off and pecking order theories of capital
10 structure using new and unifying empirical models. Our paper has made at least three
11 contributions to the literature. First, we have used an error correction model of leverage that
12 captures changes in target leverage as well as past deviations from such target as key drivers
13 of firms' dynamic leverage adjustment. Second, in our two-step estimation procedure, we
14 have employed advanced and appropriate econometric methods to estimate the dynamic,
15 partial adjustment and error correction models of leverage, thus providing more consistent
16 and efficient estimates of the adjustment speeds. Third, our paper has also conducted one of
17 the first empirical tests of both the trade-off and pecking order theories using an international
18 dataset of UK, German and French firms.
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27 Our results provide strong evidence for the trade-off theory as we find that UK,
28 German and French firms adjust towards their target leverage relatively quickly in both the
29 partial adjustment and error correction models. In particular, using the latter framework, we
30 reveal that target leverage change has a significant impact on firms' dynamic adjustment
31 behaviours. Firms in our sample countries react the most strongly to target leverage change
32 but respond much more slowly to past deviations from target leverage. This finding has
33 clearly demonstrated the advantage of the error correction model, a generalised version of the
34 partial adjustment model, in studying firms' dynamic adjustment behaviours in particular and
35 improving our understanding of corporate capital structure in general.
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43 Finally, we show that UK, German and French firms do not closely follow the
44 pecking order theory's prediction. Specifically, these firms only use debt to offset a small
45 fraction of their financing deficit or surplus, which is inconsistent with the pecking order
46 theory. More importantly, in specifications nesting the trade-off and pecking order theories,
47 the former theory explains firms' financing decisions better than the latter theory. In sum, our
48 results consistently show that trade-off considerations are of first-order importance to UK,
49 German and French firms, which undertake dynamic adjustment towards target leverage in an
50 active and rapid manner.
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Table 1. Variable Definitions & Descriptive Statistics

Panel A: Descriptive Statistics for UK Firms					
Variable	Obs	Mean	Std. Dev.	Min	Max
Market leverage	11,635	0.191	0.195	0.000	0.824
Collateral value of assets	11,635	0.296	0.247	0.000	0.933
Non-debt tax shields	11,635	0.049	0.040	0.000	0.226
Profitability	11,635	0.009	0.252	-1.647	0.379
Growth opportunities	11,635	1.586	1.757	0.260	12.781
Size	11,635	10.094	2.125	4.705	15.273
Cash flow deficit	11,635	0.036	0.229	-0.478	1.759
Panel B: Descriptive Statistics for German Firms					
Variable	Obs	Mean	Std. Dev.	Min	Max
Market leverage	3,640	0.278	0.250	0.000	0.875
Collateral value of assets	3,640	0.249	0.186	0.000	0.874
Non-debt tax shields	3,640	0.060	0.049	0.000	0.333
Profitability	3,640	-0.002	0.156	-0.885	0.363
Growth opportunities	3,640	1.091	0.997	0.166	8.356
Size	3,640	11.779	2.016	6.412	17.558
Cash flow deficit	3,640	0.005	0.118	-0.310	1.023
Panel C: Descriptive Statistics for French Firms					
Variable	Obs	Mean	Std. Dev.	Min	Max
Market leverage	2,503	0.294	0.236	0.000	0.912
Collateral value of assets	2,503	0.194	0.159	0.003	0.796
Non-debt tax shields	2,503	0.055	0.042	0.002	0.247
Profitability	2,503	0.028	0.114	-0.553	0.343
Growth opportunities	2,503	1.095	0.889	0.137	6.488
Size	2,503	11.968	2.200	6.703	16.778
Cash flow deficit	2,503	0.010	0.105	-0.238	0.755

Notes: This table presents the descriptive statistics, including the mean, standard deviation (Std.Dev.), minimum (Min) and maximum (Max), for the variables under consideration in the paper. Panel A, B and C reports the statistics for firms in the UK, Germany and France, respectively. Market leverage is the ratio of total debt divided by the market value of equity plus the book value of debt. Collateral value of assets is the ratio of fixed assets to total assets. Profitability is the ratio of *EBITDA* to total assets. Non-debt tax shields are the ratio of depreciation to total assets. Growth opportunities are the market value of equity plus the book value of debt to total assets. Size is the log of total assets in 1980 price. Cash flow deficit is defined as $(-CF+I+DIV+\Delta C)$, where *CF* denotes Cash flow after tax and interest including change in working capital (i.e., *CF* = Cash flow from Operating activities less Investment return and servicing of finance and Taxation). *I* is Net investment (i.e. *I* = Capital Expenditures plus Acquisitions and Disposals). *DIV* is equity dividends paid. ΔC is net change in cash including change in working capital. Obs. denotes the number of observations available.

Table 2. Target Leverage Estimations for Market Leverage

Variables	UK	Germany	France
	(1)	(2)	(3)
Collateral value of assets	0.181*** (0.013)	0.386*** (0.036)	0.261*** (0.048)
Non-debt tax shields	0.314*** (0.049)	0.102 (0.079)	0.327*** (0.094)
Profitability	-0.132*** (0.008)	-0.242*** (0.024)	-0.302*** (0.035)
Growth opportunities	-0.019*** (0.001)	-0.038*** (0.003)	-0.052*** (0.004)
Size	0.040*** (0.002)	0.068*** (0.006)	0.035*** (0.005)
Constant	-0.250*** (0.024)	-0.578*** (0.068)	-0.130* (0.068)
Estimators	<i>FE</i>	<i>FE</i>	<i>FE</i>
Observations	11,635	3,640	2,503
<i>R</i> -squared	0.118	0.168	0.189
Number of Firms	1,340	446	316

Notes: This table reports the regression results for target leverage modelled by Equation (3), as follows:

$$D_{it}^* = \beta' \mathbf{x} + w_{it},$$

where \mathbf{x} is a vector of five firm characteristics, namely collateral value of assets, non-debt tax shields, profitability, growth opportunities and firm size, and β is the vector of the parameters. *FE* denotes the (within-group) fixed-effects estimator. Robust standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively. See Table 1 for variable definitions.

Table 3. Testing the Trade-off Theory Using the Partial Adjustment Model

Variables	UK			Germany			France		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>TLD</i>	0.425*** (0.025)	0.433*** (0.014)	0.434*** (0.015)	0.455*** (0.046)	0.483*** (0.027)	0.495*** (0.027)	0.442*** (0.047)	0.517*** (0.029)	0.512*** (0.031)
Constant	0.001* (0.001)	0.002*** (0.001)	0.004*** (0.001)	-0.003** (0.001)	-0.003** (0.001)	0.001 (0.001)	-0.007*** (0.001)	-0.006*** (0.001)	0.000 (0.001)
Estimators	<i>AHIV</i>	<i>GMM</i>	<i>SYSMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSMM</i>
Observations	8,819	8,819	10,209	2,668	2,668	3,147	1,841	1,841	2,167
Number of firms	1,340	1,340	1,340	446	446	446	316	316	316
<i>AR2</i> test	-1.381	-1.376	-1.373	0.516	0.506	0.529	0.780	0.669	0.747
Sargan test	-	177.4***	245.1***	-	93.35	140.0**	-	96.99	123.4

Notes: This table reports the estimation results for the partial adjustment model of leverage specified by Equation (2), as follows:

$$\Delta D_{it} = \alpha + \lambda TLD_{it} + u_{it},$$

where ΔD_{it} is market leverage change. TLD_{it} stands for the deviation of lagged leverage from target leverage. See Table 2 for target leverage estimations. *AHIV* denotes the Anderson and Hsiao's (1982) instrumental variable estimator. *GMM* and *SYSMM* denote Arellano and Bond's (1991) and Blundell and Bond's (1998) estimators, respectively. *AR2* test is a test for second-order serial correlation, under the null of no serial correlation. Sargan test is a test for over-identifying restrictions under the null of valid instruments. Robust standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively.

Table 4. Testing the Trade-off Theory Using the Error Correction Model

Variables	UK			Germany			France		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>TLC</i>	0.719*** (0.050)	0.776*** (0.044)	0.759*** (0.042)	0.681*** (0.072)	0.844*** (0.064)	0.863*** (0.061)	0.777*** (0.082)	0.931*** (0.067)	0.933*** (0.071)
<i>LECM</i>	0.335*** (0.028)	0.390*** (0.014)	0.397*** (0.015)	0.380*** (0.054)	0.428*** (0.025)	0.454*** (0.026)	0.299*** (0.059)	0.440*** (0.030)	0.439*** (0.032)
Constant	0.001** (0.001)	0.002*** (0.001)	0.004*** (0.001)	-0.003** (0.001)	-0.003** (0.001)	0.002 (0.001)	-0.005*** (0.001)	-0.005*** (0.001)	-0.001 (0.001)
Estimators	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>
Observations	8819	8819	10209	2668	2668	3147	1841	1841	2167
Number of firms	1340	1340	1340	446	446	446	316	316	316
<i>AR2</i>	-1.248	-1.336	-1.344	0.952	1.090	1.100	1.117	1.021	1.074
Sargan test	-	317.9***	411.4***	-	170.7	220.3	-	165.0	179.6
<i>F</i> -test	49.70***	70.82***	67.54***	24.08***	46.56***	39.41***	12.83***	41.92***	41.74***

Notes: This table reports the estimation results for the error correction model of leverage specified by (6), as follows:

$$\Delta D_{it} = \alpha + \lambda TLC_{it} + \gamma LECM_{it} + u_{it},$$

where ΔD_{it} is market leverage change. The independent variables are TLC_{it} and $LECM_{it}$, which denote target leverage change and (lagged) deviation from target leverage (i.e., lagged error correction term), respectively. See Table 2 for target leverage estimations. *AHIV* denotes the Anderson and Hsiao's (1982) instrumental variable estimator. *GMM* and *SYSGMM* denote Arellano and Bond's (1991) and Blundell and Bond's (1998) estimators, respectively. *AR2* test is a test for second-order serial correlation, under the null of no serial correlation. Sargan test is a test for over-identifying restrictions under the null of valid instruments. *F*-test is a test for the difference between the coefficients TLC_{it} and $LECM_{it}$, under the null of no difference, $TLC_{it}=LECM_{it}$. Robust standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively.

Table 5. Testing the Pecking Order Theory

	UK	Germany	France
Variables	(1)	(2)	(3)
<i>DEF</i>	0.171*** (0.007)	0.424*** (0.024)	0.135*** (0.031)
Constant	0.001 (0.001)	-0.000 (0.002)	-0.000 (0.003)
Estimators	<i>FE</i>	<i>FE</i>	<i>FE</i>
Observations	10,209	3,147	2,167
<i>R</i> -squared	0.061	0.106	0.010
Number of firms	1,340	446	316
<i>F</i> -test	13579.56***	588.79***	763.18***

Notes: This table reports the estimation results for the pecking order model specified by Equation (8), as follows:

$$\Delta D_{it} = \alpha + \beta DEF_{it} + \varepsilon_{it}$$

where ΔD_{it} is market leverage change. DEF_{it} is the cash flow deficit variable, defined by Equation (9). *FE* denotes the (within-group) fixed-effects estimator. *F*-test is the test for the null hypothesis that $\beta=1$. Standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively.

Table 6. Testing the Trade-off and Pecking Order Theories Using the Augmented Partial Adjustment Model

Variables	UK			Germany			France		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>TLD</i>	0.386*** (0.027)	0.405*** (0.014)	0.410*** (0.015)	0.402*** (0.048)	0.442*** (0.028)	0.457*** (0.027)	0.439*** (0.049)	0.514*** (0.033)	0.508*** (0.034)
<i>DEF</i>	0.150*** (0.012)	0.145*** (0.012)	0.115*** (0.009)	0.298*** (0.041)	0.271*** (0.039)	0.251*** (0.036)	0.049 (0.085)	0.040 (0.081)	0.061 (0.067)
Constant	0.002*** (0.001)	0.003*** (0.001)	0.001 (0.001)	-0.004*** (0.001)	-0.003*** (0.001)	0.001 (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.000 (0.001)
Estimators	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>
Observations	8,819	8,819	10,209	2,668	2,668	3,147	1,841	1,841	2,167
Number of firms	1340	1340	1340	446	446	446	316	316	316
<i>AR2</i>	-1.501	-1.511	-1.450	0.334	0.329	0.373	0.899	0.778	0.880
Sargan test	-	180.7***	242.9***	-	98.01	142.1	-	97.07	121.7
F-test	4843.50***	5313.36***	9539.67***	290.34***	350.44***	438.98***	126.12***	139.51***	199.01***

Notes: This table reports the estimation results for the augmented partial adjustment model of leverage that nests the pecking order theory specified by (10), as follows:

$$\Delta D_{it} = \alpha + \delta TLD_{it} + \beta DEF_{it} + u_{it},$$

where ΔD_{it} is market leverage change. TLD_{it} is the deviation of lagged leverage from target leverage. See Table 2 for target leverage estimations. DEF_{it} is the cash flow deficit variable, defined by Equation (9). *AHIV* denotes the Anderson and Hsiao's (1982) instrumental variable estimator. *GMM* and *SYSGMM* denote Arellano and Bond's (1991) and Blundell and Bond's (1998) estimators, respectively. *AR2* test is a test for second-order serial correlation, under the null of no serial correlation. Sargan test is a test for over-identifying restrictions under the null of valid instruments. *F*-test is the test for the null hypothesis that $\beta=1$. Robust standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively.

Table 7. Testing the Trade-off and Pecking Order Theories Using the Augmented Error Adjustment Model

Variables	UK			Germany			France		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>TLC</i>	0.638*** (0.051)	0.719*** (0.041)	0.710*** (0.039)	0.586*** (0.072)	0.754*** (0.057)	0.776*** (0.054)	0.771*** (0.084)	0.923*** (0.069)	0.924*** (0.072)
<i>LECM</i>	0.308*** (0.029)	0.366*** (0.015)	0.377*** (0.015)	0.342*** (0.055)	0.395*** (0.027)	0.424*** (0.027)	0.298*** (0.060)	0.437*** (0.034)	0.436*** (0.035)
<i>DEF</i>	0.153*** (0.012)	0.142*** (0.011)	0.112*** (0.009)	0.297*** (0.041)	0.272*** (0.039)	0.242*** (0.034)	0.054 (0.091)	0.048 (0.083)	0.061 (0.066)
Constant	0.002*** (0.001)	0.002*** (0.001)	0.001 (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	0.002 (0.001)	-0.005*** (0.001)	-0.005*** (0.001)	-0.001 (0.001)
Observations	8,819	8,819	10,209	2,668	2,668	3,147	1,841	1,841	2,167
Estimators	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>	<i>AHIV</i>	<i>GMM</i>	<i>SYSGMM</i>
Number of firms	1,340	1,340	1,340	446	446	446	316	316	316
<i>AR2</i> test	-1.345	-1.419	-1.381	0.701	0.824	0.864	1.229	1.135	1.191
Sargan test	-	299.4***	394.2***	-	173.2	223.2*	-	163.9	180.0
<i>F</i> -test 1	35.87***	62.74***	62.01***	8.88***	40.08***	40.76***	24.16***	46.54***	39.12***
<i>F</i> -test 2	4890.59***	5844.68***	10515.42***	290.11***	353.76***	510.54***	108.89***	130.65***	201.56***

Notes: This table reports the estimation results for the augmented error correction model of leverage that nests the pecking order theory specified by Equation (11), as follows:

$$\Delta D_{it} = \alpha + \lambda TLC_{it} + \gamma LECM_{it} + \beta DEF_{it} + u_{it}$$

where ΔD_{it} is market leverage change. TLC_{it} and $LECM_{it}$ denote target leverage change and (lagged) deviation from target leverage (i.e., lagged error correction term), respectively. Note that target leverage is estimated in Table 2. DEF_{it} is the cash flow deficit variable, defined by Equation (9). *AHIV* denotes the Anderson and Hsiao's (1982) instrumental variable estimator. *GMM* and *SYSGMM* denote Arellano and Bond's (1991) and Blundell and Bond's (1998) estimators, respectively. *AR2* test is a test for second-order serial correlation, under the null of no serial correlation. Sargan test is a test for over-identifying restrictions under the null of valid instruments. *F*-test 1 is a test for the difference between the coefficients on TLC_{it} and $LECM_{it}$, under the null of no difference, $TLC_{it} = LECM_{it}$. *F*-test 2 is the test for the null hypothesis that $\beta = 1$. Robust standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively.

Table 8. Target Leverage Estimation for Book Leverage

Variables	UK	Germany	France
	(1)	(2)	(3)
Collateral value of assets	0.175*** (0.013)	0.359*** (0.026)	0.113*** (0.036)
Non-debt tax shields	0.348*** (0.049)	-0.033 (0.057)	-0.030 (0.071)
Profitability	-0.124*** (0.008)	-0.142*** (0.018)	-0.253*** (0.027)
Growth	0.008*** (0.001)	-0.003 (0.002)	-0.003 (0.003)
Size	0.023*** (0.002)	0.043*** (0.004)	0.028*** (0.004)
Constant	-0.129*** (0.024)	-0.378*** (0.049)	-0.110** (0.051)
Estimators	<i>FE</i>	<i>FE</i>	<i>FE</i>
Observations	11,635	3,640	2,503
<i>R</i> -squared	0.065	0.109	0.073
Number of Firms	1,340	446	316

Notes: This table reports the regression results for target (book) leverage modelled by Equation (3):

$$D_{it}^* = \beta' \mathbf{x} + w_{it},$$

where \mathbf{x} is a vector of five firm characteristics, namely collateral value of assets, non-debt tax shields, profitability, growth opportunities and firm size, and β is the vector of the parameters. *FE* denotes the (within-group) fixed-effects estimator. Robust standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively. See Table 1 for variable definitions.

Table 9. Testing the Trade-off and Pecking Order Theories Using the Augmented Error Correction Model of Book Leverage

Variables	UK			Germany			France		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>TLC</i>	0.915*** (0.093)	0.877*** (0.075)	0.850*** (0.074)	0.520*** (0.119)	0.625*** (0.089)	0.722*** (0.086)	0.747*** (0.152)	0.829*** (0.119)	0.730*** (0.107)
<i>LECM</i>	0.346*** (0.040)	0.376*** (0.023)	0.375*** (0.024)	0.267*** (0.054)	0.289*** (0.035)	0.302*** (0.034)	0.342*** (0.074)	0.314*** (0.050)	0.333*** (0.047)
<i>DEF</i>	0.180*** (0.019)	0.175*** (0.019)	0.141*** (0.015)	0.306*** (0.033)	0.302*** (0.031)	0.280*** (0.028)	0.172** (0.079)	0.174** (0.078)	0.164*** (0.060)
Constant	0.003*** (0.001)	0.004*** (0.001)	0.000 (0.001)	-0.000 (0.001)	0.000 (0.001)	0.003*** (0.001)	0.000 (0.001)	0.000 (0.001)	-0.000 (0.001)
Estimators	AHIV	GMM	SYSGMM	AHIV	GMM	SYSGMM	AHIV	GMM	SYSGMM
Observations	8,819	8,819	10,209	2,668	2,668	3,147	1,841	1,841	2,167
Number of firms	1340	1340	1340	446	446	446	316	316	316
AR2 test	-0.407	-0.433	-0.354	0.0672	0.0987	0.149	2.353	2.228	2.232
Sargan test	-	246.1	292.5	-	152.4	191.7	-	156.0	169.4
<i>F</i> -test 1	38.56***	50.59***	46.17***	4.28**	14.05***	22.91***	6.93***	17.19***	15.56***
<i>F</i> -test 2	1851.18***	1972.52***	3508.82***	441.25***	503.98***	679.19***	109.73***	113.35***	195.10***

Notes: This table reports the estimation results for the augmented error correction model of leverage that nests the pecking order theory specified by Equation (11), as follows:

$$\Delta D_{it} = \alpha + \lambda TLC_{it} + \gamma LECM_{it} + \beta DEF_{it} + u_{it}$$

where ΔD_{it} is book leverage change. TLC_{it} and $LECM_{it}$ denote target (book) leverage change and (lagged) deviation from target (book) leverage (i.e., lagged error correction term), respectively. See target (book) leverage estimations in Table 8. DEF is the cash flow deficit variable, defined by Equation (9). $AHIV$ denotes the Anderson and Hsiao's (1982) instrumental variable estimator. GMM and $SYSGMM$ denote Arellano and Bond's (1991) and Blundell and Bond's (1998) estimators, respectively. $AR2$ test is a test for second-order serial correlation, under the null of no serial correlation. Sargan test is a test for over-identifying restrictions under the null of valid instruments. F -test 1 is a test for the difference between the coefficients TLC_{it} and $LECM_{it}$, under the null of no difference, $TLC_{it}=LECM_{it}$. F -test 2 is the test for the null hypothesis that $\beta=1$. Robust standard errors of coefficients are reported in parentheses. *, ** and *** indicate the coefficient significant at the 10%, 5% and 1% levels, respectively.