The Substitutability Of Debt And Non-det Tax Shields And Their Influence On Financing Decisions: An Empirical Analysis

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ABSTRACT: The influence of taxes on financing decisions has been a focus of an enormous body of corporate finance research for decades. There is no doubt that the deductibility of interest paid on debt by a company, shields that company, shields that company from part of the tax burden. This is probably one of the major reasons for the used of debt financing for some companies, and could possibly be one of the sources of the creation of the net present value of debt financing. However, the interest tax shield creates incentive to employ debt financing only if a firm has enough taxable income to shield. The existence of other (non-debt) tax shields like accelerated depreciation allowances on investments, tax loss carry-forwards (or backwards), and expensed research and development (R&D) expenditures, diminishes that attractiveness of interest tax shields and creates a substitution effect between these two types of tax shields. Theoretical extensions of the basic non-debt tax shields theory have suggested that even this substitution effect between the two types of tax shields is not that straight forward. In this study, empirical investigations are conducted using UK companies' panel data to validate the extent theories surrounding the substitutability of debt and non-debt tax shields. Consistent with the basic theoretical predictions a strong significant inverse relation is evident between gearing (debt tax shields) and non-debt tax shields. Results also lend some support to the extensions to the basic theory that firms with lower levels of non-debt tax shields need not have higher gearing, and also that the degree of substitutability changes depending on the level of investment (or production process) for a given firm.

INTRODUCTION

The use of debt financing remains an area of interest in corporate finance literature; numerous hypotheses have been developed about the choice to finance with debt and the implications of the choice. The testing of these hypotheses and related modeling has enabled the theory of corporate capital structure choice to make a considerable progress since the pioneering works by Modigliani and Miller (1958, 1963). The extensions to Miller (1977) model and departures from these earlier works show that capital structure choice may be relevant to a firm's value, suggesting the existence of an optimal capital structure. However, as Bradley *et al* (1984) argue, the upshot of these extensions has been the recognition that the existence of an optimal capital structure is essentially an empirical issue as to whether or not the various leverage-related costs are economically significant enough to influence the costs of corporate borrowing. The relaxation of the perfect and complete markets assumptions embedded in Modigliani and Miller's irrelevance propositions ushered the search for the imperfections that could render one capital structure better than the other.

One such extension come from De Angelo and Masulis (1980) model whose implications were that for firms with relatively higher levels of non-debt tax shields, the far of losing (not using) non-debt tax shields is likely to create a substitution effect between debt and non-debt tax shields is likely to create a substitution effect between debt and non-debt tax shields. According to De Angelo and Masulis, this substitution effect implies the capital structure decisions are relevant and that there is an optimal capital structure to a given firm. There have been significant modifications to this basic theoretical argument by the example Dotan and Ravid (1985), Dammon and Senbet (1988) and Sener (1989). Empirical validation in this area however, has been both rudimentary and conflicting.[1] In

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[1] Most empirical studies on determinants of capital structure simply try to verify the hypothesized relation between non-debt tax shield and gearing

addition some studies have used inappropriate variable like depreciation as proxies for non-debt tax shield (see Bradley *et al*, 1984; Titman and Wessels, 1988; and Ozkan, 2001). The appropriate step forward here is for one to conduct a rigorous empirical analysis on the basic theory and all its extensions by using more appropriate variables.

This paper presents an examination of the relationship between non-debt tax shields and gearing by suing a sample of 702 UK firms. Additional tests are also carried out to cover the modifications of the basic theory. UK provides a suitable independent testing ground for these theories it is also a large development economy (though no as large as the US), and is an industrialized economy with a number of similar features and institutions like the US where most of these theories were developed.

The study is considered to be useful to both academics and practitioners. To academics the study extends our general understanding of the existing evidence about debt and non-debt tax shields and their influence on corporate capital structure decision by attempting to identify more appropriate proxies for the theoretical attributes and by making attempts to validate theoretical extensions to the basic investment and tax planning decisions, especially those who happen to have debt or are planning to employ debt financing in their firms. As part of their decisions process they have to consider the different types (and sources) of debt in relation to their firms' attributes like optimum investment level, non-debt tax shields, investment opportunities, collateral, risk, related agency problems and costs. These attributes together with the firm's tax status are among the factors that may influence a stream of future cash flow and affect the value of a firm. This makes the study relevant even to tax planners who may with to balance their investment (non-debt) tax shield with debt tax shield, or to consider the relative importance of substitution effects (De Angelo and Masulis, 1980) versus the income effects of an increase in the level of their firm's investment (Dammon and Senbet, 1988).

Briefly, the findings of this study are that non-debt tax shield is strongly negatively related to gearing, implying the potential substitutability which could in itself result in an optimal level of gearing. However, the relationship is significantly stronger for firms with relatively higher levels of non-debt tax shields, suggesting that firms with lower levels of non-debt tax shields may not necessarily employ higher gearing. The degree of substitutability is also influenced by the level of investment (or production process) for a given firm.

This paper is similar in focus to Sener (1989) and can be related to other empirical studies on determinants of capital structure, like Bradley *et al* (1984), Titman and Wessels (1988), and Chiarella *et al* (1992), to the extend to which they investigate the relationship between non-debt tax shields and capital structure. However, these previous studies only examine the relationship between non-debt tax shields and capital structure as presented by De Angelo and Masulis (1980) and they fall short of investigating the extensions to the basic theory, which have been provided, by both Dotana and Ravid (1985) and Dommon and Sebnet (1988). This study extends investigations to cover these modifications. The paper proceeds as follows: Section two revisits the literature relating to non-debt tax shields as a determinant of financing decisions. Section three presents the testable hypotheses, and discusses the methodology and variable used to test the hypotheses. Section four presents and discusses the results. Section five draws some conclusions. Tables are relegated to the appendix.

see Bradley *et al*(1984), Titman and Wessels (1988), Chiarella *et al* (1992), and Bennett and Donnelly (1993) to mention a few. Exceptions to this include Sener (1989) who in addition to theoretical extensions to incorporate inflation effects also conducts empirical investigation of De Angelo and Masulis (1980) with industry classification.

LIETRATURE

De Angelo and Masulis (1980) presents a theory of substitutability between non-debt and debt tax shields by arguing that firms with relatively large non-debt tax shields relative to their expected cash flow will have low debt levels. Although De Angelo and Masulis (1980) refer mainly to the Miller (1977) model, which they extend, the non-debt tax shield argument rests on Modigliani and Miller (1958, 1963) analysis (henceforth referred to as MM. The outcome form MM analysis is that the advantage a firm gets from gearing comes from the interest tax shield that arises as a result of the deductibility of interest for tax purposes, and that because the costs of capital declines as more and more debt is used, the value of a 'corporate tax paying firm' is maximized when it uses 100 percent (risk-free) debt. Miller's (1977) modification to MM, incorporated differential personal taxes and concluded that the personal tax disadvantage of debt, together with the supply side adjustment by firms may wipe away the interest tax shield advantage. While this ensures industry (or economy wide equilibrium, it implies that capital structure is irrelevant for a particular firm. Miller's (1977)model tried to explain why firms do not actually use 100 percent debt by incorporating more realistic tax analysis took the capital structure theory back to the original MM irrelevancy argument, this time for different reasons.

Although MM (1958, 1963) and indeed Miller (1977) did not explicitly include this in their assumptions, the interest tax shields create incentives to use debt only if a firm has enough taxable income to justify the 100 per cent (or any other 'reasonable' level of gearing). The U.K tax laws, and indeed tax codes in other jurisdictions, allow other deductions in addition to interest on debt to be made form a firm's taxable income. These are for example accelerated depreciation allowance on fixed assets and some investment, tax-loss-carry-forwards, and expensed research and development expenditures. Elsewhere, notably the US, oil and/or other mining depletion allowances, and investment tax credit also from part of these non-debt tax shields.

It is at this point where De Angelo and Masulis (1980) question the implications of Miller (1977) model, by extending it to incorporate even more realistic simple modifications in analyzing the effects of corporate tax code. They analyse how Miller (1977), and by implication, MM change after incorporating non-debt tax shields. According to De Angelo and Masulis (1980), capital and depletion allowances, investment tax credits and other non-debt tax shields are substitutes for the tax benefits of gearing. The possibility of losing (non using) non-debt tax shields due to exhaustion of taxable income creates a substitution effect between the level of non-debt tax shields and the tax benefit of gearing. This being the case firms with substantial non-debt tax shields relative to their profitability will be inclined to use less gearing. Because firms have different levels of non-debt tax shields over time, their model brings a new dimension into Miller (1997) analysis, and implies that capital structure decisions are relevant to a give firm and that there is an optimal level of gearing (*a unique interior optimum*) whether or not gearing related costs (like bankruptcy, or agency costs are incorporated into analysis (De Angelo and Masulis, 1980, pp.12-18).

In extended Miller's (1977) equilibrium, and with positive bankruptcy costs, De Angelo and Masulis model further shows that the net-marginal personal tax savings is of the same order of magnitude to the expected bankruptcy costs thereby refuting Miller's 'horse and rabbit stew' analogy regarding the *tax-benefit-bankruptcy cost* trade off model. This arises because the successive increase in the level of gearing reduces the chances of having taxable income and leads to a reduction in the expected value of the interest tax shields. This line of extension also generates for each firm *a unique interior optimum* level of gearing within the market equilibrium (pp. 19-20).

Extensions to the Basic Theory

The basic non-debt tax shield arguments by De Angelo and Masulis (1980) have so far been extended, and several empirical studies have tried to very them. The crux of their substitution effect of the tax shield hypothesis relies heavily on their underlying assumption of independence between the firm's optimum investment and financing decisions plus the use of historical cost accounting. Treating output level as exogenous, Dotan and Ravid (1985) theoretically modified De Angelo and Masulis (1980) model by edogenizing the firm's investment decisions. In the their extensions, they generated a model where the production and gearing decisions both giving rise to tax shields that act as substitutes for each other are concurrently mode. They suggest that less gearing be employed to finance higher productive capacity. Their model confirms De Angelo and Masulis (1980) non-debt tax shield hypothesis.

In another theoretical extension to De Angelo and Masulis (1980), Dammon and Senbet (1988) also relaxes the independence assumption and argue that the certainty of the net effect of an increase in investment tax shield on optimal gearing level cannot be guaranteed as this is a function of the trade-off between the De Angelo and Masulis' substitution effect and the income effect from an increase in optimum investment. This being the case, the tax shield prediction changes in response to whether the firm's optimum investment and financing decision are independent or not. There has been some documented evidence of significant interactions between the firm's optimum investment and financing decisions (see Sener, 1989, p.25). Dammon and Senbet (1988) demonstrate that the relationship between gearing and non-debt tax shields is not that straight forward.

Another related assumption in De Angelo and Masulis (1980) is that operating and financing leverage are independent because firms in the same industry use similar production processes and have constant business and total risk This being the case, a firm's gearing level is a function of its business risk and therefore non-debt tax shield and gearing level are negatively related across industries. Releasing this assumption, Dammon and Senbet (1988) argue that non-debt tax shields and gearing for firms in the same industry may increase simultaneously and put the firms in a new risk class. They further argue that firms with lower non-debt tax shields need not have higher interest (debt) tax shields. They however, confirm De Angelo and Masulis non-debt tax shield argument for firm with identical production process.

Building on both Dotan and Ravid (1985) and Dammon and Senbet (1988), Sener (1989) avoids the use of historical cost accounting, introduces inflation effects on the firms capital structure. The study then tests the De Angelo and Masulis non-debt tax shield and tax rate hypotheses with and without industry classification. The findings indicate a positive relationship between the optimum level of investment and debt leverage as claimed by Dammon and Senbet (1988). Sener's results also refute De Angelo and Masulis (1980) tax rate hypothesis as the inverse relationship is observed between gearing and effective tax rate.

All is not well with the findings of previous empirical studies on the relationship between non-debt tax shields and gearing as there has not been any consensus so far. While some studies have generated results that contradict the theory, others had vague findings. After getting perverse results (significant buy positive), Bradley *et al.* (1984) suggest that lack of consensus may be due to *variable measurement error* whereby researchers may use a non-debt tax shield that is highly correlated with the level of tangible assets. If this is the case then what is tested is tangibility and not non-debt tax shields. However, it is noteworthy mentioning here that Bradley *et al,* (1984) used depreciation as a measure of non-debt tax shield. Depreciation is likely to be highly correlated with tangible (fixed) assets, which in turn is likely to be positively related to gearing. Mandelker and Rhee (1984) confirm De Angelo and Masulis (1980) tax shields hypothesis. Long and Malitz (1985), and Titman and Wessels (1988) and insignificant negative results despite the later using a relatively new and innovative methodology. Mackie-Mason (1988) findings are inconsistent with theoretical predictions. Finally, in what they claim to be the first evidence that is consistent with De Angelo and Masulis (1980) hypothesis, Chiarella *et al.* (1992) find that their proxy for non-debt tax shield is negatively related to gearing and is significant at 1% for three out of four of their gearing measures.

What is of most relevance to this study is that De Angelo and Masulis (1980) and its extensions, generates testable hypotheses that firms will select a level of gearing, which is negatively related to the level of available non-debt tad shields. The related extensions also provide ground for additional test for robustness of the results. Given the contradictory and unsatisfactory findings, unsuccessful attempts to explain them and interesting extensions, a justification exists for further research.

RESEARCH DESIGN

Hypotheses

Three hypotheses are tested in this study. From De Angelo and Masulis (1980) I test the following hypothesis:

1. H_0: The level of non-debt tax shields is not negatively related to a firm's gearing ratio.
   H_1: The level of non-debt tax shields is negatively related to a firm's gearing ratio.

From Dammon and Senbet (1988) I test the following hypotheses:

2. H_0: Firm with low levels of non-debt tax shields have higher gearing ratio.
   H_1: Firm with low levels of non-debt tax shields do not higher gearing ratio.
3. H_0: Firm with higher levels of investment in fixed assets do not exhibit a more significant investment inverse relationship between non-debt tax shield and gearing than other firms
   H_1: Firm with higher levels of investment in fixed assets exhibit a more significant investment inverse relationship between non-debt tax shield and gearing than other firms

Data and Methodology

Data and Variable Computation

The data was taken from Data Stream. The database contains accounting data and market values. Panel data relating to a total of 702 UK industrial (non-financial) companies were collected, from which both independent and dependent variable were computed. The data related to the 16-years from 1985 to 2000.

Independent Variable

The literature provides may different ways of measuring the level of non-debt tax shields. Common examples being the ratio of depreciation over total assets (D/TA); and the ratio of investment tax credits over total assets (ITC/TA). Bradley *et al.* (1984) measure the non-debt tax shield as the sum of annual depreciation charges and investment tax credits divided by the sum of annual earnings before depreciation, interest and taxes. Because of its availability of this data is the US, a number of other studies use investment tax credit (ITC), as a proxy for non-debt tax shields. ITC however, are not used in the UK, the fact that is reflected in our data source. Lack of data for investment tax credit in the UK prevents this study to come up with similar measure. The ratio of depreciation to total assets (D/TA) is also avoided due to perverse results obtained by previous studies, which have used it (see Bradley *et al*, 1984, and Titman and Wessels, 1988). Instead, this study uses another measure of non-debt tax shield.

Following Titman and Wessels (1988) and Chiarella *et al*, (1992) a direct measure of non-debt tax shields is derived using corporate tax payments (T), operating income (OI), interest payments (i), and the corporate tax rate applicable during the period (ô $_c$) using the following equation:

$$NDT = OI - i - T/\tau_c \quad (1)$$

Equation 1 simply states that corporate tax payments are equal to corporate tax rate multiplied by whatever remains after interest payments and non-debts tax shields have been taken out of the operating income, i.e.,

$$T = \tau_c\,(OI - i - NDT)$$

Which is the same as

$$T = \tau_c\,(OI) - \tau_c i - \tau_c\,(NDT)$$

And also the same as:

$\tau_c (NDT) = \tau_c (OI) - \tau_c i - T$

Dividing throughout by τ_c gives,

$(NDT) = (OI) - \tau_c - i - T/\tau_c$

However, it is important to note that equation 1 used here differs from the one used by both Titman and Wessels (1988) and Chiarella *et al*, (1992) in that while they used one average rate for the whole period covered by their respective data, here our equation captures τ_c for each of the 16 years covered. The regressions in this study used the natural log of this measure of non-debt tax shields.

Extensions to De Angelo and Masulis (1980) are also tested in this study. Relying on the suggestion that capital intensity may be an indicator of production technology (see for example Boyle and Eckhold, 1996, p.9; and MacKay and Phillips 2002, p.10) This study uses the ratio of fixed assets to total assets (Fan/Tan), both net of depreciation and intangibles, a proxy for capital intensity, to test for a modified model by Dammon and Senbet (1988), which suggest that the cross-sectional differences in non-debt tax shields need not be inversely related to gearing if firms have different production technologies.

Dependent Variable

The dependent variable in the models used in this study is gearing ratio (or leverage ratio as it is known in the US) for which a total of 12 different measures are used in this study. Finance theory does not restrict us to a single ratio as a measure of gearing, neither does the theory straightjacket researchers as to how gearing should be computed. Measurers of gearing are tools in assessing the probability that the firm will meet both interest and principal payments on debt as they fall due. Debt ratios also highlight protection of investors form insolvency and the ability of companies to obtain financing for potentially profitable investment opportunities. Financial analysts assert that "however leverage measures may be calculated they should be computed consistently both over time and when making comparisons between companies" (Samuels *et al*, 1995, p.18).

As Titman and Wessels (1988) and Chiarella *et al*, (1992) argue, a single measure of gearing may not be appropriate because some theories of capital structure have different implications for the different types of debt. These theories predict different relationships between firm attributes and measures of gearing. For example Myers (1977) predict that short-term debt ratios might be positively related to growth opportunities if growth firms pursue a policy of rolling over short maturity debt claims because short-term debt does not induce sub optimal investment decisions. Jensen and Meckling (1976) and Warner (1979) among others, argue that issuing convertible debt may reduce the agency costs of debt. Titman and Wessels (1988) also finds that smaller firm size and short-term financing are positively related and interprets such findings to be due to high transaction costs that small firms face when they opt for long-term debt or equity.

16-years' average of appropriate variable were computed for each firm in the sample. Table 1 provides descriptive statistics for all variable reported in the results. Table 2 presents a correlation matrix for the same variable. Recognizing the fact that capital structure decisions are influenced by many considerations (determinants), a multiple regression model (equation2) was generated. This OLS-regression model was used to empirically test the two hypotheses in this study:

$$Lev = \acute{a} + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_n X_n + \mathring{a} \quad (2)$$

Where:

Lev = gearing measure,

$X_1 \ldots X_n$ are proxies for the ten independent variables, one of them is measure of non-debt tax shield (NDTS) explained in equation 1 $\mathring{a}$ is the random error

In the interest of space, only the coefficients for non-debt tax shields (the focus of this paper) are reported here. Regressions were run first for the whole sample of 702 observations. Table 3 provides regression coefficients for this regression. To test the extension by Dammon and Senbet (1988) that inverse relationship between gearing and non-debt tax shields may not obtain for firms with lower levels of non-debt tax shields, the sample was segmented into four quartiles according to the level of non-debt tax shields. Table 4(a) and table 4(b) show the results for the quartile with highest and lowest levels of non-debt tax shields respectively. To test the other extension that substitutability of debt and non-debt tax shields depend on the level investment (production process), the original sample was divided into four quartiles according to the level of capital intensity (Fan/Tan). Regression was run for each of these quartiles in a similar way to previous regressions. Tables 5(a) and 5(b) depict the results from the quartiles with highest and lowest levels of capital intensity (Fan/Tan).

RESULTS

As table 3 shows all measures of gearing are inversely related to the non-debt tax shield proxy (NDTS). Among the 12 gearing measures, 10 are significant; 8 at 1%, and 2 at 5% only two, long term debt (LTD/TA) and current liabilities (CL/TA) are not. However, the magnitude of LTD/TA appears to support the negative relationship

Table 1: *Descriptive statistics*

Variable	N	Mean	Median	TrMean	StDev
TLp/TA-BV	702	0.54	0.53	0.53	0.17
TLp/TA-BV	702	0.41	0.39	0.40	0.18
Dp/TA-BV	702	0.11	0.09	0.10	0.08
Dp/TA-MV	702	0.08	0.07	0.08	0.06
Dp/E-BV	702	0.26	0.21	0.24	0.24
Dp/E-MV	702	0.14	0.11	0.13	0.12
Dp/CAPp-BV	702	0.18	0.17	0.17	0.12
Dp/CAPp-MV	702	0.11	0.09	0.10	0.08
LTDp/TA-BV	702	0.02	0.01	0.02	0.03
STD/TA-VA	702	0.04	0.04	0.04	0.03
CL/TA-BV	702	0.41	0.40	0.41	0.12
EBITDA/I	702	1.9	1.9	1.9	0.79
LnNDTS	702	8.2	8.3	8.2	1.6
Fan/Tan	702	0.36	0.33	0.35	0.19

Variable	SE Mean	Minimum	Maximum	Q1	Q3
TLp/TA-BV	0.006	0.11	099	0.42	064
TLp/TA-BV	0.007	0.02	0.99	0.27	053
Dp/TA-BV	0.003	0.00	0.31	0.04	0.16
Dp/TA-MV	0.002	0.00	0.25	0.02	0.12
Dp/E-BV	0.009	0.00	1.08	0.07	0.38
Dp/E-MV	0.005	0.00	0.49	0.03	0.22
Dp/CAPp-BV	0.005	0.00	0.50	0.06	0.27
Dp/CAPp-MV	0.003	0.00	0.32	0.03	0.17
LTDp/TA-BV	0.001	0.00	0.12	0.002	0.05
STD/TA-VA	0.001	0.00	0.14	0.01	0.07
CL/TA-BV	0.005	0.15	0.69	0.32	0.50
EBITDA/I	0.033	0.00	3.37	1.44	2.4
LnNDTS	0.73	1.57	8.3	8.2	1.6
FAn/Tan	0.007	0.01	0.94	0.23	0.46

Table 2: *Correlation matrix*

	TLp/TA-B	TLp/TA-M	Dp/TA-BV	Dp/E-BV	Dp/E-MV	LTDp/TA	STD/TA-B	CL/TA-BV	EBITDA/I	LnNDTS
TLp/TA-M	0.460									
	0.000									
TLp/TA-M	0.388	0.258								
	0.000	0.000								
Dp/E-BV	0.526	0.358	0.857							
	0.000	0.000	0.000							
Dp/E-MV	0.271	0.591	0.704	0.705						
	0.000	0.000	0.000	0.000						
LTDp/TA	0.197	0.234	0.652	0.612	0.574					
	0.000	0.000	0.000	0.000	0.000					
STD/TA-B	0.301	0.200	0709	0.591	0.536	0.318				
	0.000	0.000	0.000	0.000	0.000	0.000				
CL/TA-BV	0.765	0.317	-0.044	0.081	-0.045	-0.073	-0.016			
	0.000	0.000	0.298	0.053	0.296	0.092	0.706			
EBITDA/I	-0.277	-0.509	-0.241	0.295	-0.422	-0.202	-0.161	-0.133		
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002		
LnNDTS	0.103	-0.175	0.282	0.255	0.127	0.180	0.291	-0.046	0.291	
	0.025	0.000	0.000	0.000	0.006	0.000	0.000	0.327	0.000	
FAn/Tan	-0.250	-0.022	0.290	0.150	0.240	0.226	0.244	-0406	-0.011	0.075
	0.000	0.575	0.000	0.000	0.000	0.000	0.000	0.000	0.803	0.097

Cell contents: Pearson correlation
P-Value

Table 3: *Regression coefficients for the whole sample of 702 firms*

Model	Gearing Ratio	Constant	BDTS	Observations	R-Sq (adj.)%	F-stat
BOOK VALUE GEARING MEASURES						
1B	TL/TA-BV	.27274 (3.98)*	-0.0263 (-3.3)*	702	72.2	94.83
2B	D/TA-BV	-.12066 (-1.19)[a]	-0.01383 (-2.18)[a]	702	37.7	22.51
3B	D/E-BV	-.6371 (-4.47)*	-.0571 (-2.98)*	702	33.6	27.74
4B	D/CAP-BV	-.2572 (-2.97)*	-0.0353 (-3.54)*	702	40.4	24.74
5B	LTD/TA-BV	-0.0610 (-2.46)*	-0.0033 (-1.16)	702	21.6	10.41
6B	STD/TA-BV	-0.756 (-2.51)*	-0.0075 (-2.15)[a]	702	25.6	12.48
7B	CL/TA-BV	-0.5046 (-8.60)*	-0.0039 (-0.58)	702	66.4	69.70
8B	EBITDA/I	2.3489 (-7.16)*	0.3487 (-9.22)*	702	67.6	71.44
MARKET VALUE GEARING MEASURES						
1M	TL/TA-MV	.21319 (3.44)*	-.0373 (1.16)*	702	77.7	127.8
2M	D/TA-MV	-.1158 (-2.75)*	-.01631 (-3.36)*	702	40.4	24.62
3M	D/E-MV	-.30014 (-3.33)*	-.01631 (-3.4)*	702	39.8	23.32
4M	D/CAP-MV	-0.22392 (-3.62)*	-0.0335 (-3.798*	702	43.5	26.84

Coefficients that are significantly different from zero at 1% and 10% are marked with *, *a*, and *b* respectively. The numbers in the parentheses in columns 3 and 4 are corresponding t-statistics

Table 4(a): *Regression coefficients for the whole sample of 702 firms*

Model	Gearing Ratio	Constant	BDTS	Observations	R-Sq (adj.)%	F-stat
BOOK VALUE GEARING MEASURES						
1B	TL/TA-BV	0.2403 (0.87)	-0.1151 (-2.81)*	141	67.6	14.56
2B	D/TA-BV	-0.4092 (-2.10)[a]	-0.695 (-2.35)[a]	141	41.6	5.45
3B	D/E-BV	-0.4374 (-1.93)[a]	-0.0546 (-2.52)*	141	38.5	10.68
4B	D/CAP-BV	-0.3661 (1.08)	-0.1309 (-2.56)[a]	141	31.7	3.83
5B	LTD/TA-BV	-0.0627 (-0.51)	-0.0025 (0.13)	141	9.2	1.6
6B	STD/TA-BV	-0.1582 (-1.11)	-0.0447 (-2.03)[a]	141	13.9	1.91
7B	CL/TA-BV	0.7403 (3.45)*	-0.038 (-1.09)	141	65.4	12.68
8B	EBITDA/I	5.23 (4.32)*	0.5112 (2.99)*	141	65.5	12.73
MARKET VALUE GEARING MEASURES						
1M	TL/TA-MV	0.2108 (0.98)	-0.1151 (-3.36)*	141	75.2	20.99
2M	D/TA-MV	-0.4026 (-2.30)[a]	-0.0632 (-2.40)[a]	141	33.8	4.19
3M	D/E-MV	-0.3977 (-1.18)	-0.1504 (-2.87)*	141	28.7	3.38
4M	D/CAP-MV	-0.2582 (-1.08)	-0.1020 (-2.75)*	141	29.9	3.52

Coefficients that are significantly different from zero at 1%, 5% and 10% are marked with *, *a*, and *b* respectively. The numbers in the parentheses in columns 3 and 4 are corresponding t-statistics

Table 4 (b): *Regression coefficients for the quartile with the lowest level NDTS*

Model	Gearing ratio	Constant	NDTS	Observations	R-sq (adj.)	F-stat
BOOK VALUE GEARING MEASURES						
1B	TL/TA-BV	0.0737 (0.40)	-0.0110 (-0.94)	141	80.2	26.06
2B	D/TA-BV	-0.1760 (-1.29)	-0.0119 (-1.36)	141	40.8	5.26
3B	D/E-BV	-1.131 (-2.26)*	-0.0791 (-0.93)	141	30.9	7.51
4B	D/CAP-BV	-0.4764 (-2.23)a	-0.0307 (-2.26)a	141	55.3	8.52
5B	LTD/TA-BV	-0.0045 (-0.07)	-0.0022 (-0.570	141	10.0	1.66
6B	STD/TA-BV	-0.0484 (-0.65)	-0.0046 (-1.00)	141	23.3	2.85
7B	CL/TA-BV	0.3141 (-1.61)	0.001 (-0.06)	141	68.4	13.98
8B	EBITDA/I	3.585 (3.11)*	0.2363 (3.5)	141	63.1	10.97
MARKET VALUE GEARING MEASURES						
1M	TL/TA-MV	0.0565 (-0.30)	-0.0150 (-1.23)	141	78.5	23.5
2M	D/TA-MV	-0.1707 (-1.58)	-0.0127 (-1.23)b	141	47.2	6.44
3M	D/E-MV	-0.6227 (-2.55)a	-0.0385 (-1.44)	141	43.3	5.32
4M	D/CAP-MV	-0.4633 (-2.72)*	-0.0315 (-1.67)b	141	44.0	5.38

Coefficients that are significantly different from zero at 1%, 5% and 10% are marked with *, *a*, and *b* respectively. The numbers in the parentheses in columns 3 and 4 are corresponding t-statistics

between gearing and non-debt tax shield. In terms of level of significance, adjusted R-squared, and the corresponding t-statistics, table 3 shows that the market value measures of gearing support the inverse relationship better than the book value measures. This is consistent with the capital structure theory, which is prescribed in terms of market value of a firm (Modigliani and Miller, 1958, 1963).

As for the insignificant coefficient depicted by CL/TA, the explanation could be that current liabilities may have not be reflecting financing decisions but mainly operational decisions. It should be noted here that because the coverage ratio (EBITDA/I) is the 'inverse income gearing', its significant positive relation in all the tables, is consistent with the hypothesized negative relation between non-debt tax shields and capital gearing. It is therefore obvious that we should reject the null in the first hypothesis. These results provide a strong support for De Angelo and Masulis (1980) that non-debt tax shields are negatively related to the level of gearing. This is another strong evidence after Chiarella *et al.* (1992) known to the researcher with such results.

Despite the use of a smaller sub-sample than the one sued in table 3, table 4(a) has almost identical results as table 3. This is evidence that the firms that have higher levels of non-debt tax shields drive the inverse relationship between

Table 5 (a): *Regression coefficients for the quartile with the highest level capital intensity (FA/TA)*

Model	Gearing ratio	Constant	NDTS	Observations	R-sq (adj.)	F-stat
BOOK VALUE GEARING MEASURES						
1B	TL/TA-BV	0.0141 (0.34)	-0.0449 (-3.81)[*]	141	72.6	26.6
2B	D/TA-BV	-0.1701 (-1.83)[n]	-0.0120 (-1.34)	141	44.3	8.42
3B	D/E-BV	-0.7733 (-2.68)[*]	-0.0678 (-2.36)[a]	141	36.4	6.6
4B	D/CAP-BV	-0.3625 (-2.44)[a]	-0.0350 (-2.40)[a]	141	42.0	8.01
5B	LTD/TA-BV	-0.0402 (-0.94)	-0.0024 (-0.57)	141	20.5	3.38
6B	STD/TA-BV	-0.1126 (-1.94)[b]	-0.0076 (-1.40)	141	20.7	3.24
7B	CL/TA-BV	0.2065 (-2.52)[a]	-0.0308 (-3.9)	141	72.1	24.78
8B	EBITDA/I	2.931 (4.91)[*]	0.2784 (4.93)[*]	141	66.3	19.17
MARKET VALUE GEARING MEASURES						
1M	TL/TA-MV	-0.0407 (-0.33)	-0.0463 (-3.76)[*]	141	66.9	21.21
2M	D/TA-MV	-0.1567 (-1.88)[b]	-0.0114 (-1.41)	141	33.1	5.40
3M	D/E-MV	-0.3903 (-2.01)[a]	-0.0365 (-1.28)	141	32.3	5.18
4M	D/CAP-MV	-0.3044 (-2.36)[a]	-0.0285 (-1.51)	141	36.5	5.99

Coefficients that are significantly different from zero at 1%, 5% and 10% are marked with *, *a*, and *b* respectively. The numbers in the parentheses in columns 3 and 4 are corresponding t-statistics

Table 5 (b): *Regression coefficients for the quartile with the lowest level capital intensity (FA/TA)*

Model	Gearing ratio	Constant	NDTS	Observations	R-sq (adj.)	F-stat
BOOK VALUE GEARING MEASURES						
1B	TL/TA-BV	0.0192 (0.10)	-0.0969 (-3.20)*	141	60.1	18.21
2B	D/TA-BV	-0.0967 (-0.85)	-0.0039 (-0.22)	141	15.5	3.11
3B	D/E-BV	-0.3068 (-0.94)	-0.0641 (1.26)	141	20.7	3.93
4B	D/CAP-BV	-0.2613 (-1.41)	-0.0529 (-1.85)[b]	141	25.9	4.88
5B	LTD/TA-BV	-0.0217 (-0.43)	-0.0027 (-0.34)	141	7.7	1.92
6B	STD/TA-BV	-0.0284 (-0.46)	-0.0076 (-0.21)	141	14.7	2.85
7B	CL/TA-BV	0.3222 (-1.88)[b]	-0.0689 (-2.28)	141	57.8	15.45
8B	EBITDA/I	3.0375 (3.85)*	0.5739 (4.37)*	141	59.8	16.7
MARKET VALUE GEARING MEASURES						
1M	TL/TA-MV	-0.0414 (-0.28)	-0.1167 (-4.79)*	141	72.4	32.12
2M	D/TA-MV	-0.1361 (-1.53)	-0.0115 (-0.80)	141	17.2	3.37
3M	D/E-MV	-0.3825 (-2.19)[a]	-0.0794 (-2.76)	141	25.9	4.92
4M	D/CAP-MV	-0.2792 (-2.18)[a]	-0.0571 (-2.71)	141	27.4	5.23

Coefficients that are significantly different from zero at 1%, 5% and 10% are marked with *, *a*, and *b* respectively. The numbers in the parentheses in columns 3 and 4 are corresponding t-statistics

gearing and non-debt tax shields. Consistent with the theoretical extensions provided by Dammon and Senbet (1988), table 4 (b) has fewer significant results than table 4(b). With the exception of income gearing, the only three significant results in table 4(b) are significant at 5% and 10%, while most of the results in table 3 and 4(a) are significant at 1%, and the remaining are significant at 5%. The null in hypothesis number two is also rejected. This suggests that firms with lower levels of non-debt tax shields need not have higher levels of gearing. While this vindicates De Angel and Masulis (1980) theory, it also supports the extension by Dammon and Senbet (1988) who argue that firms with lower non-debt tax shields need not have higher debt tax shield.

The results in the table 5(a) and 5(b) show the results of tests as to whether the substitutability of debt and no-debt tax shields depends on the level of investments in fixed assets (production process). The Table 5(a) shows the results for the quartile with highest level of fixed assets (Fan/Tan), while table 5(b) shows the results for the quartile with lowest level of fixed assets (FAn/Tan). a comparison of the two tables show that out of the 12 measures of gearing, 6 (50%) shows that higher levels of fixed assets commands an inverse relationship between gearing and non-debt tax shield, 4 measures do not discriminates between the two sub-samples, and the remaining 2 are inconsistent with the expected results.

Overall we conclude that the quartile with highest level of (FAn/Tan) shows a relatively stronger negative relationship between gearing and non-debt tax shields. This indicates that firms that have invested in higher levels of fixed assets have higher non-debt tax shields, which is significantly negatively related to gearing. Once again the null in the last hypothesis is rejected. This confirms Dammon and Senbet (1988) that the relationship between non-debt tax shields and gearing changes depending on the level of investment for a given firm. The relatively weaker results, in favour of rejecting the null, in the last test compared with other tests in this study, is evidence significant role in the substitutability of debt and non-debt tax shields. This could be the case because the firms whose substantial levels of non-debt tax shields arise form sources other than investment in fixed assets may have been left out from sources other than investment in fixed assets may have been left out from the sample used in table 5(a), and some of them might be included in table 5(b).

CONCLUSION

The study uses U.K companies' panel data from 1985 to 2000 to conduct empirical investigations on financing decisions. Particularly, the study examines whether non-debt tax shields can a substitute for gearing (debt-tax shield). The study also uses multiple measures of gearing in a bid to uncover those theories that predict different theoretical relationship between the attributes and different definitions of gearing. The traditional capital structure cross-sectional OLS regressions are used to determine the relationship between non-debt tax shield and gearing, and how investments decisions influence the relationship. The study makes some valuable contribution to the knowledge on capital structure in the area of non-debt tax shields are an inverse determinant of capital structure, and that firms with a relatively higher levels of non-debt tax shields need not employ large amount of debt financing because they already have alternative tax shields. The evidence is consistent with De Angel and Masulis (1980) predictions, and Chiarella *et al*, (1992) findings.

Additional robustness tests revealed that the inverse relationship between non-debt tax shields and gearing in significantly stronger for firms with higher levels of non-debt tax shields. The implication here is that firms with low levels of non-debt tax shields may not necessarily have higher gearing. The results further shows that firms with higher levels of investments in fixed assets also have higher levels of non-debt tax shields, and these firms exhibit a significant negative relationship between level of non-debt tax shields and gearing than other firms.

However, the evidence also suggest that non-debt tax shields from sources other than investment in fixed assets also pay a significant role in the substitutability of debt and non-debt tax shields.

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