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Determinants of capital structure: comparison of empirical evidence for the use of different estimators

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Abstract. *This paper briefly tries to define the fundamentals underlying capital structure theories and evaluates whether some a priori assumed macroeconomic determinants can be related to the leverage parameters of interest examined in the paper. For this purpose, we conduct an empirical research that covers 90 selected firms traded on the BSE Stock Exchange. For the empirical analysis panel data methodology has been applied. The study period is 2002-2009 Our main results reveal that there is a negative and statistically significant relationship between non-debt tax shields and size and debt and there is a positive and statistically significant relationship between growth and ratio of fixed assets to total assets debt.*

Keywords: debt, dynamic panel estimators, static panel models, capital structure, BSE stock exchange.

JEL Classification: C23, G32.
REL Classification: 11B.

1. Introduction

The root of the modern capital structure theory arises from the seminal paper by Modigliani and Miller (1958) popularly termed as the MM theory. The MM theory states that, based on the assumptions of the an absence of brokerage, tax and bankruptcy costs, investors can borrow at the same rate as corporations and they would tend to have the same information as management about a firm's future investment opportunities. The MM theory proves that under some restrictions, a firm's value would be unaffected by its capital structure and thus assumes that earnings before income tax would not have been related to the use of debt, leading to the inference that capital structure may be irrelevant. Despite the fact that some of the fundamental assumptions of the theory were unrealistic in the eyes of investors and other economic agents, the MM theory was generally accepted and subsequent research focused on relaxing some of its assumptions in order to develop a more realistic approach. In this sense, Modigliani and Miller published another paper in 1963 considering some of the criticisms or deficiencies of their theory and relaxed the assumption[(1)] that there were no corporate taxes. Further, other assumptions were later relaxed to build the trade off theory, which suggests that a firm's target leverage is determined by taxes and costs of financial distress and thus the interest payments tend to be tax deductible making debt less expensive than the use of equity financing. Further developments in the same line were made with the development of pecking order theory of Myers (1984). It states that firms prioritize their sources of financing - from internal financing to equity issues, according to the law of least effort, or of least resistance, preferring to raise equity as a financing means of last resort. Hence, internal funds are likely to be used first, and only when they are depleted will the firms realize new equity issues. This theory maintains that businesses adhere to a hierarchy of financing sources and prefer internal financing when available, and debt is preferred over equity if external financing is required. The theory suggests that the firms consider external finance if and only if internal finance has not been sufficient. In case of using external financing, the firms issue the cheapest security first so they start with debt, and then possibly apply hybrids such as convertible bonds, and going to equity only as a last resort. In contrast to the trade-off theory, there is no well-defined target leverage ratio in the pecking order theory: the debt ratio varies when there is an imbalance between internal funds and real investment opportunities. In this study, we have attempted to identify the critical factors affecting the capital structure of Indian firms. For the purpose of analysis, a panel model has been estimated for the years 2002 to 2009. The study finds a negative and statistically significant relationship between non-debt tax shields and size and debt. There is a positive and statistically significant relationship between growth and ratio of fixed assets to total assets debt.

The paper is organized as follows. The next section discusses about some possible determinants of the capital structure of the firms and provides empirical evidences. The third section briefly deals with the estimation methodology and data source. The fourth section presents the results, whilst the discussions on results have been presented in section five. The last section concludes the paper.

2. Literature review and macroeconomic determinants of the capital structure

The empirical literature suggests a number of factors that may influence the financial structure of firms. For example, Harris and Raviv (1991) suggest that the leverage of firms tends to be affected by fixed assets, investment opportunities, advertising expenditures, the possibility of bankruptcy, and profitability and uniqueness of the product. Salawu (2006) revealed that ownership structure and management control, growth and opportunity, profitability, issuing cost, and tax issues associated with debt are the major factors influencing bank's capital structure. Following Rajan and Zingales (1995); Banerages, Heshmati and Wihlborg (2000) and Bevan and Danbolt (2001) we have taken company size, profitability, tangibility, growth opportunities and non-debt tax shields as the possible determinants of capital structure. We discuss the relevant literature for each of these variables below.

The nature of a firm's assets has an impact on capital structure. Tangible assets are less subject to informational asymmetries and usually they have a greater value than intangible assets in the event of bankruptcy. In addition, moral hazard risks are reduced when the firm offers tangible assets as collateral, because this constitutes a positive signal to the creditors. Creditors can sell off these assets in the event of default. Hence, the trade off theory predicts a positive relationship between measures of leverage and the proportion of tangible assets. However, empirical evidence relating to this are mixed. For example, Bradley et al., (1984); Rajan and Zingales (1995); Kremp et al., (1999) and Frank and Goyal (2002) find leverage to be positively related to the level of tangibility. However, Chittenden et al., (1996) and Bevan and Danbolt (2001) find the relationship between tangibility and leverage to depend on the measure of debt applied. Further, managers of highly levered firms will be less able to consume excessive perquisites, since bondholders more closely monitor such firms. The monitoring costs of this agency relationship are higher for firms with less collateralizable assets. Therefore, firms with less collateralizable assets might voluntarily choose higher debt levels to limit consumption of perquisites (Drobetz and Fix, 2003). Hence, the agency model predicts a negative relationship between tangibility of assets and leverage. Firms with more tangible assets have a greater ability to secure debt.

Alternatively, Grossman and Hart (1982) argue that the agency costs of managers consuming more than the optimal level of perquisites is higher for firms with lower levels of assets that can be used as collateral. The monitoring costs of the agency relationship are higher for firms with less collateralizable assets. Consequently, collateral value is found to be a major determinant of the level of debt financing (Omet and Mashharance, 2002). From a pecking order theory perspective, firms with few tangible assets are more sensitive to informational asymmetries. These firms will thus issue debt rather than equity when they need external financing (Harris and Raviv, 1991), leading to an expected negative relation between the importance of intangible assets and leverage.

The trade-off theory predicts an inverse relationship between size and the probability of bankruptcy, i.e., a positive relationship between size and leverage. However, the pecking order theory of the capital structure predicts a negative relationship between size and leverage that is larger firm exhibits increasing preference for equity relative to debt. Further, as mentioned by Shapiro and Titman (1985) and Castanias (1983), that because of bankruptcy risk, managers would not likely to use debt choice. However, since larger firms have a chance to be more diversified, they have relatively little bankruptcy risk (Titmand and Wessels, 1988). Warner (1977) suggests that bankruptcy costs would be higher for smaller firms. Research evidences for this variable are also ambiguous (Drobetz and Fix, 2003). For example, Friend and Hasbrouck (1988), Crutchley and Hansen (1989) and Berger et al., (1997) report a positive relationship between firm's size and leverage, whilst Feri and Jones (1979) suggest that firm's size has a significant impact on leverage even though the sectoral decisions have been observed to vary among industries. Rajan and Zingales (1995) argued that larger firms tend to be more diversified and fail less often, so size may be an inverse proxy for the probability of bankruptcy. Large firms are also expected to incur lower costs in issuing debt or equity. Thus, large firms are expected to hold more debt in their capital structure than small firms. The measure of size used in this paper is the natural logarithm of net sales similar to the approach followed by Drobetz and Fix (2003). They discuss the logarithm of total assets as an alternate; however, they accept the net sales as a better proxy for the measure of size.

The trade-off theory suggests that firms with more investment opportunities have less leverage because they have stronger incentives to avoid under-investment and asset substitution that can arise from stockholder-bondholder agency conflicts (Drobetz and Fix 2003). Therefore, this theory predicts a negative relationship between leverage and investment opportunities. In the similar line, Jensen's (1986) free cash flow theory suggests that firms with more investment

opportunities have less need for the disciplining effect of debt payments to control free cash flows. Nevertheless, the pecking order theory supports a positive relationship. According to the pecking order theory, debt typically grows when investment exceeds retained earnings and falls when the investment is less than retained earnings. The empirical evidence regarding the relationship between leverage and growth opportunities are also mixed, suggesting the operation of both theories. For example, Titman and Wessles (1988), Barclay and Smith (1996) and Chen et al., (1997) find a negative relationship between growth opportunities and the level of either long-term or total debt. Similarly, Rajan and Zingales (1995) also find a negative relationship between growth opportunities and leverage. They suggest that this may be due to firms issuing equity when stock prices are high. As mentioned by Hovakimian et al. (2001), large stock price increases are usually associated with improved growth opportunities, leading to a lower debt ratio. However, Bevan and Danbolt (2001) find a negative relationship between growth and long-term debt, but find total leverage to be positively related to the level of growth opportunities. On the other hand, Beran and Danbolt (2001) find short-term debt to be positively related to growth opportunities.

Profitability plays an important role in leverage decisions. In the framework of trade-off theory, agency costs, taxes, and bankruptcy costs push more profitable firms toward higher book leverage. This is due to, first, decline in the expected bankruptcy costs when profitability increases and Second, the deductibility of corporate interest payments induces more profitable firms to finance with debt. In a tradeoff theory framework, when firms are profitable, they prefer debt to benefit firm the tax shield. In addition, if past profitability is a good proxy for future profitability, profitable firms can borrow more, as the likelihood of paying back the loans is greater. However, in the agency models of Jensen and Meckhing (1976), Easterbook (1984), and Jesen (1986), higher leverage helps control agency problems by forcing managers to pay out more of the firm's excess cash. However, the pecking-order model predicts a negative relationship between book leverage and profitability. Again, the empirical evidence on the issue is mixed. For instance, Toy et al., (1974), Kester (1986), Titman and Wessels (1988), Harris and Raviv (1991), Bennett and Donnelly (1993), Rajan and Zingales (1995), and Michaeles et al. (1999), Booth et al. (2001), Bevan and Danbolt (2001) all find leverage to be negatively related to the level of profitability (supporting the pecking-order theory). Whilst Jensen, Solberg and Zorn (1992) find leverage to be positively related to the level of profitability (supporting the trade-off theory). To test the effect of profitability on leverage, we use return on assets (measured by the ratio between Operating Income and Total Assets).

Although interest is tax deductible due to default risk, firms may tend to use other tax shields. Tax laws allow certain tax deductions to be made from a company's taxable income. Depreciation on tangibles and intangibles are also tax deductible. The effective tax rate has been used as a possible determinant of the capital structure choice. According to Modigliani and Miller (1958), if interest payments on debt are tax-deductible, firms with positive taxable income have an incentive to issue more debt. That is, the main incentive for borrowing is to take advantage of interest tax shields. Accordingly, in the framework of the trade-off theory, one hypothesizes a negative relationship between leverage and non-debt tax shields. DeAngelo and Masulis (1980) argue that the marginal corporate savings from an additional unit of debt decreases with increasing non-debt tax shields. This is because of the likelihood of bankruptcy increases with leverage.

3. Methodology and data(2)

3.1. Static panel models

In the panel data framework, there are three types of models, mostly used to assess the relationship between debt and its determinants. These are: a pooled Ordinary Least Squire (OLS) regression, panel model with random effects and the panel model with fixed effects. Following the previously defined determinants of debt used in this study one can write a pooled OLS regression in the following way:

$$\begin{aligned} \mathrm{LEV}_{\mathrm{it}} &= \beta_0 + \beta_1(\mathrm{NDTS}_{\mathrm{it}}) + \beta_2(\mathrm{PROF}_{\mathrm{it}}) + \beta_3(\mathrm{SIZE}_{\mathrm{it}}) + \beta_4(\mathrm{TANG}) + \\ &+ \beta_5(\mathrm{EVOL}_{\mathrm{it}}) + \beta_6(\mathrm{GROWTH}_{\mathrm{it}}) + \varepsilon_{\mathrm{it}}, \end{aligned} \tag{1}$$

where i indexes firms, t indexes time, LEV_{it} is the level of debt (ratio between Total Liabilities and Total Assets), $NDTS_{it}$ are non-debt tax shields (ratio between Depreciations and Total Assets), $PROF_{it}$ is profitability (ratio between Operating Income and Total Assets), $SIZE_{it}$ is size (Logarithm of Total Sales), $TANG_{it}$ is asset structure (ratio between Fixed Assets and Total Assets), $EVOL_{it}$ is the level of risk (absolute value of percentage change of Operating Income), $GROWTH_{it}$ are growth opportunities (Growth of Total Sales), and ε_{it} is the error term which is assumed to have a normal distribution and varies over both country and time. However, by using a pooled OLS regression, firms' unobservable individual effects are not controlled therefore, as Bevan and Danbolt (2004) conclude, heterogeneity, a consequence of not considering those effects, can influence measurements of the estimated parameters. Nevertheless, it is possible to control

the implications of firms' non-observable individual effects on the estimated parameters by using panel models of random or fixed effects. Hence, by considering the existence of non-observable individual effects, we have can re-write equation (1) as:

$$\begin{aligned} LEV_{it} &= \beta_0 + \beta_1(NDTS_{it}) + \beta_2(PROF_{it}) + \beta_3(SIZE_{it}) + \beta_4(TANG) + \\ &\beta_5(EVOL_{it}) + \beta_6(GROWTH_{it}) + u_{it}, \end{aligned} \quad (2)$$

where: $u_{it} = \mu_i + \varepsilon_{it}$, with μ_i being firms' unobservable individual effects. The difference between a polled OLS regression and a model considering unobservable individual effects lies precisely in μ_i.

In our empirical work we used the LM test for testing the relevance of unobservable individual effects. The null hypothesis of this test is that unobservable individual effects are irrelevant and hence, not rejecting the null hypothesis leads us to conclude that unobservable individual effects are not relevant, and so a pooled OLS regression would be an appropriate way of carrying out an evaluation of debt determinants. However, the contrary, reject the null hypothesis leads us to conclude that a pooled OLS regression is not the most appropriate way of carrying out analysis of the relationship between debt and its determinants.

Even if we have tested for the irrelevance of unobservable individual effects of firms, question of correlation between firms' unobservable individual effects and debt determinants in not solved. We can proceed with a panel model of random effects, if there is no correlation between firms' unobservable individual effects and debt determinants and if this is present the most appropriate way would be a panel model with fixed effects. We used the Hausman test to test the possible existence of such a correlation. The null hypothesis of the Hausman test is non-existence of correlation between unobservable individual effects and the explanatory variables, in this study, debt determinants, against the null hypothesis of existence of a correlation. We would proceed with a panel model of random effects if the null hypothesis, not rejected and if the null hypothesis is rejected, we would proceed with a panel model of fixed effects. Further, based on the results of the LM and Hausman tests, we will also present the evaluation of the most appropriate panel model. In addition to that, unlike other studies, we have also analyzed the model of two-way effect in which we assumed that company specific and period specific effects are random as there is every possibility of the presence of both effects simultaneously.

3.2. Dynamic panel estimators

It would be worthy to mention that static panel models do not allow us to analyze the possible dynamism existing in firm decisions when choosing their capital structure. This allows us to evaluate the dynamic panel estimators. Further, these models have greater power to control endogenity and allow us to determine the level of adjustment of actual debt towards the optimal level of debt. We can describe that adjustment process as follows:

$$LEV_{i,t} - LEV_{i,t-1} = \alpha(LEV^{*}_{i,t} - LEV_{i,t-1}) \tag{3}$$

where $LEV_{i,t}$ is the actual debt of a company *i* in period *t*, $LEV_{i,t-1}$ is the actual debt of company *i* in period *t-1* and, $LEV^{*}_{i,t}$ is the optimal debt of a company *i* in period *t*. Regrouping the terms and solving to the order of $LEV_{i,t}$, we have:

$$LEV_{i,t} = \alpha LEV^{*}_{i,t} + (1-\alpha)LEV_{i,t-1}) \tag{4}$$

If $\alpha = 1$ we have $LEV_{i,t} = \alpha LEV^{*}_{i,t}$, the actual level of debt, forcing equal to the optimal level of debt forcing firms to manage an optimal capital structure. On the contrary, if, $\alpha = 0$ we have $LEV_{i,t} = LEV_{i,t-1}$ i.e., There is no adjustment of the level of actual debt towards the optimal level of debt. Therefore, a high value of α, means a close proximity of the level of actual debt to optimal level of debt, whereas a low values of α, means less proximity between the actual level of debt and optimal level of debt.

It is important to mention that the optimal level of debt depends on the firms' specific characteristics that are on the determinants considered relevant in explaining debt as pointed out by Kremp et al. (1999), Shyam-Sunder and Myers (1999), Miguel and Pindado (2001), Ozkan (2001) and Gaud et al. (2005). Therefore, the optimal level of debt is given by:

$$\begin{aligned} LEV^{*}_{i,t} = {} & \lambda_0 + \lambda_1(NDTS_{it}) + \lambda_2(PROF_{it}) + \lambda_3(SIZE_{it}) + \lambda_4(TANG) + \\ & \lambda_5(EVOL_{it}) + \lambda_6(GROWTH_{it}) + u_{it}, \end{aligned} \tag{5}$$

Substituting (5) in (4), and solving to the order of $LEV_{i,t}$, we have:

$$\begin{aligned} LEV^{*}_{i,t} = {} & \beta_0 + \delta(LEV_{i.t-1}) + \beta_1(NDTS_{it}) + \beta_2(PROF_{it}) + \beta_3(SIZE_{it}) + \\ & \beta_4(TANG) + \beta_5(EVOL_{it}) + \beta_6(GROWTH_{it}) + \eta_i + e_{it}, \end{aligned} \tag{6}$$

Where, $\delta = (1-\alpha)$, $\beta_0 = \alpha\lambda_0$, $\beta_1 = \alpha\lambda_1$, $\beta_2 = \alpha\lambda_2$ $\beta_3 = \alpha\lambda_3$ $\beta_4 = \alpha\lambda_4$, $\beta_5 = \alpha\lambda_5$, $\beta_6 = \alpha\lambda_6$, $\eta_i = \alpha\mu_i$ and $e_{it} = \alpha\varepsilon_{it}$

To control the correlation between and $LEV_{i,t-1}$ and between e_{it} and $LEV_{i,t-1}$ in estimating equation (6) using static panel models which can propose siased and inconsistent of the evaluated parameters, Arellano and Bond (1991) propose evaluation of the equation (6) at level variables in first differences, and the use of debt lags and its determinants at level as instruments. However, Blundell and Bond (1998) concluded that when the dependent variable is persistent, there being a high correlation between its values in the current period and in the previous period, and the number of periods is not very high, the GMM (1991) estimator is inefficient; the instruments used to generally be weak. In such cases by considering a system with variables at level and first differences Blundell and Bond (1998) extend the GMM (1991) estimator. For the variables at the level in equation (6), the instruments are the variables lagged in first differences. In the case of the variables in first differences in equation (6), the instruments are those lagged variables at level. However the GMM (1991) and GMM system (1998) dynamic estimators can only be considered robust on confirmation of two conditions: 1) if the restrictions created, a consequence of using the instruments, are valid; and 2) there is no second order autocorrelation. Therefore, to test the validity of the restrictions we use the Sargan test in the case of the GMM (1991) estimator and the GMM system (1998) estimator. The null hypothesis in the Sargan test indicates the restrictions imposed by the use of the instruments are valid against the alternative hypothesis that the restrictions are not valid. Rejection of the null hypothesis leads us to conclude that the estimators are not robust. Further, we also test for the existence of first and second order autocorrelation through Arellano and Bond (1991) test. The null hypothesis is that there is no autocorrelation against the alternative hypothesis being the existence of autocorrelation. Rejection of the null hypothesis of the existence of second order autocorrelation leads us to conclude that the estimators are not robust.

4. Results

Before conducting regression analysis, correlation analysis was carried out in order to find out whether there is any evidence of severe multicollinearity among the test variables(3). Since we do not find evidence of multicollinearity (see Appendix 1), regression analysis has been carried out with the incorporation of all variables simultaneously. First, we present the results of the static panel model analysis. Results of static panel data models have been presented in Table 1.

Table 1. *Regression results of Static Panel data models*

Panel data Models: Dependent variable is $LEV_{i,t}$; standard error in parenthesis					
Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5
	OLS	FE-CS	RE-CS	RE-CS with AR(1)	RE-CS-Time
$NDTS_{i,t}$	-0.20313*** (0.0342)	-0.1765*** (0.04823)	-0.1826*** (0.04259)	-0.20014*** (0.04715)	-0.194059*** (0.0429)
$PROF_{i,t}$	-0.006817 (0.004960)	0.001064 (0.0028295)	0.0005335 (0.002818)	0.0006793 (0.0021408)	0.000935 (0.002816)
$SIZE_{i,t}$	-0.000681 (0.003533)	-0.0078*** (0.0023)	-0.00721*** (0.00227)	-0.004512** (0.00216)	-0.006968** (0.003305)
$TANG_{i,t}$	0.178434*** (0.0395)	0.118618*** (0.0390)	0.12826*** (0.03679)	0.11302*** (0.039502)	0.114088*** (0.03699)
$EVOL_{i,t}$	-8.00E-05** (4.05E-05)	-6.10e-06 (0.000023)	-9.32e-06 (0.0000232)	-0.000018 (0.0000188)	-8.46E-06 (2.33E-05)
$GROWTH_{i,t}$	5.66E-06* (3.13E-06)	1.08e-06 (1.80e-06)	1.30e-06 (1.79e-06)	2.42e-06* (1.40e-06)	1.14E-06 (1.79E-06)
C	0.293354*** (0.029958)	0.35348*** (0.02466)	0.347997*** (0.0317)	0.3405797*** (0.0309)	0.35517*** (0.03619)
Model summary					
R^2	0.066562	0.773270	0.049241	----------	0.039332
F-test	8.473773***	5.33***	6.154503***	----------	4.865314***
Rho AR	---------	--------	----------	0.51275378	----------
Cross-section random S.D.	----------	0.2077346	0.20115479	0.19221114	0.201223
Idiosyncratic random S.D.	----------	0.12428549	0.12428549	0.1116443	0.123394
Rho	----------	0.73640379	0.72371944	0.74773208	0.7231
Theta	----------	----------	----------	0.64886484	----------
Period random S.D	----------	----------	----------	----------	0.016621
BP-LM test	----------	----------	$chi^2_{(1)}$ = 1269.64***	----------	----------
Hausman test	----------	----------	$chi^2_{(4)}$= 6.59	----------	----------
Fixed effect (F-test)	----------	$F_{(89,624)}$= 21.85***	----------	----------	----------
Wald chi^2	----------	----------	36.93***	28.77***	----------
Firms included	90	90	90	90	90
Total observations	170	170	170	170	170

Notes: 1. The LM test has $\chi 2$ distribution and tests the null hypothesis that unobservable individual effects are irrelevant in explaining the dependent variable, against the alternative hypothesis of relevance of unobservable individual effects in explaining the dependent variable. 2. The Hausman test has $\chi 2$ distribution and tests the null hypothesis that unobservable individual effects are not correlated with the explanatory variables, against the null hypothesis of correlation between unobservable individual effects and the explanatory variables. 3. The Wald test has $\chi 2$ distribution and tests the null hypothesis of insignificance as a whole of the parameters of the explanatory variables, against the alternative hypothesis of significance as a whole of the parameters of the explanatory variables. 4. The F test has normal distribution N(0,1) and tests the null hypothesis of insignificance as a whole of the estimated parameters, against the alternative hypothesis of significance as a whole of the estimated parameters. 5. ***, **, and *denote significance at 1, 5 and 10 % level of significance respectively. 6. EF, CS, BP-LM, SD denotes fixed-effect, cross-section, Breusch and Pagan's Lagrange multiplier for random effect, and standard deviation respectively. 7. [----] denotes results are not computed.

Source: Author's calculation.

From an analysis of the results of the Wald and F tests, we can conclude that we cannot reject the null hypothesis that the explanatory variables do not explain, taken as a whole, the explained variable, and so the determinants selected in this study can be considered explanatory of the debt.

The results of the LM test indicate we can reject the null hypothesis, at the 1 % significance, that firms' unobservable individual effects are not significant. Therefore, a pooled OLS regression will not be the most appropriate way of carrying out an evaluation of the relationship between debt and its determinants, since we do not consider the heterogeneity of firms, a heterogeneity which cannot be measured by the relationship between debt and its determinants. However, the results of the Hausman test show that we cannot reject the null hypothesis of absence of correlation between firms' unobservable individual effects and debt determinants. Therefore, we can conclude that the most appropriate way to carry out an evaluation of the relationship between debt and its determinants is an evaluation of a random effects panel model. The similarity of the results obtained in terms of significance and significance of the coefficients of variation, using random or fixed effects, shows that the correlation between unobservable individual effects and debt determinants is not relevant. Therefore, and given the possible existence of autocorrelation, we assess the random effects panel model, consistent with the existence of first order autocorrelation. In the final step of static panel data model, i.e., Model 5, we also estimated the model of two-way effect wherein both cross-section and period specific effects are assumed fixed.

Next we present the results of the GMM (1991) and GMM system (1998) dynamic estimators. The results are presented in Table 2. The results of the Wald tests allow us to conclude that the determinants used in this study can be considered, as a whole, explanatory of the debt.

Table 2. *GMM (1991) and GMM (1998) estimates result*

Panel data Models: Dependent variable is $\boldsymbol{LEV_{i,t}}$; standard error in parenthesis		
Independent variables	GMM (1991)	GMM (1998)
$LEV_{i,t-1}$	0.4940653*** (0.0751869)	0.4545991*** (0.0710414)
$NDTS_{i,t}$	-0.2551332*** (0.0674686)	-0.2157173*** (0.0513694)
$PROF_{i,t}$	0.0010241 (0.0016644)	0.0004238 (0.0014219)
$SIZE_{i,t}$	-0.0228289** (0.0104641)	-0.0231829*** (0.0073044)
$TANG_{i,t}$	0.0754454 (0.0497679)	0.1068677*** (0.037752)
$EVOL_{i,t}$	-0.0000392 (0.0000285)	-0.000028 (0.0000244)
$GROWTH_{i,t}$	4.19e-06** (1.73e-06)	3.54e-06** (1.46e-06)

Panel data Models: Dependent variable is $LEV_{i,t}$; standard error in parenthesis		
Independent variables	GMM (1991)	GMM (1998)
C	0.358712*** (0.0966603)	0.3393815*** (0.0656582)
Model summary		
Wald chi^2	214.88***	225.62***
AB test	Z1= -2.0867** Z2= 1.2007	Z1= -2.1744** Z2= 1.216
Sargan test	chi2(20) = 32.64561**	chi2(26) = 38.88394**
Firms included	90	90
Total observations	170	170

Notes: 1. In the GMM(1991) estimator the instruments used are $(\mathrm{LEV}_{i,t-2}, \sum_{K=1}^{n} Z_{k,i,t-2})$, in which $Z_{k,i,t-2}$ are the debt determinants lagged two periods. 2. In the GMM system (1998) estimators the instruments used are $(\mathrm{LEV}_{i,t-2}, \sum_{K=1}^{n} Z_{k,i,t-2})$, in the first difference equations, and $(\Delta\mathrm{LEV}_{i,t-2}, \sum_{K=1}^{n} \Delta Z_{k,i,t-2})$, in the level equations. 3. The Wald test has $\chi 2$ distribution and tests the null hypothesis of overall non-significance of the parameters of the explanatory variables, against the alternative hypothesis of overall significance of the parameters of the explanatory variables. 4. The Sargan test has $\chi 2$ distribution and tests the null hypothesis of significance of the validity of the instruments used, against the alternative hypothesis of non-validity of the instruments used. 5. The Z1 test has normal distribution N(0,1) and tests the null hypothesis of absence of first order autocorrelation, against the alternative hypothesis of existence of first order autocorrelation. 6. The Z2 test has normal distribution N(0,1) and tests the null hypothesis of absence of second order autocorrelation against the alternative hypothesis of existence of second order autocorrelation. 7. Standard deviations in brackets. 8. *** significant at 1% significance; ** significant at 5% significance; * significant at 10% significance.
Source: Author's calculation.

From the results of the Sargan tests, we can conclude that we can reject the null hypothesis of instrument validity, and consequent restrictions generated, from use of the GMM (1991) and GMM system (1998) dynamic estimators respectively. However, the results of the second order autocorrelation tests concerning respectively the GMM (1991) and GMM system (1998) dynamic estimators, allow us to conclude that we cannot reject the null hypothesis of absence of second order autocorrelation. Therefore, given the validity of the absence of second order autocorrelation, but instruments invalidity we cannot conclude that the GMM (1991) and GMM system (1998) dynamic estimators are efficient and robust.

5. Discussion of results

Next, we present the comparison of the results of the models previously presented. First, we compare the results of the static panel models, then we compare the results of the dynamic panel estimators, and finally we go on to compare the results of the static and dynamic panel estimators. The summary of the results of the signs and statistical significance concerning the relationship between debt and its determinants are presented in Table 2.

5.1. Comparison of the results of static panel models

Observing the results presented in Table 1, we can conclude the results of a pooled OLS regression are different from those obtained using panel models of random and fixed effects. The first difference is related to the relationship between profitability and debt. Whereas using a pooled OLS regression the estimated parameter is negative, considering a panel model with random or fixed effects, the relationship becomes positive though insignificant statistically in all cases. The second difference is related to the relationship between $EVOL_{it}$ and debt. Whereas using polled OLS regression the estimated parameter is statistically significantly negative, considering a panel model with fixed and random effects though the relationship is negative but statistically insignificant. The third difference is related to the relationship between sales and debt. Whereas sales are negative, but insignificant in case of polled OLS, considering the model of panel with fixed and random effect sales tend to be statistically significantly negative. The fourth difference is related to the relationship between growth and debt. Whereas growth is significant with a positive sign in case of polled OLS, considering the case of panel with fixed and random effect growth turned to be insignificant but the sign remains the same.

Further, considering the relevance of unobservable individual effects, given by the results of the LM test, we can draw the following conclusions from the results of the static panel models: 1) there is a negative and statistically significant relationship between non-debt tax shields and debt; 2) there is a negative and statistically significant relationship between sales and debt; 3) there is a positive and statistically significant relationship between growth and debt; 4) there is a positive and statistically significant relationship between ratio of fixed assets to total assets and debt; and 5) statistically, the relationships between profitability and debt and POCI and debt are not significant.

5.2. Comparison of the results of the dynamic panel estimators

Comparing the results of the dynamic estimators GMM (1991) and GMM system (1998), we find that the coefficient of ratio of fixed assets to total assets is insignificant in case of GMM (1991) while significant in case of GMM (1998)

and all other results are same in terms of sign and significance of the explanatory variable under consideration.

Using the GMM (1991) dynamic estimator, we obtain an impact of debt in the previous period on debt in the current period, which is statistically significant at 1% significance, of $\delta = 0.494$, and so with $\delta = (1-\alpha)$, we have an adjustment of actual debt towards the optimal level of debt off $\alpha = 0.506$. Applying the GMM system (1998) dynamic estimator the impact of debt in the previous period of debt in the current period is statistically significant at the 1% significance, of $\delta = 0.455$, and so the adjustment of actual debt towards the optimal level of debt is $\alpha = 0.545$.

The parameter measuring the impact of non-debt tax shields on debt is negative using both GMM (1991) and GMM system (1998) dynamic estimators and statistical significant at the 1 % level. As far as the relationships between other explanatory variables and debt is concerned, we find that growth is positively significant in both cases; profitability is insignificant in both cases, though carrying a positive sign; sales are negatively significant in both the cases; POCI insignificant, but carries a negative sign in both cases and ratio of fixed assets to total assets is insignificant in case of GMM (1991) while significant in case of GMM (1998) though carries positive sign in both cases. However, it should be noted that the results obtained from GMM (1991) and GMM (1998) are not robust, as the assumption of instrument validity do not hold good[(4)].

6. Conclusions

The study was intended to identify the determinants of capital structure for Indian firms using a panel framework. For the analysis, we have taken 90 firms during the period 2002-2009, comprising of a panel model with fixed and random effects. We also used GMM (1991) and GMM (1998) estimates of our analysis. We found that that results obtained from the GMM (1991) and GMM (1998) are not robust as the assumption of instrument validity was not found to hold good. Therefore, based upon LM test and Hausman test, we conclude that: 1) there is a negative and statistically significant relationship between non-debt tax shields and debt; 2) there is a negative and statistically significant relationship between sales/size and debt; 3) there is a positive and statistically significant relationship between growth and debt; 4) there is a positive and statistically significant relationship between ratio of fixed assets to total assets and debt; and 5) the relationships between profitability and debt and POCI and debt are not statistically significant.

Further, we find that the Indian firms adjust the level of actual debt towards the optimal level of debt with speed of adjustment between 0.50 and 0.55, which is

profound when compared with adjustments of other country firms. Kremp et al. (1999) obtain values for adjustment coefficients of 0.53 and 0.28 for Germany and France respectively, Shyam-Sunder and Myers (1999) 0.59 in the United States, Miguel and Pindado (2001) 0.79 for Spain, Ozkan (2001) 0.57 for the United Kingdom and Gaud et al. (2005) values between 0.14 and 0.387, according to the type of debt used, for Switzerland.

We find a negative and statistically significant relationship between non-debt tax shields and debt and so we can conclude that Indian firms do reduce debt, given the greater possibility of non-debt tax shields.

We confirm the existence of a positive relationship, though insignificant, between profitability and debt. This result suggests the most profitable Indian firms resort more to debt rather opting first for internal financing.

Given the negative and statistically significant relationship between size/sales and debt, we conclude that smaller firms turn more into debt than larger firms, since the former do not have enough stuff to go for internal financing therefore only external sources are left for them.

Further, we find a positive, statistically significant relationship between asset structure and debt. This implies that the asset structure of the firms also plays dominant role in debt seeking. We also find a positive, statistically significant relationship between growth opportunities and debt. This implies that to achieve higher and higher growth Indian firms go for debt financing.

Finally, we do not find a statistically significant relationship between level of risk and debt and between growth profitability and debt. Based on the results obtained, we cannot conclude that a greater level of collaterals contributes to firms increasing debt, that a higher level of risk contributes to decreasing debt or that firm's use debt to finance their growth.

To sum up, we can conclude that Indian firms adjust the actual level of debt towards the optimal level of debt and the level of adjustment is substantial. Size, growth opportunities, capital structure and non-debt tax shields can be considered determinant factors in explaining the capital structure of Indian firms, and consequently in explaining the adjustment towards the optimal level of debt.

Notes

(1) The underlying rationale for the MM theory is that solely the left hand side of the balance sheet, which reflects the company's investment policy (Drobez and Fix, 2003), determines the value of the firm. Therefore, their theory suggests that the value of the firm tends to be independent from the debt balance of the company, and instead is largely affected by the presence of a number of projects handled with positive net present value (NPV).

(2) This section is heavily based on the work of Serrasqueiro and Nunes (2008). For the analysis data of all variables is obtained Capital line data base for the period 2002 to 2009.

(3) It is important to mention that though we do not have evidence of sever multicollinearity between the variables analyzed. But correlation is somewhat higher between $EVOL_{i,t}$ and $GROWTH_{i,t}$ and hence provide evidence of near multicollinearity however, care should be taken in analyzing the correlation matrix presented in Appendix 1, since it is computed by ignoring the panel structure of the data and that is utilized for analysis.

(4) Summary of all results relating to sign and significance of the parameters related to the variables is presented in Appendix 2.

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Appendix 1: Descriptive statistics & correlation analysis

Table A1. *Descriptive statistics*

	$LEV_{i,t}$	$NDTS_{i,t}$	$PROF_{i,t}$	$SIZE_{i,t}$	$TANG_{i,t}$	$EVOL_{i,t}$	$GROWTH_{i,t}$
Mean	0.292653	0.300254	0.261199	6.954037	0.386395	40.72013	197.6891
Median	0.291171	0.216359	0.255022	7.373254	0.361368	20.82680	19.07655
Maximum	1.101908	1.848915	2.346667	12.63313	1.799929	7152.750	117407.5
Minimum	0.000000	0.000000	-33.40313	0.000000	0.000000	-3489.543	-74.97216
Std. Dev.	0.243161	0.281408	1.795818	2.510073	0.244647	339.0820	4379.802
Skewness	0.402393	2.026714	-17.99475	-0.830592	0.934493	13.03922	26.67762
Kurtosis	2.231777	8.338604	335.9027	3.262921	5.068553	304.8653	714.3571
Jarque-Bera	37.13537	1347.929	3363583.	84.85980	233.1606	2754083.	1526627
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Source: Author's calculation							

Table A2. *Pearson's correlation analysis*

	$LEV_{i,t}$	$NDTS_{i,t}$	$PROF_{i,t}$	$SIZE_{i,t}$	$TANG_{i,t}$	$EVOL_{i,t}$	$GROWTH_{i,t}$
$LEV_{i,t}$	1						
$NDTS_{i,t}$	-0.1722	1					
$PROF_{i,t}$	-0.05786	0.08840	1				
$SIZE_{i,t}$	-0.02550	0.0540	0.0975041	1			
$TANG_{i,t}$	0.08744	0.3940	0.09661851	-0.01650	1		
$EVOL_{i,t}$	-0.047603	0.023040	0.02717152	0.00370	-0.03995	1	
$GROWTH_{i,t}$	0.01941	-0.0047070	-0.0035461	0.024669	0.00845	0.76384	1
Source: Author's calculation							

Appendix 2

Table A3. *Summary of the results of applying the various estimators: Empirical evidence for India*

$LEV_{i,t}$	Expected Sign	OLS	Fixed effect	Random effect	Random effect AR(1)	Two-way Random effect	GMM (1991)	GMM (1998)
$LEV_{i,t-1}$	+	----	------	---------	-------	-------	+***	+***
$NDTS_{i,t}$	-	-***	-***	-***	-***	-***	-***	-***
$PROF_{i,t}$	-	- (n.s.)	+(n.s.)	+(n.s.)	+(n.s.)	+(n.s.)	+(n.s.)	+(n.s.)
$SIZE_{i,t}$	+	- (n.s.)	-***	-***	-**	-**	-**	-***
$TANG_{i,t}$	+	+***	+***	+***	+***	+***	+(n.a)	+***
$EVOL_{i,t}$	-	-**	-(n.s.)	-(n.s.)	-(n.s.)	-(n.s.)	-(n.s.)	-(n.s.)
$GROWTH_{i,t}$	+	+*	+(n.s.)	+(n.s.)	+*	+(n.s.)	+**	+**

Note: (1) n.s. denotes not significant and (2) *** significant at 1% significance; ** significant at 5% significance; * significant at 10% significance.
Source: Author's calculation.

Appendix 3

Table A4. *BSE listed companies considered for analysis*

SL.No	Name of the company	SL.No	Name of the company
1	Aban Offshore Ltd	46	Lanco Infratech Ltd
2	ABB Ltd	47	Larsen & Toubro Ltd
3	AIA Engineering Ltd	48	Mahindra & Mahindra Ltd
4	Apollo Hospitals Enterprise Ltd	49	Maruti Suzuki India Ltd
5	Areva T&D India Ltd	50	Mcleod Russel India Ltd
6	Aurobindo Pharma Ltd	51	MphasiS Ltd
7	BEML Ltd	52	MRF Ltd
8	Bharat Electronics Ltd	53	National Aluminium Company Ltd
9	Bharat Forge Ltd	54	Neyveli Lignite Corporation Ltd
10	Bharat Heavy Electricals Ltd	55	NHPC Ltd
11	Bharat Petroleum Corporation Ltd	56	NMDC Ltd
12	Biocon Ltd	57	NTPC Ltd
13	Blue Star Ltd	58	Oil & Natural Gas Corpn Ltd
14	Cadila Healthcare Ltd	59	Opto Circuits (India) Ltd
15	Cipla Ltd	60	Oracle Financial Services Software Ltd
16	Colgate-Palmolive (India) Ltd	61	Orchid Chemicals & Pharmaceuticals Ltd
17	Crompton Greaves Ltd	62	Patni Computer Systems Ltd
18	Cummins India Ltd	63	Piramal Healthcare Ltd
19	Divis Laboratories Ltd	64	Power Grid Corporation of India Ltd
20	Dabur India Ltd	65	Praj Industries Ltd
21	Dr Reddys Laboratories Ltd	66	Punj Lloyd Ltd
22	Essar Oil Ltd	67	Rajesh Exports Ltd
23	Financial Technologies (India) Ltd	68	Ranbaxy Laboratories Ltd
24	GAIL (India) Ltd	69	Reliance Industrial Infrastructure Ltd
25	Gammon India Ltd	70	Reliance Industries Ltd
26	Gitanjali Gems Ltd	71	Reliance Infrastructure Ltd
27	Glaxosmithkline Pharma Ltd	72	Rolta India Ltd
28	Glenmark Pharmaceuticals Ltd	73	Ruchi Soya Industries Ltd
29	Godrej Consumer Products Ltd	74	Sesa Goa Ltd
30	GVK Power & Infrastructure Ltd	75	Siemens Ltd
31	Havells India Ltd	76	Steel Authority of India Ltd
32	HCL Technologies Ltd	77	Sterlite Industries (India) Ltd
33	Hero Honda Motors Ltd	78	Sun Pharmaceuticals Industries Ltd
34	Hindalco Industries Ltd	79	Suzlon Energy Ltd
35	Hindustan Petroleum Corporation Ltd	80	Tata Motors Ltd
36	Hindustan Zinc Ltd	81	Tata Power Company Ltd
37	Indian Oil Corporation Ltd	82	Tata Steel Ltd
38	Infosys Technologies Ltd	83	Tech Mahindra Ltd
39	ITC Ltd	84	Thermax Ltd
40	Jindal Steel & Power Ltd	85	United Spirits Ltd
41	JSW Energy Ltd	86	Usha Martin Ltd
42	JSW Steel Ltd	87	Videocon Industries Ltd
43	Jubilant Organosys Ltd	88	Welspun Corp Ltd
44	Jyoti Structures Ltd	89	Whirlpool of India Ltd
45	Lakshmi Machine Works Ltd	90	Wipro Ltd

Source: Author's calculation.