Vidyasagar University Journal of Commerce
Vol. 19, 2014/ISSN 0973-5917

DETERMINANTS OF CAPITAL STRUCTURE OF SELECTED INDIAN CEMENT COMPANIES - A QUANTILE REGRESSION APPROACH

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Abstract

The paper examines the impact of eight firm - pecific determinants of capital structure, viz., firm size, tangibility, growth opportunities, profitability, non-debt tax shields, operating risk, liquidity and firm age, over the entire conditional distribution of leverage through the application of quantile regression methodology on a balanced panel data related to a selected sample of 22 Indian cement companies listed on NSE over a period of 5 years from 2007-08 to 2011-12 .

Introduction

Capital structure (or financial leverage[1]) refers to the combination of debt and equity capital used by a firm to finance its long-term operations. The strategic financing decision involving the choice of the most appropriate mix of equity and debt finance in the firm's capital structure is known as capital structure decision. Since the seminal work of Modigliani & Miller (1958) the capital structure framework has been extensively studied for more than five decades. The issue of non - linearity in capital structure decisions, however, has been addressed by few studies so far [Fattouh et al. (2005, 2008) , Nieh et al. (2005), Arce et al. (2009), Bahng & Jeong (2012), Wellalage & Locke (2012) and Krishnankutty & Chakraborty (2013)]. The present study is primarily an attempt to extend the research in this direction with an ' intra-industry' approach focusing on the Indian cement industry, which as a producer ranks second globally after China with production reaching 272 million tonnes (MT) over the period 2006-2013 and expected to touch 407 MT by 2020; and which, according to a study by Global Construction Perspectives and Oxford Economics, is capable of becoming the world's third largest construction market after China and the U.S.A by 2025 with an expected annual volume of output of US$ 1 trillion[2] .

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[1] Debt-equity ratio, hereafter referred to as 'leverage' only .

[2] http://www.ibef.org/industry/cement-india.aspx .

2. Theoretical Aspects of Capital Structure and Literature Review

2.1 Capital Structure Theories

Since the proposition of the value-irrelevance hypothesis by Modigliani & Miller (M & M, 1958), two dominant and conflicting approaches to the theoretical framework of debt-equity choice have been developed to consider various factors of market imperfections (such as taxation, bankruptcy costs, transaction costs, agency problems[3] and asymmetric information[4]) originally ignored by M & M: static trade-off hypothesis and pecking order hypothesis .

2.1.1 Static Trade - Off Hypothesis (STOH)

It is derived from the models based on taxes , bankruptcy costs and agency problems. This hypothesis proposes that the value of a firm may be maximized at an optimal level of capital structure where the marginal benefits of debt equal the marginal costs of debt, holding its assets and investment plans constant. The benefits of debt include :

(1) Tax advantage of debt, interest on debt being tax deductible[5]; and

(2) Reduced agency costs of free cash flow[6]: Corporate managers have the incentive to waste free cash flow on perquisites and bad investment. Debt financing acts as a disciplinary device to mitigate managerial free cash flow waste[7].

The costs of debt include :

(1) Bankruptcy costs of debt, i.e., the increased costs of financing with debt instead of equity that result from a higher probability of bankruptcy [8] ;

(2) Agency costs of debt, i.e., the costs resulting from conflicts between managers (who may want to invest in risky projects for the benefit of shareholders seeking high rates of return) and bondholders (who being interested in a safer investment may want to place restrictions on the use of their money to reduce their risk); and [9]

(3) Loss of non-debt tax shields[10] which substitutes and diminishes the benefits from interest tax shields[11] .

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[3] Conflicts of interest between either stockholders and managers or stockholders and bond holders (Jensen & Meckling, 1976).

[4] A situation in which one party in a transaction has relevant and superior information compared to another.

[5] M-M (1963), Kraus & Litzenberger (1973), Scott (1976), Bradley et al. (1984), Leland & Toft (1996).

[6] Free cash flow is cash flow in excess of that required to fund all projects that have positive net present values when discounted at the relevant cost of capital.

[7] Jensen & Meckling (1976), Jensen (1986).

[8] Kraus & Litzenberger (1973) , Scott (1976), Bradley et al. (1984), Leland & Toft (1996) .

[9] Jensen & Meckling (1976) , Myers (1977) , Bradley et al. (1984) , Leland & Toft (1996) .

[10] Such as accelerated depreciation allowances on investments , tax loss carry - forwards or backwards , research and development expenditures , preliminary and preoperative expenditure etc.

[11] DeAngelo & Masulis (1980) , Bradley et al. (1984) .

2.1.2 Pecking Order Hypothesis (POH)

This hypothesis, propounded by Myers (1984) and Myers & Majluf (1984) states that the cost of financing increases with transaction costs and information asymmetry between managers (having superior information about the true condition of the firm) and potential investors. So firms prioritize their sources of financing preferring the following order: internal financing, debt, convertible securities, preferred shares, and equity shares. In contrast to trade -off hypothesis, there is no optimal capital structure.

2.2 Determinants of Corporate Capital Structure

Based on the above theories and prior empirical studies [Titman & Wessles (1988), Harris & Raviv (1991), Rajan & Zingales (1995), Bhaduri (2002), Huang & Song (2006), Delcoure (2007), Eldomiaty (2008), Akhtar & Oliver (2009) and Mukherjee & Mahakud (2012) and the references cited therein] the determinants of capital structure may be grouped as firm-specific, industry-specific and macro-economic .

This study considers the following eight firm- specific determinants of capital structure of Indian cement companies : firm size, tangibility , profitability, growth opportunities , non-debt tax shields , business risk , firm age and liquidity.

The implications of STOH and POH on these determinants are discussed below .

(1) Firm size

STOH : Larger firms are likely to have higher debt levels to maximise the tax benefits from debt (Rajan & Zingales ,1995) . Also , agency costs model predicts that larger firms having lower monitoring costs will tend to be using more debt than smaller firms.

(Um , 2001) Hence, firm size will be positively related to leverage .

POH : Larger firms, being better known, will have less asymmetric information problems , should tend to have more equity than debt and thus have lower leverage. Hence, firm size and leverage are expected to be negatively related .

(2) Tangibility

STOH : Tangible assets, which can be used as collateral for debt, suffer a smaller loss of value when firms go into distress and reduce the scope of asset substitution effect (Harris & Raviv, 1991; Titman & Wessels 1988). Hence, firms with more tangible assets should have higher leverage .

POH : Tangibility will generate less information asymmetries between potential investors and shareholders. So the cost of issuing equity will fall, resulting in lower levels of debt. Hence , tangibility and leverage are expected to be negatively related.

(3) Profitability

STOH : Profitable firms would employ more debt since expected bankruptcy costs are lower and expected tax shields are higher. Hence, profitability is expected to be positively related to leverage .

POH : Firms with large retained earnings will tend to have less debt. Hence , leverage and profitability are expected to be negatively related.

(4) Growth opportunities

STOH : Firms with growth opportunities may find it difficult and costly to rely on debt for financing , as the degree of risk may be high for growth oriented investments. Growth opportunities which can be thought of as real options will have associated agency costs making it difficult for a firm to borrow against them than against tangible fixed assets (Myers ,1977). Hence , leverage and growth opportunities will be negatively related .

POH : A firm with growth opportunities is expected to rely on debt to finance such investments in order to maintain its debt - equity ratio as its equity increases due to the large retention of earnings. Thus , leverage and growth opportunities are expected to have a positive relationship.

(5) Non - Debt Tax Shields (NDTS)

STOH : NDTS act as an alternative to interest tax shields of debt . Hence , NDTS is expected to be negatively related to leverage .

POH : No specific relation exists .

(6) Business Risk

STOH : Business risk serves as a proxy for the probability of bankruptcy . Firms with high business risk are likely to face higher costs of bankruptcy and will therefore use less debt. Similarly, earnings volatility may limit the probability of fully utilizing the benefits from tax shields leading to lower level of debt .

POH : Higher volatility in earnings will lead potential investors to require a higher rate of return , making it more expensive to issue equity due to more information asymmetries; so risky firms will tend to have higher levels of debt . Hence , business risk and leverage are expected to be positively related .

(7) Liquidity

STOH : The disciplining benefit of debt due to agency problems causes cash-rich firms to acquire additional debt so that , after meeting the debt servicing obligation, managers have little free cash flows to squander . Moreover , a firm should have high liquidity in order meet high debt service obligation. Hence, leverage is expected to be positively related to liquidity .

POH : More liquid firms, being in the possession of more internal funds, tend to borrow less. Hence, leverage and liquidity are expected to be negatively related .

(8) Firm Age

STOH : Younger firms cannot afford debt as their bankruptcy costs are high, and their earnings are too low to utilize the benefit of interest tax shield. Hence, age and leve-rage are expected to be positively related .

POH : Younger firms would be more prone to facing the problems of asymmetric information and so they are likely to avoid the equity market and instead depend on debt . Hence, leverage is expected to be negatively related to age .

The expected relationships between leverage and the above firm- specific determinants derived from Static Trade-Off Hypothesis and Pecking Order Hypothesis are summa-rized in Table 1.

2.4 Issue of Non-Linearity in Capital Structure Decisions

The non-linearity issue in capital structure choices of firms has been studied from the following perspectives :

(1) Application of polynomial functional forms of second-order or third-order . Arce et al. (2009) tested whether the mis-specifications of the linear model of Lemmon et al. (2008) are concerned with non- linear models and confirmed that higher-order terms were significant .

(2) Application of quantile regression methodology which, unlike mean regression , properly captures the heterogeneous relations between capital structure and its determinant variables for the entire distribution of capital structures of firms. Fattouh et al. (2005), Fattouh et al. (2008), Bahng & Jeong (2012), Wellalage & Locke (2012) and Krishnankutty & Chakraborty (2013) applied this methodology in the studies on British, Korean , Australian , Kiwi (New Zealand) and Indian firms respectively . The pioneering study by Krishnankutty & Chakraborty (2013) in the context of Indian corporate firms, considers 213 non-financial companies comprising the Bombay Stock Exchange 500 index (BSE 500) during a period of 10 years from 2002 to 2011.

(3) Application of threshold level model used to find a threshold debt ratio where capital structure decisions can be explained or split by two different linear functions. If the current debt ratio is below this threshold debt ratio, the firm will increase its debt ratio and vice versa [Nieh et al. (2005)].

3. Research Methodology

3.1 Data Source and Sample Selection

The secondary data, obtained from CMIE Prowess database, is of panel data type consisting of a selected sample of 22 Indian cement companies listed on the National Stock Exchange (NSE) of India over a period of 5 years from 2007-08 to 2011-12. The companies having positive net worth, positive profitability and maintaining their identities and reporting annual financial statements continuously, for the entire period of the study, have been selected for the study .

3.2 Dependent and Independent Variables

Based on previous empirical studies the variables used in this study include :

(A) Dependent Variable : Quasi Market Value of Debt to Equity ratio expressed as:

$$MDER = \frac{\text{Book Value (BV) of Total Debt}^{12}}{\{\text{BV of Total Debt + Market Capitalization (MC) of equity shares}\}} \quad (1)$$

(B) Independent Variables :

(a) Firm Size (SIZE) = Natural logarithm of Total Assets (TA) (2)

(b) Tangibility (TANG) = (Tangible Fixed Assets / TA) (3)

(c) Non – Debt Tax Shields (NDTS) = (Depreciation & Amortizations / TA) (4)

(d) Profitability (PROF) = Return on Assets (ROA)
= [Earnings Before Interest and Tax (EBIT) / TA] (5)

(e) Growth Opportunities (GROW) = Market to Book Ratio

$$= \frac{\text{MC of equity shares} + (\text{BV of Total Assets} - \text{BV of Equity})}{\text{BV of Total Assets}} \quad (6)$$

(f) Business Risk (BRISK) = Coefficient of Mean Absolute Deviation of EBIT

$$= [\, |\, EBIT_t - AVE(EBIT)_t \,| \, / AVE(EBIT)_t \,] \quad (7)$$

where $AVE(EBIT)_t$ = cross - sectional mean of EBIT for a particular period;

(g) Liquidity (LIQ) = Current ratio = (Current Assets /Current Liabilities) (8)

(h) Firm Age (AGE) = Natural logarithm of (Y - t) (9)

where Y = year of incorporation of firm[13] , and t = relevant time period of study.

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[12] Includes preference share capital

[13] All firm in the sample were incorporated before the first period (2007-08) of the study .

3.3 Econometric Model

The Ordinary Least Square (OLS) regression technique models the relation between a set of Independent variables (IVs) and a Dependent Variable (DV) estimating the conditional mean value of the DV for given levels of IVs ; the regression coefficient associated with an IV representing the change in the DV produced by a one unit change in the IV. A more comprehensive picture of the effect of the IVs on the DV can be obtained by using Quantile Regression (QR) methodology which models the relation between a set of IVs and specific quantiles[14] of the DV; the quantile regression parameter estimating the change in a specified quantile of the DV produced by a one unit change in the IV. Quantile regression is able to describe the entire conditional distribution of the DV thus exploring the possible non-linear effects (i.e., the variability of the regression coefficients at different quantiles of the DV) in the relationships between the DV and the IVs . Also , QR considers the heterogeneous characters of the sample units whereas OLS regression considers only the 'average sample unit'. Moreover, QR is robust to outliers and works better than OLS regression, especially for non-normal data.

The quantile regression model was introduced by Koenker & Bassett (1978).

Let (y_i, x_i) , i = 1, 2 , …, n , be a sample from some population where y_i is the dependent variable and x_i' is a (K×1) vector of regressors. Assuming that the q^{th} quantile of the conditional distribution of y_i is linear in x_i , the conditional quantile regression model may be written as:

$$y_i = Q_? (y_i / x_i) + e_{? i} \quad (10)$$

$$Q_? (y_i / x_i) = \inf \{ y : F_i (y | x) \geq ? \} = x_i' ß_? \quad (11)$$

$$Q_? (e_{? i} / x_i) = 0 \quad (12)$$

where $Q_? (y_i/x_i)$ denotes the ?-th conditional quantile of y_i conditional on the regressor vector x_i ; ß is the unknown vector of parameters to be estimated for different values of ? in (0,1); e is the vector of error terms; and F_i (.| x) denotes the conditional distribution function. The entire distribution of y, conditional on x, can be traced by varying the value of ? from 0 to 1.

The estimator for $ß_?$ is obtained by solving the following linear programming problem (Koenker & Hallock, 2001):

$$\arg\min \sum_{i=1}^{\Pi} \rho_\theta(yi - xi\square\beta_\theta) \quad (13)$$

[14] Quantiles are points taken at regular intervals from the cumulative distribution function (CDF) of a random variable. A quantile or percentile is a general term for median, quartile, decile, etc.

where $\rho_{?}(\delta)$ is a loss function defined as :

$$\rho_{\theta}(\delta)\begin{bmatrix} \theta\delta & if\,\delta \leq 0 \\ (\theta-1)\delta & if < 0 \end{bmatrix} \quad (14)$$

The loss function assigns $\rho_{?}$ a weight of ? to positive residuals and a weight of (1-?) to negative residuals .

The following linear quantile regression model for panel data is specified for this study :

$$Q_{\theta}(MDER_{it}) = \alpha_{\theta} + \sum \beta_{\theta,\kappa} X_{it} + \varepsilon_{\theta it} \quad (15)$$

where α = intercept ; i = company ; t = time ; k = 1 , 2 , …, 8 ; X = SIZE , TANG , NDTS, PROF , GROW , BRISK , LIQ and AGE .

We will consider five quantiles namely 5^{th} , 25^{th} , 50^{th} , 75^{th} and 95^{th} . EViews 8 software has been used for econometric analysis . The estimates of the standard errors of the coefficients are obtained by applying the modified Markov Chain Marginal Bootstrapping [MCMB – A (MCMB autocorrelation algorithm which is robust to heteroskedasticity] proposed by Kocherginsky, He , and Mu (2005) with 100 bootstrap replications .

3.4 Statement of Hypothesis

The generalized Null Hypothesis may be stated as :

$H_{0(X)}$: There is no significant impact of determinant ' X ' on the quasi Market Debt - Equity Ratio (MDER) of Indian cement companies listed on the NSE during the period 2007-08 to 2011-12 , at the $?^{th}$ conditional quantile of MDER conditional on X [X = SIZE , TANG , NDTS , PROF , GROW , BRISK , LIQ and AGE ; ? = 0.05, 0.25 , 0.5 , 0.75 , 0.95] .

4. Empirical Results and Findings

From the descriptive statistics in Table 2, we see that mean and median values of MDER are 0.36 and 0.38 respectively suggesting that on average Indian cement companies listed on the NSE was less than moderately levered during the period 2007-08 to 2011-12. All variables except SIZE, TANG, and AGE are positively skewed. MDER, SIZE, TANG and AGE are platykurtic whereas the other variables are leptokurtic. The J-B test statistics and the corresponding p values show that for all the variables except MDER, the normality hypotheses are rejected at statistical significance levels of 1 % or 10 %. Since most of the variables are non- normal, quantile regression methodology is more appropriate than pooled OLS or fixed effects/random effects panel data regression .

The results of quantile regression (along with pooled OLS regression) are enumerated in Table 3 . TANG is positively related to leverage, whereas PROF, GROW and AGE are negatively related to leverage, over the entire conditional distribution of leverage. SIZE , NDTS, BRISK and LIQ are positively related to leverage at (5^{th} and 25^{th} quantiles), (5^{th} , 25^{th} , 75^{th} and 95^{th} quantiles), 95^{th} quantile, and 5^{th} quantile respectively; and negatively related elsewhere. At the 5^{th} quantile all the variables are statistically significant at 1 % level. At the 25^{th} quantile all variables, except SIZE, NDTS are significant at 1% or 10 % level . At the 50^{th} quantile or median, TANG , PROF, GROW and BRISK are significant at 1% level whereas LIQ is significant at 10% level . At the 75^{th} quantile, TANG and GROW are significant at 1 % level; and NDTS and PROF are significant at 1% level. At the 95^{th} quantile, TANG, NDTS and GROW are significant at 1% level; and SIZE and LIQ are significant at 5% level. TANG and GROW appear to be the most significant determinants throughout the entire conditional distribution of leverage. The indirect relationships between SIZE and leverage from the 50^{th} quantile onwards imply that at moderate to high levels of debt, firm size will no longer act as safe collateral for additional debt. Also, larger firms having less information asymmetry are likely to issue more equity than debt. Moreover , firms having extremely high levels of debt are more likely to reduce debts. GROW is negatively related to leverage at all quantiles following the prediction of trade-off hypothesis. The increase in the absolute values of the coefficients of GROW with increase in the levels of leverage quantile imply that the marginal effects of GROW increase with increase in debt due to the increase in agency costs associated with the intangible growth opportunities with additional debt. The negative relationship between BRISK and leverage upto 95^{th} quantile (as per trade-off hypothesis) changes to a positive one at 95^{th} quantile corroborating the prediction of pecking order hypothesis that risky firms are more likely to have higher levels of debt due to greater information asymmetries . Moreover, the marginal impact of BRISK on leverage decreases with increase in debt. Since LIQ is positively related to leverage only at the 5^{th} quantile , the disciplining benefit of debt in reducing managerial wastages of free cash flows may be said to be manifested only at very low levels of debt. The graphical views of non-linearity in the relationships between capital structure and the considered determinant variables are shown in Fig.(1) . From Table 4, which enumerates the applicability of the Static Trade-Off Hypothesis (STOH) and Pecking Order Hypothesis (POH) for each variable at various quantiles (along with the relevant level of statistical significances) , we observe that the results of quantile regression may be said to weigh more in favour of STOH than POH in respect of the sample of Indian cement companies during the given period of study .

5. Concluding Remarks

The results of quantile regression analysis considering the Indian cement companies listed on the NSE during the period 2007-08 to 2011-12 indicate marked non-linearities in the relationships between leverage and its firm-specific determinants with the estimated regression coefficients of the explanatory variables changing magnitudes and statistical significance accompanied by change of signs (in some cases) at different quantiles . Moreover , considering the applicability of the Static Trade - Off Hypothesis (STOH) or Pecking Order Hypothesis (POH) for the determinants at various quantiles , it may be inferred that STOH outweighs POH for the sample under study. This study, though limited to a particular industry, is primarily an attempt to affirm the existence of non-linearities in capital structure determinants of corporate firms in the Indian scenario. Further researches concerning non-linear behaviours of corporate capital structure determinants may be conducted by considering additional variables and using variants of the quantile regression methodology.

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TABLE 1
Theoretical Impact of Firm - specific Factors on Capital Structure

Firm - specific Determinants of Capital Structure	Static Trade - off Hypothesis	Pecking Order Hypothesis
Firm Size	Positive	Negative
Tangibility	Positive	Negative
Non - Debt Tax Shields	Negative	No specific relation
Profitability	Positive	Negative
Growth Opportunities	Negative	Positive
Business risk	Negative	Positive
Liquidity	Positive	Negative
Age	Positive	Negative

TABLE 2
Descriptive Statistics of Variables

Variables	MDER	SIZE	TANG	NDTS	PROF	GROW	BRISK	LIQ	AGE
Mean	0.359191	9.670673	0.574336	0.045100	0.142964	1.170764	0.939191	1.082364	3.616155
Median	0.375500	9.917000	0.599000	0.038000	0.135500	0.986500	0.782000	0.905000	3.497000
Maximum	0.803000	12.34300	0.822000	0.246000	0.402000	2.971000	5.451000	3.920000	4.745000
Minimum	0.000000	6.761000	0.272000	0.009000	0.004000	0.402000	0.016000	0.310000	2.079000
Std. Dev.	0.217194	1.382920	0.139479	0.036916	0.080433	0.551571	0.946370	0.613606	0.670866
Skewness	0.011061	-0.369899	-0.434949	3.224888	0.815082	1.128895	2.376312	2.275754	-0.402982
Kurtosis	2.132637	2.236690	2.265656	14.38540	3.859202	3.536545	9.080131	10.05945	2.350185
Jarque-Bera	3.450372	5.178905	5.939924	784.7905	15.56347	24.68351	272.9624	323.3633	4.912585
JB (Prob.)	0.178140	0.075061	0.051305	0.000000	0.000417	0.000004	0.000000	0.000000	0.085752
Obs.	110	110	110	110	110	110	110	110	110

TABLE 3
Results of Quantile Regression

Regressors	Q 0.05	Q 0.25	Q 0.5	Q 0.75	Q 0.95
CONSTANT	-0.352 *** (-20.318)	0.544 *** (4.331)	0.743 *** (4.304)	0.825 *** (5.048)	1.192 *** (7.386)
SIZE	0.058 *** (33.140)	0.005774 (0.527)	-0.006 (-0.361)	-0.024 (-1.465)	-0.040 ** (-2.091)
TANG	0.603 *** (43.089)	0.330 *** (3.155)	0.354 *** (3.492)	0.510 *** (4.232)	0.394 *** (3.370)
NDTS	0.359 *** (3.356)	0.183 (0.752)	-0.092 (-0.214)	1.242 * (1.858)	0.738 *** (3.327)
PROF	-0.420 *** (-27.915)	-0.763 *** (- 4.187)	-0.768 *** (-3.857)	-0.480 * (-1.700)	-0.001 (-0.056)
GROW	-0.057 *** (-31.794)	-0.150 *** (-6.822)	-0.199 *** (- 4.519)	-0.251 *** (-5.000)	-0.285 *** (-7.716)
BRISK	-0.137 *** (-62.540)	-0.052 *** (-3.908)	-0.045 *** (-2.833)	-0.020 (-1.045)	0.015 (0.745)
LIQ	0.035 *** (31.162)	-0.095 *** (-3.549)	-0.076 * (-1.702)	-0.020 (-0.497)	-0.052 ** (-2.063)
AGE	-0.065 *** (-34.938)	-0.026 * (-1.748)	-0.017 (-1.086)	-0.023 (-1.036)	-0.035 (-0.914)
Pseudo R^2	0.268	0.443	0.420	0.408	0.445
Adjusted Pseudo R^2	0.210	0.399	0.374	0.361	0.401

The first observations represents estimated coefficients ; the second observations within ( ) are the values of *t* - statistic . * , ** and *** represents significance levels of 10 % , 5 % and 1 % respectively .

Table 4
Applicability of STOH or POH at various Quantiles

	Q 0.05	Q 0.25	Q 0.5	Q 0.75	Q 0.95
SIZE	STOH ***	STOH	POH	POH	POH **
TANG	STOH ***	STOH **	STOH ***	STOH ***	STOH ***
NDTS	-	-	STOH	-	-
PROF	POH ***	POH ***	POH ***	POH *	POH
GROW	STOH ***	STOH ***	STOH ***	STOH ***	STOH ***
BRISK	STOH***	STOH ***	STOH ***	STOH	POH
LIQ	STOH ***	POH ***	POH *	POH	POH **
AGE	POH ***	POH *	POH	POH	POH

Quantile estimates of coefficients with 95 % confidence interval

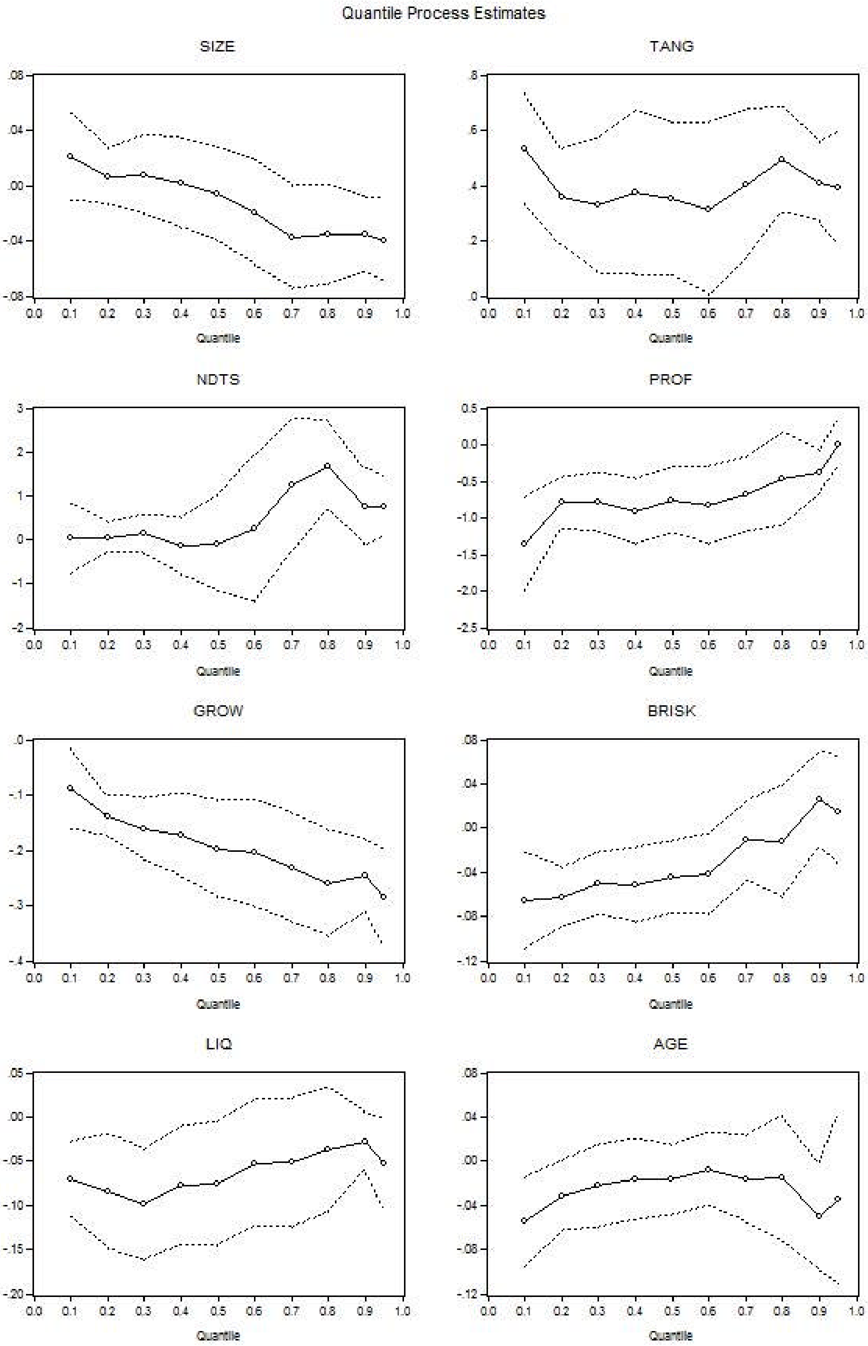

Figure 1