

# An Insight into the Capital Structure Determinants of the Pharmaceutical Companies in Bangladesh

Mahabuba Lima

## Abstract

*Determining the optimal capital structure is one of the most fundamental policy decisions faced by financial managers. Since optimal debt ratio influences firm's market value, different firms determine capital structures at different levels to maximize their market value. This issue naturally contributed to the emergence of several competing capital structure theories (MM theory, trade-off theory, agency theory, pecking order theory) with an aim to help firms decide their optimal capital structure. However, conclusions drawn by these theories in explaining capital structure choice of firms are still controversial. Moreover, the factors those determine the optimal capital structure of firms have been debated for a long time. Numerous researches have been carried out over the years on these issues. But the empirical researches have not been very successful in providing satisfactory answers. Not only that, most of these empirical studies have been conducted on the developed countries' perspective. This paper attempts to focus on the factors determining the capital structure choice and the conformity of these factors with the predictions drawn by the competing capital structure theories in the context of Bangladesh. Multiple regression model has been used for the pooled data of listed pharmaceutical companies in Bangladesh considering agency cost of equity, growth rate, operating leverage, bankruptcy risk, tangibility and debt service capacity as the determinants and the Debt Ratio (DR) as the dependent variable. The results proved that the regression is a good fit and the determinants explain about 69% variation of the capital structure of pharmaceutical companies. All the six variables prove to be statistically significant determinants of capital structure. Growth rate, operating leverage, tangibility and debt service capacity are positively related with the capital structure whereas agency cost of equity and bankruptcy risk show negative relation. This empirical analysis finds that agency cost theory and static trade-off theory help describe the capital structure pattern of the pharmaceutical companies in Bangladesh.*

**Keywords:** Capital structure determinants, MM theory, trade-off theory, pecking order, agency theory, financial leverage/capital structure/debt ratio.

## 1. INTRODUCTION

One of the many objectives of financial managers is to maximize the wealth of shareholders. Shareholders' wealth maximization depends on some issues like managing lower cost of capital, generating tax shield benefits from debt financing, reducing the agency costs of debt and equity etc. And all these issues are determined and managed by reaching at a point of optimal capital structure. As a result, financial managers strive to ensure the optimal mix of debt and equity in the firm's capital structure. Whether such an optimal capital structure exists in reality or not? What are the potential factors those affect such optimal capital structure? These are the questions to be answered by a researcher. In other words, aim of a researcher is to identify the potential determinants of capital structure in a given industrial settings so that the financial managers can benefit from this to make an optimal mix of debt and equity to maximize wealth of shareholders.

Although the above questions are of paramount importance, academic theories and literatures have not been very useful to provide satisfactory answers on such practical questions. Rather, the theories of capital structure still remain one of the most controversial issues in modern corporate finance. Not only there is any universal theory of capital structure, but also the assumptions of the several conditional theories contradict with one another. This is not the end of the story. Empirical results show no strong

consensus despite decades of intensive researches. Such disagreement over basic empirical results in turn proves disagreement about desirable features for theories.

Moreover, the contemporary theories and the empirical researches are primarily based on aspects of and data from developed western economics. Few researches are carried on the perspective of developing economies. Hence, it is hard to say whether conclusions from theoretical and empirical research carried out in developed economies are also applicable for developing economies too; or a different set of factors work in deciding capital structure in developing economies? Rajan and Zingales (1995) studied the G-7 countries. This work is extended by including some data from emerging economies by Booth et al in 2001. Their conclusions suggest that there were some common attributes in the capital structures of firms in different countries but they felt the necessity of further research to be carried out to identify the determinants of capital structure in particular institutional settings or countries.

Like other developing economies, the area of research for capital structure is still unexplored in Bangladesh. Researches made on the ground of capital structure theories and determinants of capital structure in the context of Bangladesh are small in number. Only Haque (1989) and Chowdhury (2004) shed light on this issue. As a result, the study of capital structure determinants bears significant importance. This study attempts to test the influence of various independent factors in the capital structure and the conformity of these factors with the predictions drawn by capital structure theories. Unlike Chowdhury (2004) who focus on the capital structure determinants on both Japan-Bangladesh contexts, sample of this paper, on the other hand, spans only Bangladeshi companies. Chowdhury (2004) focused on agency cost model of capital structure and used some agency variables. Whereas in this paper, I have examined the determinants of capital structure in a detailed way focusing on agency cost, trade-off and pecking order model with variables like agency cost of equity, growth rate, operating leverage, bankruptcy risk, tangibility and debt service capacity on the 17 Bangladeshi pharmaceutical companies listed on Dhaka Stock Exchange Ltd. as of June 30, 2009.

The paper is organized as follows: Section 1 gives a brief introduction of the background of the study. Section 2 describes capital structure theories and observed capital structure patterns from previous empirical studies. Section 3 sheds light on the research design, methodology and measurement issues. Section 4 summarizes the results from the empirical analysis. Finally section 5 presents the conclusion.

## **2. CAPITAL STRUCTURE THEORIES AND OBSERVED CAPITAL STRUCTURE PATTERNS**

The history of modern theory of capital structure started with the path-breaking paper of Modigliani and Miller published in 1958. In this paper, they used some restrictive set of assumptions and contended in their first proposition that the impact of financing on the value of the firm is irrelevant. The Miller and Modigliani (M&M) propositions assert that there would be arbitrage opportunities in the perfect capital market if the value of the firm depends on its capital structure. They also argue that if investors and firms can borrow at the same rate, investors can neutralize any capital structure decisions the firm's management may take (home-made leverage). Though their proposition theoretically sounds good but it is only valid under perfect market conditions (no tax is one of them) which were not actually possible in real world. They corrected this proposition in 1963 incorporating the effect of tax on value and cost of the capital of the firm (Modigliani and Miller 1963). Their new proposition contends that, in the world of corporate tax, the value of the firm depends on the variation of the debt level and tax shield benefit on interest payments. In 1976, Miller brought forward the next version of irrelevance theory of capital structure. He appealed that, capital structure decisions of firms with both corporate and personal taxes circumstances are irrelevant (Miller 1977).

Then there develops static tradeoff model. According to this model, optimal capital structure does exist. A firm sets its target debt level and then gradually moves towards it. This theory asserts that a firm's optimal debt-equity ratio is achieved at the point when the marginal present value of the tax on additional debt is equal to the increase in the present value of financial distress costs. Under this theory, a firm's target leverage is driven by three competing forces: (i) taxes, (ii) costs of financial distress (bankruptcy costs), and (iii) agency costs. Both tax-based and agency-cost-based models belong to the static tradeoff models as supported by Kraus and Litzenberger (1973), Jensen and Meckling (1976), Miller (1977), Kim (1978), Bradley, Grossman and Hart (1982), Jarrel and Kim (1984), Jensen (1986), Harris and Raviv (1990), Stulz (1990) and Chang (1999).

Agency theory developed by Jensen and Meckling in 1976 also suggest for an optimal debt level in capital structure by minimizing the agency costs arising from the divergent interest of managers with shareholders and debt holders. Jensen and Meckling (1976) suggest that either ownership of the managers in the firm should be increased in order to align the interest of managers with that of the owners or use of debt should be motivated to control managers' tendency for excessive perk consumptions. Jensen (1986) presents agency problem associated with free-cash flow. He suggests that free cash flow problem can be somehow controlled by increasing the stake of managers in the business or by increasing debt in the capital structure, thereby reducing the amount of "free" cash available to managers.

There are several capital structure theories like signaling theory and pecking order theory those apply notion of asymmetric information with an attempt to explain the role asymmetric information plays in determining the optimal capital structure. Ross (1977) laid down the foundations of signaling theory and its various extensions. He assumes that managers being the insiders have a better knowledge about the true distribution of future returns of the firm whereas investors do not. According to Ross, investors interpret larger levels of leverage as a signal of the firm's current stable income, high future cash flows and managers' confidence about the performance of their own firm. Accordingly, Ross (1977) concludes that investors take larger levels of debt as a signal of higher quality and that profitability (as a proxy of quality performance) and leverage are thus positively related.

On the other hand, pecking order theory, suggested by Myers and Majluf in 1984, who captured the effect of asymmetric information upon the mispricing of new securities, says that there is no well-defined target debt ratio. They say that investors generally perceive that managers are better informed of the price sensitive information of the firms. Investors' perception is such that managers issue risky securities when they are overpriced. This perception of investors leads to the underpricing of new equity issue. Sometimes this underpricing becomes so severe that it causes substantial loss to the existing shareholders. To avoid the problem arising from information asymmetry firms fulfill their financing needs by preferring retained earnings as their main source of financing, then debt and finally external equity financing as a last resort. Capital structure is thus arranged by a hierarchy of preferences for the issuance of new capital. This has been termed as "Pecking Order Theory".

While studying determinants of capital structure in the context of Bangladesh I have come across the most initial studies examined in the international level. In a cross sectional analysis Rajan and Zingales (1995) find that "the determinants of capital structure that have been reported for the U.S. (size, growth, profitability, and tangible assets) are important in other countries as well". The analysis by Booth et al (2001) suggests that the developing countries face more or less same factors in determining capital structure. Recent work by Kremp et al. (1999), De Miguel and Pindado (2001), and Ozkan (2001) also focuses on the issue of capital structure decisions, offering better insight on the determinants explaining the target debt-to-equity ratio. A very recent study by Drobetz and Fix (2003) tested leverage predictions of the trade-off and pecking order models using Swiss data. Confirming the pecking order model but contradicting the trade-off model, they say that "more profitable firms use less leverage. Firms with more investment opportunities apply less leverage, which supports both the trade-

off model and a complex version of the pecking order model. Leverage is also closely related to tangibility of assets and the volatility of a firm's earnings".

Recent study carried out by Gaud, Jani, Hoesli, André and Bender (2003) on Swiss companies uses growth opportunity, size, profitability, tangibility, operating risk as determinants of capital structure. Size, tangibility and risk variables have a positive impact on leverage whereas growth opportunity and profitability shows a negative relation. Baral (2004) uses growth rate, size, business risk, dividend payout ratio, operating leverage, profitability and debt service capacity in his study on listed companies of Nepal. The first five variables show a positive relation with leverage whereas the last two proves to have negative relation. Huang and Song (2002) in their analysis on Chinese company, includes growth rate, size, profitability, tangibility, non-debt tax shield, tax, ownership structure, volatility as determinants of capital structure. Their study shows that profitability and non-debt tax shield is strongly negatively related with leverage. Volatility, size and ownership of institutes are positively related whereas tax and management shareholding, as per their expectation, have no significant effect on leverage. A very recent study by Shah and Khan in 2007 includes growth opportunity, size, profitability, tangibility, earning volatility and non-debt tax shield as important determinants of capital structure. Their study reveals that tangibility and size are positively related, where profitability and growth opportunity are negatively related. Non-debt tax shield and earning volatility appear to have no significant impact on leverage.

At national level, Haque (1989) empirically tested the Bangladeshi firms and finds that capital structure do significantly vary among industries and it has no significant impact on firm's profitability, dividend and market value. Chowdhury (2004), based on Bangladeshi and Japanese panel data, did another study on capital structure determinants with agency variables and finds agency-debt, bankruptcy risk, growth rate, profitability and operating leverage to significantly affect capital structure choice.

### **3. Research Design, Methodology, Measurement Issues**

#### **3.1 Data Description**

This study is based on secondary data. The main source of data is the Dhaka Stock Exchange (DSE). Information was collected from annual reports of the concerned listed companies from DSE library and also from the website of individual companies. This study focuses on the pharmaceutical sector. Among 20 listed companies under this industry 17 have been chosen based on their consistency of performance, data availability and favorable (positive) figures. Companies showing inconsistent observations on the balance sheet are excluded to avoid complicity of statistical analysis.

#### **3.2 Statement of Hypotheses**

This study has tested the following null hypotheses on relation between the independent variables and capital structure of listed pharmaceutical companies:

- H<sub>01</sub> : There is no significant relation between the agency cost of equity and debt ratio.
- H<sub>02</sub> : There is no significant relation between the growth rate and debt ratio.
- H<sub>03</sub> : There is no significant relation between the operating leverage and debt ratio.
- H<sub>04</sub> : There is no significant relation between the bankruptcy risk and debt ratio.
- H<sub>05</sub> : There is no significant relation between the tangibility ratio and debt ratio.
- H<sub>06</sub> : There is no significant relation between the debt service capacity and debt ratio.



hypothesizes that reduction in agency equity cost should increase the use of tax subsidized debt. Following Dodd (1986), the proxy used in this study is the percentage of share held by the largest shareholders. Trade-off theory, which calls for a trade-off between marginal benefit of debt financing with its marginal costs, assumes that firms with high agency cost of equity go for lower level of debt. This is because; firms having high agency cost of equity also experience high cost of debt demanded by debt holders as risk premium. This naturally contributes to a lower debt level. Pecking order theory gives prediction in the opposite line. As per this theory, high agency cost of equity de-motivates equity financing and prefers retained earnings and debt financing if necessary.

## **ii. Growth Rate**

Empirically, the relationship between growth opportunity and level of leverage experiences controversy. According to agency cost theory, agency cost is likely to be higher for growing companies having wider choice of future investment. Hence, growth rate is negatively related with long-term debt level (Jensen and Meckling 1976). This conclusion is supported by the empirical studies done by Kim and Sorensen (1986), Titman and Wessels (1988), Barclay et al. (1995) and Rajan and Zingales (1995) but Kester rejected this relation (1986). According to trade-off theory, companies with high growth opportunities use limited debt because in the case of bankruptcy, the value of high growth opportunities is close to zero, (Myers, 1984; Williamson, 1988 and Harris and Raviv, 1990). Firms with less growth prospects should use debt because it has a disciplinary role (Jensen, 1986; Stulz, 1990). Pecking order theory, contrary to the agency cost theory, shows positive relation between growth rate and leverage of growing enterprises. This is because a higher growth rate implies a higher demand for funds, and, *ceteris paribus*, a greater reliance on external financing through the preferred source of debt (Sinha 1992), (Myers 1984). Thus, the pecking order theory suggests a higher proportion of debt in capital structure of the growing companies than that of the stagnant no-growth companies. However, Chaplinsky and Niehaus (1990), Chung (1993), have got the evidence contrary to the pecking order theory. Chowdhury (2004) also expected a positive sign between growth opportunities and leverage but found a negative relationship between the two. A common proxy for growth opportunities is the compounded growth in assets for last five years.

## **iii. Operating Leverage**

Operating leverage is defined as the use of fixed costs in the operation of a firm. A firm has a high degree of operating leverage if it employs a greater amount of fixed costs and a small amount of variable costs and vice versa. Operating leverage affects the capital structure. The high degree of operating leverage i.e. use of higher proportion of fixed cost in the total costs over a period of time can intensify the variability in future earnings. Both the bankruptcy cost theory and agency cost theory predict the negative relation between operating leverage and debt level. As per bankruptcy cost theory, higher operating leverage enhances the chance of business failure and the greater amount of bankruptcy costs to be incurred. From this point of view, trade-off theory says that high degree of operating leverage raises the marginal costs of debt and lowers the level of debt as well. Considering the high chances of bankruptcy costs to be incurred, pecking order theory also suggests that a firm should use contractually obliged debt less and rely more on retained earnings. Thus, all these theories suggest that as operating leverage increases, the debt level in capital structure of the enterprises should decrease. Chowdhury (2004), in his study carried on both Japan and Bangladeshi firms, also found a result consistent with the prediction drawn by above mentioned theories. The proxy for the variable is the ratio of the percentage change in EBIT to the percentage change in sales.

#### **iv. Bankruptcy Risk**

Corporate tax system facilitates the firm to introduce more debt capital in their capital structure to get tax shield benefit on interest expenses. As a result, possibilities of bankruptcy become greater because of high chance of default on interest and capital repayments for the firms. If the transfer of ownership from shareholders to debt holders under default is costless, the mere possibility of bankruptcy should have no impact on the capital structure (Baron, 1976; Fama, 1980; Haugan, 1976 and Stiglitz, 1974). But disputes among the claimholders in case of default or bankruptcy are resolved in the process of formal bankruptcy proceedings. The proceedings are more or less costly. These cost includes administration costs, legal cost etc. Thus, a higher risk of bankruptcy increases bankruptcy costs and reduce the attractiveness of debt. Hence, an optimal capital structure with a higher bankruptcy risk is arranged with low amount of debt. This negative relation between bankruptcy risk and leverage is predicted by agency theory, trade-off theory and pecking order theory. In this study, bankruptcy cost is proxied in terms of co-efficient of variation of the ratio of EBIT to total assets.

#### **v. Tangibility Ratio**

Capital structure theories generally state that tangibility is positively related to leverage. Jensen and Meckling (1976) in their pioneering paper on agency cost, ownership and capital structure, point out that “the agency cost of debt exists as the firm may shift to riskier investment after the issuance of debt, and transfer wealth from debt holders to shareholders to exploit to the option nature of equity. If a firm’s tangible assets are high, then these assets can be used as collateral, diminishing the lender’s risk of suffering such agency costs of debt”. Hence, a high ratio of tangible assets is expected to give rise to high leverage ratio. The trade-off theory also supports such prediction. Moreover, liquidation value of tangible assets should be higher than that of intangible assets in the event of bankruptcy. Williamson (1988) and Harris and Raviv (1990) suggest leverage should increase with liquidation value and both papers suggest that leverage is positively correlated with tangibility. This prediction is confirmed by several well-known empirical studies like Marsh (1982), Long and Malitz (1985), Friend and Lang (1988), Rajan and Zingales (1995), Wald (1999). According to pecking order theory, a firm with more tangible assets has less information asymmetry problem. This theory says that less information asymmetry problems imply a higher preference for equity and lower dependence on debt thus leading to a negative relation between the tangible assets and leverage (Harris and Raviv, 1991). The ratio of tangible assets to total assets is selected as a proxy for tangibility of assets.

#### **vi. Debt Service Capacity**

The debt service ratio is calculated by dividing the operating income by total interest charges and this ratio indicates the firms’ ability to meet its interest payment out of its annual operating income (Keoun and others 1986). Therefore, the higher debt service ratio means the higher operating income and higher capacity of the enterprises in servicing debt. As per agency theory, firm’s ability to service its debt reduces agency cost and motivates use of debt to get high tax shield benefit from higher operating income. According to trade-off theory, firm with more operating income borrow more, ceteris paribus, to shield their income from corporate tax. Hence, the high debt capacity ratio (supported by high operating income) is seemed to have positive relation with the capital structure of the enterprises. But, pecking order theory suggests that when a firm has high operating income it can retain more earnings and rely more on internal financing than on debt. Empirical studies by (Bhat 1980), (Baral J. Keshar 2004) confirms the prediction of pecking order theory. According to Baral J. Keshar (2004) “financial institutions do not manage the funds considering their debt service capacity and they do not have debt according to their debt service capacity”. The Indian studies also show the results in the same line.

**Table 1: Summary of Theoretical Predictions  
(Relationship between Determinants and Debt Ratio)**

Independent Variables	Expected Sign		
	Agency Theory	Trade-off Theory	Pecking order Theory
Agency Cost of Equity (AE)	(-)ve	(-)ve	(+)ve
Growth Rate (GR)	(-)ve	(-)ve	(+)ve
Operating Leverage (OL)	(-)ve	(-)ve	(-)ve
Bankruptcy Risk (BR)	(-)ve	(-)ve	(-)ve
Tangibility Ratio (TR)	(+)ve	(+)ve	(-)ve
Debt Service Capacity (DSC)	(+)ve	(+)ve	(-)ve

**Table 2: Variable Definitions**

Variables	Proxies
Debt Ratio (DR)	TD 2008/TA 2008
Agency Cost of Equity (AE)	% of shares held by largest shareholders in FY 2008
Growth Rate (GR)	$[\{(TA\ 2008/TA\ 2004)^{(1/N-1)}\} - 1]$
Operating Leverage (OL)	(% Change in EBIT) / (% Change in Sales)
Bankruptcy Risk (BR)	Coefficient of Variation of ratio of EBIT to Total Assets for 2004-2008
Tangibility Ratio (TR)	Total Fixed assets 2008/Total Asset 2008
Debt Service Capacity (DSC)	EBIT 2008/ Interest Charges 2008

#### **4. EMPIRICAL ANALYSIS & INTERPRETATIONS OF THE RESULTS**

This section presents the result of regressions of the previously defined measure of leverage on the six proposed determinants of capital structure using samples of 17 pharmaceutical companies of Bangladesh. Table 3 presents descriptive statistics for the variables used in my estimates. The data are collected from Annual Reports of the respective pharmaceutical companies listed on Dhaka Stock Exchange for which I have a minimum of five consecutive years' of data for the period 2004-2008. Summary statistics in table 3 include the mean and the standard deviation for Period 2004-2008. Summary statistics in Appendix 2 contains more information on skewness, kurtosis, minimum and maximum value.

**Table 3: Descriptive Statistics**

Variables	Mean	Std. Deviation
Debt Ratio	.675747	1.3231621
Agency Cost of Equity	.542665	.1776727
Growth Rate	.141518	.2182464
Operating Leverage	2.150694	3.4331502
Bankruptcy Risk	.027712	.0746218
Tangibility Ratio	.576124	.3963370
Debt Service Capacity	29.208624	91.1443868

Multiple regression was run in SPSS using the Least Square Estimation Method to test the set hypotheses or more clearly to test how the independent variables explain the capital structure. Before running the regression, investigation into the multicollinearity problem was carried out using the Pearson Correlation method. First of all, bivariate (pair-wise) correlations among the independent variables were examined to find out the multicollinearity problem. The existence of correlation of about 0.80 or larger indicates that there is problem of multicollinearity (Lewis-Back 1993). Table 4 presents the Pearson correlation coefficients for the variables used in my estimations. None of the pair-wise coefficient of correlation was 0.80 or larger.

**Table 4: Correlations Matrix**

	AE (X <sub>1</sub> )	GR(X <sub>2</sub> )	OL(X <sub>3</sub> )	BR(X <sub>4</sub> )	TR(X <sub>5</sub> )	DSC(X <sub>6</sub> )
AE (X <sub>1</sub> )	1.000*	-.174	.399	.362	.174	.437
GR(X <sub>2</sub> )		1.000	-.388	.144	-.385	-.025
OL(X <sub>3</sub> )			1.000	-.004	-.194	-.095
BR(X <sub>4</sub> )				1.000	-.032	.759
TR(X <sub>5</sub> )					1.000	-.167
DSC(X <sub>6</sub> )						1.000

Theory says that pair-wise correlation approach of addressing the multicollinearity problem fails to take into account the relation of independent variables among themselves. Even correlation coefficient of less than 0.50 in the pair-wise correlation matrix does not prove that the variables are not strongly correlated to one another. Since multicollinearity affects the validity of the model so it calls for a more precise diagnosis of this problem. So, auxiliary regression of each independent variable on all other independent variables was run to assess the multicollinearity problem more accurately. Table 5 presents the summary of regression results of auxiliary equations. The R<sup>2</sup> near to 1 indicates the high multicollinearity. Values of R<sup>2</sup> in the auxiliary equation 1.3 where operating leverage is the dependent variable and in the equation 1.4 where bankruptcy risk is the dependent variable are 0.702 and 0.724 (Table 5) respectively which is near to 0.8 but do not exceed the limit. So a moderate level of collinearity is observed in this case. Then, question may arise why does this collinearity occur? In postulating that a firm's financial leverage is linearly related with the above mentioned variables, economic theory presumes that these variables may have some dependence on one another. In practice, when data for empirical analysis is collected, there is no guidance that there will be no correlations among the regressors. As a matter of fact, in most applied work it is almost impossible to find two or

more variables that may not be correlated to some extent. So values of  $R^2$  near to 0.8 for operating leverage and bankruptcy risk are considered allowable for the convenience of this study.

**Table 5: Results of the Auxiliary Equations Used to Assess Multicollinearity**

Equations	R Square	Adjusted R Square	Std. Error of the Estimate
Equation 1.1	.611	.435	.1335972
Equation 1.2	.633	.467	.1593695
Equation 1.3	.702	.567	2.2594730
Equation 1.4	.724	.599	.0472720
Equation 1.5	.657	.502	.2797852
Equation 1.6	.657	.502	.2797852

After checking up the multicollinearity problem, SPSS was run. Table 6 presents the estimated results. Explanatory power of the model as indicated by  $R^2$  (multiple coefficient of determination) and adjusted  $R^2$  is fairly good. The model explains around 69.1% of the variation in the dependent variable/capital structure. The adjusted explanation of the model is about 50.5%. The F value which is a measure of overall significance of the estimated regression and also a test of significance of  $R^2$  is 3.719. The significant value of F proves that the relationship between the debt ratio and determinants are linear.

**Table 6: Model Summary (Equation 1)**

R Square	Adjusted R Square	Std. Error of the Estimate	F Statistics
.691	.505	.9310776	3.719

a Predictors: (Constant), AE, GR, OL, BR, TR, DSC  
 b Dependent Variable: DR

**Table 7: Determinants of Capital Structure- Regression Results**

	B	Std. Error	T	Sig.
(Constant)	0.561	.909	.617	.551
AE (X <sub>1</sub> )	-6.857	2.101	-3.263*	.009
GR(X <sub>2</sub> )	3.748	1.762	2.128***	.059
OL(X <sub>3</sub> )	0.546	.124	4.392*	.001
BR(X <sub>4</sub> )	-12.962	5.939	-2.183***	.054
TR(X <sub>5</sub> )	3.378	1.003	3.367*	.007
DSC(X <sub>6</sub> )	0.019	.006	3.085*	.012

a Dependent Variable: DR  
 \*significant at .01 level  
 \*\* significant at .05 level  
 \*\*\* significant at .1 level

The variables- agency cost of equity, growth rate, operating leverage, bankruptcy risk, tangibility ratio and debt service capacity have statistically significant effect on the capital structure. (Table 7) Thus, the empirical model showing the impact of independent variables on capital structure is shown in the following equation:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 \dots \dots \dots (1)$$

Or,  $Y = 0.561 - 6.857AE + 3.748GR + 0.546OL - 12.962BR + 3.378TR + 0.019DSC$

**Results of the Analysis**

Table 7 shows the result summary for regression analysis. The parameter estimates reveal that all the six variables are found to be significant determinants of capital structure. After analyzing the results for the effects of independent variables on financial leverage, it is found that agency cost of equity and bankruptcy risk is negatively related with leverage whereas growth rate, operating leverage, tangibility and debt service capacity of the firms are positively correlated. Table 8 summarizes the sign observed for the determinants from this study along with their theoretical predictions. In this section, I will try to focus on the results of this empirical analysis regarding significant independent variables and their implication based on the competing capital structure theories discussed in the literature part.

**Table 8: Summary of Theoretical Predictions  
(Relationship between Determinants and Debt Ratio)**

Independent Variables	Expected Sign			Observed sign
	Agency Theory	Trade-off Theory	Pecking order Theory	
Agency Cost of Equity (AE)	(-)ve	(-)ve	(+)ve	(-)ve
Growth Rate (GR)	(-)ve	(-)ve	(+)ve	(+)ve
Operating Leverage (OL)	(-)ve	(-)ve	(-)ve	(+)ve
Bankruptcy Risk (BR)	(-)ve	(-)ve	(-)ve	(-)ve
Tangibility Ratio (TR)	(+)ve	(+)ve	(-)ve	(+)ve
Debt Service Capacity (DSC)	(+)ve	(+)ve	(-)ve	(+)ve

**Discussion of the Variables**

**i. Agency Cost of Equity**

The t statistics is used for examining the relation of agency cost of equity on debt ratio. The calculated t value is compared to the critical t value at the desired level of significance. If the calculated value of t exceeds the critical value then the null hypothesis is rejected. t value associated with agency cost of equity ratio (-3.263) rejected the first null hypothesis  $H_{01}$  that there is no significant relation between the agency cost of equity and debt ratio. It is rejected at 1% significant level. Thus, the alternative hypothesis is accepted. The negative beta co-efficient of agency cost of equity (-6.857) means that holding the influence of all other variables constant, on average, debt ratio decreases by 6.857 % as the agency cost of equity increases by 1%. This result is supported by theoretical prediction of agency model and trade-off model (which calls for a negative relation) and the result found by (Huang and Song 2002). Implication of this negative relation is that in Bangladesh percentage of largest shareholding is held by sponsors/directors who incline to concentrate ownership and control within themselves. According to agency theory, this type of shareholding conforms to the features of closely held companies. Monitoring cost borne by minority shareholders is significantly low and agency cost of equity is expected to be minimal. Hence the companies prefer debt financing to get tax shield benefit until marginal cost of debt exceeds marginal benefit of debt.

## **ii. Growth Rate**

Growth ratio under this study shows a t-value of 2.128 against a low p-value of .059. This t value rejects the 2<sup>nd</sup> null hypothesis  $H_{02}$ . This rejection occurs at 10% significant level. Thus the alternative hypothesis is accepted meaning that growth rate is one of the most important determinants of leverage in pharmaceutical companies of Bangladesh and positively related to debt ratio. The beta co-efficient of growth rate (3.748) means that debt ratio increases by 3.748% as the growth rate increases by 1%, ceteris paribus. The positive coefficient of growth variable holds the relation postulated by pecking order theory true in Bangladeshi context. This is because a higher growth rate implies a higher demand for funds, and, ceteris paribus, a greater reliance on external financing through the preferred source of debt (Sinha 1992), Kester (1986), (Myers 1984). However, this findings contradicts with the result found by Chowdhury(2004), Barclay et al. (1995) and Rajan and Zingales (1995), Titman and Wessels (1988) and Kim and Sorensen (1986).

## **iii. Operating leverage**

The calculated t value of operating leverage rejects the 3<sup>rd</sup> null hypothesis ( $H_{03}$ ). The t value is statistically significant at 1% level meaning that there is significant relation between operating leverage and capital structure. Beta co-efficient for this determinant is .546. This statistically significant positive relation is inconsistent with the theoretical predictions given by agency cost, trade-off and pecking order theory. Not only that, this independent variable is the most significant determinant with the largest t-value of 4.392. My finding conforms to the finding of (Baral J. Keshar 2004) but contradicts with that of Chowdhury (2004). The reason why operating leverage in this study shows positive sign may be that pharmaceutical companies using higher fixed cost in the operation; especially in research and development expenditure, can use it as a negotiable instrument for borrowing, especially long term borrowing. Because, expenditure in R&D, if proves to be successful, will become asset and source of future earnings for the companies. As a result, the higher the fixed cost made for R&D, the higher will be the level of debt. This positive result is supported by the results of previous research (Rajan and Zingales, 1995; Kremp et al., 1999; Frank and Goyal, 2002).

## **iv. Bankruptcy Risk**

The calculated value of t statistics of bankruptcy risk rejects the 4<sup>th</sup> null hypothesis ( $H_{04}$ ) at 10% significant level that there is no significant relation between bankruptcy risk and financial leverage. Thus, the alternative hypothesis is accepted. The statistically significant negative relation (beta co-efficient is -12.962 and t-value of -2.183) is consistent with the result of Chowdhury (2004) who also obtained a negative relationship between the two. The findings about bankruptcy risk of this study confirm the prediction of agency cost theory, trade-off theory and pecking order theory. Implication of this finding is that high bankruptcy risk arising from expected future financial distress cost and legal cost de-motivates use of fixed contractual obligation, i.e. debt by pharmaceuticals companies. Hence, a negative relation is observed in this empirical study.

## **v. Tangibility Ratio**

The theoretical predictions on the relationship between tangibility and leverage are as follows - the trade-off and agency theories predict a positive relationship whereas the pecking-order theory predicts a negative one. Beta co-efficient of tangibility ratio confirms the prediction of Jensen and Meckling's (1976) agency cost theory and Myers' version of trade-off theory. Tangibility, with beta coefficient of 3.378 is positively related to leverage. That means, all other things remaining the same, debt ratio increases by 3.378% for 1 percentage point increase in tangibility ratio. This relationship is statistically significant because it has the third highest t-value of 3.367 against a very low p-value of .007. This shows that tangibility is one of the most important determinants of leverage in pharmaceutical companies of Bangladesh. Thus 5<sup>th</sup> null hypothesis ( $H_{05}$ ) is rejected by the statistically significant (at

1% significance level) positive relationship between tangibility and leverage. The reason why tangibility is significantly related to leverage is clear. Because firms can use tangible assets as collateral when negotiating borrowing, especially long term borrowing. Creditors feel relaxed about receipts of interest when they observe tangible assets like land, building, machinery etc. of borrowing firms as security. Thus creditors will be more willing to advance credit to those firms having more fixed assets as security against debt. This result is supported by the results of previous research (Rajan and Zingales, 1995; Kremp et al., 1999; Frank and Goyal, 2002).

#### **vi. Debt Service Capacity**

Beta coefficient of debt service capacity tests the last hypothesis. The relation between the debt service capacity and financial leverage is positive (beta co-efficient is .019) and statistically significant at 1% significant level (with t-value of 3.085). Thus, the alternative hypothesis is accepted rejecting the null hypothesis ( $H_{06}$ ) that there is no significant relation between debt service capacity and financial leverage. This result aligns with the relation predicted by agency cost and trade-off model. Agency theory suggests that a firm's ability to service debt from higher operating income reduces agency cost and motivates use of debt to get high tax shield benefit. Trade-off theory suggests that pharmaceutical companies with high operating income manage their funds considering their debt service capacity and decorate more debt to get tax shield benefits from debt financing. This result goes in line with the findings of (Keoun and others, 1986) but contradicts the findings obtained by Baral J. Keshar (2004).

### **5. SUMMARY AND CONCLUSION**

This paper has tested the influence of six determinants on capital structure, through using Least Square method by running multiple regression analysis on the dataset of listed pharmaceutical companies of Bangladesh for the period FY2004 to FY2008. My multiple regression analysis suggests that the model explains around 69.1% of the variation in the dependent variable/debt ratio. The adjusted explanation of the model is about 50.5%. Thus, the unexplained proportion of the variation is satisfactorily low. The independent variables-agency cost of equity, operating leverage, growth rate, bankruptcy risk, tangibility and debt service capacity proves to be statistically significant determinants of capital structure. Beta coefficients associated with agency cost of equity, operating leverage, tangibility and debt service capacity are statistically significant at 1% level. These facts conclude that agency cost of equity, operating leverage, tangibility and debt service capacity play a major role in the determination of the capital structure of pharmaceutical companies of Bangladesh. Whereas beta coefficients associated with growth rate and bankruptcy risk are statistically significant at 10% level. This also represents their significance in deciding optimal capital structure. Agency cost of equity and bankruptcy risk is negatively related with leverage whereas growth rate, operating leverage, tangibility and debt service capacity of the firms are positively correlated. Important observations of this study is that both agency cost model and static trade-off model help describe the capital structure pattern of the pharmaceutical companies as because most of the determinants have shown desired sign as predicted by these two theories. Another important finding of this paper is that the factors working on firms' capital structure in other countries also work in a similar fashion in Bangladesh. Question may arise, why and how the findings in developed countries in terms of capital structure determinants are mostly portable to pharmaceutical companies of Bangladesh. One possible explanation is that pharmaceutical sector is the promising and contributing part of the country's economy and the players of this industry take care of the theoretical conclusions and empirical findings regarding capital structure determinants while taking optimal capital structure decision. Yet, some independent variables show mixed results. Financing pattern and choice of individual company, legal and regulatory environment, corporate tax policies, tax holiday treatment, study period, sampling error etc. might cause some variables of this study to show mixed behavior and not to explain the capital structure in a better way. Further future study on capital structure determinants may be extended and this will surely lead to significant new insights.

## References

- Baker, G.P., M. C. Jensen and K.J. Murphy. 1988. "Compensation and incentives: Practice vs. theory *Journal of Finance*", Vol. 43, pp. 593-615
- Baral, Keshar Jung. 1996. "Capital Structure and Cost of Capital in Public Sector Enterprises in Nepal." Ph.D thesis. Delhi University.
- Baral, 2004. 'Capital structure Determinants:a case study of listed companies of Nepal', The Journal of Nepalese Business Studies, Vol. I, 2004, No. 1
- Barclay, M. J., C. W. Smith, and R. L. Watts.1995. The Determinants of Corporate Leverage and Dividend Policies. *Journal of Applied Corporate Finance* 7:4.
- Baron, D.P. 1974, 'Default risk, Homemade Leverage and the Modigliani-miller theorem', *American economic Review*, vol. 64, March, pp. 176-182
- Berger, G. Philip, Eli Ofek and David L. Yermack, 1997, Managerial entrenchment and capital structure decisions, *Journal of Finance* 52, 1411-1438.
- Bhat, Ramesh Kumar. 1980. Determinants of Financial Leverage : Some Further Evidence. *Chartered Accountant* 29: 451-456
- Booth, L., Aivazian, V., Demirguc-Kunt, A. and Maksimovic, V., 'Capital structure in developing countries', *Journal of Finance*, Vol. 56, 2001, pp. 87-130.
- Bradley, Jarrell and Kim. 1984. "On the existence of an optimal capital structure: theory and evidence, *Journal of Finance*", Vol. 39, pp. 857-878
- Brealey, R., and S. Myers, 2000 (6th ed.), *Principles of Corporate Finance*, McGraw-Hill.
- Brennan, M., and A. Kraus, 1987, Efficient Financing under Asymmetric Information, *Journal of Finance* 42, 1225-1243.
- Chaplinsky, Susan, and Greg Niehaus. 1990. The Determinants of Inside Ownership and Leverage. Working Paper, University of Michigan.
- Chow, G. (1982). 'The Demand for external Auditing: Size, Debt and Ownership Influences', *The Accounting review*, PP. 272-291
- Chowdhury, D. 1993. 'Agency Costs and Corporate Governance', Unpublished Ph.D Dissertation, University of Lancaster.
- Chowdhury, D. 1996. 'Agency Costs and capital Structure:Theory and Evidence', *Finance and Banking*, university of Dhaka, Vol. 5, No. 1 & 2, pp. 24-39
- ....., 2004. Capital Structure Determinants: Evidence from Japan & Bangladesh. *Journal of Business Studies*, Vol.xxv,No.1, June 2004 pp:23-45
- ....., 2004. The Role of Institutions for Corporate Governance: The Cases of Japan and Bangladesh. *DU journal of marketing*, Vol. No. 7, June 2004
- Chung, Kee H. 1993. Asset Characteristics and Corporate Debt Policy: An Empirical Test. *Journal of Business Finance and Accounting* 20: 83-98.
- DeAngelo, H. and Masulis, R., 'Optimal capital structure under corporate and personal taxation', *Journal of Financial Economics*, Vol. 8, 1980, pp. 3-29.
- De Miguel, A. and Pindado J., 'Determinants of capital structure: new evidence from spanish panel data', *Journal of Corporate Finance*, Vol. 7, 2001, pp. 77-99.
- Donaldson, Gordon. 1961. *Corporate Debt Capacity: A Study of Corporation Debt Policy*. Boston: Division of Research , Graduate School of Business Administration, Harvard University.
- Donaldson, G. 1984. "Managing Corporate Wealth", Hitt, M. Praeger, New York
- Drobotz and Fix 2003. What are the Determinants of the Capital Structure? Some Evidence for Switzerland Department of Finance, Working Paper No. 4/03

- Durand, David. 1959. Cost of Debt and Equity Funds for Business: Trends and Problems of Measurement. In *The Management of Corporate Capital*. Edited by Ezra Solomon. New York: The Free Press.
- Easterbrook, F., 1984, Two-Agency Cost Explanations of Dividends, *American Economic Review* 74, 650-659.
- Fama, E. F. 1980, 'Agency problems and the theory of the firm', *Journal of Political Economy*, Vol 88. pp. 288-298
- Fama, E.F. and Jensen, Michael, 1983, Agency problem and residual claims, *Journal of Law and Economics* 26, 327-349.
- Gaud, P., E. Jani, M. Hoesli, and A. Bender, 2003, *The Capital Structure of Swiss Companies: An Empirical Analysis using Dynamic Panel Data*, FAME working paper 68.
- Graham, J., and C. Harvey, 2001, *The Theory and Practice of Corporate Finance: Evidence from the Field*, *Journal of Financial Economics* 60, 187-243.
- Grossman, S. and Hart, O., 'Corporate financial structure and managerial incentives', In McCall, J. (ed.), *The economics of information and uncertainty*: University of Chicago Press, 1982.
- Haque, Z. 1989. 'Capital Structure Patterns: A survey of Companies Listed on The Dhaka Stock Exchange Limited', The University grants Commission of Bangladesh, Dhaka.
- Harris, M. and Raviv, A., 'Capital structure and the informational role of debt', *Journal of Finance*, Vol. 45, 1990, pp. 321-49.
- Harris, M., and Raviv, A., 'The theory of capital structure', *Journal of Finance*, Vol. 46, 1991, pp. 297-355.
- Haugen, R., and L. Senbet, 1977, The Insignificance of Bankruptcy Costs to the Theory of Optimal Capital Structure, *Journal of Finance* 23, 383-393.
- Hindley, B. 1970. 'Separation of Ownership and Control in Modern Corporation', the *Journal of Law and Economics*, April, PP 185-222
- Huang, S.G., Song, F.M. 2002. "The Determinants of Capital Structure: Evidence from China." Hong Kong Institute of Economics and Business Strategy, Working Paper No. 1042
- Jalilvand, A. and Harris R.S., 'Corporate behavior in adjusting to capital structure and dividend targets: an econometric study', *Journal of Finance* Vol. 39, 1984, pp. 127-145.
- Jensen, Michael C. and William H. Meckling. 1976. Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics* 3: 305-360.
- Jensen, M., 'Agency costs of free cash flow, corporate finance and takeovers' *American Economic Review*, Vol. 76, 1986, pp. 323-329.
- Keoun, Arthur J. and others. 1986. *Basic Financial Management*, 3rd ed. New Delhi: The Journal of Nepalese Business Studies Prentice-Hall of India Private Ltd.
- Kester, Carl W. 1986. Capital and Ownership Structure : A Comparison of United States and Japanese Manufacturing Corporation. *Financial Management* 15 : 5-16.
- Kim., H. 1978. 'A Mean-Variance Theory of optimal Capital Structure and Corporate Debt Capacity', *Journal of Finance*, March, pp. 45-63
- Kim, W. and E. Sorensen. 1986. Evidence on the Impact of the Agency Costs of Debt on Corporate Debt Policy. *Journal of Financial and Quantitative Analysis* 21 : 131-144.
- Klein, L.S., O'Brien, T.J., Peters, S.R. 2002. "Debt vs. Equity and Asymmetric Information: A Review." *Financial Review*, 37, pp. 317-350
- Krasker, W. 1986. 'Stock Price Movements in Response to Stock Issues under Asymmetric Information'. *Journal of Finance* 41, 93-105.
- Kraus, A. and R. Litzenberger. 1973. "A state preference model of optimal financial leverage, *The Journal of Finance*", Vol. 28, pp. 911-921
- Kremp, E., Stöss E., and Gerdesmeier, D. 'Estimation of a debt function: evidence from French and German firm panel data', in Sauvé, A., Scheuer, M. (ed.) *Corporate finance in Germany and France. A joint research project of Deutsche Bundesbank and the Banque de France*, SSRN working paper, 1999.

- Leland, H.E., Pyle, D.H. 1977. "Information Asymmetries, Financial Structure, and Financial Intermediation." *Journal of Finance*, 32, pp. 371-387
- Lewis-Beck, Michael S. 1993. "Applied Regression: An Introduction," in *Regression Analysis*, ed. Michael S. Lewis-Beck. *International Handbook of Quantitative Applications in the Social Sciences*, vol. 2, Singapore: Sara Miller McCune, Sage Publications, Inc: 1:68.
- Miller, Merton H. 1977. Debt and Taxes. *Journal of Finance* 32:261-275.
- Modigliani, Franco and Merton H. Miller. 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. *American Economic Review* 48:261-297.
- Modigliani, Franco and Merton H. Miller. 1963. Corporate Income Taxes and the Cost of Capital: A Correction. *American Economic Review* 53: 433-443.
- Myers, S.C., 'Determinants of corporate borrowing', *Journal of Financial Economics*, Vol. 5, 1977, pp. 147-175.
- Myers, Stewart C. and Nicholas S. Majluf. 1984. Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have. *Journal of Financial Economics* 13 : 187-221.
- Myers, Stewart C. 1984. The Capital Structure Puzzle. *Journal of Finance* 39: 575-592.
- Narayanan, M. P., 1988, Debt versus equity under asymmetric information, *Journal of Financial and Quantitative Analysis* 23, 39-51.
- Neihaus, G.R. (1985), 'The Relationship between Accounting Method Choices and Ownership Structure', Working pPaper, Washington University
- Noe, Thomas, 1988, Capital Structure and signaling game equilibria, *Review of Financial Studies* 1, 331-356.
- Ozkan, A., 'Determinants of capital structure and adjustment to long run target: evidence from UK company panel data', *Journal of Business Finance and Accounting*, Vol. 28, 2001, pp.175-199.
- Rajan, R.G. and Zingales, L., 'What do we know about capital structure? Some evidence from international data', *Journal of Finance*, Vol. 50, 1995, pp. 1421-60.
- Ross, Stephen A. 1977. The Determination of Financial Structure: the Incentive Signaling Approach. *Bell Journal of Economics* 8: 23-40.
- Ross, S.A., Westerfield, R.W., Jaffe, J. (1996), *Corporate Finance*. Boston, MA: Times Mirror Higher Education, fourth edition
- Scott, James H. 1976. A Theory of Optimal Capital Structure. *Bell Journal of Economics* 7: 33-54.
- Shah and Khan, 'Determinants of Capital Structure: Evidence from Pakistani Panel Data' *International Review of Business Research Papers*, Vol. 3 No.4, 2007, Pp.265-282
- Sinha, Siddharth. 1992. Inter-Industry Variation in Capital Structure in India. *Indian Journal of Finance and Research* 2: 13-26.
- Solomon, Ezra. 1963. *The Theory of Financial Management*. New York: Columbia University Press.
- Stiglitz, J. E., 'Some aspects of the pure theory of corporate finance: bankruptcies and takeovers', *Bell Journal of Economics and Management Science*, Vol. 3(2), 1972, pp. 458-482.
- Stulz, R., 'Managerial discretion and optimal financing policies', *Journal of Financial Economics*, Vol. 26, 1990, pp. 3-27.
- Taggart, R.A., 'A model of corporate financing decisions', *Journal of Finance*, Vol. 32, 1977, pp. 1467-1484.
- Titman, Sheridan and Roberto Wessels. 1988. The Determinants of Capital Structure Choice. *Journal of Finance* 43 : 1-19.

**Appendix 1: Descriptive Statistics**

	Debt Ratio	Agency Cost of Equity	Growth Rate	Operating Leverage	Bankruptcy Risk	Tangibility Ratio	Debt Service Capacity
Mean	.657261	.536111	.152044	2.150694	.018233	.552072	27.583372
Median	.370400	.500000	.085650	1.519300	.020150	.483650	3.445950
Mode	.0176(a)	.5000	-.0895(a)	-4.0475(a)	-.1590(a)	.1432(a)	-.4586(a)
Std. Deviation	1.2860495	.1745960	.2163892	3.4331502	.0828130	.3978130	88.6914908
Variance	1.654	.030	.047	11.787	.007	.158	7866.181
Skewness	4.021	.607	1.916	.612	.248	1.650	4.160
Std. Error of Skewness	.536	.536	.536	.550	.536	.536	.536
Kurtosis	16.667	.763	4.700	1.122	4.026	2.947	17.487
Std. Error of Kurtosis	1.038	1.038	1.038	1.063	1.038	1.038	1.038
Range	5.7105	.7178	.9144	13.4879	.4031	1.5354	381.2807
Minimum	.0176	.1878	-.0895	-4.0475	-.1590	.1432	-.4586
Maximum	5.7281	.9056	.8249	9.4404	.2441	1.6786	380.8221
Percentiles							
25	.164925	.428225	.008900	.634050	.003750	.253000	1.002400
50	.370400	.500000	.085650	1.519300	.020150	.483650	3.445950
75	.576850	.596800	.283825	3.680350	.041500	.722625	9.167125

**Appendix 2: Auxiliary Regression Equations used to assess the Multicollinearity Problems**

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 \dots \dots \dots (1)$$

$X_1 = a + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 \dots \dots \dots (1.1)$
$X_2 = a + b_1X_1 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 \dots \dots \dots (1.2)$
$X_3 = a + b_1X_1 + b_2X_2 + b_4X_4 + b_5X_5 + b_6X_6 \dots \dots \dots (1.3)$
$X_4 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_5X_5 + b_6X_6 \dots \dots \dots (1.4)$
$X_5 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_6X_6 \dots \dots \dots (1.5)$
$X_6 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 \dots \dots \dots (1.6)$

Where  $X_1, X_2, X_3 \dots X_6, a$  and  $b_1, b_2, b_3 \dots b_6$  indicate the same as in the model (1)