

## Chapter 3

### The Determinants of Capital Structure and Research Methods

We will examine the determinants and the relationships between capital structure represented by debt ratio and seven variables: firm size, profitability, growth, collateral value of tangible assets, business risk, cash and earning volatility. Specifically, we use three models to examine the relationships: two-variable regression analysis, multiple regression analysis, and vector autoregression (VAR) model. The concept of Granger causality is included in the VAR Model.

#### 3.1 The Determinants of Capital Structure

The variation in debt ratios across firms and industries are different. In principle, managers take into account the various costs and benefits associated with debt and equity financing when they select capital structure. In this section we discuss some variables that may affect a firm's debt-equity choice.

##### 3.1.1 Firm Size

Graham and Harvey (2001) find that firms are very concerned about their credit rating, which can be view as an implication of concern about distress. Banks and financial institutions may choose not to lend to firms with low credit rating, even though these firms are willing to pay higher rate of interest. Warner (1977) provides evidence that suggests that direct bankruptcy costs appear to constitute a larger proportion of a firm's value as that value decreases. Large firms are usually more diversified having more stable cash flows, with better credit rating, less asymmetric information and less agency costs, suggesting that large firms would be more highly leveraged. Additionally, large firms may be able to exploit economies of scale in issuing securities. Because of

information asymmetries, smaller firms also are likely to face higher costs for obtaining external funds. Chung (1993) has similar arguments. Mehran, Taggart, and Yermack (1999) find that firm size has a strong positive effect on debt financing. Fama and French (2002) finds that there are positive relations between leverage and firm size. However, March (1982), Titman and Wessels (1988) find that debt ratios are negatively related to firm size.

Wang (王瑛璋, 1993) studied 91 firms spread out in 16 industries in Taiwan over the period from 1987 to 1992. He finds that debt ratio is positively correlated to firm size. Yang, Liao, and Huang (楊淑媛, 廖四郎, 黃瑞靜, 2000) also reach the same conclusion for 267 firms across traditional and high-tech industries in Taiwan that larger firms borrow more.

### 3.1.2 Profitability

The pecking order theory suggests that firms follow the order from retained earnings, debt, down to the issue of new equity to raise capital. The reasons can be that taxes and transaction costs favor funding new investment with retained earnings and debt over issuing new equity. Or issuing equity conveys adverse information to outside investors because of asymmetric information (Majluf and Myers, 1984). Overall, the past profitability of a firm, and hence the amount of earnings available to be retained, should be an important determinant of its current capital structure.

The negative association of debt ratio with profitability has been found in many literatures. Titman and Wessels (1988) show that profitability had a negative impact on debt ratios of U.S. companies during the period of 1974-1982. Rajan and Zingales (1995) studied the G-7 countries except Germany and find that debt ratio has a negative association with profitability. Wang's (王瑛璋, 1993) study supports the negative

association of debt ratio with profitability.

### 3.1.3 Growth

Growth opportunity can be viewed as a firm's value being largely generated by its perceived ability to develop new products that will dominate the market and make profits. Although growth opportunities are feasible that can add value to a firm, they are intangible capital assets and do not generate current taxable income. The growth opportunities may be accompanied with the unknown impact of future risks. Growth opportunities also cannot be collateralized in practice for debt financing. Implication of these reasons is that there is a negative relation between debt ratios and growth opportunities. However, Titman and Wessels (1988) do not find support for an effect on debt ratios arising from future growth.

From the viewpoint of underinvestment problem, Graham and Harvey (2001) find that debt policy of most firms is not affected by underinvestment concerns. However, more growth than non-growth firms are likely to indicate that underinvestment problems are a concern, which is consistent with the reasoning of Underinvestment problem which refers to a firm's equity holders who may pass up profitable (positive NPV) investments if they perceive that the profits will be used to pay off existing debt holders, that is, most of the benefits of the profitable investments will be captured by debt holders. Overall, Graham and Harvey's finding contrasts with results in many large sample studies that debt usage is inversely related to variables measuring growth opportunities (Barclay and Smith, 1995, Graham, 1996, Graham, Lemmon, Schallheim, 1998). Wang (1993) also finds that the long term debt ratios are positively related to growth opportunities. However, The prediction that growth firms have high leverage is refuted by many empirical studies (see Rajan and Zingales , 1995, and references cited

therein).

In sum, the influence of a firm's future growth on its debt ratio is ambiguous.

#### 3.1.4 Collateral Value of Tangible Assets

Assumption of lower risk than equity holders is fundamental to debt providers who focus on the value of the collateral in case things go wrong. Debt providers do not want to lose money as they do not share in the upside of a firm's investment. They will keep an eye on whether the cash flow of the firm is sufficient to repay the debt. Issuance of debt secured by a firm's property with known market values avoids the potential risk of debt providers. Besides, higher assets liquidity may lead a firm to increase debt capacity. If the firm defaults, debt providers have the legal right to seize the collateral. For this reason, firms with more collateralizable assets may choose higher debt levels to take advantage of using external debt while enjoying benefit of tax deduction of interest payment. Firms with good credit rating may have established a long-term close relationship with debt providers. Under the prerequisite that the relationship can substitute for part of physical collateral, firms may benefit from providing less collateral for debt financing.

Jensen and Meckling (1976) suggest there is a positive relation between debt ratios and the capacity of firms to collateralize their debt. Marsh (1982) used the ratio of fixed assets to total assets as the proxy variable for collateral value of tangible assets. His finding supports that debt ratio is positively correlated with collateral value of tangible assets. Titman and Wessels (1988) do not find supportive evidence of positive relation between debt ratio and collateral value. Wang (王瑛璋, 1993) finds that there is a positive relation between debt ratio and collateral value for firms in Taiwan.

### 3.1.5 Business Risks

Given a total risk, a firm has to balance between its business risk and financial risks. The riskier policy such as higher R&D expenses, lower capital expenditures, investing in other companies, and higher leverage increases a firm's risk, leading to the greater the potential for conflicts of interest between equity holders and debt holders. As debt providers may seek more secure positions, a firm therefore has to decrease its financial risks when it senses an increasing business risk in the competitive markets. The implication is that greater business risk will make firms tend to reduce the use of debt. One example is that if consumers think or feel that a firm might go out of business, they will not purchase that firm's products because that firm will not stand behind its products. Consumers are therefore under the risk of without obtaining the after-sale service. Under the circumstances, the firm's potential business risk increases in the product market and logically it must not use debt financing for further new investments. However, Graham and Harvey (2001) find little evidence that business risk in product markets affect debt decisions.

### 3.1.6 Cash

When managers of firms see a negative number of forecasted cash, it means additional financing is necessary, or a need to scale down or withdraw investment projects. Some companies may prefer to hold larger position of cash ready for future use: to pay off debts, as a reserve for unexpected downturn, stock repurchase if stock is undervalued, spending of attractive investment, or other opportunities that may arise. In sum, the implication of cash is

- What the firm's EPS would be under different financing and investment scenarios.

- How much cash will the firm have at the end of the year
- How much additional funding will the firm need to raise
- What will the firm's debt ratio would be next year

The three big telecom companies in Taiwan all hold a large amount of cash. We therefore include this factor to examine its relation with debt ratio in this particular study.

### 3.1.7 Earnings volatility

Graham and Harvey (2001) find that “CFOs are also concerned about earnings volatility when making debt decisions (rating of 2.32 out of 4), which is consistent with the tradeoff theory that firms reduce debt usage when the probability of bankruptcy is high (Castanias, 1983)”. Many authors have also suggested that a firm's optimal debt level is a decreasing function of the volatility of earnings. Titman and Wessels (1988) do not find evidence in support of the effect on debt ratio arising from earnings volatility.

### 3.1.8 A Comment on Tax Rate

The MM theory implies that, other things being equal, the incentive to use debt financing increases when a firm's marginal tax rate is high due to the tax deductibility of interest expense. Thus, a firm that finances its operations with debt reduces its taxable income, potentially lowering its expected marginal tax rate. Some previous studies (Titman and Wessels, 1988; Gaver and Gaver, 1993) examine the correlation between debt ratio and tax rates and do not find a positive relation. In response to CFOs' opinion in the U.S., Graham and Harvey (2001) find that the corporate tax advantage of debt is moderately important in capital structure decisions. Beattie, Goodacre, and Thomson's

survey in the U.K. (2006) indicate that tax code contributes to the relatively low importance attached to tax deductibility of interest. On the other hand, Rajan and Zingales (1995), Grham (1996), Grham, Lemmon, and Schallheim (1998) find a positive relation between debt usage and tax rates.

Marginal tax rate is difficult to measure in practice and it is not surprising that the marginal tax rate is almost never explicitly calculated in literatures. Instead, proxies are used to represent a firm's tax status. Popular tax proxies used in literatures include non-debt tax shields and taxes paid over pre-tax income. By using taxes paid over pre-tax income as the proxy for tax rate, table 3.1 shows the tax rate of the three telecom companies from 2001 to 2007. Over the past seven years, the tax rate of Chunghwa Telecom is not volatile while its debt ratio seems to decline in the first four years and go up in the past three years. No obvious pattern between debt ratio and tax rate for Taiwan Mobile is observed. For FarEastone Telecom the debt ratio and tax rate go exactly in the opposite direction. Overall the low tax rate may not be an important factor when managers of the three companies make their capital structure decisions.

**【Table 3.1 : Debt Ratios and Tax Rates】**

Year	Chunghwa		Taiwan Mobile		FarEastone	
	Debt Ratio	Tax Rate	Debt Ratio	Tax Rate	Debt Ratio	Tax Rate
2007	15.08%	21.03%	62.08%	17.91%	14.01%	15.13%
2006	13.23%	22.12%	23.17%	7.48%	17.66%	9.80%
2005	11.33%	20.05%	25.88%	11.33%	21.29%	9.40%
2004	23.12%	17.93%	33.22%	14.20%	21.56%	3.50%
2003	23.04%	17.62%	46.91%	7.76%	39.76%	0.00%
2002	24.96%	22.45%	55.07%	3.07%	35.28%	0.00%
2001	24.31%	20.54%	43.59%	7.10%	38.87%	0.00%

In this study, tax rate is not included for quantitative analysis based on the following reasons. First of all, degree of freedom will be further decreased in the multiple variable regression analysis since there are about 30 quarterly data for each of the three companies. The decrease in the degree of freedom when doing regression analysis would induce spurious relation and the results may be biased or misleading. The situation is even worse in the analysis of Granger causality by use of vector autogression. Secondly, recent surveys in the U.S. and in the U.K. show that tax rate is relatively low importance compared to financial flexibility or credit rating when managers of a firm make decisions on capital structure. Finally, as mentioned earlier, the transfer of tax shields utilizing the associated tax deduction may not intrigue managers due to the low tax rate of the three telecom companies.

## 3.2 Definitions of Proxy Variables

### 3.2.1 Capital Structure

Long-term, short-term, or even convertible debt divided either by market or by book values of total assets can be used to measure financial leverage for specific purpose of study. As we are interested in a macro-view of the capital structure, all kinds of debts are combined to be the total debts for the purpose of this study. We choose to measure debts, assets and equity in terms of book value rather than market value. Since there is high volatility of market value depending on the situation of economy, the use of market value may not reflect the real value of debts and assets. Equity is also easily to be influenced by stock markets. Besides, high volatility of market value may lead to misspecification, resulting in spurious regression and bias. In this paper, the proxy variable for capital is the debt ratio  $Y$  defined as follows:

$$Y = \text{book value of total debts} / \text{book value of total assets}$$



### 3.2.2 Firm Size

Titman and Wessels (1988) indicates that the correlation between the natural logarithm of total sales (LnS) and the natural logarithm of total assets Ln (TA) is very high. Therefore, parameter estimates of regression models are not sensitive to the choice between LnS or LnTA as an indicator for size. The reason for the use of natural logarithm is to avoid extreme values. We follow the convention to use the natural logarithm of the total sales as the proxy variable for firm size.

$X_1$  = the natural logarithm of book value of total assets (LnS)

### 3.2.3 Profitability

Return of equity, Return of assets, operating profit over net sales, operating profit over total assets, net income over net sales, are some indicators of a firm's profitability. The theory of firms begins with a simple assumption that firms try to maximize their profits. We use net income over net sales as the proxy variable for profitability since it can express the contribution of unit net sales to net income.

$X_2$  = net income / net sales

### 3.2.4 Growth

There are several indicators of growth used in literature including capital expenditures over total assets, the growth of total assets measured by the percentage change in total assets (Titman and Wessels, 1988), growth rate of EBIT and growth rate of net sales. Net sales is an important indicator of a firm's performance and is popularly used by market observers to evaluate the growth potential of that firm. The percentage change in net sales is used as the proxy variable for growth.

$X_3$  = percentage change in net sales

### 3.2.5 Collateral value of tangible assets

From the viewpoint of debt providers, the value of intangible assets is not easy to evaluate. Among tangible assets, fixed assets served as collateral easily secure the debt of a firm. Thus, the ratio of fixed assets to total assets is used as the proxy variable for collateral value of tangible assets.

$X_4$  = ratio of fixed assets to total assets

### 3.2.6 Business Risk

Business risk refers to a firm's possible fluctuation of EBIT, also called operating profit, resulting from instability of sales or cost due to industry environment, market competition, management ability, and production scale. EBIT is an extreme important measure of earning power from ongoing operations. Without considering depreciation and amortization, debt providers closely watch a firm's EBIT because it is an indicator of the amount of cash that such a firm will be able to use to pay off debts. We use business leverage, defined as follows, as the proxy variable for business risk.

$X_5$  =  $(\Delta \text{EBIT} / \text{EBIT})$  over  $(\Delta \text{net sales} / \text{net sales})$

### 3.2.7 Cash

In this study, cash equivalent is included in cash. We use the natural logarithm of cash as the proxy variable for cash.

$X_6$  =  $\text{Ln}(\text{cash})$

### 3.2.8 Earnings Volatility

We follow Titman and Wessels (1988) to use the standard deviation of the percentage change in EBIT as the proxy variable for earnings volatility.

$X_7$  = standard deviation of the percentage change in EBIT

### 3.3 Model Specifications

#### 3.3.1 Two-Variable Regression Analysis

In the two-variable regression, namely the bivariate, the dependent variable is related to a single explanatory variable (independent variable) as follows:

$$Y = \beta_0 + \beta_1 X_1 + \varepsilon \quad \dots\dots\dots (1)$$

where Y is the dependent variable,  $X_1$  is the explanatory variable,  $\beta_0$  and  $\beta_1$  are constants to be estimated, and  $\varepsilon$  is the error term or disturbance which represents all other factors that cannot be fully explained only by the variable  $X_1$  in the regression model. Thus, for instance, if  $X_1$  is growth rate, we can examine the relationships between capital structure and growth rate.

#### 3.3.2 Multiple Regression Analysis

The multiple regression is a natural extension of two-variable regression as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \quad \dots\dots\dots (2)$$

where Y is the dependent variable,  $X_1$  through  $X_7$  are the explanatory variables,  $\beta_0$  through  $\beta_7$  are constants to be estimated, and  $\varepsilon$  is the error term or disturbance which represents all other factors that cannot be fully explained by the variables  $X_1$  through  $X_7$

in the regression model. Testing of the overall significance of the multiple regression is the F test:

$$H_0 : \text{All slope coefficients are simultaneously zero } (\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0)$$

$$H_1 : \text{Not all slope coefficients are simultaneously zero}$$

### 3.3.3 Vector Autoregression

Two time series VAR models, VAR(1) and VAR(2), are used to analyze the interrelationships between the capital structure and each of the seven variables. The general form of VAR model can be represented as follows:

$$X_t = a_{10} + \sum a_{1j} X_{t-j} + \sum b_{1j} Y_{t-j} + \varepsilon_{X,t} \quad \dots\dots\dots (3)$$

$$Y_t = a_{20} + \sum a_{2j} X_{t-j} + \sum b_{2j} Y_{t-j} + \varepsilon_{Y,t} \quad \dots\dots\dots (4)$$

where  $X_t$  represents each of the seven variables and  $Y_t$  is the capital structure.  $a$  and  $b$  with subscripts are coefficients.  $\varepsilon_{X,t}$  and  $\varepsilon_{Y,t}$  are white noise disturbances which may be correlated. When  $j=1$ , it is a first-order vector autoregression model, denoted VAR(1) and  $j=2$  is a second-order vector autoregression model, denoted VAR(2). The most basic form of a VAR treats all variables symmetrically without making reference to the issue of dependence versus independence. Test of restrictions can be based on the simple F tests in the VAR system (3) and (4) in which the two identical dependent variables imply that these tests can be based on the results of simple OLS estimates. The VAR system (3) and (4) are used to do forecasts and analysis of Granger causality.

The reason we do not go beyond using VAR(3) or higher order system is concerning about the selection of the appropriate lag length. Inclusion of too many lags reduces the power of hypothesis test to reject the null since the increased number of lags

necessitates the estimation of additional parameters and a loss of degrees of freedom. The degrees of freedom are quickly eroded as more variables are included and it is unlikely to capture the systems dynamics. Due to availability of data, with about 30 quarterly data for each of the three companies, and the reason that the latest data have more significant impact on dependent variables, we decided to use lag lengths of 1 and 2 to do Granger causality test.

Although regression analysis deals with the dependence of one variable on other variables, it does not necessarily establish causal connection between variables no matter how strong or how suggestive the statistical relationship between variables would be. On the other hand, Granger causality means that a lead-lag relationship is evident between variables in a multivariate time series like system (3) and (4). It refers to the effect of past values of time series  $\{X_t\}$  on the current value of  $Y_t$ . Hence, Granger Causality actually measures whether the current and past values of  $\{X_t\}$  help forecast future values of  $\{Y_t\}$ . For instance, in conventional macroeconomics there is an argument in favor of conducting a monetary policy related to price level. The issue is whether fluctuations in money supply help predict future fluctuations in price levels that are not already predicted on the basis of price level itself or other readily observable variables. The increase in money supply Granger causes the increase of price level (inflation) if the increase in price level results from the increase in money supply. Thus, the increase in money supply is the cause of the increase in price level.

In our case, we will study whether the change of capital structure Granger causes the change of one of the seven factors, say, firm size, or the change of firm size Granger causes the change of capital structure. It is also possible that the change of capital structure and that of firm size are cause and effect to each other. The strength of Granger

causality may change over time. Granger causality is not a one-way cause and effect in the sense that there can be bidirectional causality.

### 3.4 Data Sources and Study Periods

The sources of all data are the Taiwan Economic Journal (TEJ, 台灣經濟新報), the annual reports of the three firms, and the official web site of the Market Observation Post System (公開資訊觀測站) in Taiwan. The variables discussed in previous sections were analyzed by use of quarterly data for Chunghwa Telecom over the 2000 through the first quarter of 2008 time period, for Taiwan Mobile over the third quarter of 1999 through the first quarter of 2008 time period, and for FarEastone over the 2001 through the first quarter of 2008 time period. These original data for this study are shown in tables A.1 to A.3 in Appendix 1.

