

## Chapter 4

### Results and Discussions

#### 4.1 Descriptive Statistics and Correlation Analysis

Table 4.1 reports the descriptive statistics of the three companies. We find that the average debt ratio of the three companies is 22.98%, lower than those of, for example, conventional cement industry (30.55%), aviation (70.15%), TFT-LCD industry (53.90%), and note book/cellular original equipment manufacturing industry (45.61%) over the study period in Taiwan. The small standard error of firm size of the three companies in between their max and min values indicates that the telecom industry is approaching mature.

Tables 4.2 to 4.4 provide the results of the Pearson correlation analysis for the three companies, respectively. For Chunghwa Telecom, the debt ratio is positively correlated to firm size and collateral value of tangible assets, and negatively correlated to profitability. The debt ratio has no correlation with the other four factors. These results completely match the results of two-variable and multiple regression analysis as described in the next sections. For Taiwan Mobile, the debt ratio is positively correlated to collateral value of tangible assets, and negatively correlated to firm size and profitability, also matching the results of two-variable regression. Additionally, the debt ratio is negatively correlated to cash and has no correlation with the remaining three factors. For FarEastone Telecom, the debt ratio is positively correlated to collateral value of tangible assets, and negatively correlated to firm size, matching the results of two-variable regression analysis. The debt ratio has no correlation with the remaining five factors. The implication of the correlation between debt ratio and factors under considerations are further explained in the following sections.

**【Table 4.1 : Descriptive Statistics of the Three Companies】**

Variables	Mean	Median	Standard Error	Max	Min
Chunghwa Telecom					(n=32)
Debt Ratio	0.1763	0.1762	0.0542	0.2791	0.1050
Firm Size	19.9541	19.9578	0.0238	20.0002	19.9046
Profitability	0.2741	0.2587	0.0387	0.2959	0.1406
Growth	0.0010	0.0037	0.0277	0.0416	-0.0561
Collateral	0.8068	0.8215	0.0670	0.8091	0.6992
Business risk	21.4403	0.7038	146.5614	906.0093	-145.5908
Cash	16.9063	17.1498	0.9762	18.2171	15.0947
Earning Volatility	0.2549	0.2678	0.0711	0.3416	0
Taiwan Mobile					(n=34)
Debt Ratio	0.4201	0.4541	0.1071	0.6208	0.2317
Firm Size	18.4625	18.5731	0.2488	18.7780	17.8390
Profitability	0.3059	0.3238	0.1381	0.4884	-0.3928
Growth	0.0191	0.0100	0.0620	0.2198	-0.1432
Collateral	0.5488	0.5052	0.0948	0.7549	0.4421
Business risk	27.0135	4.4427	129.1149	538.4254	-279.1998
Cash	15.2681	15.0498	0.6908	16.5143	13.9274
Earning Volatility	0.3567	0.3389	0.0944	0.6087	0
FarEastone Telecom					(n=28)
Debt Ratio	0.2888	0.3035	0.0972	0.4312	0.1401
Firm Size	18.1508	18.2953	0.2324	18.4421	17.7271
Profitability	0.2727	0.2669	0.0597	0.3750	0.1768
Growth	0.0094	0.0120	0.0418	0.0676	-0.1009
Collateral	0.4888	0.3871	0.1675	0.8060	0.3229
Business risk	1.3973	0.1261	18.1047	55.0004	-58.6796
Cash	14.7866	14.8993	0.7189	16.0686	13.1137
Earning Volatility	0.1920	0.2044	0.0541	0.2516	0

【Table 4. 2 : Pearson Correlation Analysis of Chunghwa Telecom】

		Debt Ratio	Firm Size	Profitability	Growth	Collateral	Business Risk	Cash	Earning Volatility
		Y	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>
Debt Ratio	Y	1 (0.0)							
Firm Size	X <sub>1</sub>	0.5228 (0.0021)	1 (0.0)						
Profitability	X <sub>2</sub>	-0.3448 (0.0533)	-0.0254 (0.8903)	1 (0.0)					
Growth	X <sub>3</sub>	-0.0108 (0.9532)	0.0443 (0.8099)	0.4471 (0.0103)	1 (0.0)				
Collateral	X <sub>4</sub>	0.3955 (0.0251)	-0.1976 (0.2784)	-0.0752 (0.6826)	-0.1338 (0.4654)	1 (0.0)			
Business Risk	X <sub>5</sub>	-0.1358 (0.4586)	-0.0172 (0.9256)	-0.1055 (0.5656)	0.0023 (0.9902)	-0.2541 (0.1605)	1 (0.0)		
Cash	X <sub>6</sub>	-0.2528 (0.1628)	0.3306 (0.0646)	0.0129 (0.9441)	0.0932 (0.6120)	-0.9089 (0.0)	0.2788 (0.1222)	1 (0.0)	
Earning volatility	X <sub>7</sub>	-0.2170 (0.2328)	-0.0561 (0.7603)	0.4724 (0.0063)	-0.0162 (0.9300)	0.1795 (0.3257)	0.0217 (0.9062)	-0.1580 (0.3878)	1 (0.0)

\* The first figure in the table is the coefficient, and the second in the parenthesis is the p-value.

\*\* H<sub>0</sub>: There is no correlation.

【Table 4. 3 : Pearson Correlation Analysis of Taiwan Mobile】

		Debt Ratio	Firm Size	Profitability	Growth	Collateral	Business Risk	Cash	Earning Volatility
		Y	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>
Debt Ratio	Y	1 (0.0)							
Firm Size	X <sub>1</sub>	-0.3535 (0.0403)	1 (0.0)						
Profitability	X <sub>2</sub>	-0.3413 (0.0482)	0.2324 (0.1860)	1 (0.0)					
Growth	X <sub>3</sub>	0.1515 (0.3921)	-0.6046 (0.0002)	0.0532 (0.7652)	1 (0.0)				
Collateral	X <sub>4</sub>	0.3392 (0.0497)	-0.8473 (0.0)	-0.0003 (0.9988)	0.4488 (0.0078)	1 (0.0)			
Business Risk	X <sub>5</sub>	0.0461 (0.7957)	0.1308 (0.4609)	0.0301 (0.8658)	-0.0712 (0.6890)	-0.0062 (0.9721)	1 (0.0)		
Cash	X <sub>6</sub>	-0.3422 (0.0476)	0.1076 (0.5445)	0.1636 (0.3552)	-0.0820 (0.6447)	-0.2433 (0.1656)	-0.0984 (0.5798)	1 (0.0)	
Earning volatility	X <sub>7</sub>	0.2061 (0.2423)	0.0589 (0.7406)	-0.2439 (0.1646)	-0.4364 (0.0099)	0.0149 (0.9332)	-0.1333 (0.4522)	-0.3803 (0.0265)	1 (0.0)

\* The first figure in the table is the coefficient, and the second in the parenthesis is the p-value.

\*\* H<sub>0</sub>: There is no correlation.

【Table 4. 4 : Pearson Correlation Analysis of FarEastone Telecom】

		Debt Ratio	Firm Size	Profitability	Growth	Collateral	Business Risk	Cash	Earning Volatility
		Y	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>
Debt Ratio	Y	1 (0.0)							
Firm Size	X <sub>1</sub>	-0.7560 (0.0)	1 (0.0)						
Profitability	X <sub>2</sub>	-0.6918 (0.1318)	0.6852 (0.0001)	1 (0.0)					
Growth	X <sub>3</sub>	-0.1272 (0.5188)	0.3302 (0.0861)	0.1195 (0.5446)	1 (0.0)				
Collateral	X <sub>4</sub>	0.8163 (0.0)	-0.9844 (0.0)	-0.6043 (0.0007)	-0.3651 (0.0561)	1 (0.0)			
Business Risk	X <sub>5</sub>	-0.0067 (0.9728)	-0.1004 (0.6113)	-0.0023 (0.9909)	0.0447 (0.8213)	0.0867 (0.0.6609)	1 (0.0)		
Cash	X <sub>6</sub>	0.0121 (0.9513)	0.2560 (0.1886)	0.1932 (0.3245)	0.3764 (0.0483)	-0.2367 (0.2253)	0.1652 (0.4009)	1 (0.0)	
Earning volatility	X <sub>7</sub>	-0.1957 (0.3183)	0.3863 (0.0423)	0.3160 (0.0104)	0.5711 (0.0015)	-0.3674 (0.0544)	0.0801 (0.6854)	0.4079 (0.0312)	1 (0.0)

\* The first figure in the table is the coefficient, and the second in the parenthesis is the p-value.

\*\* H<sub>0</sub>: There is no correlation.

## 4.2 Results of Two-Variable Regression

Table 4.5 is a summary based on the results of the two-variable regression analysis of the three telecom companies, as shown in tables 4.6 to table 4.8, respectively. The results in table 4.5 shows the same pattern for the three companies except the relationship between debt ratio and firm size for Chunghwa Telecom.

【Table 4.5 : Results of Two-Variable Regression Analysis】

Companies	Chunghwa	Taiwan Mobile	FarEastone
Firm Size	++*	—	—
profitability	—	—	—
Growth	N	N	N
Collateral	+	+	+
Business risk	N	N	N
Cash	N	N	N
Earning volatility	N	N	N

\* The double '+' sign indicates the strong positive relationship between the factor and debt ratio. A single '+' or '-' sign means moderate positive or negative relationship between the factor and debt ratio. 'N' means there is no significant relationship between the factor and debt ratio.

### A. Results of the effect of firm size

When a firm has lower expected bankruptcy costs and is less likely to default, the standard single-firm tradeoff theory predicts that the firm should issue more debt. Mehran, Taggart, and Yermack (1999) find that the positive effect of firm size on debt financing is quite strong. Chung's (1993) study supports their arguments. Chunghwa Telecom is the largest and leading telecom company in Taiwan. With high profitability, good credit rating and the Ministry of Transportation and Communications as its biggest shareholder (34%), our results also show that the debt ratio of Chunghwa Telecom is positively related to its firm size. Many studies focusing on Taiwan's industries about the effect of firm size on debt ratio suggest that the firm size is an important determinant

of capital structure and debt ratio is positively correlated to firm size (王瑛璋, 1993, 楊淑媛, 廖四郎, 黃瑞靜, 2000, and references cited therein). Liu (1999) finds that there is a significant positive relationship between long term debt ratio and firm size for publicly listed companies in China. However, the debt ratios of Taiwan Mobile and FarEastone Telecom are negatively related to their firm size. This is consistent with the observation of March (1982), Titman and Wessels (1988). From the viewpoint of the conflict between equity holders and debt holders, one explanation would be that the major shareholders of the two companies have a greater incentive to make choices that benefit equity holders more than debt holders.

If we look at table A.1 in Appendix 1, indeed, the debt ratio of Chunghwa Telecom seems not to be positively related to its firm size. Chunghwa Telecom stepped into the Cellular phone market in 1995. The liberalization and opening of telecom market in Taiwan led Taiwan Mobile and FarEastone Telecom to start their cellular phone operation in January, 1998. The development of network technology further provided opportunities for the telecom industry in Taiwan to offer broadband services. Our study period is from 2000 to 2008. Chunghwa Telecom's investments have been mainly on construction of cellular phone base stations since 1995, and related hardware equipments of broadband services since 2000, plus the construction of new fiber network since 2005<sup>1</sup>. The debt ratio used in this study for Chunghwa Telecom includes its investments on fixed line services. We believe if the related investments in fixed line are excluded and the focus is on the investments of base stations, broadband services equipments and construction of fiber network, the debt ratio of Chunghwa telecom

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<sup>1</sup> According to the 2007 annual report of Chunghwa Telecom, the application of fiber network for retail customers includes digital home services, such as video phone, MOD (Multimedia-on-Demand), HDTV, video monitoring, remote care, and remote learning. Unified Communication Service will be available specifically for corporate customers.

would be positively related to its firm size during the study period.

In short, from the viewpoint of single firm, the effect of firm size in the telecom industry in Taiwan on debt ratio is ambiguous. That is, the debt ratio of Chunghwa telecom is positively related to its firm size and the debt ratios of Taiwan Mobile and FarEastone Telecom are negatively related to their firm size.

For the cross-firm comparison, Graham, Lemmon and Schallheim (1998) suggest that large firms are more likely to be debt financed than their smaller counterparts. The size of Taiwan Mobile is larger than that of FarEastone Telecom and the debt ratio of Taiwan Mobile is higher than that of FarEastone Telecom. However, the debt ratio of the largest Chunghwa Telecom is lower than those of its smaller counterparts.

#### B. Results of the effect of profitability

The high EPS implies that the three companies have been very profitable since the year of 2000. The negative association of debt ratio with profitability as shown in table 4.5 for all three companies supports the implication of the pecking order theory that, holding investment fixed, leverage is lower for more profitable firms. This result is consistent with reports from other literatures as noted in section 3.2.3.

The negative association between debt ratio and profitability also indicates that transaction costs of debt financing, implied by pecking order theory, may be an important determinant of capital structure choice. That is, the consideration of various leverage-related costs and benefits may be significant when using debts. However, a more reasonable and intuitive explanation would be: why should firms inefficiently leave retained earnings sitting there and go benefit debt holders?

#### C. Results of the effect of collateral value



Among tangible assets, fixed assets are more easily to serve as collateral to secure the debt of a firm. At the end of the 1<sup>st</sup> quarter of 2008, the ratios of fixed assets to total assets of Chunghwa Telecom, Taiwan Mobile and FarEastone Telecom are 69.92%, 59.61%, and 32.53%, respectively. With high ratios of fixed assets to total assets, the three companies would take advantage of using some of their fixed assets as collateral for debt financing. Studies in many literatures provide empirical evidence in support of the positive relationship between debt ratio and collateral value of tangible assets. Our results in table 4.5 reach the same conclusion that collateral value has a positive influence on debt ratio for all three companies.

The positive relationship between debt ratio and collateral value of tangible may have an implication in the pecking order theory. Asymmetric information about which the firm's managers have better information than outside equity holders may result in higher costs associated with issuing securities. Issuance of equity is also time-consuming and may end up with losing the best timing of investment opportunity. However, issuing debt by tangible assets with known market values not only can avoid these costs, but also is less time-consuming. For this reason, firms with tangible assets that can be used as collateral are expected to take advantage of the potential collateral value of tangible assets to borrow more for new investment opportunities if they do not have enough retained earnings. This establishes the order from debt to equity.

#### D. Results of the effect of other factors

The results of the simple two-variable regression analysis shows that there is no impact of growth, business risk, cash and earnings volatility on the debt ratio for the three companies. This indicates the costs and benefits of the four variables are small when managers of the three companies make their debt financing policies.

That the telecom market in Taiwan tends to grow slightly may lead to the results of no definite relationship between debt ratios and growth for the three companies. Our results are consistent with Titman and Wessels (1988) without finding empirical evidence to support an effect on debt ratios arising from future growth.

The three companies are all quite profitable over the study period. None of the three companies will go out of business in the future due to the risk in product markets as mentioned previously in section 3.1.6. Business risks should not affect its debt ratio. This view is supported by our results that debt ratios of the three companies are not related to their business risk as shown in table.4.5. Particularly, the business risk resulting from material impact of the case of FarEastone's investment into FETC that occurred in 2006 seems not to affect the debt ratio of FarEastone Telecom<sup>2</sup>.

Free cash flow is cash flow in excess of that needed to fund all projects that have positive net present values when discounted at the relevant cost of capital. Conflicts of interest between shareholders and managers over payout policies are especially severe when firms produce substantial free cash flow. All three companies have a huge amount of cash in hands. To enhance the return of shareholder's equity, Chunghwa conducted share repurchase program and capital reduction with cash in 2007 and 2008<sup>3</sup>. Taiwan Mobile and FarEastone took similar actions, respectively<sup>4</sup>. It is therefore expected that cash have no effect on the debt ratios of the three companies as predicted by our results

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<sup>2</sup> In 2006, FETC (遠通電收) was accused of illegally getting the license to run the intelligent electronic ticketing system (ETC) in Taiwan's free way. On August 11, 2006, the Company announced a proposal to withdraw from FETC by unconditionally donating its FETC shareholding to the Government, so that the Government will be able to plan the future for ETC operation on a brand new basis. The case is still suspending and unresolved.

<sup>3</sup> In August 2007, Chunghwa's Board of Directors approved the second share repurchase program or NT\$7.2 billion, the equivalent of 1.14% of the total shares outstanding. Buying operations will be on the open market over a two-month period starting on August 29, 2007. In April 2007, the Board of Directors approved its first capital reduction of NT\$9.67 billion, resulting in the return of NT\$0.91 per share in cash to shareholders. In June 2008, Chunghwa's Board of Directors approved a further capital reduction of NT\$19.1 billion, resulting in the return of NT\$1.6 per share in cash to shareholders.

<sup>4</sup> In December 2007, Taiwan Mobile reduced capital by returning NT\$1.2 billion, the equivalent to NT\$2.4 per share in cash to shareholders. In March 2008, FarEastone Telecom reduced capital by returning NT\$7,745 million, the equivalent to NT\$1.92 per share in cash to shareholders.

shown in table 4.5. It seems that managers of the three companies are all motivated to disgorge the cash rather than investing it at below the cost of capital. With huge amount of cash, share repurchase and capital reduction are becoming important forms of payout considered by managers of the three companies. If cash is not used to pay off debts, it provides flexibility for managers of the three companies to seek for the availability of good investment opportunities, to return capital to shareholders or conduct share repurchase at the appropriate time to alter payout.

The high EPS and low earnings volatility, as shown in tables 1.2 to 1.4, indicates that the three companies are less likely to default, and have lower expected bankruptcy costs. If there are investment opportunities, the firm should issue more debt in case the retained earnings are not enough. However, consistent with empirical evidence documented by Titman and Wessels (1988), our results show that the debt ratios of the three companies are not affected by the earnings volatility. Again, the most probable explanation would be that the telecom markets in Taiwan will grow slowly in the future.

Our findings about the telecom industry in Taiwan by using the simple two-variable regression analysis, under the prerequisite that the telecom market in Taiwan is potentially close to mature, can be summarized as follows:

- Among the seven factors under study, the major determinants of capital structure are firm size, profitability and collateral value of tangible assets.
- The effect of firm size on capital structure is ambiguous. Profitability has a negative influence on capital structure. The collateral value of tangible assets has a positive effect on capital structure.
- Growth, business risk, cash and earnings volatility have no impact on the capital structure.

【Table 4.6 : Statistical Data of Two-Variable Regression of Chungghwa Telecom\*】

Dependent Variable: Debt Ratio

Independent Variables	Intercept	Slope	R <sup>2</sup>	Adjusted R <sup>2</sup>	F-statistic	F-probability
Firm size**	-24.0186	1.2126	0.2787	0.2555	11.9807	0.0016
t-statistic	-3.4359	3.4613				
p-value	0.0017	0.0016				
Profitability	0.3012	-0.5016	0.1277	0.0996	4.5392	0.0412
t-statistic	5.1355	-2.1305				
p-value	0	0.0412				
Growth	0.1743	-0.0211	0.0001	-0.3320	0.0035	0.9532
t-statistic	18.0903	-0.0591				
p-value	0	0.9532				
Collateral	-0.1271	0.3777	0.1542	0.1270	5.6534	0.0238
t-statistic	-0.9891	2.3777				
p-value	0.3303	0.0238				
Business risk	0.1774	0	0.0184	-0.0143	0.5638	0.4586
t-statistic	18.1799	-0.7509				
p-value	0	0.4586				
Cash	0.4317	-0.0151	0.0752	0.0453	2.5200	0.1226
t-statistic	2.6934	-1.5874				
p-value	0.0113	0.1226				
Earning Volatility	0.2185	-0.1655	0.0471	0.0153	1.4830	0.2328
t-statistic	6.0825	-1.2178				
p-value	0	0.2328				

\* Level of significance is 5%.

\*\* This is the regression of “Debt Ratio = -24.0186 + 1.2126 × Firm Size”. The interpretation is the same for other independent variables.

【Table 4.7 : Statistical Data of Two-Variable Regression of Taiwan Mobile\*】

Dependent Variable: Debt Ratio

Independent Variables	Intercept	Slope	R <sup>2</sup>	Adjusted R <sup>2</sup>	F-statistic	F-probability
Firm size	3.0027	-0.1399	0.1336	0.1073	5.0880	0.0308
t-statistic	2.6244	-2.2555				
p-value	0.0130	0.0308				
Profitability	0.5037	-0.2713	0.1275	0.1010	4.8215	0.0352
t-statistic	12.3350	-2.1958				
p-value	0	0.0352				
Growth	0.4151	0.2618	0.0230	-0.0076	0.7525	0.3921
t-statistic	21.4950	0.8675				
p-value	0	0.3921				
Collateral	0.2049	0.3936	0.1255	0.0990	4.7377	0.0368
t-statistic	2.0226	2.1766				
p-value	0.0513	0.0368				
Business risk	0.4191	0	0.0021	-0.0291	0.0682	0.7957
t-statistic	22.0078	0.2611				
p-value	0	0.7957				
Cash	1.2043	-0.0512	0.1083	0.0813	4.0074	0.0536
t-statistic	3.0797	-2.0019				
p-value	0.0042	0.0536				
Earning Volatility	0.3368	0.2336	0.0425	0.0125	1.4194	0.2423
t-statistic	4.6584	1.1914				
p-value	0	0.2423				

\* Level of significance is 5%.

\*\* This is the regression of “Debt Ratio = 3.0027 - 1.1399 × Firm Size”. The interpretation is the same for other independent variables.

【Table 4.8 : Statistical Data of Two-Variable Regression of FarEastone Telecom\*】

Dependent Variable: Debt Ratio

Independent Variables	Intercept	Slope	R <sup>2</sup>	Adjusted R <sup>2</sup>	F-statistic	F-probability
Firm size	6.2334	-0.3274	0.6108	0.5964	42.3807	0
t-statistic	6.8328	-6.5100				
p-value	0	0				
Profitability	0.4571	-0.6058	0.1506	0.1191	4.7864	0.0375
t-statistic	6.0012	-2.1878				
p-value	0	0.0375				
Growth	0.2916	-0.2962	0.0162	-0.216	0.4279	0.5188
t-statistic	15.3101	-0.6542				
p-value	0	0.5188				
Collateral	0.0509	0.4903	0.6924	0.6810	60.7856	0
t-statistic	1.5399	7.7965				
p-value	0.1352	0				
Business risk	0.2889	0	0	-0.0384	0.0012	0.9728
t-statistic	15.3850	-0.0344				
p-value	0	0.9728				
Cash	0.3344	-0.0027	0.0004	-0.0367	0.0095	0.9231
t-statistic	0.8249	-0.0974				
p-value	0.4166	0.9231				
Earning Volatility	0.3564	-0.3518	0.0383	0.0013	1.0351	0.3183
t-statistic	5.1732	-1.0174				
p-value	0	0.3183				

\* Level of significance is 5%.

\*\* This is the regression of “Debt Ratio = 6.2334 – 0.3274 × Firm Size”. The interpretation is the same for other independent variables.

### 4.3 Results of Multiple Regression

Table 4.9 summarizes the estimated relations of the multiple regression analysis for the three companies. The null hypothesis of joint test is that all slope coefficients are simultaneously zero.

For Chunghwa Telecom, the result is

$$\text{Debt Ratio} = -27.4792 + 1.3693 \times (\text{Firm Size}) - 0.4234 \times (\text{Profitability}) \dots\dots\dots(5) \\ + 0.5353 \times (\text{Collateral})$$

$$\text{Adjusted } R^2 = 0.5632 \quad \text{F-statistic} = 6.7090 \quad \text{p-value} = 0.0002$$

With the p-value of F-probability = 0.0002 at the significance level of 5%, clearly we do not accept the null hypothesis. This result is surprising because it perfectly matches the result of the simple two-variable regression analysis. That is, the debt ratio of Chunghwa Telecom is strongly positively related to its firm size and collateral value of tangible assets, but is negatively related to its profitability. The other four factors, growth, business risk, cash and earnings volatility, have no effect on its debt ratio. Equation (5) has the power to identify meaningful variation in debt ratio in response to firm size, profitability and collateral value of tangible assets. Overall, the explanatory power of the multiple regression model for the debt ratio of Chunghwa Telecom is high.

For Taiwan Mobile, the result is difficult to interpret because the values of the F-statistic for the whole regression model and the t-statistic for each of the seven independent variables imply that all slope coefficients are not significantly statistically different from zero, yet the adjusted  $R^2$  is 0.0948. There is no effect of growth, business risk, cash and earnings volatility on the debt ratio, which is consistent with the simple two-variable regression analysis. However, compared to the simple two-variable regression analysis, the effects of firm size, profitability and the value of collateral assets are gone. It is possible that some other factors that are not included in this model may have better explanatory power.

In empirical analysis it is not unusual to obtain a reasonable adjusted  $R^2$ , as in the case of Taiwan Mobile, with some of the regression coefficients that either are statistically insignificant or have signs that are contrary to a priori expectations. A reasonable adjusted  $R^2$  is not evidence in favor of the model. Therefore, the logical or theoretical relevance of the seven independent variables to the debt ratio, their statistical inference and the question as to why we cannot explain the bizarre results of the multiple regression for Taiwan Mobile will be left as a further study.

For FarEastone Telecom, the result is

$$\text{Debt Ratio} = 0.6417 \times (\text{Growth}) + 1.2263 \times (\text{Collateral}) \dots\dots\dots(6)$$

$$\text{Adjusted } R^2 = 0.7808 \quad \text{F-statistic} = 14.743 \quad \text{p-value} = 0$$

Again we do not accept the null hypothesis. Consistent with the result of simple two-variable regression, the collateral value of tangible assets has a positive effect on debt ratio; business risk, cash, and earnings volatility have no influence on debt ratio at all. However, the effects of firm size and profitability on debt ratio disappear, and the positive effect of growth on debt ratio emerges in equation (6).

The debt ratio of FarEastone Telecom has been with a trend of decrease since 2001 and the net sales have been stabilized in the past few years. In view of the more recent data in the past few years having more significant impact on debt ratio, it is unlikely that the growth has a positive influence on debt ratio. Therefore, the portion of the positive relation between the debt ratio and growth could be spuriously induced in equation (6).



【Table 4.9 : Results of Multiple Regression \*】

Dependent Variable: Debt Ratio

Companies	Chunghwa	Taiwan Mobile	FarEastone
Independent Variables			
Intercept	-27.4791	1.4199	-8.8496
t-statistic	-4.7060	0.3512	-1.6147
p-value	0	0.7283	0.1220
Firm Size	1.3693	-0.0354	0.4497
t-statistic	4.5624	-0.1795	1.5177
p-value	0.0001	0.8589	0.1447
Profitability	-0.4234	-0.2096	0.3614
t-statistic	-1.8486	-1.2953	1.4753
p-value	0.0769	0.2066	0.1557
Growth	0.3277	0.1141	0.6417
t-statistic	1.2039	0.2482	2.2897
p-value	0.2404	0.8059	0.0330
Collateral	0.5353	0.2173	1.2263
t-statistic	1.8520	0.4916	3.2531
p-value	0.0764	0.6271	0.0040
Business risk	0	0	-0.0006
t-statistic	-0.1665	0.3776	-1.1691
p-value	0.8691	0.7088	0.2561
Cash	0.0018	-0.0293	0.0211
t-statistic	0.1058	-0.9169	1.5065
p-value	0.9166	0.3676	0.1476
Earning Volatility	-0.1016	0.1223	-0.2106
t-statistic	-0.9074	0.4800	-0.9780
p-value	0.3732	0.6352	0.3397
R <sup>2</sup>	0.6618	0.2868	0.8377
Adjusted R <sup>2</sup>	0.5632	0.0948	0.7808
F-statistic	6.7090	1.4935	14.7430
p-value	0.0002	0.2133	0

\* Level of significance is 5%.

#### 4.4 Results of Granger Causality

In the absence of a model we cannot determine whether it is, for instance, the firm size that affects capital structure choices or a firm's capital structure that affects its firm size. In this section we try to use the concept of Granger causality to establish causal connection between variables.

For the results to be statistically meaningful, the time series need to be stationary. Unfortunately, the augmented Dickey-Fuller test indicates that there is a unit root for the debt ratio time series of FarEastone Telecom because it exhibits a trend to decline over time. The debt ratio time series of FarEastone Telecom is non-stationary. The augmented Dickey-Fuller test also verifies that the cash time series of Chunghwa Telecom is non-stationary since it exhibits a distinguishing feature of an upward trend over time. We therefore exclude the Granger causality test on FarEastone Telecom and on the cash time series of Chunghwa Telecom. Table 4.10 summarizes the results of Granger causality based on the VAR models

##### A. Chunghwa Telecom

The results of VAR(2) model in table 4.10 indicates that the debt ratio Granger causes firm size, though the VAR(1) model does not exhibit this phenomenon. We look at two lags in the VAR(2) model. Referring to the data of Chunghwa Telecom in table A.1 of Appendix 1, for instance, that the debt ratio decreases from 0.1508 (past value) in December 2007 to 0.1283 (current value) in March 2008 predicts that the firm size would decrease from December 2007 to March 2008. Indeed, the firm size decreases from 19.9581 in December 2007 to 19.9563 (current value) in March 2008, though it is only a slight change. Similarly, that the debt ratio increases from 0.1111 (past value) in September 2007 to 0.1508 (current value) in December 2007 predicts that the firm size

would increase from 19.9223 in September 2007 to 19.9581 (current value) in December 2007. Carefully examining the numbers of debt ratio and firm size of Chunghwa Telecom in table A.1, we find that the Granger causality between the two variables is not always correct for all quarters because the strength of the causality may change over time for some reasons. But it gives correct prediction in most quarters. Thus, the knowledge of the debt ratio series provides useful information about the future value of firm size. With the adjusted  $R^2$  in the VAR(2) model being 0.2059, the debt ratio series seem to be able to capture the true data generating process in the VAR(2) model for Chunghwa Telecom. The implication is that the choice of capital structure would be able to forecast its firm size and have an influence on it. Since the debt ratio was as low as 0.1283 in the 1<sup>st</sup> quarter of 2008, Chunghwa Telecom may be able to take advantage of the low debt ratio to increase its firm size in the future.

The results in table 4.10 show that the effects of firm size on debt ratio are not significant. That is, the firm size does not Granger cause the debt ratio of Chunghwa Telecom. Thus, the causality is unidirectional: debt ratio affects firm size but not the reverse.

As to the profitability, the result is similar to that of firm size. The causality is unidirectional. Profitability does not help predict the future values of debt ratio. The reverse does happen in accord with the VAR(2) model that debt ratio affects profitability in the opposite direction-- the debt ratio decreases from lag 2 (past value) to lag 1 (current value) predicts that the profitability would increase from lag 2 to lag 1 (current value). This result is logically and practically reasonable. Managers of firms represent the interest of equity holders to create maximum profit, a basic assumption in firm theory. Other things being equal, decrease of debt ratio implies that less interest

payments necessitate more profit. The adjusted  $R^2$  of the VAR(2) model is 0.1469. Again, the causality occurs in most quarters, not all of them.

The causality between collateral values of tangible assets and debt ratio is bidirectional in terms of the VAR(1) model in table 4.10. It shows that the collateral value of tangible assets and debt ratio should Granger cause each other in the same direction. VAR(1) is not so robust as VAR(2) since it only considers the effect of current value of one variable on current value of the other variable. Moreover, Chunghwa has being very profitable, it is possible that Chunghwa would be able to get credit loans without collateral or other forms of loans with less collateral. Thus, the evidence of the bidirectional Granger causality between collateral values of tangible assets and debt ratio is weak.

Finally, growth, business risk and earnings volatility do not exhibit Granger causality with debt ratio for Chunghwa Telecom.

Compared to the simple and multiple regression models, we have a further understanding of the relationship that debt ratio Granger causes the firm size in the same direction and Granger causes the profitability in the opposite direction. The bidirectional Granger causality between collateral values of tangible assets and debt weakly explains the positive association between them in the simple and multiple regression models.

## B. Taiwan Mobile

The only unidirectional Granger causality observed is the effect of cash on debt ratio for Taiwan Mobile. Both the results of VAR(1) and VAR(2) show that the cash Granger causes the debt ratio. Referring to the data of Taiwan Mobile in table A.2 of Appendix 1, for instance, that the cash increases from 14.7171 (past value) in December

2007 to 14.8570 (current value) in March 2008 predicts that the firm size would decrease from 0.6208 in December 2007 to its current value of 0.4865 in March 2008. Similar to the results of Chunghwa Telecom, the Granger causality occurs for most quarters, but not all of them. The adjusted  $R^2$  is 0.5724 for VAR(1) and 0.6242 for VR(2), respectively. It is possible that Taiwan Mobile used some of its cash to pay off debts except conducting capital reduction recently. Overall, the Granger causality reveals the importance of cash over other factors on the operation of Taiwan Mobile.



【Table 4.10 : Results of Granger Causality】

Factors	Models	Does the debt ratio Granger cause the factor?		Does the factor Granger cause the debt ratio?	
		Chunghwa Telecom	Taiwan Mobile	Chunghwa Telecom	Taiwan Mobile
		p-value	p-value	p-value	p-value
Firm Size	VAR(1)	0.4976(N)	0.4048(N)	0.2800(N)	0.6286(N)
	VAR(2)	0.0267(+)	0.7523(N)	0.9745(N)	0.1250(N)
Profitability	VAR(1)	0.9654(N)	0.1843(N)	0.7982(N)	0.4980(N)
	VAR(2)	0.0443(-)	0.0974(N)	0.7111(N)	0.1423(N)
Growth	VAR(1)	0.2394(N)	0.2714(N)	0.5901(N)	0.4246(N)
	VAR(2)	0.0583(N)	0.3558(N)	0.8234(N)	0.4053(N)
Collateral	VAR(1)	0.0165(+)	0.1715(N)	0.0006(+)	0.4341(N)
	VAR(2)	0.0765(N)	0.4878(N)	0.1108(N)	0.3518(N)
Business risk	VAR(1)	0.1247(N)	0.4470(N)	0.1203(N)	0.7033(N)
	VAR(2)	0.2804(N)	0.0052(N)	0.5542(N)	0.5793(N)
Cash	VAR(1)	N/A	0.7139(N)	N/A	0.0250(-)
	VAR(2)	N/A	0.7144(N)	N/A	0.0641(-)
Earning Volatility	VAR(1)	0.7329(N)	0.2068(N)	0.4640(N)	0.2664(N)
	VAR(2)	0.0936(N)	0.4092(N)	0.4033(N)	0.9831(N)

\* The null hypothesis is  $H_0$  : no Granger causality at the significance level of 5 %.

\*\* VAR(1) and VAR(2) represent the first and the second order of vector autoregression.

\*\*\* The “N” sign in the parenthesis means that there is no Granger causality between debt ratio and factors. The “+” sign in the parentheses means that a positive change in debt ratio Granger causes a positive change in factors or vice versa. The “-” sign in the parentheses means that a negative change in debt ratio Granger causes a negative change in factors or vice versa.

\*\*\*\* The VAR model is not applicable in the non-stationary cash time series of Chunghwa Telecom.