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Estimating Beta for Non-Market Traded Telephone Companies

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Abstract

Stock prices are the inputs necessary for the direct estimation of systematic risk. However, there are two occasions when price data are unavailable; when the investment is a division of a market traded company or when the stock of a company is closely-held and not traded. This paper develops a methodology for estimating systematic risk for non-market traded telephone companies. This paper combines the analytic and "pure play" approaches to estimating systematic risk and uses a stepwise regression procedure in developing the model. Variables which are specific to public utilities are used. The results suggest this methodology provides reasonably good estimates for systematic risk of non-market traded telephone companies.

ESTIMATING BETA FOR NON-MARKET TRADED TELEPHONE COMPANIES

I. Introduction[1]

In the finance literature, the relationship between a firm's risk and its required return has received much attention. The capital asset pricing model formulated by Sharpe [23] and Lintner [19] recognizes that the risk which is asset-specific may be diversified away and, hence, in efficient markets, only undiversifiable or systematic risk is related to an asset's required return. The model relating required return to systematic risk for any asset j is,

$$R_j = R_F + B_j(R_m - R_F), \tag{1}$$

where R_j = the expected rate of return on asset j;

R_F = the rate of return on a riskless asset;

R_m = the expected rate of return on a market portfolio of risky assets; and

B_j = the systematic risk coefficient, beta.

Beta is defined as,

$$B_j = \frac{\rho_{jm}\sigma_j\sigma_m}{\sigma_m^2}, \tag{2}$$

where ρ_{jm} = the correlation between the returns on asset j and the market portfolio; and

σ_j and σ_m = the standard deviations of the return on asset j and the market, respectively.

Equation (1) shows that an asset's required return is a positive function of the systematic risk measure, B_j, while equation (2) shows that beta depends on how an asset's return is related to the market's return, and how variable is the return from the asset.

Stock prices are the necessary inputs in the direct determination of systematic risk. There are two common occasions when price data are not available: when the investment is a division of a market traded company and when the common equity of a company is sporadically traded or not traded at all (closely-held firms). While this lack of information is not a problem for many corporations, the lack of data does hinder the calculation of the necessary rate of return to compensate investors for the risk associated with their non-market traded investment.

The lack of market price information is a significant problem for state public utility commissions which must determine the required cost of equity capital for utilities. Some public utilities have diversified into unregulated areas and therefore state public utility commissions must separate the regulated and unregulated areas in order to arrive at a required rate of return for the regulated area alone. If this is not done, regulators may create a subsidization problem where profits from the unregulated portion subsidize the regulated portion or vice versa. If these subsidization problems occur, inefficient resource allocation will result in consumers being over- or undercharged for the utility's service and investors earning too high or too low a return on their investment.

The objectives of this research are to determine a methodology for arriving at a rate of return on equity for utilities using non-market rather than market data and to apply the methodology to non-market traded telephone companies.

II. Review of Previous Studies

Lev (18) demonstrated the operating risk of a firm is directly related to its systematic risk while Hamada (14) showed that a positive relationship exists between financial leverage and systematic risk. Rubinstein (21) effectively synthesized these relationships with the following model:

$$R_j = R_F + \lambda^* \rho(R_j^*, R_m)\sqrt{VAR\ R_j^*} + \lambda^* \rho(R_j^*, R_m)\sqrt{VAR\ R_j^*}\left[\frac{B_j}{S_j}\right], \quad (3)$$

where $\lambda^* = \frac{R_m - R_F}{\sigma_m}$;

$\rho(R_j^*, R_m)$ = the correlation of an asset's unlevered returns with the market's returns;

$\sqrt{VAR\ R_j^*}$ = the standard deviation of an asset's unlevered returns; and

$\frac{B_j}{S_j}$ = the market value debt/equity ratio for asset or firm j.

Hence, the return on asset j, R_j, is a function of the risk-free rate, operating and financial risk.

In comparing equation (3) with the capital asset pricing model of equation (1), it is observed that the beta, B_j, of equation (1) includes both operating and financial risk. If different assets or different divisions of a firm have different operating risks and/or debt capacity, then different returns are required from the various assets or divisions. Because market data are unavailable for these divisions, efforts have been made to relate the operating and financial characteristics to beta.

Efforts to link the market related systematic risk measure to company specific information include studies by Turnbull [25], Myers [20], and Senbet and Thompson [22]. Turnbull concluded that beta was a non-positive function of growth in expected cash flows and that the duration of a firm's projects and the firm's responsiveness to microeconomic changes also impacted on beta. In contrast, Myers indicated that beta was positively related to growth and that cyclicality and earnings volatility were also determinants of beta. Senbet and Thompson demonstrated that the conflicting views of Myers and Turnbull concerning the relationship between growth and beta were due to the particular stochastic process assumed. Bowman [6] concluded that a firm's systematic risk is related to its accounting beta and earnings variability and that size, dividends and growth are not related to a firm's systematic risk.

The Analytic Approach

In the absence of market related data, the required return for a division, an asset, or a non-market traded firm may be estimated by either an analytic or an analogy approach. Bower and Jenks [5] point out that the analytic approach "involves working from revenue, margin, asset salability and other operating and structural characteristics [5, p. 46]."

Early attempts to empirically explain systematic risk with accounting information include studies by Ball and Brown [1], Beaver, Kettler, and Scholes [3] and Gonedes [13]. While the variables and methodologies varied, all three studies concluded that the use of accounting data improves the forecast of systematic risk and that a statistically significant relationship exists between accounting and market based estimates of systematic risk. Bildersee [4] found that using non-accounting variables with accounting variables improved upon previous models used to examine the relationship between market and accounting based estimates of systematic risk. More recently, Eskew [10] used an accounting based model in an examination of beta. In general, he found that growth, size, and earnings variability produced smaller forecast errors than models based only on market data. Elgers and Murray [9] found that the choice of market index significantly impacts on the ability of accounting data to predict systematic risk, thus partially reconciling the conflicting results of earlier studies. Hill and Stone [16] examined the relationship between accounting-based and market-based measures of systematic risk and concluded accounting data have significant value for explaining market betas. Finally, Chance [7] also found that business risk and financial leverage variables could be used to provide better estimates of beta.

The Analogy or "Pure Play" Approach

The analogy or "pure play" approach involves finding market traded firms whose product line and operating characteristics are similar to the division or firm in question. Bower and Jenks [5] utilize the analogy approach for determining the divisional betas for a large corporation. They utilized a sample of firms in the same industry as the division to calculate an unlevered beta. Adjustments were then made to account for differences in debt capacity. Van Horne [26] presented similar method of analysis for determining divisional hurdle rates. A sample of firms in the same industry as each division was used to estimate an average beta for each division. Judgment then was used to adjust the average beta for firm specific risks. Fuller and Kerr [12] also utilized a "pure play" approach but tried to identify market traded firms "engaged solely in the same line of business as the division." They concluded that the pure play method is a "valid procedure for estimating the beta of a division."

III. Method of Analysis

While use of either the analytic or "pure play" approach will produce a measure of risk for non-market traded firms, this research attempts to estimate betas through the merging of these two conventional approaches. The merging of the two methods is accomplished by limiting the analysis to one industry (utilities) and by relating the market determined risk measure to accounting measures of risk that best reflect the risks associated with that industry.

The estimation of betas for non-market traded utility companies is accomplished through the following procedures. First, a market-determined beta is calculated for all electric, electric/gas, gas distribution and telecommunication companies which meet the following criteria: the firm must (1) have frequently traded stock on the NYSE, and AMEX or O-T-C market, (2) a December 31 fiscal year end, (3) not be a subsidiary of another firm and (4) have accounting data available on the Compustat Tapes for the period 1978-1982.[2] A population of 162 firms meet the criterion. The familiar market model is used in the beta calculation:

$$R_{jt} = a_0 + B_j R_{mt} + e_t \quad (4)$$

where: R_{jt} = return for month t for security j;

R_{mt} = return for month t on the market index (S&P 500);

B_j = market beta for security j; and

e_t = error term.

This regression equation is run using 60 months of data for the period January, 1978 through December, 1982. A summary table of the beta estimates is presented below.

Table 1

Market Beta Statistics

Mean Beta	0.481
Standard Deviation	0.310
High Beta	1.728
Low Beta	0.076

The second step involves the selection of a set of accounting variables to explain the cross sectional variation of the market betas. Eskew [10], Elgers [8], Elgers and Murray [9] and Thakkar [24] use accounting variables which are similar to the variables in the Beaver, et. al. study [3]. The variables examined in the Beaver et. al. study (dividend payout, growth, leverage, liquidity, asset size, variability of earnings and covariability of earnings) are general measures of risk which they applied to all firms on the Compustat Tapes having complete financial data for the years 1947 through 1962 [3, pp. 663-4].

Since this paper examines public utility companies only, with their limited earnings potential and unique accounting treatment of construction projects (allowance for funds used during construction), more specific accounting measures are used. The following list of areas of risk and return, while not exhaustive, does capture the important relationships suggested in utility stock analysis and are used in this analysis. This list includes: (1) Asset Turnover, (2) Operating Margins, (3) Capital Structure, (4) Dividend Policy, (5) Profitability, (6) Interest Coverage, and (7) Earnings Quality.

Where appropriate at least one ratio for each category of risk is based on standard accounting data and one ratio is based on cash flow data. The use of ratios which reflect cash flow is important when analyzing public utility companies due to the accounting practice known as Allowance for Funds Used During Construction (AFUDC).[3] This accounting procedure derives an AFUDC rate based on the approximate overall net of tax cost of capital and applies the rate to cash invested in construction. Once the amount of AFUDC is determined it is added to direct construction costs and simultaneously credited to income in each accounting period. This non-cash income is eventually recovered as cash through future depreciation charges. The AFUDC procedure is not used in non-regulated industries.

Asset turnover is measured by the average return on assets and the average cash flow to total assets for the 1978-1982 period. The operating margin is measured by the average operating income to total assets and operating revenue to total assets for the same period. Capital structure is measured by the average long-term debt and common equity ratios. Dividend policy is considered by using the five year average dividend payout ratio (common dividends/net income available to common) and the five year average dividends as a percent of cash flow ratio. The profitability measures selected are the average return on equity and the average ratio of cash flow to common equity. The coverage ratios selected are the average interest coverage-less AFUDC, the average cash flow to interest charges ratio and the average interest expense as a percent of operating income. Earnings quality measures selected are the five year average ratios of internal generation of funds as a percent of construction and AFUDC as a percent of net income. The Compustat data inputs are presented in Appendix A.

These variables are calculated for each of the 162 utilities, and Table 2 presents the summary statistics for these variables.

INSERT TABLE 2 HERE

The market betas are then regressed on the accounting data variables using a stepwise regression technique in order to choose those accounting variables which contributed most to explaining the variation in the systematic risk measure.[4] The stepwise procedure ceases when the inclusion of the next variable increases the adjusted R squared by less than .01. The seven variables in the regression equation when this limiting criterion is met, in order to importance, are (1) Dividend Payout, (2) Cash Flow/Common Equity, (3) Operating Revenue to Total Assets, (4) Internal Generation of Funds as % of Capital Expenditure, (5) Interest Expense as % of Operating Income, (6) Cash Flow to Total Assets; and (7) Interest Coverage Less AFUDC.

TABLE 2

Accounting Variable Statistics

Variable	Mean	Standard Deviation
Cash Flow/Total Assets	.086	.031
Return on Assets	.039	.017
Operating Income/ Total Assets	.065	.015
Operating Revenue/ Total Asset	.602	.454
Common Equity Ratio	.411	.100
Long-term Debt Ratio	.488	.082
Cash Flow/Common Equity	.291	.100
Return on Equity	.126	.032
Dividend Payout Ratio	.668	.180
Dividend as % of Cash Flow	.322	.152
Cash Flow/Interest Charges	3.060	5.265
Interest Coverage - Les AFUDC	3.001	6.475
Interest Expense as % of Operating Income	.586	.180
Internal Generation of Funds as % of Construction	.627	.503
AFUDC as % of Net Income	.267	.243

Table 3 presents the correlation matrix of those seven variables included in the final regression equation. It should be noted that the correlation matrix indicates multicollinearity is present in the data.

INSERT TABLE 3 HERE

While the multicollinearity severely limits the model results for inferential purposes, it presents no problem when using the model results for predictive purposes.

Table 4 presents the adjusted R squared for each step in the regression while Table 5 shows the results of the seven variable regression

INSERT TABLE 4 & 5 HERE

equation. While the multicollinearity means the significance tests must be viewed with caution, the results indicate all seven variables appear to be relevant explanators and the regression equation is highly significant. The adjusted R^2 of .5965 of the model is superior to the results reported in previous studies which have attempted to explain the relationship between the beta coefficient and accounting variables.[5] The favorable results are expected due to the limiting of the sample to regulated utilities and the construction of variables which are designed especially for these utilities.

IV. Testing the Model

This section uses the seven variable model developed earlier to estimate a beta for each of the 162 utilities. This is accomplished by

TABLE 3
Accounting Variables Corrolation Matrix
In Order of Inclusion in Stepwise Regression

		Dividend Payout Ratio	Cash Flow/ Common Equity	Operating Revenues/ Total Assets	Internal Generation of Funds	Interest Expense as Operation Income	Cash Flow/ Total Assets	Interest Coverage Less AFUDC
1	Dividend Payout Ratio	1.0000						
2	Cash Flow/Common Equity	- .5081	1.0000					
3	Operating Revenue/Total Assets	- .3699	.2950	1.0000				
4	Internal Generation of Funds	- .3461	- .4228	- .7234	1.0000			
5	Interest Expense as % Operation Income	.3735	- .4777	- .3947	- .5693	1.0000		
6	Cash Flow/Total Assets	- .5589	.7409	.5117	.6623	- .8027	1.0000	
7	Interest Coverage-Less AFUDC	- .2274	.1742	.4991	.6897	- .4847	.5577	1.0000

TABLE 4

Stepwise Regression Results

Variable Input	Adjusted R Squared For Variable Inputs	Increased Explanatory Power Provided by Variable Input
(1) Dividend Payout	.3724	
(2) Cash Flow/ Common Equity	.4740	.1016
(3) Operating Revenue/ Total Assets	.5080	.0340
(4) Internal Generation of Funds	.5496	.0416
(5) Interest Expenses as % Operating Income	.5601	.0105
(6) Cash Flow/Total Assets	.5831	.0230
(7) Interest Coverage - Less AFUDC	.5965	.0134

TABLE 5

Regression Results of Final Equation

Variable	Coefficient	t - Values*
(1) Dividend Payout	- .5305	4.8626
(2) Cash Flow/ Common Equity	.6648	2.4519
(3) Operating Revenue/ Total Assets	.2846	5.6050
(4) Internal Generation of Funds	- .1438	2.4423
(5) Interest Expenses as % Operating Income	.6207	4.0485
(6) Cash Flow/ Total Assets	5.4958	3.8615
(7) Interest Coverage -	- .0093	2.4809
(8) Constant	- .2483	

Adjusted R squared = .5965
F = 35.007 Significant at 1% level.

*All variables are significant at 5% level.

using the values of the firm specific variables in the model. The results are presented in Table 6. As can be seen, the standard devia-

INSERT TABLE 6 HERE

tion for the projected betas is less than for the actual market betas. In addition, the highest and lowest betas are moved toward the mean of 0.481. The correlation between the actual and projected betas is 0.784.

The lower panel in Table 6 summarizes the differences between the actual and projected betas relative to the standard error of the estimates of the actual betas. One hundred and seventeen (71%) of the projected betas are within one standard error; 34 (21%) are between one and two standard errors; 9 (6%) are between two and three standard errors; while 4 (2%) are beyond three standard errors.

The final step in this process involves using the regression coefficients and the accounting data from non-market traded telephone companies to project a "market" beta for the non-market traded telephone companies. Sixteen non-market traded telephone companies with data on the Compustat Tapes are used as a test of the model. All sixteen companies are divisions of five market traded telephone companies. The test companies are predominantly from the Midwest portion of the country although test companies from other areas of the country are included. The accounting data and the projected betas for the sixteen non-market traded telephone companies are presented in Table 7.

INSERT TABLE 7 HERE

TABLE 6

A Summary of Actual and Projected Betas

	Actual	Projected
Mean Beta	0.481	0.481
Standard Deviation	0.310	0.243
High Beta	1.728	1.368
Low Beta	0.076	0.141

Correlation between Actual and Projected Beat: .784 (significant at .001 level).

Difference Between Actual and Projected Betas

	No.	%	Cumulative %
Less than 1 standard error	115	70.99	70.99
Between 1 and 2 standard errors	34	20.99	91.98
Between 2 and 3 standard errors	9	5.56	97.54
Beyond 3 standard errors	4	2.47	100.01

TABLE 7

ACCOUNTING DATA VARIABLES AND PROJECTED BETAS
FOR SIXTEEN TELEPHONE COMPANIES

	Company	Dividend Payout Ratio	Cash Flow/ Common Equity	Operating Revenue/ Total Assets	Internal Generation of Funds	Interest Expense as % Operating Income	Cash Flow/ Total Assets	Interest Coverage	Projected Beta
1.	Central Tel. - Delaware	.9141	.4983	.4034	.7997	.3662	.1564	4.0201	.6473
2.	Central Tel. - Florida	.7973	.4470	.4077	.9631	.3306	.1625	4.6891	.6581
3.	Central Tel. - Illinois	.9233	.4304	.4701	.9342	.2794	.1674	5.6037	.5888
4.	Eastern Illinois Tel.	.7200	.3979	.3561	1.0135	.3242	.1547	4.8004	.5966
5.	General Tel. - Florida	.6524	.4456	.3977	.7860	.4308	.1409	3.3347	.7148
6.	General Tel. - Illinois	.6564	.3812	.4088	.9668	.3137	.1537	4.9681	.6274
7.	General Tel. - Indiana	.6598	.3774	.3857	.9065	.3631	.1386	3.9984	.5819
8.	General Tel. - Southwest	.7270	.4212	.3637	.5271	.4784	.1333	2.7508	.6776
9.	Illinois Bell Tel.	.8517	.3201	.4697	.8262	.3551	.1364	4.1396	.4591
10.	Indiana Bell Tel.	.7047	.3106	.4380	.8897	.2981	.1437	5.1223	.5083
11.	Michigan Bell Tel.	.8685	.2875	.4228	.7650	.3790	.1263	3.6594	.4877
12.	Ohio Bell Tel.	.9027	.3001	.4105	.5859	.3776	.1295	3.7779	.4258
13.	Southwestern Bell Tel.	.7777	.2954	.4594	.7695	.3439	.1335	4.1222	.4644
14.	United Tel. - Indiana	.6702	.3865	.4082	.8484	.3362	.1579	4.5225	.6837
15.	United Tel. - Pennsylvania	.7417	.3606	.3571	.9204	.3817	.1418	4.0440	.6457
16.	Wisconsin Bell Tel.	.8025	.3031	.4198	.7998	.3378	.1333	4.4938	.4325

Several observations should be made concerning Table 7. There are substantial differences across firms in the accounting variables. The cash flow/common equity variable ranges from .2875 to .4983. The internal generation of funds variable ranges from .5270 to 1.0135. The interest coverage ratio varies from 2.7508 to 5.6037. However, no one variable accounts for most of the variation in the projected betas.

The projected betas range from .4258 to .7148 and seem to be at reasonable levels. The mean beta for the Central Telephone, General Telephone and United Telephone companies is .6314, .6504 and .6647, respectively, while the average beta for the Bell companies is .4630. This result suggests that the Bell operating companies have less systematic risk than the smaller independent telephone companies. It should be noted that these betas are "raw" betas. No adjustments have been made to reflect estimation biases.

V. Conclusion

The popularity of beta as a measure of risk has motivated researchers to produce useful measures to predict betas for firms which are not market traded or are divisions of larger diversified firms. The conventional approaches to solving this problem are the "pure play" or analogy method and the analytic method which empirically explains systematic risk with non-market data.

This research attempts to estimate or project betas through a merging of the two conventional approaches, i.e., by limiting the research to one industry (the utility industry) and using explanatory variables that best reflect the risks associated with that industry. The main empirical findings are:

(1) Accounting variables which reflect cash flow are more useful in explaining beta for utilities than standard accounting ratios.

(2) The ability of specialized accounting variables to "explain" differences among betas for firms in one industry produce results superior to those studies which do not make these distinctions.

While the results of this study are gratifying, further research examining the linkages between market and non-market data is needed. The findings presented in this study are only applicable to the utility industry and may not be applicable to other industries or situations.

FOOTNOTES

[1]This study is a continuation of the analysis as to the cost of equity capital of Illinois Bell Telephone Company presented to the Illinois Commerce Commission (17) in Ill. C.C. Docket No. 82-0005.

[2]We are not implying that the risks faced by all utilities are identical, only that risks faced by these firms are comparable and that these firms constitute a legitimate population of firms for purposes of this analysis.

[3]For 1981, the First Boston Corporation (FBC) reported that non-cash AFUDC accounted for 45.3 percent of the net income reported by the 75 utilities in the FBC Composite. An average FBC utility which reported a 12.6 percent return on equity and a dividend coverage ratio of 1.36 for 1981 actually had a 6.9 percent return on equity and a dividend coverage ratio of 0.61 if AFUDC is excluded from earnings.

[4]Foster (11, pp. 282-284) presents a concise summary of the stepwise multiply regression technique although he considers the approach "brute empiricism." But as Bildersee (4, p. 88) noted, when there is no particular hypothesis as to the relationship between various variables and beta, a stepwise regression is used "to observe the impact of the statistically most important independent variables in our study and to keep other, apparently less important, variables from cluttering up the study."

[5]The models presented by Beaver, et. al., Bildersee, and Eskew produced R squareds of .447, .369, and .2703 respectively. When Bildersee included non-accounting variables with accounting variables, his adjusted R squareds ranged from .292 to .528.

APPENDIX A

Compustat Data Inputs

Variable	Data Inputs
Return on Assets	D28/D2
Cash Flow/Total Assets	(D26 + D143 + D141 + D200 + D201 + D202 + D203 + D24 + D206)/D2
Operating Income/Total Assets	D19/D2
Operating Revenue/Total Assets	D12/D2
Long Term Debt Ratio	
Common Equity Ratio	D175/D186
Dividend Payout Ratio	D217/D28
Dividends as % of Cash Flow	D217/(D26 + D143 + D141 + D200 + D201 + D202 + D203 - D24 + D206)
Return on Equity	D27/D175
Cash Flow/Common Equity	(D26 + D143 + D141 + D200 + D201 + D202 + D203 - D24 + D206)/D175
Interested Coverage - Less AFUDC	(D19 - D24)/D23
Cash Flow/Interest Charges	(D26 + D143 + D141 + D200 + D201 + D202 + D203 + D24 + D206)/D23
Interest Expense as % of Operating Income	D23/D19
Internal Generation of Funds	(D28 - D29 + D200 + D201 + D202 + D203 - D24 + D206)/
AFUDC as % of Net Income	D24/D26

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