Risk Structure Analysis for Cost of Capital : A Demonstrative Study using Financial Indices

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Abstract

Economic value added (EVA) is introduced on two levels: as index for evaluation of corporation and as index for evaluation of business unit. In the latter case, application of one and the same cost of capital to all business units of a business corporation may be possible, but it is a fundamental policy for EVA to apply different cost of capital to business units with different risks. Estimate of cost of capital of business units is a problem to be resolved. The author, focusing on the question of the estimate of cost of capital of business units, has conducted a demonstrative study on risk structure of cost of capital estimates by using financial indices of Japanese manufacturers (37 automotive industries, 141 electrical and electronic machinery industries, 63 food processing industries, 98 chemical industries, 125 general machinery industries) for a period of 5 years from 1995 to 1999.

The author presumes that β is explained by a regression formula $\beta = B_0 + \Sigma B_i Y_i + \alpha$ (Y_i: financial indices) and selects 40 explanatory variables from financial statements as risk components. Using their financial indices, the author concludes through a series of statistical analyses that there is a good likelihood of estimating cost of capital for Japanese industries and is convinced that it will lead to more reliable and practical results by assigning averages and variances to 40 primary financial indices for a period of 3 to 5 years selected in this demonstrative study.

Key Words: Economic Value Added (EVA), Business Unit, Cost of Capital, β Value, Financial Indices, Risk Structure Analysis.

1. Introduction

Since 1998 Japanese industries have successively introduced "economic value added" (EVA)[(1)] to their accounting. It suggests that fast all of them are calculating EVA not only on corporate level, but also on business unit (business department, or "inner-company") level, i.e. they

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expect that EVA is used on corporate level for disclosure of information for shareholder relationship and simultaneously for the purpose of inner control as an index of management accounting on business unit level.

It is, however, to be resolved how to calculate cost of capital of respective business units for the purpose of measuring EVA on business unit level. It is a fundamental policy to apply different cost of capital to different business units with different risks. How shall the cost of capital be estimated in order that EVA should work as a tool for inner control? This study has the purpose to investigate and clarify this issue.

Not only capital asset pricing model (CAPM) which is often referred to in financial theory textbooks, but also arbitrage pricing model (APM) and dividend discount model (DDM) require information on market prices of equities of the business concerned, i.e. it is presumed that it is listed in securities exchanges and its business values are measurable in market [1]. Accordingly such models will be applicable to listed companies, but not to non-listed companies and business units.

Heretofore business comparison method and multivariate analysis method are used to estimate cost of capital for non-listed companies and business units. Another option is product β model. They are, however, far from satisfactory and practical because they have too arbitrary factors, their calculus is too complicated, or contrarily, the models as such are too much simplified.

The author is interested in "Business Approach" proposed by Stewart [9] as a promising method to resolve these problems. It estimates business cost of capital c from four risk factors (operating risk, strategic risk, asset risk and size and variance) and thereby deriving weighted average of cost of capital[(2)]. The method to estimate risks and thereby weighted average of cost of capital gives us a useful key in order to estimate cost of capital not only of listed companies but also of non-listed companies and business units.

Risk is one of the components of cost of capital. Varying risk varies cost of capital. From this viewpoint cost of capital must be estimated from risk structure. Calculus of such risk on business unit level will lead to estimate of capital risk that is varying dependently on business units.

The author has thus conducted this demonstrative study on risk structure of Japanese manufacturers (37 automotive industries, 141 electrical and electronic machinery industries, 63 food processing industries, 98 chemical industries, 125 general machinery industries) for a period of 5 years from 1995 to 1999. The author is interested in β value comprehensively representing various risks. The author presumes that β is explained by a regression formula $\beta = B_0 + \sum B_i Y_i + \alpha$ (Y_i : financial indices) and selects 40 items from financial indices as risk components, extracts effective indices as explanatory variables of β value from these financial indices, using principal components analysis and stepwise regression analysis.

2. Risk Structure Analysis

The first effort to estimate cost of capital which are based on risks derived from financial indices is a business approach made by Stern Stewart & Company [9, pp. 449-472, "The Operating Approach to the Cost of Capital"]. Stewart [9, p .445] defines business cost of capital, describing that "C, will not change as leverage is altered because it reflects the risk in the assets regardless of how the assets are financed." In addition, he explains that weighted average of cost of capital C* is derived by Eq. (1)

$$C^* = c\ (1 - t^*\ \text{Debts/Total Capital}) \quad (1)$$

where t is marginal tax rate.

Stern Stewart & Company analyzed financial indices of more than 1,000 US and Canadian listed companies in order to calculate business cost of capital c and statistically extracted 4 risk factors (18 risk indices) consisting of operating risk, strategic risk, asset risk and size and variance.

Stern Stewart & Company furthermore describes that as for the relationship between business cost of capital c and equity cost of capital y the former theoretically equals to the latter in funding without indebtedness [9, pp. 281-286]. This relationship is represented by following equations:

$$\begin{aligned} Y &= \text{business cost of capital (c)} + \text{financial risk premium} \\ &= \text{risk-free rate} + \text{business risk premium (BRP)} + \text{financial risk premium (FRP)} \\ &= R_f + BRP + FRP \\ &= R_f + BRI(\text{business risk index}) * MRP\ (\text{market risk premium}) + FRI * MRP \\ &= R_f + (BRI + FRI) * MRP \\ &= R_f + \beta * MRP \end{aligned} \quad (2)$$

As is seen from these formulae, β value is a comprehensive index reflecting both BRI (business risk index) and financial risk premium (FRP). If business risk is risk of assets as asserted by Stewart [9], both risk of assets and financial risk must be able to be estimated to some extent from financial indices (risk components).

The assumption of Eq. (1) is, however, ambiguous, and in addition, risk factors extracted from U.S. and Canadian businesses will not be applicable directly to Japanese businesses. On the other hand, the method to estimate risks gives us a useful implication in order to estimate risks from financial indices used in this business approach.

For the purpose of this study, the statistical method of extracting financial indices which are components of risk factors and thereby calculating cost of capital as their function on

the assumption that risk constituents which have influence on cost of capital will be estimated from financial index is called "risk structure analysis". The author reviews in this study whether the comprehensive β value is effectively and demonstratively estimated from financial indices. This method, if successful, would be very helpful for cost of capital estimate of non-listed businesses and business units.

3. Design of Study

3.1 Verifying Process.

The author verifies how reliably the financial indices obtained from financial statements will explain the risks by using them as explanatory variables.

The explanation capability will be tested by measuring the reliability of following multivariable regression:

$$\beta = B_0 + \sum B_i Y_i + \alpha \quad (Y_i: \text{ financial indices}) \tag{3}$$

where Y_i = financial indices, α = estimated error.

In order to obtain the most optimal combination of financial indices used as explanatory variables of the regression defined above, the author reviews 40 financial indices typically used in business analysis and selects the most optimal explanatory variables from them, using principal components analysis and stepwise regression analysis.

3.2 Samples.

The author selects (1) 37 automotive industries, (2) 141 electrical and electronic machinery industries, (3) 63 food processing industries, (4) 98 chemical industries, and (5) 125 general machinery industries[3] out of corporations listed on the First Section of the Tokyo Stock Exchange as samples for this analysis. The analysis period is 5 years from 1995 to 1999.

3.3 Selection of Explanatory Variables and Response Variables.

3.3.1 Explained Variables.

The β provided in Nikkei NEEDS Database is selected for this study. It is the correlation coefficient vis-à-vis Nikkei Average Stock Index for 60 months (more specifically, the regression coefficient of monthly return of stock investment to respective equities vis-à-vis monthly price change rate of Nikkei Average Stock Index as representative index of market). β value used in this analysis is the annual average of monthly β values.

Table 1. Financial Indices used as Explanatory Variables

*** Profitability**	
(1) Rate of return on investment	
1. Operating profit ratio of total capital	Operating profit / Total capital
2. Current profit ratio of total capital	Current profit / Total capital
3. Profit ratio of net worth	Net profit in real terms / Owner's equity
(2) Rate of Return on sales	
4. Rate of return on sales	Net profit in real terms / Sales
5. Ratio of operating income to sales	Operating profit / Sales
6. Ratio of current income to sales	Current profit / Sales
(3) Capital Turnover	
7. Total assets turnover	Sales / Total assets
8. Fixed assets turnover	Sales / Fixed assets
9. Receivables turnover period (day)	Receivables / Sales* 365
10. Trade payables turnover period (day)	Trade payables / Sales* 365
11. Inventories turnover period (day)	Inventories / Sales* 365
(4) Ratio of sales to R&D expenditure	Sales / R&D expenditure
(5) Leverage ratio	Return on owner's equity / Earning ratio
*** Productivity**	
12. (1) Value added per employee	Value added / Number of Employee @
13. (2) Sales per employee	Sales / Number of Employee @
14. (3) Labor share	Wages and salaries / Value added
15. (4) Dividend rate for stockholder's equity	(Interim dividend + Term-end dividend) / equity
16. (5) After-tax profit per share	After-tax profit / Number of shares issued and outstanding
*** Safety**	
17. (1) Ratio of cash flow to interest-bearing indebtedness	Cash flow / Interest-bearing indebtedness
18. (2) Quick ratio	Liquid assets / Liquid liabilities
19. (3) Current ratio	Current assets / Current liabilities
20. (4) Fixed asset ratio	Fixed assets / Owner's equity
21. (5) Ratio of fixed assets to long-term capital	Fixed assets / (Owner's equity + Fixed liabilities)
22. (6) Ratio of owners' equity to total assets (B)	Owners equity / Total assets
23. (7) Debt ratio	(Total Liabilities − Former allowance for special purpose) / Owner's equity
24. (8) Average interest rate of interest-bearing indebtedness	Interest paid / Interest-bearing indebtedness
25. (9) Interest coverage (A)	(Operating profit + Interest received) / Interest paid
26. (10) Depreciation rate	Depreciation in real terms / (Total depreciable assets + Depreciation in real terms)
*** Growth**	
27. (1) Growth rate of current profit	(Operating profit in this term / Operating profit in previous term) − 1
28. (2) Growth rate of after tax profit	(Net profit in this term / Net profit in previous term) − 1
29. (3) Growth rate of owner's equity	(Owner's equity in this term / Owner's equity in previous term) − 1
30. (4) Growth rate of total assets	(Total assets in this term / Total assets in previous term) − 1
31. (5) Growth rate of Sales	(Sales in this in this term / Sales in previous term) − 1
*** Size**	
32. (1) Cash flow	Net profit + Depreciation in real terms − Dividend paid − Officers Bonus
33. (2) Interest-bearing indebtedness	Short-term borrowings + Long-term borrowings + Borrowings from employees + Bonds and convertible bonds + Note receivables discounted
34. (3) Owner's Equity	Capital + Former allowance for special purpose
35. (4) R&D expenditure	
36. (5) Total assets	
37. (6) Sales	
38. (7) Number of employees	

* Net profit in real terms = Net profit − Reversal from former allowance for special purpose + Addition to former allowance for special purpose.

@: average of numbers at commencement and end of the term.

3.3.2 Response Variables.

Which financial indices relate to β value may be a priori presumed to some extent. The author takes, however, into account indices of different nature as many as possible in the analysis from the viewpoint of practical feasibility, in order to prevent the analysis results from being anticipatorily biased, and adopts primary data posted in financial statements to the extent possible, in addition to financial indices frequently used in order to confirm how strong cost of capital can reflect the risks constituting cost of capital. The selected 40 financial indices are shown in Table 1.

3.4 Analysis of Automotive Industry.

3.4.1 Verification of Variables.

Explanatory and explained variables are verified to be normally distributed. Indices not normally distributed are logarithmically converted.

3.4.2 Correlation Analysis.

Single correlation analysis is then conducted between explained variable β and each of 40 explanatory variables. As for absolute values of single correlation coefficients, at 11 indices including ratio of current profit to total liabilities and net worth the coefficient exceeds 0.3, but none of them do not exceed 0.4.

3.4.3 Principal Component Analysis.

Principal components analysis is then conducted for 40 explanatory variables by way of correlation matrix method in order to objectively determine how many factors are included in 40 explanatory variables subjectively selected by the author and to integrate several factors included therein. The reason why the correlation matrix method is selected is to conduct principal components analysis after normalization of data (average = 0 and variance =1) without being influenced by unit of selected variables.

Table 2 shows variables (financial indices) extracted by principal components analysis and their respective characteristics. As is shown on the Table, they are integrated to 8 principal components, of which cumulative contribution ratio is about 80%.

Principal components analysis is a method that will seek a few comprehensive indices (principal components) from many variables related to a phenomenon so that they constitute a good representation of these variables, and still keeping the information obtained as much as possible. By the analysis results discussed above, the 40 variables are verified from their characteristics to have a good spectrum of explanatory variables (8 kinds of information). Whether such characteristics have to do with β is to be determined by the following analysis.

Table 2. Characteristics of Principal Components of Automotive Industries

	Indices	Characteristics
Principal component I	Operating profit ratio of total capital, Current profit ratio of total capital, Rate of return on sales, Ratio of operating income to sales, Ratio of current income to sales.	Profitability index (excl. Profit ratio of net worth)
	After-tax profit per share	After-tax profit per share
	Quick ratio, Current ratio, Fixed asset ratio, Ratio of fixed assets to long-term capital, Ratio of owners' equity to total assets, Debt ratio, Ratio of cash flow to interest-bearing indebtedness, Interest coverage, Depreciation rate	Safety indices reflecting assets conditions
Principal component II	Value added per employee, Sales per employee	Indices reflecting human productivity
	Cash flow, Owner's equity, Interest-bearing indebtedness, Total assets, Sales, Number of employees	Indices reflecting business size
Principal component III	Profit ratio of net worth	Profit ratio of net worth
Principal component IV	Total assets turnover, Fixed assets turnover, Receivables turnover period (days), Inventories turnover period (days)	Turnover indices
Principal component V	Leverage ratio	Leverage ratio
Principal component VII	Growth rate of current profit, Growth rate of after tax profit, Growth rate of owner's equity	Growth Indices relating to change rates
Principal component VIII	Average interest rate of interest-bearing indebtedness	Average interest rate of interest-bearing indebtedness

3.4.4 Stepwise Multiple-regression Analysis.

The author then uses the method called "stepwise regression" in order to construct Multiple-regression model. The basic idea of this method is as follows: An explanatory variable is selected from many ones by way of including or excluding them one by one at every step, where the most contributory variable is included into, and variables less contributory below the predetermined level are excluded from, the model. Under the situation where there are so many highly correlated variables, an explanatory variable newly adopted will be excluded from the model if the persuasiveness of the model does not thereby increase because it is judged less contributory than another variable existing in the model. In contrast, it is included in the model if the persuasiveness of the model thereby increases because it is judged more contributory than the variable existing in the model, which will be excluded. This process being continued, mutually highly independent variables is selected, i.e. one or two variables from respective groups of similar factors must be finally included in the model. The author selects in performing the stepwise Multiple-regression analysis the explanatory

variables of which factor loadings are high in 8 kinds of factors found in the principal components analysis discussed above or which are highly single-correlative with the explained variable β, and does not exclude variables which are highly mutually correlative intentionally. 32 financial indices are thus selected as starting explanatory variables in the stepwise analysis of automotive industries, as shown in Table 3.

Table 3. Explanatory Variables used in Stepwise Analysis of Automotive Industries

	Explanatory Variables
(1) Profitability index	Operating profit ratio of total capital, Current profit ratio of total capital, Rate of return on sales, Ratio of operating income to sales, Ratio of current income to sales
(2) After-tax profit per share	After-tax profit per share
(3) Safety indices reflecting assets conditions	Quick ratio, Current ratio, Fixed asset ratio, Ratio of fixed assets to long-term capital, Ratio of owners' equity to total assets, Debt ratio, Interest coverage, Ratio of cash flow to interest-bearing indebtedness, Depreciation rate
(4) Indices reflecting human productivity	Value added per employee, Labor share, Sales per employee
(5) Indices reflecting business size	Total assets, Sales, Number of employees, Cash flow, Interest-bearing indebtedness, Owner's equity
(6) Profit ratio of net worth	Profit ratio of net worth
(7) Turnover indices	Total assets turnover, Fixed assets turnover
(8) Growth Indices relating to change rates	Growth rate of current profit, Growth rate of after tax profit, Growth rate of owner's equity
(9) Average interest rate of interest-bearing indebtedness	Average interest rate of interest-bearing indebtedness
(10) Leverage ratio	Leverage ratio

The results of starting stepwise Multiple-regression analysis are shown in Table 4. The number of explanatory variables narrows down to as few as 13 in cases of automotive industries.

The number of explanatory variables, i.e. 13, is too many for a model. Further verification of correlation among the 13 variables reveals that the initial effectiveness criteria are loose enough ($F_{in} = F_{out} = 2$) to produce co-linearity among the 13 variables. T-values which represent the effectiveness of regression coefficient are below the significant level of 5% in ratio of current profit to sales, quick ratio and sales per employee ($t_{0.05}$ nearly equals to 1.96). It seems to be too early to cease the stepwise regression analysis here. After several try-and-errors, the author finally obtains 6 explanatory variables shown in Table 5, and finds a multiple correlation coefficient of 0.603 in Multiple-regression analysis using these 6 variables.

Table 4. Starting Stepwise Analysis of Automotive Industries

Name of Objective Variable	Residual sum of squares	Multiple correlation coefficient	Contribution rate	R*^2	R**^2	Residual degrees of freedom	Residual standard deviation
β - value	22.336	0.645	0.416	0.394	0.373	356	0.25

Names of variables	Partial regression coefficient	Standard error	t - value	Bilateral P - value	Standard partial regression coefficient	Tolerance
Constant	1.749	0.328	5.338	0		
Ratio of current income to sales (%)	-0.028	0.018	-1.585	0.114	-0.204	0.099
Fixed assets turnover	0.138	0.032	4.381	0	0.447	0.157
Liquid ratio	-0.001	0.001	-1.951	0.052	-0.155	0.262
Growth rate of total assets (%)	0.005	0.002	2.922	0.004	0.137	0.749
Total assets turnover	0.316	0.065	-4.84	0	-0.478	0.168
Operating profit ratio of total capital (%)	-0.029	0.013	-2.225	0.027	-0.261	0.119
Value added per employee (100,000 yen)	0.006	0.001	4.988	0	0.446	0.205
ln (Ratio of cash flow to interest-bearing indebtedness)	0.116	0.022	5.411	0	0.353	0.386
ln (Total capital)	-0.708	0.223	-3.174	0.002	-2.848	0.002
Average interest rate of interest-bearing indebtedness (%)	0.015	0.007	1.996	0.047	0.086	0.879
Debt ratio (%)	0.002	0.001	3.085	0.002	0.669	0.035
ln (Owner's equity)	0.641	0.226	2.836	0.005	2.558	0.002
Sales per employee (100,000 yen)	0	0	-1.934	0.054	-0.253	0.096

The author conducts analysis in similar way of electrical and electronics industries, general machinery industries, food processing industries and chemical industries. The results are shown in Table 5.

4. Discussion

4.1 Automotive Industries.

The largest factor of risk in automotive industries, first of all, is the total capital. As it is

Table 5. Analysis Results of 5 Industry Sectors

	Variables	Partial regression coefficients	Standard partial regression coefficients	Order of influence
Automotive Industries Multiple correlation coefficient = 0.603	Total assets turnover	-0.111	-0.164	6
	Operating profit ratio of total capital (%)	-0.04	-0.361	4
	Value added per employee (100,000 yen)	0.004	0.403	3
	ln (Ratio of cash flow to interest-bearing indebtedness)	0.127	0.423	2
	ln (Owner's equity)	-0.123	-0.546	1
	Average interest rate of interest-bearing indebtedness (%)	0.045	0.223	5
	Constant	1.973		
Electric and Electronic Industries Multiple correlation coefficient = 0.512	Current profit ratio of total capital (%)	-0.0067	-0.1092	6
	Ratio of current income to sales (%)	0.005	0.1286	5
	Liquid ratio(%)	-0.0002	-0.1304	4
	After-tax profit per share (yen)	-0.0006	-0.1396	3
	ln (Owner's equity)	-0.0634	-0.3212	1
	ln (Growth rate of sales)	0.006	0.0281	7
	ln (Growth rate of current profit)	0.0379	0.2015	2
	Constant	1.6346		
General Machinery Industries Multiple correlation coefficient = 0.536	Profit ratio of net worth (%)	0.00275	0.0973	6
	Current profit ratio of total capital (%)	-0.01775	-0.31376	1
	Inventories turnover period (day)	0.00088	0.10764	5
	ln (Financial leverage ratio)	0.11407	0.19635	4
	Sales per employee (100,000 yen)	0.00028	0.20087	3
	Cash flow	-0.00001	-0.25601	2
	Constant	0.90113		
Food Processing Industries Multiple correlation coefficient = 0.677	ln (Number of employee) (man)	-0.098	-0.306	2
	ln (Inventories turnover period (day))	0.160	0.273	3
	Trade payables turnover period (day)	-0.004	-0.176	4
	ln (liquid ratio (%))	-0.100	-0.135	5
	Operating profit ratio of total capital (%)	-0.043	-0.383	1
	Dividend rate for stockholder's equity (%)	0.057	0.127	6
	Constant	1.699		
Chemical Industries Multiple correlation coefficient = 0.640	After-tax profit per share (yen)	-0.0011	-0.1743	3
	Sales per employee (100,000 yen)	-0.0002	-0.1596	4
	Labor share	0.0003	0.1373	5
	Fixed assets turnover	-0.0708	-0.2122	2
	ln (Total assets)	-0.0807	-0.3304	1
	Operating profit ratio of total capital (%)	-0.0150	-0.1371	6
	Constant	2.1548		

in negative correlation with risk, a larger enterprise has smaller risk. This demonstrates the assertion by Stewart [2, Japanese Translation p. 422]: Larger companies take less risk per decision made. In the second place comes the ratio of cash flow to interest-bearing indebtedness, in the third place the value added per employee. These two indices are in positive correlation with risk. As the value added includes operating profits, depreciation, wages, etc., larger depreciation or higher wages (not to say operating profits) makes risk higher.

4.2 Electrical and Electronics Industries.

The largest risk factor here is the owner's equity. It is also a factor of business size as in automotive industries and in negative correlation with risk. In the second place comes the growth rate of current profit. As it is in positive correlation with risk, more rapid growth means higher risk. In the third place comes the after-tax profit per share, which is in a negative correlation with risk. Risk will rationally be smaller with higher profit per share.

4.3 General Machinery Industries.

The largest risk factor here is the ratio of current profit to sales. In the second place comes the cash flow. Both of them are in negative correlation with risk. Larger profit or cash flow generating capability makes risk smaller. In the third place come the sales per employee, which is in positive correlation. Higher sales per employee mean fewer employees per unit of sales, i.e. such industry is considerably technology-intensive. Risk is higher in those industries.

4.4 Food Processing Industries.

Food processing industries are small in size in relation to other industries and may be described as labor-intensive. The largest risk here is the operating profit ratio of total capital. In the second place comes the number of employees. These two factors are in negative correlation with risk. Profitability (the operating profit ratio of total capital), and, due to their relative labor-intensiveness, the number of employees have significant effects to risk. The third largest factor is the inventories turnover period, which is positively correlated with risk. As the characteristics of food processing industries consist in a rapid turnover of inventories, longer turnover period of inventories makes risk larger.

4.5 Chemical Industries.

In the first place come also the total assets. In such larger-sized industries as automotive, electric and chemical industries the size of business is the most important factor to risk, i.e. the most characteristic factor of any industry is likely to have mostly effects on risk. The

fixed assets turnover comes in the second place, the after-tax profit per share comes in the third, which are both negatively correlated with risk. As chemical industries are typical process industries, the turnover of fixed assets including plant and equipment is an important matter to businesses. A rapid turnover makes risk smaller.

5. Summary and Conclusion

Summing up the analysis above, the author draws the following conclusion from this demonstrative study:

(1) Multiple correlation coefficients of 0.5 to 0.6 are obtained from primary data of financial statements of businesses which represent Japanese manufacturing sectors, i.e. automotive, electric, general machinery, and food processing and chemical. It means that there will be a good likelihood of estimating cost of capital from their financial indices.

(2) Various industries have their own risk. For respective industry sectors different factors which explain their characteristics most illustratively are selected, i.e. the risk consists of different factors, depending on industry. The author does not agree with Stewart in this respect. Stewart's model is problematic in that the risk of an industry can be estimated from that of others if appropriately adjusted.

(3) The most influential factor on risk is total capital or owner's equity in case of big businesses in automotive, chemical and electric industries, while profit rate is of a minor importance. Instead, profit rate comes first in case of food processing and general machinery industries. It means, size is the most important factor in big business while profit rate, i.e. standard for profitability, is mostly emphasized in smaller industries which are concentrated in food processing and general machinery industries.

(4) The third factor in electric and chemical industries is after-tax profit per share. If it is interpreted as dividend-generating capacity, it is an evidence of valuing shareholder relations.

(5) In all of 5 industry sectors, volume of cash flow representing debt servicing capacity or such productivity factors as turnover period (or turnover) come in the second or third place. Generally speaking, volume of sales is the key.

The demonstrative analysis of this study has obtained, as discussed above, several significant results. The most important one is that such results are obtained under limited conditions, especially using only primary data in financial statements from Japanese businesses. It means that there is a good likelihood of estimating cost of capital from financial indices by performing risk structure analysis of Japanese industries. The explanatory variables extracted in 5 industry sectors are not only statistically significant, but also helpful in manage-

ment accounting.

Although the results of this study have not been satisfactorily reviewed, it makes us imagine some influential problems at this moment. First is the selection of financial indices. As discussed above, the author selects 40 explanatory variables from primary data posted in financial statements, taking the practical feasibility into account, in order to verify to what extent they can explain risk factors. The fact that Multiple correlation coefficients of 0.5 to 0.6 is obtained exclusively from primary data in financial statements has a significant meaning, as it means that there will be a good likelihood of estimating cost of capital from financial indices. Stewart emphasizes 5-year averages and variances in selection of data for risk indices. From the viewpoint of risk, persuasiveness of financial indices of an accounting period is limited. Taking into account business worth and present worth of capital, it is necessary to think about averages and variances for a 3 to 5 years period for financial indices related to growth and stability of business enterprises in order to set up effective cost of capital. Thus they are the key data for constructing a more reliable and practical model.

Adoption of β value is another problem. A lag effect is unavoidable for β value. In this study β corresponds to financial indices in the same accounting period. According to other studies, the smaller is the business, the longer is the lag. How to reflect the lag is a somewhat complicated problem, but should be addressed seriously in future.

Notes

(1) EVA is a registered trademark of Stern Stewart & Company. Explanation and calculation are made in detail in Stewart [9], etc.

(2) The weighted average of cost of capital C^* is calculated by the formula proposed by Stern Stewart & Company: $C^* = c\ (1 - t^*$ Debts/Total Capital).

(3) Data source:

- Nikkei NEEDS Financial Statements of Respective Companies, CD-ROM (Nihon Keizai Shimbun, Inc.)
- For R&D expenditure of electrical machinery industry, Financial Data, CD-ROM (Toyo Keizai Inc.)

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