

Capital Budgeting Use in Canada: Sophistication and Risk Attributes

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Abstract

This study uses a sample of 80 of the 1989 Financial Post's Top 500 Canadian Corporations to test for correlation between the selection of capital budgeting techniques and three variables measuring the degree of environmental uncertainty: (1) firm's systematic risk (i.e., firm's beta), (2) industry's systematic risk (i.e., industry beta) and (3) management's self assessment of its corporate risk.

Introduction

The selection of appropriate capital budgeting techniques as part of making capital investment decisions is an essential managerial activity. Of particular interest to both practitioners and researchers is the identification and relative importance of market-based and management-perceived risk factors that determine the adoption of naive vs. sophisticated capital budgeting methods. This study, designed to fill what appears to be an empirical gap in this area, incorporates several elements of Schall and Sundem's (1980) research and, as well, formulates improved operational definitions of two measures of sophistication and introduces a management-perceived environmental risk measure. Specifically, Schall and Sundem (1980) found no significant relationship between market-based risk variables (i.e., firm's beta and industry beta) used as a surrogate for assessing the firm's environmental risk, and some selected variables measuring the degree of sophistication of management in handling capital budgeting decisions. They hypothesized that firms operating in an uncertain environment use more sophisticated capital budgeting as well as sophisticated risk analysis methods.

The current study extends and complements Schall and Sundem's approach by (a) also testing for a correlation between an environmental risk variable based on management perception of corporate risk and the use of more sophisticated capital budgeting techniques and risk analysis, and (b) providing more robust measures of two sophistication variables included in Schall and Sundem.

Based on data collected from a sample of 80 firms of the Financial Post 1989 Top 500 Canadian Corporations, our results lend support to Schall and Sundem's (1980) findings regarding the lack of significant correlation between market-based risk measures and the use of more sophisticated techniques. However, our results also reveal a

consistent significant correlation between higher level of environmental uncertainty as assessed by firm's management and the use of more sophisticated capital investment evaluation techniques. This provides a meaningful empirically-based contribution to the literature.

Survey of Relevant Literature

Recent empirical research studies reveal an increase in use of sophisticated capital investment evaluation techniques [Klammer (1972); Schall, Sundem and Geijsbeek (1978); Kim (1982); Baumgartner and Irvine (1977); Blazouske, Carlin and Kim (1988)]. At the same time, the relationship between type of evaluation technique and other firm-related variables such as size, debt ratio, riskiness of firm's environment, and firm's performance have received much attention in the literature [Christy (1966); Kim (1982); Klammer (1973); Schall and Sundem (1980)]. The findings of these and other studies, however, are not conclusive. Christy (1966) found no relationship between earnings per share growth and the use of sophisticated techniques. Klammer (1973) concluded that profit performance is not associated with the use of sophisticated techniques. Kim (1982) concluded that there is a positive relationship between the level of sophistication of the capital budgeting decision process, firm performance, and size. In the same study, Kim did not find a significant relationship between the use of more sophisticated techniques and an internal profit-based risk measure. Both Klammer (1973) and Kim (1982) rejected the notion of common stock-based (i.e., market-based) performance-risk measures on the grounds that the market participants are not informed on how management evaluates capital investment projects (1). Lending support to this conclusion, Schall and Sundem (1980) found no association between the degree of sophistication of the capital budget-

ing process and two market-based risk measures. They rationalized the lack of a significant relationship on the basis that firms' capital investment methods are not publicly available information.

Because of the concern in the current study with the association between the use of more sophisticated capital budgeting methods and firms' environmental risk, a thorough review of Schall and Sundem's (1980) work is warranted. Their thesis was that companies operating in an uncertain environment tend to use more sophisticated capital investment evaluation techniques and risk analysis (1980, p. 7). They tested the correlation between each of four sophistication measures and two basic measures of risk, with size and debt ratio (percentage of long term debt to total debt and equities) treated as moderating variables. Industry measure of systematic risk (i.e., industry beta) was used as the basic indicator of environment uncertainty. Firm's beta, however, was employed as a substitute measure when size or debt ratio showed a statistically significant correlation with any of the four sophistication measures.

Apart from the lack of statistically significant results as already mentioned, their study merits an extension for several other reasons. First, there is a need to improve the measures of sophistication. For example, the definition of sophisticated techniques, in our opinion, should not be limited to discounted cash flow methods. Other finance- (i.e., capital assets pricing model, option pricing model and arbitrage theory) and management science-based (e.g., PERT, decision theory, linear and dynamic programming) capital budgeting techniques should be included in the definition. In addition, importance or priority weights, or scores, can be used to assess whether or not a specific firm is a sophisticated user. As well, we believe that risk analysis and risk class assignment of investment projects as measures of sophistication can both be measured using an assessment scale. The Schall and Sundem (1980) study classified firms as "sophisticated" if respondents merely indicated that risk associated with a capital investment project was assessed. Also, firms were classified as "sophisticated" if they assigned assets to different risk classes. As a result of our changes, measures of sophistication were reduced to two variables: (1) firms' overall sophistication level in terms of capital budgeting methods employed, and (2) firms' overall degree of sophistication in conducting risk analysis of capital investment projects.

Research Hypothesis

This study hypothesizes that firms operating in an environment characterized by a relatively high level of uncertainty tend to use more sophisticated capital investment evaluation techniques and, as well, tend to incorporate more risk factors in evaluating capital investment projects.

Method of Analysis

The 80 firms included in this research study constitute a subset of a sample of 109 companies which responded to a detailed questionnaire administered in December 1989 to the responsible chief financial officers (Comptrollers, Treasurers or Vice-president of Finance) of the Financial Post Top 500 Canadian Firms. The data and firm characteristics provided were then examined in light of the following screening criteria to determine a given firm's inclusion in the study: (1) accessibility of relevant market return data on the University of Western Ontario Toronto Stock Exchange (Western TSE) data base, and (2) availability of other relevant data including total assets, net sales, long-term debt, and total capitalization. The screening process resulted in excluding 29 firms from the study because of lack of data items (1) and (2) referred to above. The remaining sample (80 firms) were classified into two groups: (1) a group of 54 publicly traded firms (study group 1, hereafter) for whom both data items (1) and (2) are readily available; and (2) a group of 26 government-owned and privately held firms (study group 2, hereafter) for whom only data item (2) is available.

In addition, the 80 firms studied represent a broad range of size and industries. As far as size of firm is concerned, the statistics presented in Table 1 indicate that most firms have average net sales of less than \$1 billion; 38 firms representing 70% of total number of firms in study group 1, and 18 firms representing 69% of total number of firms in study group 2. On the other hand, it appears that sample firms are more dispersed as far as the type of business is concerned. As revealed in Table 1, manufacturing firms represent a higher percentage of firms in study group 1 (about 41% of total number of firms in this group). The percentage of manufacturing firms in study group 2, however, is lower (about 19%, including the two manufacturing conglomerates). Natural resource firms in study group 1 and 2 represent about 15% and 12% of total number of firms in the two groups, respectively.

Measures Used

The following is a brief description of the operational definitions of the variables considered, along with the source of data components used in constructing each:

A - Sophistication Variables:

(a) Capital Budgeting Technique (CBT) - A firm's importance and priority score on several sophisticated and naive techniques (2) was used to determine whether the firm should be classified as a sophisticated or a naive user. The total score for each firm was computed as follows (3,4):

$$S_i = [\sum_i (A_i + B_i + C_i + D_i + E_i + \dots + J_i)] \\ + [\sum_i (P_{1i} + P_{2i} + P_{3i} + P_{4i} + P_{5i})] \dots [1]$$

Table 1
Profile of Sample Firms
Average Net Sales in \$ Billions (1984-1989)

Group:	Firm's Size:	< \$1 bl.	>\$1 bl.-< \$5 bl.	> \$5 bl.
Study Group 1:				
	Manufacturing	15	4	3
	Merchandising	1	1	0
	Natural Resources	8	3	2
	Utility	3	1	0
	Service	6	2	0
	Others	5	0	0
	Sub-total	38	11	5
Study Group 2:				
	Manufacturing	4	1	0
	Merchandising	1	1	0
	Natural Resources	2	3	0
	Utility	5	1	0
	Service	3	2	0
	Others	3	0	0
	Sub-total	18	8	0
	Total	56	19	5

$$N_i = [\sum_i (L_i + M_i + N_i + O_i + Q_i)] + [\sum_i (P_{1i} + P_{2i} + P_{3i} + P_{4i} + P_{5i})] \quad [2]$$

Where,

S_i and N_i represent the sum of importance and priority ratings of sophisticated (S) and naive (N) techniques, respectively, for firm (i),

$A_i, B_i, C_i, D_i, E_i, \dots,$ and J_i represent importance scores provided by respondent (i) for sophisticated methods A, B, C, D, E, ..., and J (equation 1),

$L_i, M_i, N_i, O_i,$ and Q_i represent importance scores provided by respondent (i) for naive methods (equation 2), and

$P_{1i}, P_{2i}, P_{3i}, P_{4i}, P_{5i}$ measure the importance scores of sophisticated methods A, B, C, D, E, ..., or J in (equation 1) or naive techniques L, M, N, O, or P (in equation 2), provided the method is used as primary (P_1), secondary (P_2), third (P_3), fourth (P_4), or fifth (P_5) technique by respondent (i).

As a result, a firm was classified on the CBT variable as a sophisticated user if its combined score on the sophisticated methods exceeds its score on the naive methods [$S_i > N_i$ -- coded 1]; otherwise it was classified as a naive user [coded 0].

(b) Risk Adjustment or Analysis (RA) - This variable

combines the importance of seven risk premiums (5) with the extent to which they are incorporated into the firm's Required Rate of Return (RRR). The actual measure is based on the total importance scores of all premiums a firm incorporates into its RRR, i.e., the sum of a firm's score on the seven risk premiums. A firm was classified as a sophisticated user (coded 1) if its total importance score exceeded the average rating of the seven factors on a seven-point scale; otherwise it was classified as naive (coded 0).

The data in Table 2 reveal the distribution of firms into sophisticated and naive as a result of applying the two measures of sophistication described in (a) and (b).

B - Environment Variables:

1. Size (Z) - was assessed in terms of the Average Annual Net Sales for the Period 1984-1989. The required information was obtained from companies' annual reports stored on microfiche, or from Moody's International Manuals covering the same period.

2. Debt Ratio (K) - was measured as the percentage of average long term debt to average total capitalization (total debt plus owners equity) for the period 1984-1989. The required data were obtained from the same sources mentioned in 1 above.

3. Firm's Beta (β) - was measured as the slope of Sharpe's

Table 2
Distribution of Firms Into
Sophisticated (S) and Naive (N)

Variable:	CBT		RA	
	N	S	N	S
Study Group:				
1	22	32	36	18
2	7	19	20	6

market model (1963) for each of the 54 firms included in study group 1. Monthly stock returns for a 60-month period (July 1984-June 1989) were regressed on the total market return for the same period. The data on stock and total market returns were obtained from the Western TSE data base.

4. Industry Beta (B) - a separate measure was obtained for each of the 54 firms included in study group 1, using an appropriate industry total market return that fits the specific firm's type of business. The industry monthly total returns for the period July 1984-June 1989 were regressed on the monthly total market returns for the same period. The required data were obtained from the same source mentioned in 3 above.

5. Management Perception of Firm's Environmental Uncertainty (MPEU) - a measure of corporate risk as perceived by corporate management. Respondents were asked to rate several factors (6) assessing the overall level of risk of the firm's business environment. The actual measure used in the analysis is the average ratings of the five factors.

$$MPEU_i = \{ \Sigma (R_i + S_i + T_i + U_i + V_i)/5 \} \quad [3]$$

Where,

MPEU_i represents the overall average rating score of management perception of environmental uncertainty for firm (i), and

R_i, S_i, T_i, U_i, V_i represent respondents' ratings on the five environmental factors listed in footnote (6) for firm (i).

Results and Discussion

The results of the statistical analysis of partial correlation between sophistication variables and environment uncertainty variables are presented in Tables 3 and 4. The researchers employed nonparametric statistics to avoid possible violations of normality assumptions. The primary research hypothesis mentioned earlier was translated into a set of testable operational hypotheses. In total, twelve such hypotheses were developed and tested to allow for all possible correlations between the two sophistication variables (CBT, RA) and the three environment uncertainty

variables (β, B, MPEU), with and without control for size (Z) and debt ratio (K):

- H₀₁: Y_{CBT β} = 0
- H₀₂: Y_{CBT B} = 0
- H₀₃: Y_{CBT MPEU} = 0
- H₀₄: Y_{RA β} = 0
- H₀₅: Y_{RA B} = 0
- H₀₆: Y_{RA MPEU} = 0
- H₀₇: Y_{CBT β.ZK} = 0
- H₀₈: Y_{CBT B.ZK} = 0
- H₀₉: Y_{CBT MPEU.ZK} = 0
- H₀₁₀: Y_{RA β.ZK} = 0
- H₀₁₁: Y_{RA B.ZK} = 0
- H₀₁₂: Y_{RA MPEU.ZK} = 0

The results presented in Table 3 (group 1) indicate that management assessment of environmental risk or uncertainty, variable (MPEU), is consistently correlated with the two measures of sophistication (CBT and RA). The significance level of the correlation (one-tail test) declined from 0.057 to .063 and from .012 to .032 after controlling for size and debt ratio. More importantly, the results indicate that the correlation between perceived risk and the level of sophistication is positive. These results call for rejecting the null hypotheses H₀₃, H₀₆, H₀₉ and H₀₁₂. Based on these results, one may conclude that management of these 54 sample firms tend to use more sophisticated capital budgeting techniques if they operate in what they perceive as a risky or uncertain corporate business environment. The results presented in Table 4 (group 2) are mixed, and only three, H₀₃, H₀₆ and H₀₁₂, are rejected. Correlation between the two variables (RA and MPEU) stands at 40% before controlling for size and financial risk. The measure, however, drops to 33% after controlling for size and financial risk.

It is important to note, however, that the data in Table 3 also reveal that market-based risk measures (β and B) are not statistically correlated with any of the two sophistication measures (CBT and RA). The lack of correlation is evident with or without controlling for size (Z) and debt ratio (K). This part of Table 3 confirms the results obtained by Schall and Sundem (1980) (7). As previous research concluded, the lack of correlation between sophistication and the market-based risk measures can be attributed to the fact that such managerial decisions are not directly observable by the stock market participants. One, however, should be aware that the lack of such correlation can also be traced to frequently encountered research limitations. These would include biased sampling procedures, selection of a particular statistical analysis technique (8) as well as the problem of defining, measuring and collecting research data. For example, only firms that met a predetermined set of screening criteria were included in the study groups 1 and 2. In addition, the current study undertook the difficult task of clarifying the terms "sophisticated" and "naive". Redefining or modifying the definition may cause a change in the results of the statistical analysis and may eventually lead to a different conclusion. As an example, most studies in this area of research classify the payback period as a simple or naive method despite the fact that some authors have concluded that the method has some logical and theoretical basis [See, for

Table 3
Partial Rank Correlation Coefficients (Study Group 1 - 54 Firms)
 (One-tail Test of Significance)

Sophistication Variables:	Environment Risk Measures			Moderating Variables	
	Market Assessment of		Management Assessment of Environment Uncertainty (MPEU)	Size (Z)	Financial Risk (K)
	Firm's Beta (β)	Industry Beta (B)			
CBT	-.1543 (.133)	.1053 (.224)	.2180 (.057)	.0111 (.468)	.0463 (.370)
RA	.0753 (.294)	.0232 (.434)	.3062 (.012)	.3132 (.011)	.1860 (.112)
CBT	-.1513 (.142)	.1071 (.225)	.2152 (.063)		
RA	.1091 (.221)	.0428 (.382)	.2589 (.032)		

Table 4
Partial Rank Correlation Coefficients (Study Group 2 - 26 Firms)
 (One-tail Test of Significance)

Sophistication Variables:	Environment Risk Measures			Moderating Variables	
	Market Assessment of		Management Assessment of Environment Uncertainty (MPEU)	Size (Z)	Financial Risk (K)
	Firm's Beta (β)	Industry Beta (B)			
CBT	N/A	N/A	.3274 (.051)	.3439 (.043)	.1380 (.465)
RA	N/A	N/A	.3971 (.022)	.3146 (.059)	.1118 (.293)
CBT	N/A	N/A	.2042 (.169)		
RA	N/A	N/A	.3274 (.059)		

example, Blatt (1979)]. Finally, the information used to operationalize the two measures of sophistication was derived from questionnaire data. Overall, such considerations limit the researchers' ability to generalize to the general population.

In addition, the statistical analysis conducted in the current study supports empirical evidence documented by earlier research studies that size is a significant factor in determining the sophistication level used in evaluating capital budgeting projects. The empirical results presented in Tables 3 and 4 show that size is significantly correlated with the two sophistication measures for study group 2 (i.e., significant at the .043 and .059 for both CBT and RA, respectively). For study group 1, size shows a significant correlation (i.e., significant at the .011 level) only with the risk analysis variable (RA).

Notwithstanding the lack of relationship between market-based risk measures and the selection of certain capital budgeting techniques, the current study documents important empirical evidence of a significant correlation between the management-perceived risk measure of business environment and the two measures of sophistication. This provides further evidence for the relevance of managers' risk perception vis-a'-vis to market risk perception. With that in mind, it is possible to conclude, that the use of more sophisticated capital budgeting methods is a common practice among managers who perceive their firm's business environment as more risky or uncertain. This observed perception and practice among respondents can be explained and understood on several grounds. First, the need to use more sophisticated capital budgeting techniques in an uncertain environment is an appropriate managerial response in most difficult-to-diversify situations. Accordingly, it is expected that managers conduct more careful and rigorous analysis of capital investment projects with increased environmental risk and uncertainty. Second, managers could be concerned with environment uncertainty on a personal level. This could be true considering the possible implications of managerial decisions on managers' promotions, tenure and overall job security. Managers facing a highly competitive or limited job market, may have to support or defend capital investment decisions by showing a higher level of sophistication and rigorous analysis. The contractual relationship between management and shareholders or owners may allow for certain types of compensation contracts which may also contribute to the use of more sophisticated techniques, especially when a risky environment prevails. Other factors that may significantly influence managers' behavior in this area include an observed increase in user-friendly electronic data analysis software that can facilitate the process of applying the more sophisticated techniques, and a higher level of university-based and in-house management education and training among corporate managers.

Contribution and Conclusion

The research presented here did not consider all the potential factors that might affect the relationship between the main variables delineated in our research hypothesis. However, the results obtained add to the stock of present knowledge by extending prior research and revealing some new dimensions of the relationships examined. On balance, the study should be viewed as a stage in model-building efforts in the search for a better understanding of capital budgeting technique use.

Further research may benefit from examining the role of other moderating variables, such as managerial executive compensation structure and corporate planning horizon, in influencing the utilization of simple vs. sophisticated forecasting techniques. The compensation structure - planning horizon interaction deserves clarification, as both appear to be partially designed to help managers counter the problem of environmental uncertainty.

Footnotes

- 1 Sundem (1974 and 1975) concluded that in simulated uncertain environments, sophisticated techniques significantly contribute more to the value of the firm.
- 2 The current study treats the following methods as sophisticated: (1) Discounted cash flows methods, (2) Capital Asset Pricing Model (CAPM), (3) Sensitivity analysis, (4) Critical Path Method (CPM), (5) Program Evaluation and Review Technique (PERT), (6) Linear or non-linear programming, (7) Decision theory, (8) Certainty equivalent, (9) Simulation, and (10) Option Pricing Model (OPM). The following were classified as naive techniques: (1) Payback period, (2) Accounting Rate of Return (ARR) or Return on Investment (ROI), (3) Business intuition, (4) Zero-Base Budgeting (ZBB), and (5) Career experience.
- 3 Respondents were asked to assign importance scores on a 1-7 scale to each technique employed. A score of 1 represents "not useful" and a score of 7 represents an "extremely useful" technique.
- 4 Respondents were asked to list the primary, secondary, third, fourth, and fifth from among capital budgeting techniques listed in footnote (1) the company employs for most capital projects. A priority score based on a 1-5 scale was used to complement the importance score, where a score of 5 is assigned to the primary method, a score of 4 is assigned to secondary method, etc.
- 5 The seven risk premiums include: (1) inflation, (2) growth in earnings, (3) firm's systematic risk (firm's beta), (4) uncertainty of long-term cash

- flows, (5) assets' mobility, (6) political risk, (7) fluctuation of foreign exchange rates.
- 6 These include a measure of: (1) the degree of competitiveness of the firm's business environment; regulated firms received zero score on this measure, (2) the degree of stability of firm's business environment, (3) the degree of uncertainty of firm's business environment, (4) a measure of the importance of the rate of change of firm's environment in determining the firm's choice of primary forecasting technique(s), and (5) the importance of the level of uncertainty of firm's environment in determining the firm's choice of primary forecasting technique(s). All the above were rated on a 1-7 scale where 1 represents low competitiveness (in No. 1), very stable (in No. 2), low uncertainty (in No. 3), and unimportant (in No. 4 and 5). A score of 7 represents very high competitiveness (in No. 1), very fast changing (in No. 2), very high uncertainty (in No. 3), and extremely important (in No. 4 and 5).
- 7 Schall and Sundem (1980) indicated that a firm's beta can be substituted for industry beta and used as a surrogate measure for environmental uncertainty under certain circumstances, such as in the case where there is significant correlation between size or debt ratio and any of the sophistication measures. In the current study, size and debt ratio both show significant correlation with risk analysis or adjustment variable. Thus, firm's beta would be the appropriate measure for environmental uncertainty. Unfortunately, such a substitution does not add to the results shown in Table 1.
- 8 The researchers also analyzed the relationship between market-based variables and the two measures of sophistication, using the logistic regression technique. The results of the statistical analysis confirmed the results presented in this paper.
- 5 Conine, T. E., Jr., "Debt Capacity and the Capital Budgeting Decision: A Comment," *Financial Management*, pp. 20-22, Spring 1980.
- 6 Kim, S. H., "An Empirical Study on the Relationship Between Capital Budgeting Practices and Earnings Performance," *Engineering Economist*, pp. 185-196, Spring 1982.
- 7 Klammer, T. P., "The Association of Capital Budgeting Techniques with Firm Performance," *The Accounting Review*, pp. 353-364, April 1973.
- 8 Klammer, T. P., "Empirical Evidence of the Adoption of Sophisticated Capital Budgeting Techniques," *Journal of Business*, pp. 337-357, July 1972.
- 9 Litzenberger, R. H. and H. B. Sosin, "A Comparison of Capital Structure Decisions of Regulated and Non-Regulated Firms," *Financial Management*, pp. 17-21, Autumn 1979.
- 10 Martin, J. D. and D. F. Scott, Jr., "Debt Capacity and the Capital Budgeting Decision: A Revisitation," *Financial Management*, pp. 23-26, Spring 1980.
- 11 Schall, L. D. and G. L. Sundem, "Capital Budgeting Methods and Risk: A Further Analysis," *Financial Management*, pp. 7-11, Spring 1980.
- 12 Schall, L. D.; G. L. Sundem and W. R. Geijsbeek, Jr., "Survey and Analysis of Capital Budgeting Methods," *Journal of Finance*, pp. 281-287, March 1978.
- 13 Sharpe, W. F., "A Simplified Model for Portfolio Analysis," *Management Science*, pp. 277-293, January 1963.
- 14 Sundem, G. L., "Evaluating Capital Budgeting Models in Simulated Environments," *Journal of Finance*, pp. 977-992, September 1975.
- 15 Sundem, G. L., "Evaluating Simplified Capital Budgeting Models Using a Time-State Preference Metric," *The Accounting Review*, pp. 306-320, April 1974.

References

- 1 Blatt, John M., "Investment Evaluation Under Uncertainty," *Financial Management*, pp. 61-81, Summer 1979.
- 2 Blazouske, J. D., I. Carlin and S. H. Kim, "Current Capital Budgeting Practices in Canada," *CMA*, pp. 51-54, March 1988.
- 3 Buamgartner, H. B. and V. B. Irvine, "A Survey of Capital Budgeting Techniques Used in Canadian Companies," *Cost and Management*, pp. 51-54, January/February 1977.
- 4 Christy, G. A., *Capital Budgeting - Current Practices and Their Efficiency*, Eugene, Bureau of Business and Economic Research, University of Oregon, 1966.