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Evaluating the Capacity of Standard Investment Appraisal Methods

Mehari Mekonnen Akalu

Department of Marketing and Organisation, Faculty of Economics, Erasmus University Rotterdam, and Tinbergen Institute

Tinbergen Institute
The Tinbergen Institute is the institute for economic research of the Erasmus Universiteit Rotterdam, Universiteit van Amsterdam and Vrije Universiteit Amsterdam.

Tinbergen Institute Amsterdam
Keizersgracht 482
1017 EG Amsterdam
The Netherlands
Tel.: +31.(0)20.5513500
Fax: +31.(0)20.5513555

Tinbergen Institute Rotterdam
Burg. Oudlaan 50
3062 PA Rotterdam
The Netherlands
Tel.: +31.(0)10.4088900
Fax: +31.(0)10.4089031

Evaluating the Capacity of Standard Investment Appraisal Methods: Evidence from the practice

Mehari Mekonnen Akalu[†]

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Abstract

The survey findings indicate the existence of gap between theory and practice of capital budgeting. Standard appraisal methods have shown a wider project value discrepancy, which is beyond and above the contingency limit. In addition, the research has found the growing trend in the use of value management models. The presence of correlation between the frequency of monitoring and project value discrepancy, and the absence of uniformity in the use of evaluation methods throughout the life span of a project are among the results of the study.

JEL Classification: G30, G31, L6, L8, L9, M10, O22, O32

Key words: Capital Budgeting, Investment Appraisal, DCF Methods, Project Analysis, Shareholder Value Analysis, Value Management Techniques

[†]PhD candidate at the Tinbergen Institute, Erasmu University, Rotterdam, Burg. Oudlaan 50, 3062PA Rotterdam, The Netherlands. I am highly indebted to my promoter, Professor J Rodney Turner for his engorgement, comments and assistance in the development of this paper.

1. Introduction

There has been a number of research works that explores the relationship between theory and practice of corporate finance. Among the many researches, the works of Mao (1970), Gitman and Forrester (1977), Schall, Sundem and Geijsbeek (1978), Ross (1986), Harris and Raviv (1996, 1998), Arnold and Hatzopoulos (2000), and Graham and Harvey (2001) can be sited as an example. Since the formulation of Modigliani and Miller (1958) model, perhaps, capital budgeting is a well-surveyed area of corporate finance. This effort is still continued today and scholars are constantly searching for the best way of making investment decisions, and try to bridge the gap between the prevailing theory and the current company practices.

This survey is also an attempt to assess the theory-practice gap in capital budgeting. The following points characterised this study. First, it has broad sampling breadth, which includes members of project management associations in addition to the usual corporate entities[1]. This will enrich the results of the survey by bringing together the ideas of project management professionals, companies and academicians. Moreover, such sampling helps to compare and contrast the opinion variations, if any, between the sample groups.

Second, the sample companies are among the largest and oldest corporate groups with sufficient experience in the area of capital budgeting. These companies are also among the top performers in the list of "Europe 500" companies, published by the *Financial Times* in 1999.

Third, before sending the questioners to the respondents, companies are evaluated using the Shareholder Value technique. Based on this result, firms are categorised into: *high*, *medium* and *low performing* groups. This sample sub-grouping will help to track any meaningful relationship between capital budgeting practices and company shareholder value performances.

Fourth, analysis of responses is made vis-à-vis performances and sample categories. This will enhance the interpretation of the survey result in relation to the sample sub-groupings.

Fifth, the survey is not only emphasising on pre-execution phases of a project but is also encompasses activities after project implementation and including project progress evaluation. In this regard, it tries to see the investment appraisal process in its entirety as oppose to analysing parts of a project process in isolation.

2. Methodology

Survey method is used in this research. Survey questionnaires are designed to capture data on different issues ranging from appraisal to project progress evaluation. It is also made to accommodate both qualitative and quantitative responses and different types of scales such as nominal, interval and ordinal so as to facilitate various ways of data analysis. In addition, respondents were not asked to identify themselves so as to reduce the possibility of response bias (Hasan *et al.* 1997). The

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[1]The association members are affiliated with particular organisations or working as a consultant and who are engaged in the area of capital budgeting and investment appraisal activities.

draft questionnaire is checked and reviewed at various levels. Finally, a pilot test was done among project engineers.

The survey is based on two groups of samples. The first group (Sample-1) comprises companies operating in the Netherlands and the United Kingdom. The initial list of potential companies is reduced into two-step process. The goal of the fist step is to identify those companies listed at the London Stock Exchange and those listed at the Amsterdam Stock Exchange markets. Of the total lists of companies, 221 of them meet this first step requirement. In order to investigate the effect of capital budgeting practice on the performance of companies, a second step of screening procedure is involved by computing the shareholder value of companies. Excluding those with incomplete data, hundred and twenty-six companies meet the second requirement. These, companies are classified into high, medium and low performing, based on their shareholder value performance[2].

The second group of samples (Sample-2) contains those professionals who are engaged in investment evaluation or project related works and affiliated with the Netherlands Project Management Institute (PMI-NL) or Association for Project Management (APM) of the United Kingdom.

Different survey researches have reported different response rates. The rate of response depends, among other things, on the number questions, questionnaire length and style of questions (Harzing, 1999, p. 198). In general, low response rate is common in cross-country mail surveys and those surveys targeted for the first line managers of a company. The response rate profile, in such surveys, ranges between 6%-16% without follow-ups or prior contact to the respondent (Harzing, 1999, p. 202). In corporate finance related survey, for instance, Graham and Harvey (2001), Trahan and Gitman (1995) have found 9% and 12% respectively.

From the total of 1196 mailed questionnaires, 217 questionnaires are returned (18.1% total response rate). After adjusting for the incomplete questionnaires and for those returns due to address changes, 10.5% response rate is obtained. Thus, given the nature of questionnaire administration (i.e. without incentives and prior contact) and the type of targeted management position (CEOs, CFOs and first line project management executives), this response rate is comparable to other similar surveys in the field.

2.1 Sample characteristics

The sample companies are heterogeneous, which helps to obtain wide range of capital budgeting experiences. Accordingly, companies are drawn from various industries (Banking and Finance, Retails and distribution, Chemicals and Pharmaceuticals, Manufacturing, Food and Leisure, and Utilities). Of which, manufacturing and retail and distribution are taking the largest share in the distribution. In terms of their financial standing, based on the 1999 data, 64% of the samples have got more than $5 billion asset value. In addition, 70% of companies employee more than 5 thousand workforce. The average annual revenue of the sample

[2] The sample size of the sub-groups is accordance to the minimum requirement set by Sekaran (2000, p.296).

companies is $9.6 billion (Table 1). In addition, the members of the professional associations are also heterogeneous in terms of their employment industry.

Table 1: Characteristics of the Corporate Sample

	Assets ($ Billion)	Revenue ($ Billion)	Number of Employees (Ths)
Total	3854.5	1210.1	5255.2
Mean	30.6	9.6	42.0
Median	7.8	4.9	24.1
Standard deviation	72.0	13.0	50.2
Maximum	459.0	83.7	261
Minimum	0.41	0.26	0.08

2.2 Statistical tests

Various statistical tests are administered to check the representativeness of the responses, the data and the accuracy of the measurement scale. Such assessment helps to draw a valid conclusion from the research. The most commonly used tests are briefly discussed below.

Table 2: Corporate (Sample 1)

Description	Category	Actual %	Expected %	Test
	Below 5,000,000	30.3	36.5	
Total Assets ($ Ths)	5,000,001-10,000,000	27.3	20.6	5%
	10,000,001-15,000,000	12.1	15.9	X^2=0.021
	Above 15,000,000	30.3	27.0	df. 3
		100	100	
Total Revenue ($ Ths)	Below 5,000,000	33.3	50.8	5%
	5,000,001-10,000,000	27.3	23.0	X^2=0.001
	10,000,001-15,000,000	21.2	11.1	df. 3
	Above 15,000,000	18.2	15.1	
		100	100	
Industry Grouping	Banking & Finance	6.1	14.3	5%
	Chem. & Pharmaceuticals	12.1	10.3	X^2=0.003
	Food & Leisure	18.2	9.5	df. 6
	Manufacturing	21.2	16.7	
	Retail & Distribution	24.2	16.7	
	Utilities	3.0	11.1	
	Others	15.2	21.4	
		100	100	
Number of Employees	Below 10,000	0.0	24.8	5%
	10,001 - 25,000	33.3	27.2	X^2=0.000
	25,001 - 40,000	6.1	11.2	df. 5
	40,001 - 55,000	18.2	11.2	
	55,001 - 70,000	18.2	8.8	
	Above 70,000	24.2	16.8	

	100	100

Goodness of fit test: This is a test necessary to determine whether the observed pattern of frequencies corresponds to the expected pattern in the population (Churchill, 1991, p.777). The goodness of fit test is performed based on various firm size measures (total asset, total revenue and number of employees) and industry groupings (Table 2).

In addition, the test has also been performed for the members of professional associations (Robert, 1999, p. 62). In all categories, the chi-square statistics is less than the critical value given the respective degree of freedom (Table 3). Thus, it can be concluded that based on the size and industry groupings, observed pattern of frequencies corresponds to the expected pattern in the population.

Table 3: Professional Members (Sample-2)

Industry Category	APM-UK		PMI-NL		Total	
	Actual %	Expected %	Actual %	Expected %	Actual %	Expected %
Banking & Finance	10.0	7.28	7.14	1.53	8.70	2.71
Chemicals & Pharmaceuticals	0.0	2.27	4.76	0.24	2.17	0.65
Constructions	4.0	4.09	2.38	1.65	3.26	2.15
Educational services	0.0	5.91	0.00	2.35	0.00	3.08
Communications, IT & Media	8.0	16.36	16.67	11.29	11.96	12.34
Manufacturing	8.0	6.82	16.67	5.65	11.96	5.89
Oil, Gas & Minerals	0.0	1.36	7.14	0.35	3.26	0.56
Project mgt. & other services	34.0	24.54	11.90	16.71	23.91	18.32
Transport & Distributions	4.0	4.55	4.76	1.88	4.35	2.43
Utilities	12.0	5.00	0.00	0.82	6.52	1.68
Others	20.0	21.82	28.58	57.53	23.91	50.19
	100	100	100	100	100	100
Chi-square	X^2 (10,5%) = 0.0014		X^2 (10,5%) = 0.000		X^2 (10,5%) = 0.000	

Non-response bias test: It measures the degree of failure to obtain information from some elements of the population that were selected and designated for the sample. The conventional method of measurement is the proxy method, whereby one compares the mean responses of one or more variables given by certain size of respondents of the last period with those of early periods (Wallace and Mellor, 1988, p.135). In order to perform the non-response bias test, 20% of the returned questionnaires are considered from the two ends. Accordingly, at 1% significant levels (using Kolmogrov-Smirnov non-parametric test), there is no difference between those responded and those who didn't.

Reliability test: The construct validly of a research is dependent on the reliability of measurement scales (Peter in Peterson, 1994, p. 381)[3]. The most commonly used measure of reliability is the Cronbach Alpha[4]. Accordingly, alpha coefficient of 81.2% (for three-item ranking scales) and 92.5% (for four-item interval Scales) are obtained. A coefficient alpha of 70% or more is regarded as an acceptable level of reliability by researchers (Petterson, 1994, pp.381-388; Nunnally, 1978). Thus, it can be said that the measures used in this survey captures the required information of the theoretical construct.

3. Data Analysis and Results

3.1 Objectives Measurement Technique

In order to establish conformity between company objectives and proposed projects, value comparison is made before implementation. This process is mostly part of the stage of project definition and requires measurement of project value and company objectives. Companies measure their objectives using various metrics. Some of them apply return based measures, while others use cash flow or combination of methods. Of the total survey, 22% of companies apply return based scales, such as ROI, ROE, while 33% of the companies apply combination of different methods. Among the sample companies, five companies are found applying accounting profit as metric to company objectives.

Table 4 depicts the various techniques applied to measure company objectives. From the table, the value management metrics dominates the category of *"other methods"*. Accordingly, total return to shareholders (TRS), shareholder value added (SVA), the economic value added (EVA) and the cash value added (CVA) are applied as a measurement of objectives. This is an indication of the transformation of measurement methods from traditional accounting based measures such as PE ratio and accounting profit, to value based techniques.

Similar pattern of usage is found across the two samples. However, the order of models is different in sample-2. Accordingly, returns (32%), cash flows (20%), and per share (7%) based models are common among this group. No particular pattern is detected in the performance sub-samples.

Table 4: Objective Measurement Metrics

Measurements	%
Returns	22
Per shares	17
Returns & Per shares	17
Cash flow	16

[3]Construct validity is defined as the extent to which the constructs of theoretical interest are successfully operationalized in the research. It emphasises both the on the reliability of the measures and its capacity to capture the required data (Abernethy *et al.* 1999).

[4]This multi-scale internal consistency measure is computed by $\alpha = k\check{r}/(1+\check{r}(k-1))$, where k number of terms in the scale $\check{r}$ average inter item correlation (Hughes and Garrett, 1990, p.186).

Returns & Cash flow	3
Other combinations	13
Other methods	14

3.2 Investment Appraisal Models

Selection of appropriate investment appraisal technique is an important element in the creation of value to shareholders. Companies vary by their choice of project appraisal model. In general, project life span and the size of project spending are considered at the time of model selection. Accordingly, when the amount of spending is large and the life of a project is longer, companies tend to use more quantitative and advanced appraisal models.

As can be seen from Table 5, most of the surveyed companies (65.8%) don't apply single method of appraisal. The application of multiple models is consistent for all projects varying with life span and amount of spending. The number of multiple model users is also at an increasing trend as one moves from the lower (€16 million) to a higher (€160 million) amount of project spending, or from lower (5 years) to higher (20 years) project life span. Since the fear of loss of investment increases with the size of investment and the risk for an investment with length of project life, it is appropriate to have such an upward and parallel trend of multiple model usage with the size of spending and length of projects life span.

Table 5: Investment Appraisal Models

Appraisal method	%
Combined methods	65.8
NPV	13.7
IRR	10.3
PBP	6.8
ARR	3.4

Similar pattern is found in the application multiple models when companies are analyzed based on their shareholder value performances (for instance 100%, 83%, and 91% for high, medium and low performing sub-samples respectively); or sample groupings (for instance, 90% and 56.4% for sample-1 and sample-2 respectively).

In the combination process, different number and types of models are combined. In this regard, 30%, 27% and 35% of the samples companies combine two, three and four models respectively in their appraisal process (Table 6). The trend shows the increasing number of methods in the combination.

Table 6: Combination of Appraisal Models

Description	%
Two models	30
There models	27
Four models	35
Others	8

According to Pike (1996), the application of a single method is declining from 31% in 1975 to 4% in 1992[5]. Conversely, the combined model usage has increased from 22% to 32% (for three-model combination) and from 11% to 32% (for the four-model combination) in the above observation periods (p. 83). In addition, firms combine the standard models with value management models, which is consistent with the findings of Arnold and Hatzopoulos (2000, pp. 610-613) and Pike (1996).

The increasing use of multiple methods in project appraisal reflects companies' tactic and strategy to minimize project value discrepancy expected in the application of a single model. Therefore, this strategy clearly indicates lack of credibility (Ross, 1995, p. 219), certainty (Demski, 1994, p.385), reliability and trust on the individual standard appraisal models for capital budgeting decisions and project or company value measurements.

3.3 Project Progress Assessment

As discussed in section 3.2, one of the possible reasons for the use of combined method of appraisal is lack of capacity of individual models to accurately measure the value of a project. In order to reduce the chance of discrepancy between actual and estimated revenue and cost of a project, firms may tend to use more than one method of appraisal at a time. This procedure is similar irrespective of project life, size and type of industry. This analysis, therefore, leads to further investigation of the size of discrepancy associated with standard appraisal methods.

In order to investigate the relationship between appraisal models and extent of discrepancy, the discrepancy data is analyzed in line with the choice of appraisal model as shown in Table 7.5[6]. Table 7 portraits the rate of discrepancy in relation to methods of investment appraisal. Accordingly, the NPV method creates larger discrepancy among the standard appraisal methods.

Table 7: Discrepancy and Appraisal Models

Methods	Rate of Discrepancy			
	0-10%	11-20%	21-30%	>30%
NPV	39	43	33	75
IRR	31	14	33	25
PBP	15	29	34	0
ARR	15	14	0	0
%	100	100	100	100

More than 30% of respondents, who have applied the NPV method, had a higher discrepancy record than other methods. When the pattern of discrepancy is analyzed in terms of project life and project spending, the discrepancy rate ranges up to 20% for major and larger projects with an estimated life of above 10 years and investment size of above €80 million. In addition, industries such as support services

[5]1975, 1980, 1986 and 1992 were the observation periods.

[6]In here discrepancy is defined as the difference between actual (initial) and expected value (revenue and/ or cost) of a project.

(0-10%) and distribution and transport (11-20%) are found highly venerable for project value discrepancy. In terms of shareholder value performance, medium and low performing companies have a record discrepancy ranging from (0-10%) and (11-20%) respectively, which is in line with their performances, i.e., higher discrepancy may lead to low company shareholder value.

One of the means of revealing the value discrepancy is project progress monitoring. In this connection, it can be assumed that the higher the frequency of monitoring, the narrower will be the expected discrepancy. That means, during frequent monitoring, the project manager can quickly fix problems that could increase the likelihood of discrepancy. Only 30% of the samples perform project evaluation in less than a year frequency (Table 8). However, about 38.8% of samples monitor their project at project milestones, which are few number of times across the life span of a project. This result is consistent between samples and performance groups. Although the optimum frequency time of monitoring depends on various factors, the survey data indicates very low rate of monitoring frequency; hence, it supports the presence of higher rate of discrepancy among surveyed companies. The consequence of such practice may lead companies to keep budget-overrun projects and increase the likelihood of an enormous performance gap between actual and project value estimates.

The frequency of progress evaluation and the size of discrepancy are correlated[7]. This makes possible to perform regression analysis so as to evaluate whether the relationship between the value discrepancy and frequency of monitoring is significant or not.

Table 8: Frequency of Progress Evaluation

Frequency	%
Weekly	2.6
Monthly	20.7
Quarterly	6.9
Yearly	7.8
Per Stage (milestone)	38.8
Twice in the project life span	6.0
Once in the project life span	17.2

Since our data set is based on multiple choices of frequencies (such as weekly, monthly, quarterly, semiannually), discrete dependent models can best fit the characteristics of the data. For this purpose, a *multinomial logit* model is chosen. The model is suitable for studies with multiple-choice settings and when company experiences are the basic unit of analysis (Greene, 2000, p. 857); Pindyck and Rubinfeld, 1998, p. 309).

In order to detect any significant variation between sample experiences, two models are formulated for the two samples and one model for the total survey. In addition, the model is tested to determine its conformity to the data set[8]. Accordingly, equation is formulated to capture the relationship between project value discrepancy and the monitoring frequency. In this model, the dependent (rate of discrepancy) and

[7]The two variables are correlated and this correlation is significant at 5% level.
[8]Significant at 5%.

independent (frequency of monitoring) variables are represented by (Y_i) and (X_i) respectively[9].

$$\text{Prob}(Y_i) = \frac{e^{\beta_j X_i}}{\sum_{k=1}^{4} e^{\beta_{jk} X_i}}$$

Where,

Y_1 (0-10%)
Y_2 (11-20%)
Y_3 (21-30%)
X_1 (Weekly)
X_2 (Monthly)
X_3 (Quarterly)
X_4 (Yearly)
X_5 (Once)
X_6 (Twice)
X_7 (Per stage).

The result of the model is depicted in Table 9. Accordingly, the discrepancies ranging between 0% and 10% are mostly associated with weekly or quarterly project assessments. On the other hand, those infrequent evaluation experiences are associated with higher discrepancy rate such as "per stage" (11-20%). Therefore, it can be deduced for this model that, rate of project value discrepancy follows the frequency of project evaluation. The result is consistent for all sample models.

Table 9: Model Statistics

Frequency of project evaluation	Parameters		
	0-10%	11-20%	21-30%
Weekly	9.21	0.00	0.00
Monthly	1.61*	1.50*	-9.90
Quarterly	11.00	9.21	0.00
Yearly	10.31	10.31	9.90
Once	2.08*	1.79*	0.69

[9]Greene (2000, p. 859) and Pindyck and Rubinfeld (1998, p. 321) have explained the detained formulation of the multinomial logit model.

Twice	1.10	1.10	-9.21
Per stage	0.69	0.98*	0.41

*Significant at 5%.

The other issue in the project progress monitoring is the methods of evaluation. In order to make the analysis more meaningful, the evaluating models are classified in terms of their relationship with either appraisal models or models used to measure company objectives. Accordingly about half of the survey respondents are evaluating project in progress using the project appraisal models irrespective of amount of spending and difference in project life span. The rest of the sample, either uses the objectives measurement models or combination of the two approaches. This result is not different by industry groupings and performance categories.

In order to assess the general capacity of commonly used appraisal methods, respondents were asked to grade the predicting (degree of precision or accuracy) and realizing (the power to provide the promised value) capacity of the standard investment appraisal methods. The respondents rated the standard appraisal methods as "very good" (in the scale of poor, good and very good) at 15% and 19% for predicting and realizing capacity respectively. This result is not consistent with the textbook argument for superiority of the standard capital budgeting methods. Had it been for textbook argument, significant number of respondents could have rated high for NPV or IRR appraisal methods.

4. Discussions

The survey findings indicate the existence of gap between theory and practice of capital budgeting. Although theoretically sound, the standard appraisal methods are unable to provide the promised project value to shareholders. This problem is explained in the existence of wider discrepancy beyond and above the contingency limit for projects. Companies' attempt to curb this problem is revealed by their simultaneous use of multiple models. Despite all this effort, the problem still persists and questions the robustness of the standard appraisal models. Thus, it is not surprising if companies are beginning to avoid using these methods, or searching for new models or applying a technique that compromises the investment appraisal process.

The survey result also shows the growing trend in the use of value management models. This indicates a gradual shift in the trend of appraisal techniques. Initially, firms were assisted by the traditional accounting methods. Later, the DCF methods improve the method of evaluation and replace the old techniques. The coming (use) of value management technique is, therefore, a drift in the use of standard capital budgeting methods.

Furthermore, the survey reveals the existence of correlation between number of times that a project is monitored and its value discrepancy. This result is robust and strongly aligns with the theoretical argument presented in the discussion.

In addition, the empirical analysis revealed the absence of uniformity in the use of valuation methods throughout the project life span. More than half of the samples perform project appraisal and subsequent project evaluation by two different sets of models (for instance, DCF and non-DCF based models). These two groups of models provide neither the same information to the decision-maker, nor do they have

the same measurement scale. This creates confusion in the interpretation of the progress result of a project and difficult to compare against the initial (promised) value. The consequence is grave; disguises the picture of true performance and make companies to keep running value-destroying projects.

Comparing the two samples, the responses are almost similar in all areas of concern. Thus, the presence of a professional member of a projects association in capital budgeting practice doesn't have a significant impact on the performance of capital budgeting or in the process of narrowing the gap between theory and practice. In case of performance sub-samples, the higher magnitude of discrepancy goes with the weak-performing group.

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