



Improved capital budgeting decision making: evidence from Canada

Improved capital budgeting

225

Karim Bennouna

Kubota Canada, Ontario, Canada, and

Geoffrey G. Meredith and Teresa Marchant

*Graduate College of Management, Southern Cross University,
Tweed Heads, Australia*

Abstract

Purpose – The purpose of this article is to evaluate current techniques in capital budget decision making in Canada, including real options, and to integrate the results with similar previous studies.

Design/methodology/approach – A mail survey was conducted, which included 88 large firms in Canada.

Findings – Trends towards sophisticated techniques have continued; however, even in large firms, 17 percent did not use discounted cash flow (DCF). Of those which did, the majority favoured net present value (NPV) and internal rate of return (IRR). Overall between one in ten to one in three were not correctly applying certain aspects of DCF. Only 8 percent used real options.

Research limitations/implications – One limitation is that the survey does not indicate why managers continue using less advanced capital budgeting decision techniques. A second is that choice of population may bias results to large firms in Canada.

Practical implications – The main area for management focus is real options. Other areas for improvement are administrative procedures, using the weighted average cost of capital (WACC), adjusting the WACC for different projects or divisions, employing target or market values for weights, and not including interest expenses in project cash flows. A small proportion of managers also need to start using DCF.

Originality/value – The evaluation shows there still remains a theory-practice gap in the detailed elements of DCF capital budgeting decision techniques, and in real options. Further, it is valuable to take stock of a concept that has been developed over a number of years. What this paper offers is a fine-grained analysis of investment decision making, a synthesis and integration of several studies on DCF where new comparisons are made, advice to managers and thus opportunities to improve investment decision making.

Keywords Capital budgeting, Discounted cash flow, Investments, Decision making, Canada

Paper type Research paper

1. Introduction

Sound financial management and capital investment decision making are critical to survival and long-term success for firms. The global financial crisis has only affirmed this truth. This paper contributes to understanding the role of accounting in business decisions by demonstrating the need for more sophistication in firms' analysis of investment choices, and provides sound advice for practitioners, in order that incorrect decision making and underinvestment can be minimized. This research investigated current capital budgeting practices of large firms in Canada, which appears to have received relatively less attention in the literature than other countries in recent times regarding use of DCF.



DCF has become the dominant evaluation method in Canada (Jog and Srivastava, 1995; Payne *et al.*, 1999), the UK (Arnold and Hatzopoulos, 2000) and the USA (Farragher *et al.*, 1999; Graham and Harvey, 2001; Ryan and Ryan, 2002). There has been a resurgence of interest in this field due to concern with the technical aspects of DCF (Bosch *et al.*, 2007; Cary, 2008; Magni, 2009) and inquiry into qualitative techniques (Pike, 2005). However, it is not always applied correctly and there are pitfalls in its casual use (Drury and Tayles, 1997). The DCF method is the preeminent decision tool available and managers should learn to use it well (Bierman and Smidt, 1993). Misuse is perhaps not surprising given the complexity of current academic debate about what constitutes the correct technique (e.g. Bosch *et al.*, 2007; Cary, 2008; Magni, 2009). As this paper and previous research show, advanced techniques may be well accepted and understood in the scholarly literature but are not universally observed in management practice.

This paper first reviews the concept of DCF, compares the popularity and prevalence of NPV versus IRR, synthesizes previous research to illustrate trends, details the “nitty gritty” of DCF from the practitioner literature and previous research, shows common pitfalls, and then explains how each of the above manifest in a current study of large firms in Canada. The paper partially fills a gap in recent empirical research in that country on capital budgeting practices and DCF techniques, in this decade.

2. Capital budgeting decision making

Capital budgeting is the process of analysing investment opportunities in long-term assets which are expected to produce benefits for more than one year (Peterson and Fabozzi, 2002). A central feature of any investment analysis is DCF, which takes into consideration the time value of money, is regarded as theoretically correct, and includes at least four different discounting models: NPV, IRR, modified internal rate of return (MIRR), and profitability index (PI) (Brigham and Ehrhardt, 2002).

Both NPV and IRR are consistent with the goal of maximising a firm's value, use cash flows and consider cash flow timing. With NPV, the present value of future cash flows is generated and when compared with initial outflows, an investment project is seen as acceptable whenever a positive NPV is the outcome. IRR is a percentage rate that equates the present value of future cash inflows with the present value of its investment outlay. Finance theory asserts that NPV is the best method for evaluating capital investment projects. In a normal project, cash outflows are followed by annual cash inflows and under these circumstances, NPV and IRR lead to the same investment decisions. Problems with the IRR technique occur in two cases and may lead to incorrect capital budgeting decisions. When project cash flows are abnormal this may lead to multiple IRR calculations, affecting both independent and mutually exclusive projects. When investment projects are mutually exclusive, scale and time differences may lead to incorrect investment decisions and this is a problem associated with the reinvestment rate assumption (Brigham and Ehrhardt, 2002).

2.1 Trends in capital budgeting decision techniques

Several studies have dealt with capital budgeting practices of firms in Canada over the past 50 years (see Table I). More than a decade has passed since the most recent study. In other words, there is a long gap from the last study in 1999 to the present, and it is the intent of this research to partially fill the gap. More current studies exist for Australia, the UK and US (Arnold and Hatzopoulos, 2000; Burns and Walker, 1997; Farragher *et al.*, 1999; Graham and Harvey, 2001; Ryan and Ryan, 2002; Truong *et al.*,

Authors/year published	Study year	Sampling frame	Method	Number of firms	Number of respondents (response rate)	%
Nicholson and Ffolliott, 1966	n/a	Canadian corporations (source of listing unknown)	Questionnaire	294	105	35.7
Hoskins and Dunn, 1974	1973	Canada's Top 100 Firms (Financial Post)	Questionnaire (12 interviews)	100	58	58
Baumgartner and Irvine, 1977	n/a	1975 CAN-FIL and Scott's Industrial Directories for Quebec, Ontario and West Provinces	Questionnaire (3 case studies)	400	99	24.8
Blazouske <i>et al.</i> , 1988	1985	1985 Financial Post 500 Industrials list	Questionnaire	500	208	41.6
Roubi <i>et al.</i> , 1991	n/a	1989 Financial Post Top 500 Canadian corporations	Questionnaire	500	80	16
Jog and Srivastava, 1995	1991	TSE 300 corporations, large foreign-owned and private corporations	Questionnaire	582	133	22.9
Szpiro and Dimnik, 1996	n/a	Scott's 1990 Directory of Ontario Manufacturers	Interviews	300	23	
Payne <i>et al.</i> , 1999	1994	Standard and Poors Compustat	Questionnaire	588	65	11.1

Table I.
Chronological and methodological synthesis of capital budgeting studies in Canada

2008). The deficiency in the literature is a Canadian phenomenon and the present study is partially justified on the basis that investigation has continued in other countries.

Pike (1996) cautioned about survey comparison, which might be problematic due to differences in the method. Nevertheless, given the rarity of longitudinal studies, such comparison is helpful in gleaning some idea about DCF trends in the past 50 years. A total of eight pre-2000 studies in Canada are synthesized in Table I, which reports overall DCF use, and specifically NPV and IRR. Capital budgeting in Canada was well researched from 1966 to 1995 but following that the literature appears to be silent. In contrast, more recent studies (post 1999) address the US, UK and Australia (see Table II). For Canada, DCF use appears to have increased from a low of around 35 percent in the early 1960s to 90 percent or more in the early 1990s. Taking all the countries and results together it is clear that DCF is entrenched in the firms covered by extant studies. There appeared to be a lower percentage of firms using NPV and more using IRR in Canada. In the other countries, in later years, there appeared to be an overall higher prevalence of both NPV and IRR. A final point to note from Table I is the relatively small questionnaire sample sizes ranging from 58 to 208 firms, and variable response rates from 11 to 58 percent (although the latter only sampled 100 firms).

2.2 Non-DCF techniques

A number of investment analysis methods do not involve discounting cash flows. The most common of these are the payback period (PP) and accounting rate of return

Table II.
Extent of use of NPV and IRR across countries and years in different studies

Authors/year published	Survey year	Retrospective year	Country	Using DCF (%)	Using IRR (%)	Using NPV (%)
Nicholson and Ffolliott, 1966 ^a (<i>n</i> = 105)	n/a		Canada	40	39.25	12.4
Hoskins and Dumm, 1974 ^b (<i>n</i> = 58)	1973	1962 1967 1972	Canada	35 65 79	17 31 47	33 54 66
Blazouske <i>et al.</i> , 1988 ^c (<i>n</i> = 208)	1985		Canada			
Jog and Srivastava, 1995 ^d (<i>n</i> = 133)	1991	1980 1985	Canada	60 65 66.1 ^e 80.9 ^f 84.9 ^g	38 40 51.2 ^e 64.3 ^f 65.1 ^g	22 25 38.0 ^e 42.9 ^f 47.6 ^g
Payne <i>et al.</i> , 1999 ^h (<i>n</i> = 65)	1994		Canada	93.8	1.98 (ranked first in importance of 6)	2.22 (ranked second in importance of 6)
Payne <i>et al.</i> , 1999 ^h (<i>n</i> = 65)	1994		USA	92.2	2.0 (ranked second in importance of 6)	1.73 (ranked first in importance of 6)
Graham and Harvey, 2001	1999		US and Canada	n/a	75.6	74.9
Ryan and Ryan, 2002 ⁱ	n/a		USA	n/a	76.7	85.1
Arnold and Hatzopoulos, 2000	1997		UK	100	81	80
Truong <i>et al.</i> , 2008(<i>n</i> = 87)	2004		Australia	n/a	80	94
Current research (<i>n</i> = 88)	n/a		Canada	80.7	87.7 ^j	94.2

Notes: ^aPercentage using NPV or IRR as primary or secondary method; ^bRespondents were asked to recall techniques used in the past (1962 and 1967); ^cPercentage using NPV or IRR as primary or secondary method. Respondents were asked to recall techniques used in 1980; ^dPercentage using NPV or IRR for; ^eReplacement projects; ^fExpansion – existing operations; ^gExpansion – new operations; ^hAverage ranking regarding the importance of capital budgeting techniques; ⁱBased on the sum of categories labelled “always” or “often”; ^jbased on the sum of categories labelled always and almost always

(ARR). (Ross *et al.*, 2002; Ross, 2007). Studies in the past 50 years show the increase in DCF has come at the expense of naive methods, particularly the ARR (see Table III).

3. Proper use of and pitfalls in DCF

Adopting DCF, and NPV in particular, is only the first step towards effective capital budgeting. It is critical to ensure that DCF techniques are properly utilized. In the UK and US this is not necessarily the case and many DCF parameters are treated inconsistently (Booth, 1999; Boquist *et al.*, 1998; Tyrrell, 1998). DCF techniques deficiencies were considered to be in the application rather than theory. As Drury and Tayles (1997, p. 86) noted:

[...] despite the increased usage of the more theoretically sound discounting techniques, several writers in both the UK and US have claimed that companies are under investing because they misapply or misinterpret DCF techniques. The following sections review misinterpretation and misapplication.

3.1 Cash flow estimation

In terms of specific aspects of correct practice, DCF techniques should be based on cash flows not accounting income (Brealey and Myers, 2003). Canadian firms did not properly determine cash flows in their capital investment analysis. Aspect misapplied were: deducting non-cash expense such as depreciation from accounting income, deducting an allocation of existing overhead costs, subtracting interest expenses and not deducting income tax (Nicholson and Ffolliott, 1966). Treatment of interest expense and other financial costs is one of the most common causes of error in estimating cash flows (Bierman and Smidt, 1993). Including interest charges in the forecasted cash flows as well as in cost of capital double counts the cost of debt and may result in rejecting valuable investment projects. Thus, interest expenses and other financing costs should never be included in project cash flows (Bierman and Smidt, 1993).

Firms are expected to recognize inflation in capital budgeting decisions (Brigham and Ehrhardt, 2002). Omitting inflation understates cash inflows and the resulting NPV particularly in long-term investment projects. There are two approaches to adjust for inflation: either real cash flows are discounted at a real rate or nominal cash flows discounted at a nominal rate. In one UK study, inflation was properly treated in DCF analysis by only 27 percent of firms (Drury and Tayles, 1997).

3.2 Discount rate

The cost of capital is a key parameter of DCF calculation. Firms are expected to use the weighted average cost of funds from various sources including debt, preferred stock and common equity (Brigham and Ehrhardt, 2002). Firms that employ a single cost of funds (for example, the cost of debt if the project is financed by borrowings) make an erroneous choice. The weights used in calculating the cost of capital should preferably be based on the firm's capital structure target or market values, rather than book values. Target values are the ideal, but market values are a good proxy for target values (Brigham and Ehrhardt, 2002). Two studies from Table I examined whether firms determined the WACC, with 56.9 percent using it one study (Jog and Srivastava, 1995) and similar results (46.2 percent) in the second (Payne *et al.*, 1999). Both studies also revealed that a large number of firms employed theoretically incorrect methods (such as the cost of debt or past experience) to determine the discount rate. In Canada, research inquiring about the weights used in computing the WACC is absent.

Table III.
Non-DCF use among
Canadian firms and gaps
in subsequent literature

Authors/year published	Survey year	Retrospective year	Most favoured	Least favoured	Accounting rate of return (%)	Payback period (%)
Nicholson and Ffolliott, 1966 ^a Hoskins and Dunn, 1974 ^b	n/a 1973	1962 1967 1972	ARR Payback period	NPV PI	60.8	51.5
Blazouske <i>et al.</i> , 1988 ^c	1985	1980 1985	IRR (primary)	ARR (primary)	27 33 38	79 80 79
Jog and Srivastava, 1995 ^d	1991		PB ^a IRR ^b IRR ^c	ARR ^a ARR ^b ARR ^c	11 9 14.9 ^f 17.5 ^g	25 19 53.7 ^f 52.4 ^g
Payne <i>et al.</i> , 1999 ^e	1994		NPV	MIRR	19.9 ^h 3.37	50.0 ^h 2.42

Notes: ^aPercentage using NPV or IRR as primary or secondary method; ^bRespondents were asked to recall techniques used in the past (1962 and 1967); ^cPercentage using NPV or IRR as primary or secondary method. Respondents were asked to recall techniques used in 1980; ^dPercentage using ARR or PB for; ^eAverage ranking regarding the importance of capital budgeting techniques; ^fReplacement projects; ^gExpansion – existing operations; ^hExpansion – new operations

3.3 Multiple discount rates and risk

Using a single WACC for all investment proposals is not advisable. The WACC is the required rate of return on any investment proposals that carry the same level of risk as the firm's existing assets. It should be adjusted up or down, depending on the type of project (for example, replacement projects are lower risk, whereas expansion or new ones are higher risk) or for different organisational units of the firm. There are two recommended methods to adjust the WACC: the pure play and the subjective approach (Ross *et al.*, 2005). The pure play consists of finding firms operating in a similar line of business to the investment project or the division. By looking at the market's required returns, the firm could develop the WACC for a division or new investment opportunity outside the firm's existing business. In cases where pure play cannot be used, management must rely on judgment. This more subjective approach consists of classifying investment projects into risk groups. High-risk projects entail an upward adjusted WACC, while low-risk investments involve downward adjustment. Varying the WACC for risk is not an easy task. Large firms in Canada and the US are cognizant of this difficulty and many are working on developing separate divisional costs of capital (Ross *et al.*, 2005).

3.4 Risk analysis methods

Effective capital investment decisions require not only the use of DCF techniques, proper cash flows, and discount rate estimates, but also risk analysis (Brigham and Ehrhardt, 2002). Uncertainty affects all the parameters required in computing NPV as part of the evaluation phase: the project's life, initial capital expenditure, cash flow estimates and the discount rate. There are many methods available to assist finance managers in handling risk (Ho and Pike, 1991). Simple techniques include adjusting the discount rates and the payback period. Sophisticated methods consist of probabilistic risk analysis such as sensitivity analysis, decision-tree analysis and Monte Carlo simulation. Previous studies (cited in Table I) suggested that more Canadian firms increasingly used sophisticated techniques when dealing with risk. In the early 1990s, the most popular method was sensitivity analysis.

3.5 Emerging approaches – real options

One of the main developments in the capital budgeting literature over the last decade has been real options. Most capital investment projects have options (for example, option to expand or to abandon) that have value (Ross *et al.*, 2005). Conventional DCF analysis should be complemented by real options analysis in order to determine the true NPV (Amram and Howe, 2002). However, NPV is often calculated without identifying and considering real options (Phelan, 1997). Previous empirical literature found that a relatively small number of firms employed real options (Block, 2007; Brounen *et al.*, 2004; Graham and Harvey, 2001; Ryan and Ryan, 2002). In Canada, there appears to be a complete absence of research regarding their use. As Jog and Srivastava (1995, p. 37) noted:

One of the growth areas in capital budgeting, the evaluation of real options, is not included in this survey ... As pointed out by one of the anonymous reviewers, this paper may have benefited greatly from an inquiry into this area. However, given of the difficulties of re-doing the survey, we will have to defer discussion on this for a future piece of work.

The present study is such a future piece of work.

3.6 Administrative procedures

As well as using correct financial techniques, the literature provides various recommendations about administration and other support for capital budgeting decisions. Preferably, there should be a capital investment manual (Pike, 1988), full-time capital budgeting staff (Klammer and Walker, 1984; Pike, 1989), use of standard model for deriving the NPV or IRR (for example a Microsoft Excel model), supportive information systems (Ho and Pike, 1996) and post-investment audits (Klammer and Walker, 1984; Pike, 1996).

4. Method

The method consisted of a mail survey in Canada. The population included the 500 firms listed in the *Financial Post* (FP500) magazine. This population was chosen for the convenience of access to the listing and on the assumption that it would be an accurate representation of the largest firms in Canada. Larger firms are more inclined to use DCF techniques and sophisticated capital budgeting methods, hence classifying the original population as large firms. Small businesses tend to use naïve methods rather than the ones prescribed by financial theory (Block, 1997; Danielson and Scott, 2006), hence, the focus on large firms. Also, it is argued that selecting the population as large firms with a similar sampling frame to previous studies facilitated comparison with these studies.

The research instrument consisted of a survey questionnaire (See Appendix). Minor problems with language and interpretation in some questions were addressed in the pre-test. The survey was mailed to each CFO, addressing firm and respondent demographics and various aspects of capital budgeting. The effective population was 478 since 22 firms from the FP500 could not be reached. That is, it was assumed that firms that could not be reached were no longer part of the population, so the effective population was defined as all those contactable firms in the FP500. The results are based on responses from 88 firms, with a response rate of 18.4 percent. Considering that the survey was addressed to time-constrained CFOs, as well as the commercial sensitivity of some of the requested information, the number of respondents and the response rate are higher than two previous studies using a similar method (Payne *et al.*, 1999) and lower than other, generally earlier, ones (Baumgartner and Irvine, 1977; Blazouske *et al.*, 1988; Jog and Srivastava, 1995; Hoskins and Dunn, 1974; Nicholson and Ffolliott, 1966). Due to confidentiality and other limitations of the method it was not possible to test for non-response bias and therefore to establish whether the sample is representative of the population.

Respondent demographics are shown in Table IV. Based on the characteristics of the largest categories, a picture emerged of CFOs aged in their 40s, with a Master's degree (typically an MBA) who had been in their current position for less than four years.

Firm demographics in Table IV show the largest industry group as manufacturing, followed by finance and energy. The mode for sales revenue was \$1000-1999 million and 1,000 to 2,499 for number of employees.

5. Results and discussion

5.1 Overall capital budgeting decision and investment analysis techniques

Of the 88 firms used in the analysis, 17 did not use DCF, which was surprising for these large firms. For the rest, there was a strong preference for DCF with 94.2 percent using NPV and 87.7 percent IRR. This slight preference for NPV over IRR confirms previous results in Australia (Truong *et al.*, 2008), the USA (Ryan and Ryan, 2002) and UK

	<i>n</i>	%	Improved capital budgeting
<i>Position</i>			
Chief financial officer	38	60.3	
Director/manager – finance/treasury/M&A/ accounting	13	20.6	
Senior/VP – finance/administration/ planning/ treasury	6	9.5	
Consultant/specialist/advisor	4	6.3	
Chief accountant – capital projects	1	1.6	
Division controller	1	1.6	
<i>Age</i>			
< 40	5	7.4	
40-49	32	47.1	
50-59	26	38.2	
≥ 60	5	7.4	
<i>Tenure</i>			
< 4 years	30	45.5	
4-9 years	22	33.3	
> 9 years	14	21.2	
<i>Education</i>			
Undergraduate	25	40.3	
Master's	31	50.0	
> Master's degree	6	9.7	
<i>Industry</i>			
Manufacturing	25	36.8	
Finance	11	16.2	
Energy	9	13.2	
Retail	8	11.8	
Transportation	7	10.3	
Utilities	4	5.9	
Technology	3	4.4	
Healthcare	1	1.5	
<i>Sales revenue (\$ million)</i>			
Under 500	6	9.0	
500 – 999	10	14.9	
1,000 – 1,999	18	26.9	
2,000 – 2,999	9	13.4	
3,000 – 3,999	5	7.5	
4,000 – 5,999	9	13.4	
6,000 – 9,999	4	6.0	
10,000 – 14,999	2	3.0	
15,000 – 24,999	3	4.5	
25 billion and over	1	1.5	
<i>Employees</i>			
Under 1,000	6	8.5	
1,000 – 2,499	20	28.2	
2,500 – 4,999	18	25.4	
5,000 – 9,999	9	12.7	
10,000 – 14,999	6	8.5	
15,000 – 19,999	2	2.8	
20,000 – 29,999	5	7.0	
30,000 and over	5	7.0	

233

Note: Only the 71 firms that reported using DCF were included in the analyses, and in some cases data was missing

Table IV.
Respondent and firm demographics

(Arnold and Hatzopoulos, 2000). Interestingly, a large percentage (78.5) still used the non-DCF payback period.

NPV is now widely utilized among Canadian corporations but a sizeable percentage use IRR as their primary model in capital decision making. Despite the drawbacks of IRR, it seems that managers find it naturally attractive because it appraises investment value in percentage terms, which can be easily compared across capital budgeting projects (Cheng *et al.*, 1994). Other discounting tools such as PI and MIRR were employed less frequently. MIRR was the least prevalent discounting technique, despite its theoretical superiority compared to IRR, and the availability of MIRR functions in popular spreadsheet software. The results also indicated that firms still relied on simple capital budgeting decision techniques such as the payback period and the ARR. This may reflect the need to investigate one of the numerous aspects of capital investment evaluation (Pike, 1996). Indeed, the different financial appraisal tools provide a variety of pertinent information for managerial decision making. For example, the payback period offers a rough gauge of both the risk and liquidity of a capital investment project (Brigham and Ehrhardt, 2002; Peterson and Fabozzi, 2002; Sangster, 1993).

The theory-practice gap is a recurrent theme in the capital budgeting literature, in particular with regard to NPV. Compared to previous Canadian studies, there has been a narrowing of the theory-practice gap (see Table II). Possible explanations for more widespread use of DCF are the availability of computer software that greatly facilitates computations (Pike, 1996; Sangster, 1993), and improvement in the formal education level of managers (Burns and Walker, 1997; Pike, 1996; Sangster, 1993). Despite the recommendations of the financial literature on using NPV as the primary technique, this research found that 42.3 percent of firms indicated a preference for IRR as compared to NPV at 57.7 percent.

In this research, an overwhelming percentage of firms (91.5 percent) correctly compute NPV or IRR on a cash flow basis rather than accounting income. In Canada, previous empirical evidence about this aspect of capital budgeting is nonexistent. The results are similar to the US study from Farragher *et al.* (1999) at 85 percent. A large proportion (87.7 percent) dealt with inflation correctly in contrast to previous research by Drury and Tayles (1997). Interest expense and other financial costs were treated properly by the majority (70 percent). In Canada, recent research on treating financing costs in capital budgeting is scarce. Over 76 percent of firms correctly employed the WACC compared to other methods (Table V), suggesting a reduction in the theory practice gap compared to past studies. Nonetheless, a sizeable number of firms still determined a required rate of return that

As shown in Table V, 29.6 percent of responding firms misapplied that area of capital budgeting analysis by using book value when calculating the WACC. The results are comparable with Gitman and Vandenberg (2000) in the USA, and Arnold and Hatzopoulos (2000) in the UK.

Only 63.4 percent of firms used different discount rate across investment projects, which is not consistent with finance theory. In Canada, research into this specific area of capital investments has been lacking. Similarly, research in the USA shows there is still a gap.

The majority of Canadian firms use risk analysis tools (see Table V), with the main ones being sensitivity analysis (92.8 percent), scenario analysis (85.3 percent) and risk-adjusted discount rate (76.8 percent). Compared to past research, this study shows a substantial increase in sensitivity analysis and risk-adjusted discount rate.

Authors/year published	Survey year	Retrospective year	Panel A. Methods for calculating the discount rate				Panel B. Determining weights in the WACC and use of multiple discount rates				Panel C. Risk analysis methods		
			Country	WACC (%)	Cost of		Target value (%)	Weights in the WACC based on		Use of multiple discount rates	Sensitivity analysis	Risk-adjusted discount rate	
					debt (%)	equity (%)		Market value (%)	Book value (%)				
Freeman and Hobbes, 1991 ^a	1989		Australia	40	39	6	16						
Jog and Srivastava, 1995	1991		Canada	47.2	21.9	4.1	26.8				60	31.5	
Payne <i>et al.</i> , 1999 ^b	1994		Canada	46.2	33.9	29.2	n/a				60	49.2	
Arnold and Hatzopoulos, 2000 ^a	1997		UK	54	11	8	25	30	44	26	n/a		
Ryan and Block, 2003	n/a		US	83.2	7.4	1.0	8.4	n/a	n/a	n/a	46.6		
Brigham, 1975	n/a		US	85.2	n/a	6.4	8.4	n/a	n/a	93.5	52		
Gitman and Mercurio, 1982 ^b	1980		US					41.8	28.8	16.4	n/a		
Gitman and Vandenberg, 2000 ^b	1997		US					49.5	34.2	19.8	n/a		
Hoskins and Dunn, 1974	1973	1962	Canada								5	24	
		1967									11	36	
		1972									31	38	
This research ^a	-	2007	Canada	76.1	9.9	1.4	12.7	50.0	20.4	29.6	63.4	92.8	76.8

Note: ^aTotal percentages do not add up to 100 due to rounding; ^bpercentages do not add up as respondents were allowed more than one answer

Improved capital budgeting

Table V.
Details of how DCF is carried out

Only four firms (8.1 percent) used real options when deciding on investment projects. The results confirm Graham and Harvey (2001) and Block (2007) who found a low incidence (11.4 percent and 14.3 percent respectively). In contrast, more recently, Truong *et al.* (2008) reported that 32 percent of firms in Australia used real options. Failing to consider real options creates a downward bias on the true project value (Phelan, 1997). The results are surprising considering the recent and extensive coverage of real options in the literature. Reasons for not using real options include scepticism, complex and cumbersome techniques, lack of management support, DCF being considered a proven method, and real options too risky (Block, 2007; Cotter *et al.*, 2003).

In terms of administration and other support, almost 58 percent possessed a capital investment manual, around 52 percent indicated that they had at least one member of their staff assigned full-time to capital budgeting and over two-thirds employed a standard model (example a Microsoft Excel model). Project related financial parameters such as expected cash outflows and inflows were satisfactorily acquired from firms' capital budgeting information systems. Conversely, project expected economic life, macroeconomics (for example the inflation rate), and post-audit review data were less frequently obtained from the information system (fewer than half indicated often or very often available). A majority conduct post-audits of major capital investment projects (84.5 percent), even though suitable data from the information system was not always reported as being available.

6. Implications for practice

A theory-practice gap remains in the DCF application among large firms in Canada. Apart from not using DCF, several areas of DCF analysis were misapplied. This study provides those evaluating investment projects as well as those conceiving capital budgeting manuals or policies, knowledge about common pitfalls which, if acted on, could improve decision making.

Large firms in Canada should provide training for managers and analysts to ensure capital budgeting tools, in general, and DCF, in particular, are applied in accordance with normative textbook approaches. Areas that need to be emphasized during training and considered in decision making are:

- DCF;
- superiority of NPV over IRR;
- multiple discount rates for different projects or divisions with different risk;
- interest expenses not to be considered in computing expected cash flows;
- the WACC is the proper discount rate rather than a single source of financing;
- target or market weights should be employed in calculating the WACC;
- use real options;
- provide a policy manual;
- dedicated staff;
- standard models;
- supportive capital budgeting information systems to ensure parameters such as expected economic life and inflation rate are readily available;
- software products to make the required analysis easier;

- post-investment audits; and
- training and review for compliance.

7. Limitations and further research

Several aspects of this research place limitations on the outcomes and may bias the results. First, non-response bias is potentially an issue with surveys. Because confidential information was sought, identifying respondents and firms was avoided in order to maximize response rate. Second, the research was limited to a small sample of Canada's largest firms. Was this sample representative of the population? Are capital budgeting practices generalisable to firms in other geographic areas? Canada could be subject to the influence of the very large neighboring economy in the USA and as the comparisons in this paper indicate, our new Canadian figures are not that different from US studies conducted this decade. Nonetheless, research method theory generally cautions about generalising results to any population outside that sampled, and other literature argues about comparing results between different cultures. Third, this study was also limited to large firms because they are most likely to employ capital budgeting procedures based on DCF as well as understand the technicality of these methods. Consequently, the extent to which large businesses rigorously and successfully adopt DCF techniques cannot necessarily be generalized to businesses of all sizes. Fourth, the study relied on a traditional survey method. This did have the advantage of facilitating comparison with previous studies that relied on a similar method, but a more novel approach could have been used. Fifth, the focus of this study was on selected aspects of capital budgeting. Successful use of DCF is one of the many decisive factors leading to successful capital investment. Other capital budgeting phases (for example, generating investment ideas) are important. Finally, this study, and much of the capital budgeting literature, assumes that managers make rational decisions, carefully using logical, proven techniques. It may well be that other dynamics are at play. The vast literature on more general managerial decision making demonstrates that this may be the case and that many decisions in a complex, fast paced environment are made on intuitive and pragmatic grounds.

Regarding further research, a fruitful area is an in-depth study of DCF practices by means of case study and interviews, to investigate contextual and organisational elements that may explain why businesses apparently misapply DCF during the appropriation stage. It may well be that attention to the technical correctness of DCF and other capital budgeting techniques takes second place to time demands and other business imperatives. Second, although most finance textbooks advocate real options, very few responding firms actually used them. It would be interesting to follow the progression of real options over the next decade, in the same vein as the surveys reported here on DCF, to identify if this technique gains more recognition in various countries, especially for those firms with large capital budgets. Finally, another area where research is limited is capital budgeting practices of small firms. For example, a study similar to that of Block (1997) or Danielson and Scott (2006) in the USA could be replicated in Canada.

8. Conclusion

This paper examined capital budgeting sophistication with field data from large firms in Canada. The literature review and survey implied improvement over time. Although each study had different characteristics, that is, dissimilar samples, questions asked and response rates, the following broad inferences can be drawn: DCF is the most favored investment decision technique, and, as advocated by the literature, have

become standard. In the past five decades, empirical studies dealing with large firms in North America and the UK have proven one point: DCF techniques have become increasingly accepted and are today the dominant methods to evaluate capital investment projects. Non-DCF techniques are still employed, though their use has declined; the WACC was relatively widely used, a majority of large firms in Canada employ sensitivity analysis as the most favored technique for dealing with risk and use of real options is limited. There is recent evidence from both academics and practitioners that DCF techniques are misused in the UK, USA and now Canada, which may lead to incorrect investment decisions.

Despite the relatively widespread use of DCF, sophistication in detailed application is moderate to good, suggesting restrained improvement since earlier studies. Although NPV and IRR were the most employed project appraisal techniques, a number of firms favor IRR as compared to NPV. Financial theory advocates using the superior NPV. There were several areas where more emphasis in training and practice could further enhance investment decision making. The main area for focus is real options, as this had the lowest prevalence. Other areas where around a third of firms could improve are administrative procedures (standard spreadsheet models, capital investment manual, more extensive details in the information system), using the WACC, adjusting the WACC for different projects or divisions, employing target or market values weights and not including interest expenses in project cash flows. A small proportion of firms also need to start using DCF.

Limitations included being confined to one country and a one-shot survey. Nonetheless, this research adds to the body of knowledge on capital investments in general and DCF in particular, by showing where Canada fits in this decade and identifying specific areas for improvement. This study improves practice by addressing the most common pitfalls encountered by those who use DCF techniques. Even though best practice in DCF is well known in academic literature, in practice it is not uniformly well-utilized. Pike (2005) indicated that capital budgeting has received considerable research attention and is unlikely to turn up surprising new findings, and this has partially proven to be the case here. Nonetheless, the room for improvement of large Canadian firms in the current era is notable and raises questions such as why this continues to be the case and why real options are not more widespread.

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Further reading

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Appendix. Survey questionnaire

1. Please indicate how frequently your company employs the following evaluation techniques when deciding which investment projects to pursue? *(Please tick one square per line)*

	<i>Never</i>	<i>Almost never</i>	<i>Almost always</i>	<i>Always</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Net present value (NPV)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Internal rate of return (IRR)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Modified internal of return (MIRR)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Profitability index	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Payback period	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accounting rate of return (*)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Real options	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify), pp.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(*) Average earnings return on assets

2. Which of the following techniques does your firm favor when deciding which investment projects to pursue? *(Please tick one square only)*

- Net Present Value (NPV)
- Internal Rate of Return (IRR)

3. When computing the Internal Rate of Return (IRR) or Net Present Value (NPV), does your firm use: *(Please tick one square only)*

- Cash flows
- Accounting income

4. In computing the Internal Rate of Return (IRR) or Net Present Value (NPV), do you deduct interest and other financing costs from revenue to arrive at cash flows?

- Yes
- No

(Continued)

5. Which of the following approaches is used in your company to determine the minimum acceptable rate of return (discount rate) to evaluate proposed capital investments? *(Please tick one square only)*

- Weighted average cost of capital (WACC)
- Cost of debt
- Cost of equity capital
- An arbitrarily chosen figure is used
- Another rate (Please specify), pp. _____

6. If the Weighted Average Cost of Capital (WACC) is used, the weights are defined by: *(Please tick one square only)*

- Book values derived from the balance sheet
- Current market values
- Target values (long term targets)

7. Do you have different rates of return that are required for different divisions, subsidiaries or projects of the firm?

- Yes No

8. When your firm uses a method requiring discounted cash flows (for example, NPV or IRR), pp. _____

Are nominal cash flows discounted at the nominal discount rate? (Or alternatively, are real cash flows (*) discounted at the real discount rate (**)?

- Yes No

(*) Real cash flows = in current terms.

(**) Real interest rate = Nominal interest rate – Inflation rate.

(Continued)

9. Which technique does your firm use to assess a project's risk? (Please tick one square per line)

	<i>Never</i>	<i>Almost never</i>	<i>Almost always</i>	<i>Always</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Scenario analysis (i.e. base case, worst-case, best-case forecasts)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensitivity analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Simulation analysis (e.g. Monte Carlo simulation)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Decision tree analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Please specify), pp.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. Which method does your firm use to incorporate risk in capital budgeting decisions? (Please tick one square per line)

	<i>Never</i>	<i>Almost never</i>	<i>Almost always</i>	<i>Always</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Risk-adjusted discount rate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Certainty equivalent approach (*)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Please specify, pp.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(*) Certainty equivalent approach: Every cash inflow that is not known with certainty is scaled down, and the riskier the flow, the lower its certainty equivalent value.

11. Please estimate the average proportion of total capital expenditures your firm made in the last five years that should be classified within these three investment categories:

(Continued)

Replacement Projects:	_____ %
Expansion Projects – Existing Operations:	_____ %
Expansion Projects – New Operations:	_____ %
Total:	100 %

12. Is there at least one member of your staff assigned full-time to capital investment analysis?

Yes No

13. Does your firm possess a capital investment manual (written capital investment guidelines)?

Yes No

14. Does your company require the use of standard model (for example, a standard Microsoft Excel® model) for deriving the Net Present Value (NPV) or Internal Rate of Return (IRR)?

Yes No

15. Does your company conduct post-audits of major capital expenditure?

Yes No

16. Please tick one square in each line indicating the degree of uncertainty or predictability in your company's environment:

	<i>Never predictable</i>					<i>Always predictable</i>	
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	
Action of suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Action of competitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Customer preferences and tastes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Behavior of financial/capital markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Related governmental regulations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Actions of trade unions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Rate of related technological changes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

(Continued)

Figure A1.

17. How often is the following investment project-related financial data for capital investment decisions obtained from your company's capital budgeting information system (*)? Please tick one box in each line.

	Never	Very little	Little	Some	Often	Very often
	1	2	3	4	5	6
Project expected cash outflows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project expected cash inflows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost of capital and required returns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project expected economic life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Macroeconomics (e.g. inflation rate)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Post-audit review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(*) Capital budgeting information system is defined as an organised collection, storage, and presentation system of data and other knowledge for capital investment decision making.

Example of capital budgeting information system includes executive information systems (EIS), decision support systems (DSS), and spreadsheet software (For example, Excel or Lotus 1-2-3).

A. Demographics

18. Please provide the following demographic information for the study. (Check one square for the items listed below)

- | | | |
|--------------------------------|-------------------------------------|---|
| a) Age of CFO (years) | b) CFO tenure (time in current job) | c) CFO education |
| <input type="checkbox"/> < 40 | <input type="checkbox"/> < 4 years | <input type="checkbox"/> Undergraduate |
| <input type="checkbox"/> 40-49 | <input type="checkbox"/> 4-9 years | <input type="checkbox"/> MBA degree |
| <input type="checkbox"/> 50-59 | <input type="checkbox"/> > 9 years | <input type="checkbox"/> non-MBA masters |
| <input type="checkbox"/> ≥ 60 | | <input type="checkbox"/> > masters degree |

(Continued)

19. Your job title? _____

B. Other information

20. Tick the square which represents your PREDOMINANT area of activity:

- Energy Manufacturing Finance Utilities Technology Retail Healthcare
 Transportation

21. What is your firm's approximate number of employees?

22. What is your firm's approximate long-term debt to total assets ratio? __ (%) (For example, 45%)

23. What is your firm's approximate net fixed assets (*) amount? \$ _____

() Defined as the value of fixed assets after depreciation*

24. What is your firm's approximate sales revenue? \$ _____

25. Please indicate how would you rate your company's performance as compared to firms of similar sales volume in your industry and regions? *(Please tick one square per line)*

	<i>Much lower</i>	<i>Lower</i>	<i>Greater</i>	<i>Much greater</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
<i>Sales growth</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>After tax return on total assets</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Profitability</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Overall firm performance</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure A1.

About the authors

Karim Bennouna holds degrees from Université du Québec à Montréal (BBA), Kansas State University (MBA), Thunderbird (Master of International Management, honours), and received his DBA from Southern Cross University in 2008. He is currently a Finance Analyst at Kubota Canada Ltd., Ontario, Canada. His prior employers include EDS and Royal Bank of Canada.

Geoffrey G. Meredith, PhD is Emeritus Professor, Graduate College of Management, Southern Cross University, NSW, Australia. Emeritus Professor Geoffrey Meredith is a graduate of the University of Queensland and after teaching at several Australian and overseas universities, set up graduate and research programs at Southern Cross University, including Australia's first research DBA. He is the author of many books and articles on finance, small enterprise

development, regional development, and his professional practice and training programs for small enterprises have been adopted by the ILO for many emerging countries.

Teresa Marchant, PhD is Lecturer, Graduate College of Management, Southern Cross University, NSW, Australia. After a career in marketing with IBM Teresa Marchant was the first to complete a PhD in the Department of Human Resource Management and Employment Relations at the University of Southern Queensland and she also has a first class honours degree in Psychology from the University of Melbourne. Most recently she has been developing scholarly materials for the national public sector management program and is researching management, human resource development, gender and higher education. Teresa Marchant is the corresponding author and can be contacted at: teresa.marchant@scu.edu.au

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247