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The evolution of the application of capital budgeting techniques in enterprises

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ABSTRACT

This study examines the evolution of the application of capital budgeting techniques. Previous studies mostly used cross-sectional inquiries to understand the capital budgeting practices of firms. Only a few researchers have undertaken longitudinal studies to generalise the findings of the individual cross-sectional studies to the wider population and to identify the emerging trends in the use of capital budgeting techniques (CBTs). This longitudinal study surveys 83 studies of capital budgeting practices across firms in India, South Africa, the United Kingdom (UK) and the United States of America (USA) for the period from 1966 to 2016. The findings show that six capital budgeting techniques, namely, the net present value (NPV), the internal rate of return (IRR), the payback period (PBP), the accounting rate of return (ARR), the return on investment (ROI) and the real option valuation (ROV), are the most popular methods for evaluating capital investments. Of these techniques, the ROV is the least used, and a general lack of familiarity with this technique and its complexity are the most commonly cited reasons for not using it. Another method that is used less than the first four techniques is the ROI. However, this technique is of growing significance and is mainly used in the UK, followed by the USA, South Africa, and India. Firms in the USA and UK have increased their use of the IRR as a primary method for evaluating capital projects and have retained the PBP as an ancillary technique to strengthen the available information when evaluating capital projects. Firms in India and South Africa are increasingly excluding both the PBP and ARR methods and are increasingly using the NPV when evaluating capital investments. Although this development is in line with the theory, it limits the scope of the available information when evaluating capital projects.

1. Introduction

This paper examines the evolution of the application of capital budgeting techniques (CBTs) in selected developing countries (South Africa and India) and developed countries (United Kingdom and United States of America) in recent decades. The period under review is from 1966 to 2016. Previous researchers, such as Sangster (1993) and Pike (1996), used longitudinal studies to generalise the findings of individual cross-sectional studies to the wider population and to identify emerging trends in the use of capital budgeting techniques. However, recent innovations in capital budgeting practices have resulted in the development and use of new techniques, such as real option valuation (ROV) methods. The ROV was proposed by Myers (1977) and further developed for use in capital

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budgeting by authors such as Luehrman (1995) and Merton (1998). Other capital budgeting techniques are the modified internal rate of return, the discounted payback period, Monte Carlo simulations and the economic value added (EVA), to name a few (Kengatharan, 2016; Rigopoulos, 2014). The continuing developments in CBTs make it important to undertake current research regarding the present practices to be able to identify trends in the use of CBTs.

Most of the previous studies (Andrews & Butler, 1986; Arnold & Hatzopoulos, 2000; Correia & Cramer, 2008; Hall & Millard, 2010; Kester & Robbins, 2011) in both developed and developing countries researched CBT practices using cross-sectional techniques. As a result, there is an information gap in how CBT preferences have evolved over the last five decades and to what extent their evolution is aligned with the relevant theoretical developments. It is also unclear whether firms in developed and developing countries have preferences for using different CBTs. Although Kester et al. (1999) and Ekeha (2011) compared CBT practices in some developing and developed countries, their findings cannot be generalised to a wider population, mainly because their studies are cross-sectional and therefore do not reflect the longitudinal trends in CBT preferences. The existing literature on the use of CBTs by firms in developed and developing countries does not provide adequate information regarding three key areas. First, the evolution of CBTs in these countries is not clearly understood. Second, the capital budgeting processes are not clearly defined. Last, the anticipated future trends in CBT remain undefined.

The significance of understanding how CBTs are used is articulated by Pike (1988), Ben-David, Graham, and Harvey (2007) and Kengatharan (2016), who concur that the use of the advanced techniques, such as the discounted cash flow (DCF), leads to increased capital investment and subsequently to enhanced earnings in the long term. The current study contributes to the capital budgeting literature by investigating whether firms are using capital budgeting techniques that have been found to enhance capital investment, which ultimately leads to increased earnings and the promotion of firm growth. Using integrative reasoning, it remains unknown whether the evolution (or non-evolution) of firms' CBT preferences in developing countries dissuades capital investment, thereby effectively limiting growth. In the same vein, it remains unknown whether the evolution of the CBTs that are used by firms in developed countries promotes investments in capital projects, thereby effectively promoting growth. This study endeavours to fill the information gap in CBT theory and practice by describing the CBT preferences in developed and developing countries and how the use of those CBTs has evolved. Last, the anticipated future trends of the capital budgeting practices in both developed and developing countries are provided.

The results of this study will contribute to the knowledge of academics and practitioners by providing insights into the evolution of capital budgeting techniques. Academics will be able to revise their educational curricula accordingly and concentrate more on theoretically sound techniques that have received little or no attention in practice thus far. Practitioners who seek to outperform their peers (according to an investment's alpha) may use this study to identify theoretically robust techniques that are seldom used in industry so that they can implement CBTs that increase earnings and promote growth.

The remainder of the paper is structured as follows: Section 2 presents the literature review regarding the use of capital budgeting techniques, Section 3 outlines the research methodology, Section 4 discusses the results and Section 5 provides the conclusion and recommendations for further research.

2. Literature review

In today's business environment, making sound capital budgeting decisions is a critical factor for survival and success (Bukvic, 2016; Hayward, Caldwell, Steen, Gow, & Liesch, 2017). Due to the competitive nature of business, companies increasingly find themselves facing many (and sometimes competing) capital investment choices. Making optimal choices is essential for businesses to remain competitive. To this end, firms often use capital budgeting techniques (CBTs) to objectively identify which investment projects are worth pursuing (Cooper, Morgan, Redman, & Smith, 2001; Correia, 2012; Neelakantam, 2015).

Although there are numerous CBTs, these techniques can be divided into three categories, namely, non-DCF (non-discounted cash flow), DCF (discounted cash flow) and alternative methods. What distinguishes the three CBT categories is the extent to which each conforms to two concepts: the time value of money and business uncertainty. Non-DCF methods do not include either of these two concepts, DCF methods only incorporate the time value of money concept, and alternative methods incorporate both the time value of money and business uncertainty concepts. It is therefore evident that there has been a steady theoretical development in CBTs, but it remains unclear whether there are any emerging trends in the application of these methods by firms in practice. It is also not yet evident whether the capital budgeting processes of firms in developing and developed countries are similar or different and whether practices are gradually converging. The next section explores the evolution of the capital budgeting practices in developing and developed countries to find answers to these questions.

2.1. Capital budgeting techniques in developed countries

Ever since Hastie (1974) reasoned that prudent capital investment appraisals should not focus on the use of one specific CBT, there has been a proliferation of new capital budgeting techniques. This study adopted a timeline approach and reviewed the developments in the CBT preferences of firms in developed and developing countries over a period of 50 years, namely, from 1966 to 2016. Table 1 summarises the literature review's key findings.

The following can be deduced from Table 1 regarding the CBT practices in developed countries:

- firms use multiple CBTs;
- the NPV, IRR and PBP are the most popular CBTs;

Table 1
Capital budgeting techniques in developed countries.

Author(s) (year)	Country	Popular method(s) (%)
Klammer (1969)[a]	USA	DCF (57%), PBP (12%)
Baker and Beardsley (1972)	USA	PBP (65%), ARR (55%), IRR (47%), NPV (44%)
Fremgen (1973)	USA	DCF (76%), PBP (14%),
Petry (1975)	USA	IRR (61%), PBP (58%), NPV (33%)
Gitman and Forrester (1977)	USA	IRR (53%), NPV (10%), PBP (9%)
Schall, Sundem, and Geijsbeek (1978)	USA	PBP (74%), IRR (65%), ARR (58%), NPV (56%)
Oblak and Helm (1980)	USA	IRR (60%), NPV (14%), ARR (14%), PBP (10%), ROI (2%)
Stanley and Block (1984)	USA	IRR (65%), NPV (16%), ARR (11%), PBP (5%)
Mills (1988)	UK	PBP (78%), IRR (68%), NPV (51%), ARR (44%)
Block (1990)[b]	USA	PBP (43%), IRR (28%), NPV (28%), ARR (18%), ROI (16%)
Drury, Braund, and Tayles (1993)	UK	PBP (86%), IRR (80%)
Drury and Tayles (1996)	UK	PBP (86%), IRR (80%)
Chadwell-Hatfield, Bernard, Philip, and Allen (1997)	USA	NPV (84%), IRR (70%)
Kester et al. (1999)	Australia	IRR (96%), NPV (96%), PBP (93%)
Arnold and Hatzopoulos (2000)	UK	IRR (81%), NPV (80%)
Graham and Harvey (2001)	USA	IRR (76%), NPV (75%)
Ryan and Ryan (2002)	USA	NPV (96%), IRR (92%)
Brounen, De Jong, and Koedijk (2004)	UK	PBP (67%), NPV (47%)
	France	PBP (50%), NPV (42%)
	Germany	PBP (51%), NPV (44%)
	The Netherlands	NPV (70%), PBP (65%)
Liljeblom and Vaihekoski (2004)	Finland	IRR (82%), PBP (77%), NPV (62%), ARR (23%)
Hermes, Smid, and Yao (2007)	Netherlands	NPV (89%), ARR (2%)
Truong, Partington, and Peat (2008)	Australia	NPV (94%), PBP (91%), IRR (80%)
Holmen and Pramborg (2009)	Sweden	PBP (57%), NPV (48%), ARR (38%), IRR (34%)
Bennouna, Meredith, and Marchant (2010)	Canada	NPV (58%), IRR (42%)
Daunfeldt and Hartwig (2014)	Sweden	NPV (61%), IRR (30%)
Horn, Kjærland, Molnár, and Steen (2015)	Sweden, Norway, and Denmark	NPV (74%), PBP (66%), IRR (51%)

[a] Cited in Klammer (1972).
[b] Cited in Block (1997).
Source: Author's review of the literature.

- the adoption of alternative CBTs is very low and slow;
- in spite of widespread criticism, non-DCF techniques are still used, and many firms combine both DCF and non-DCF techniques when making capital budgeting decisions; and
- DCF techniques have been accepted and applied more widely and faster than the alternative CBTs that have been accepted and applied thus far.

2.2. Capital budgeting techniques in developing countries

Compared to developed countries, there were relatively few studies on CBTs in developing countries during the studied period. Table 2 summarises the literature review's findings regarding the use of CBTs in developing economies.

From Table 2, the following can be inferred for developing economies:

- firms use multiple CBTs;
- the NPV and IRR are the most popular CBTs;
- the use of alternative CBTs is low;
- there is significant use of non-DCF methods; and
- firms combine DCF and non-DCF methods when making capital budgeting decisions.

2.3. Capital budgeting techniques in South Africa

There are several studies on the use of CBTs in South Africa. Table 3 summarises the key findings regarding CBTs in South Africa. Based on Table 3, the following observations can be made regarding the CBT preferences in South Africa:

- firms use multiple methods when evaluating capital investments;
- DCF methods (particularly the NPV and IRR) are the most popular CBTs;
- firms combine both DCF and non-DCF techniques when making capital budgeting decisions;
- alternative capital budgeting techniques are not popular; and
- the ROI is a relatively important CBT technique.

Table 2
Capital budgeting techniques in developing countries.

Author(s) and year	Country	Popular method(s) (%)
Porwal (1976)	India	ARR (85%), PBP (70%), IRR (10%), NPV (8%),
Dhankar (1995)	India	PBP (35%), ARR (33%), IRR (16%), NPV (15%),
Cherukuri (1996)	India, Hong Kong, Malaysia & Singapore	IRR (51%), PBP (38%), NPV (30%), ARR (19%)
Jain and Kumar (1998)	India	PBP (61%), NPV (45%)
Kester et al. (1999)	Indonesia	NPV (83%), IRR (78%), PBP (50%), ARR (20%)
	Malaysia	NPV (72%), PBP (71%), IRR (70%), ARR (37%)
	Philippines	IRR (87%), PBP (72%), NPV (67%), ARR (41%)
Hermes et al. (2007)	Chinese firms	NPV (89%), PBP (84%)
Verma, Gupta, and Batra (2009)	30 Indian firms	IRR (57%), NPV (50%), PBP (37%)
Maquieira, Preve, and Sarria-Allende (2012)	Argentina, Brazil, Chile, Colombia, Ecuador, Peru, Uruguay, and Venezuela	NPV (72%), IRR (70%), PBP (62%), ARR (15%)
Mendes-Da-Silva and Saito (2014)	Brazil	NPV (81%), IRR (74%), PBP (61%), ARR (20%)
Mbabazize and Daniel (2015)	30 Rwandan companies	IRR (25%), PBP (25%)

Source: Author's review of the literature.

2.4. Alternative methods in capital budgeting

Alternative methods provide valuable additions to the abovementioned CBTs, such as DCF methods (McDonald, 2006). However, according to (Rigopoulos, 2014), they are not often used in practice. Table 4 summarises the literature review's key findings relating to the use of the ROV. There are few studies on the use of other alternative capital budgeting methods, such as Monte Carlo simulations, game theory, decision trees, the capital asset pricing model (CAPM) and economic value added (EVA).

The reason for the non-use of alternative methods does not appear to be a lack of familiarity. These methods have been extensively discussed in the literature (Hull, 2014; McDonald, 2006). A study by Verbeeten (2006) assessed the role of alternative methods in capital budgeting and made two major findings. First, the use of, for example, ROV techniques encourages decision makers to think broadly and to incorporate the embedded flexibility in future project investment decisions. Second, any costs emanating from the time and effort that are spent applying alternative methods in capital budgeting can easily be offset by the returns arising from improved investment decisions. However, Horn, Kjærland, Molnár, and Steen (2015) argue that the complexity of alternative CBTs is their main drawback. It is assumed that practitioners prefer simple CBTs instead of the computationally intensive alternative methods. This is line with Cheng, Kite, and Raditke's (1994) study, which found that practitioners prefer methods that are convenient and understandable. This study's findings confirm that practitioners prefer to use DCF and non-DCF methods, which are relatively easy to formulate, compute and interpret for a wide range of stakeholders, including individuals with varying financial skills and knowledge.

Most studies on CBTs were contemporary cross-sectional surveys of the techniques that had been used in industry. A problem arises when one tries to generalise the outcomes of these cross-sectional studies to a wider population to identify how CBT preferences have evolved over time. Sangster (1993) compared the findings of his survey with those of earlier studies (Mclntyre & Coulthurst, 1985; Mills & Herbert, 1987 and Pike, 1983). He found that the generalisation regarding changing attitudes among firms concerning the use of CBTs is weakened by the varying survey populations, questions and analysis methods. Considering this finding, Pike (1996) conducted a panel survey of UK firms at approximately five-year intervals from 1975 to 1992 using similar questions and analysis methods. He found that, in spite of his surveying the same respondents, there were still differences because some firms had closed,

Table 3
Capital budgeting techniques in South Africa.

Author(s) (year)	Sample	Popular Method(s) (%)
Andrews and Butler (1986)	500 mining companies	IRR (45%), PBP (27%), ARR (15%)
Hall (2000)	65 Johannesburg Stock Exchange (JSE) listed companies	ROI (34%), IRR (33%), PBP (17%), NPV (17%)
Gilbert (2003)	South African manufacturing firms	PBP (79%), ROI (72%), IRR (48%)
Du Toit and Pienaar (2005)	524 JSE listed companies	IRR (37%), NPV (27%), ARR (11%)
Correia and Cramer (2008)	JSE listed companies	NPV (82%), IRR (82%), PBP (56%)
Brijlal and Quesada (2009)	South Africa	PBP (38%), NPV (36%), IRR (28%), ARR (22%)
Hall and Millard (2010)	41 JSE listed companies	ROI (33%), NPV (29%), IRR (24%)
Maroyi and van der Poll (2012)	Mining companies	NPV (69%) IRR (46%), PBP (23%)
Hall and Mutshutshu (2013)	Selected parastatals	NPV (25%), IRR (17%), ROI (17%), PBP (17%)

Source: Author's review of the literature.

Table 4
Use of real options in capital budgeting techniques.

Author (year)	Sample information	Use of real options
Busby and Pitts (1997)	Selected firms in the FTSE 100 index	0%
Geddes (1999)	Selected UK and Irish companies	2%
Graham and Harvey (2001)	Selected US firms	27%
Rigby (2001)	Firms in North America, Europe, Asia, Africa and South America	10% globally of which 7% in North America
Triantis and Borison (2001)	34 selected US companies	66% of companies have adopted only a conceptual approach
Vollrath (2001)	Selected German firms	3%
Ryan and Ryan (2002)	US Fortune 1000 companies	11%
Siddle and Rigby (2002)	Firms from over 20 countries in North America, Europe, Asia, Africa and South America	9%
Sandahl and Sjögren (2003)	Selected Swedish companies	0%
Brounen, De Jong, and Koedijk (2004)	Firms in the UK, Germany, France and the Netherlands	29% in the UK, 34% in the Netherlands, 44% in Germany and 53% in France
Block (2007)	US Fortune 1000 companies	14.3%
Baker, Dutta, and Saadi (2011)	Canadian firms	17%
Singh, Jain, and Yadav (2012)	Selected firms in India	50%
Hanaeda and Serita (2014)	Selected firms in Japan	1%
Horn et al. (2015)	Selected firms in Sweden, Norway and Denmark	6%

Source: Adapted from Horn et al. (2015).

restructured and/or changed their management during the 17-year study period. Changes in survey response rates or sample sizes as a result of company closures, restructuring and management changes are also mentioned by Rigopoulos (2014), who argues that firms are not static; thus, it is not surprising that management attitudes towards different CBTs change over time. Rigopoulos (2014) states that even when CBT preferences are surveyed in the same firms and in the same market but at different points in time, responses regarding CBT preferences may still be affected by various behavioural and market factors. Kengatharan (2016) therefore advocates the use of longitudinal analysis to understand the evolution of CBT preferences.

3. Research design and methods

Longitudinal analysis research designs have frequently been used in finance research. Early studies, such as that by Rappaport (1979), used longitudinal analysis to understand CBT trends. Miller and Friesen (1984) applied a longitudinal analysis to investigate the corporate life cycle. More recently, Rashid, Noor, Matsuki, AbRahman, and Omar (2016) used longitudinal analysis to study the relationship between a firm's financial abilities and earnings management. Longitudinal studies comprise three main variants, namely, panel surveys, cohort surveys and trend analysis surveys. These three variants of longitudinal studies are extensively discussed by Edwards (2000) and Creswell (2012). As with every research methodology, longitudinal research designs require a unique set of conditions. Studies by Sangster (1993), Pike (1996) and Rigopoulos (2014) concur that in longitudinal studies, it is vital that cross-sectional data are drawn from similar samples to permit comparisons. This study follows Sangster's (1993) approach by using trend analysis as an inquiry strategy. Pike (1996) used a panel study approach, while the studies by Mukherjee (1987), Baker, Singleton, and Veit (2011), Correia (2012) and Kengatharan (2016) were based on extensive qualitative literature review methods. In theory, panel studies can produce relatively robust longitudinal results compared to trend analysis and cohort studies (Creswell, 2012). In practice, these three methods produce similar results as long as the CBT trend data are drawn from similar samples that permit comparison. Rigopoulos's (2014) study demonstrates the processes that are involved in ensuring that the available data for analysis are similar. The data similarity does not imply that exactly the same firms must be surveyed because firms are not static. The preferences for a particular CBT are not influenced only by internal factors, such as management changes, management's behavioural attitudes, or other firm characteristics, such as size. External factors, such as price stability, also affect CBT choices. Thus, trend analysis was deemed to be a suitable research methodology for gaining an understanding of the evolution of CBTs, as it incorporates the variability of both internal and external factors.

Unlike panel and cohort studies, trend analysis survey respondents may either be different or the same. However, it is important that these respondents are drawn from the same population. To satisfy this key requirement, the current study identified CBT practices

Table 5
Number of studies on capital budgeting practices.

Country	Number of studies	As a percentage of the present study
India	17	21%
SA	16	19%
UK	20	24%
USA	30	36%
	83	100%

from cross-sectional surveys of firms in selected countries. The identified populations were firms in the UK and USA (developed countries) and India and South Africa (developing countries). Studies on the CBT practices in the UK and USA were independently analysed to understand the development of the capital budgeting practices in developed countries. Similarly, cross-sectional studies of CBT preferences in Indian and South African firms were surveyed and analysed independently to understand the evolution of the CBT preferences in developing countries. This segregation of populations by country is important because trend analysis survey designs involve identifying a population and examining changes within that population over time (Creswell, 2012).

A comprehensive search was conducted by using the University of Pretoria's online databases, including sources such as SA ePublications, Emerald, Google Scholar, Proquest, Science Direct and EbscoHost, to locate studies on the capital budgeting practices in various countries. The study's search parameters included CBTs, capital budgeting practices, capital budgeting methods and other closely related parameters.

The present study purposively sampled the UK, the USA, India and South Africa because there are many studies that discuss the capital budgeting preferences in these four countries.

For a prior study to be included in this research, it had to meet the following criteria:

- have a focus on firms that were assumed to have value maximisation as their goal;
- present a cross-sectional survey of the CBTs that were in use at the time when the study was undertaken; and
- be fewer than 50 years old as of December 2016.

There is no limit on the number of studies that can be integrated in a longitudinal (trend analysis) survey. Statistical power is enhanced when larger, rather than smaller, sample sizes are analysed.

This study extracted the quantitative information pertaining to the CBT preferences that were used by firms in the four sampled countries. Table 5 summarises the number of studies that were included in the current study.

Table 5 shows that studies on CBT preferences are more common in developed countries. Of the 83 studies that were surveyed, 36% analyse capital budgeting preferences in the USA, followed by 24% in the UK, 21% in India and 19% South Africa. The USA studies on CBT preferences started in 1966, and the most recent surveys were published in 2006. Similarly, in the UK, early studies began in 1973, and the most recent studies were conducted in 2006. By contrast, studies exploring CBT preferences in India and South Africa (developing countries) are topical thus far. In both instances, the most recent studies were published in 2016. Early studies occurred in the early 1970s, as in the USA and the UK.

3.1. Data analysis

Data pertaining to the various CBTs and rates of usage across time were collected from published studies. This study applied non-parametric methods, specifically the Mann-Kendall (MK) test and the Mann-Whitney test, to analyse the trend analysis data. The use of these statistical techniques in trend analysis is discussed below. The Mann-Kendall test was selected to assess if there is a monotonic upward/downward trend of the various CBTs that were found in practice. A monotonic upward/downward trend in a particular CBT suggests that the use of the CBT in question consistently increases/decreases over time.

To understand whether the CBT practices in developing countries are different from the CBT practices in developed countries, this study employed the Mann-Whitney test. The Mann-Whitney test does not make any distributional assumptions about CBT preferences data nor does it require the preferences of the four independent groups (countries) to be the same sample size. The Mann-Whitney test was used to evaluate whether the different CBT preferences tended to be higher (or lower) in developed countries (the UK or the USA) than in developing countries (India or South Africa).

3.2. Assessing and demonstrating the quality and rigour of the research design

Generally, longitudinal survey data are skewed by missing data, data outliers and the degree of normalcy of the data. The strategies that have been used to mitigate the potential negative impacts of these three factors on the validity of the present study's results are discussed below.

The Mann-Kendall test and the Mann-Whitney test allow for missing data when analysing trends.

This study discarded data outliers, thereby omitting them from the data analysis. The quartile range approach and transformations were used to fence the data and identify the outliers falling outside the lower limit and upper limit boundaries. The boundaries were defined as follows:

Table 6
Capital budgeting techniques in use.

Country	Number of studies	NPV	IRR	PBP	ROI	ARR	ROV
India	17	17	17	17	6	14	2
SA	16	16	16	16	8	13	2
UK	20	20	20	20	8	16	4
USA	30	30	29	30	13	28	10
	83	83	82	83	33	71	18

- Upper limit: third quartile + (1.5 × interquartile range), and
- Lower limit: first quartile − (1.5 × interquartile range).

Previous studies, such as those by Daunfeldt and Hartwig (2014), used regression analysis to understand the developments in the use of CBTs over time and the factors that affected CBT usage. Regression analysis assumes that the data follow a normal distribution. However, the CBT preferences that were identified from the literature did not follow a normal distribution.

Klammer (1972) analysed the developments in CBT preferences from 1959 to 1970. No statistical techniques were applied to test the significance of these results. Instead, year-on-year CBT preference comparisons were performed to conclude that there was an increased use of DCF methods and a decreased use of non-DCF methods. Further studies (Cooper et al., 2001; Pike, 1996; Sangster, 1993) adopted a similar year-on-year comparison approach, although they analysed larger samples. Sangster (1993) and Pike (1996) both analysed five studies from 1975 to 1989 and from 1975 to 1996, respectively. Cooper et al. (2001) analysed ten studies from 1959 to 1990.

While the year-on-year comparison approach does provide insights into how CBT preferences developed, it is challenging to make unbiased generalisations when the sample size is large and there is an uneven and inconsistent trend line. The present study therefore used the Mann-Kendall test to objectively assess the evolution of CBT preferences.

The next section discusses the empirical analysis and results.

4. Results and discussion

Numerous CBTs are described in the theory and applied in practice, but only six techniques are frequently used in appraising capital investments. Table 6 summarises the numbers of times the most frequently used CBTs were applied by the studied firms.

There is widespread use of DCF and non-DCF methods to evaluate the capital investment decisions in developed and developing countries. However, the use of alternative methods is low, despite their strong theoretical grounding. All of the reviewed studies used the NPV and the PBP. ARR use is reported in 86% of the studies, followed by ROI use at 40% and ROV use at 22%. The ROI and ROV methods were excluded from this study because there were too few data points to allow for further analysis using the Mann-Kendall and Mann-Whitney tests.

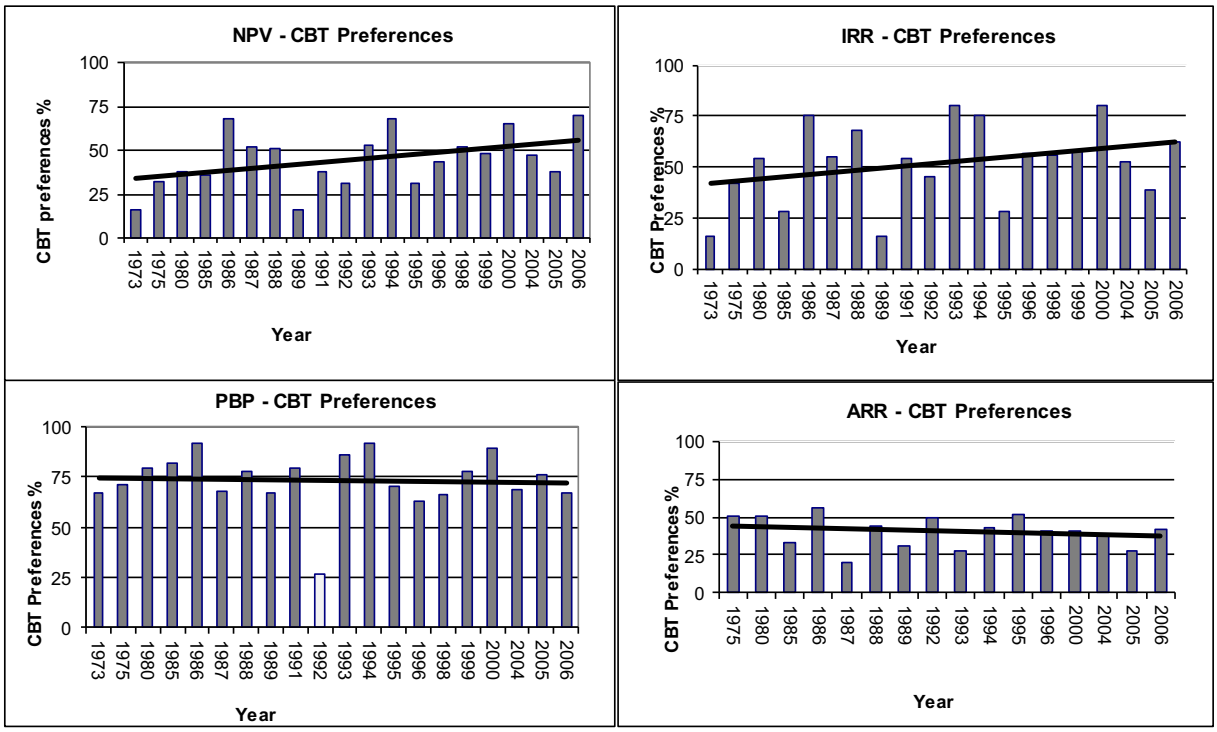

Fig. 1. Trends in UK capital budgeting techniques.

4.1. Trend analysis of capital budgeting technique preferences

4.1.1. Capital budgeting techniques in developed countries

4.1.1.1. Firms in the UK. Fig. 1 shows the CBT preference trends in the UK. (More detailed information is provided in Appendix A - Panel A.1: UK.) The unshaded preferences are adjusted for the outlier effect. The use of DCF methods, such as the NPV and the IRR, is increasing in UK firms. By comparison, the use of non-DCF methods, such as the PBP and the ARR, has decreased, as represented by the trend line in the two lower quadrants of Fig. 1 below. This development (the increased use of DCF methods) is supported by current theoretical principles.

Regarding non-DCF methods, early studies (Carsberg & Hope, 1976; Pike, 1983; Westwick & Shohet, 1976) on CBTs reported higher preferences (with an average of 50%) for the ARR method compared to recent studies (Alkaraan & Northcott, 2006; Block, 2005), which used the ARR less (with an average of 35%). Further analysis on this trend is presented below to assess whether the decreased use of the ARR technique in the UK is significant. The preference for the PBP technique appears to be stable, fluctuating around a mean use level of 74%. The Mann-Kendall test was used to evaluate whether these trends are significant.

Regarding the use of DCF methods, the trend line suggests significant increases in the preferences for the NPV and IRR techniques. These findings corroborate those of other studies (Baker, Dutta, & Saadi, 2011; Baker, Singleton, & Veit, 2011; Drury, Braund, & Tayles, 1993; Kengatharan, 2016; Mukherjee, 1988) in that UK firms have changed their CBT preferences from the use of non-DCF methods to DCF methods. An important debate topic is whether the increased use of DCF methods is gradually leading to the phasing out of non-DCF methods in evaluating capital investments. The findings of this study suggest that non-DCF methods are retained and increasingly being used as ancillary methods for evaluating capital investments.

4.1.1.2. Firms in the USA. As in the UK, firms in the USA have increased their usage of the NPV and IRR, which is in line with textbook recommendations regarding CBTs (Bierman & Smidt, 2014; Brealey, Myers, Allen, & Mohanty, 2012; Carsberg & Hope, 1976; Porwal, 1976; Purohit, Lall, & Panda, 1994). The preference for the PBP is increasing in the USA, unlike in the UK, where it was observed to be relatively stable. The literature attributes the continued preference for the PBP technique to its simplicity, especially when assessing the liquidity risk of a project. Risk management tools, such as the PBP, are likely to continue to play a key role in guiding corporate decision making in a business environment that is becoming increasingly volatile due to changes in both qualitative factors (climate, technology, wars, and migration) and quantitative factors (sales revenue and the term structure of interest rates). The decreased use of the ARR can arguably be attributed, in part, to the increased prominence of private equity firms. This reasoning emanates first from Mukherjee's (1988) assertion that the ARR is mostly used in publicly listed companies. Second, recent findings by Kersley and Koutsoukis (2016) show that there has been an increase in the number of private equity firms and a decrease in the number of public companies in the USA. Therefore, the apparent declining preference for the ARR in the USA may be due to the decrease in the number of publicly listed firms.

Fig. 2 (more detailed information is provided in Appendix A - Panel A.2: USA) shows an increased use of the NPV, IRR and PBP, thereby indicating that these are the main techniques that are used for evaluating capital budgeting decisions in the USA. However, the use of the ARR is decreasing.

4.1.1.3. Significance of the capital budgeting techniques in developed countries. Table 7 summarises the Mann-Kendall trend test results and indicates how CBT preferences have developed in the UK and USA over the last five decades. First, the ARR technique is diminishing in significance, both in the UK and the USA. However, the use of the PBP and IRR has increased in the USA. UK firms have

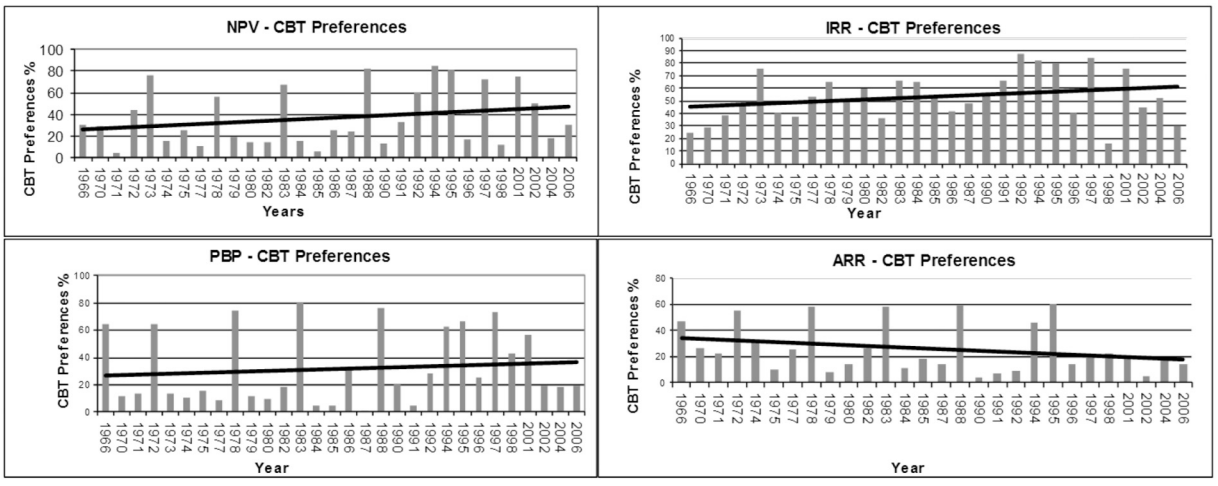

Fig. 2. Trends in US capital budgeting techniques.

Table 7
Capital budgeting trends in developed countries.

Country	Metric	NPV	IRR	PBP	ARR
UK	Tau	0.3750	0.3714	0.1714	−0.3333
UK	|Tau critical @ 0.05|	0.1544	0.1544	0.1544	0.1544
UK	Coefficient of Variation	0.4044	0.4079	0.3779	0.2834
UK	Trend	Sig. Increasing	Sig. Increasing	Sig. Increasing	Sig. Decreasing
USA	Tau	0.1379	0.6208	0.3464	−0.4378
USA	|Tau critical @ 0.05|	0.1140	0.1140	0.1140	0.1470
USA	Coefficient of Variation	0.7193	0.3045	1.0165	0.6308
USA	Trend	Sig. Increasing	Sig. Increasing	Sig. Increasing	Sig. Decreasing

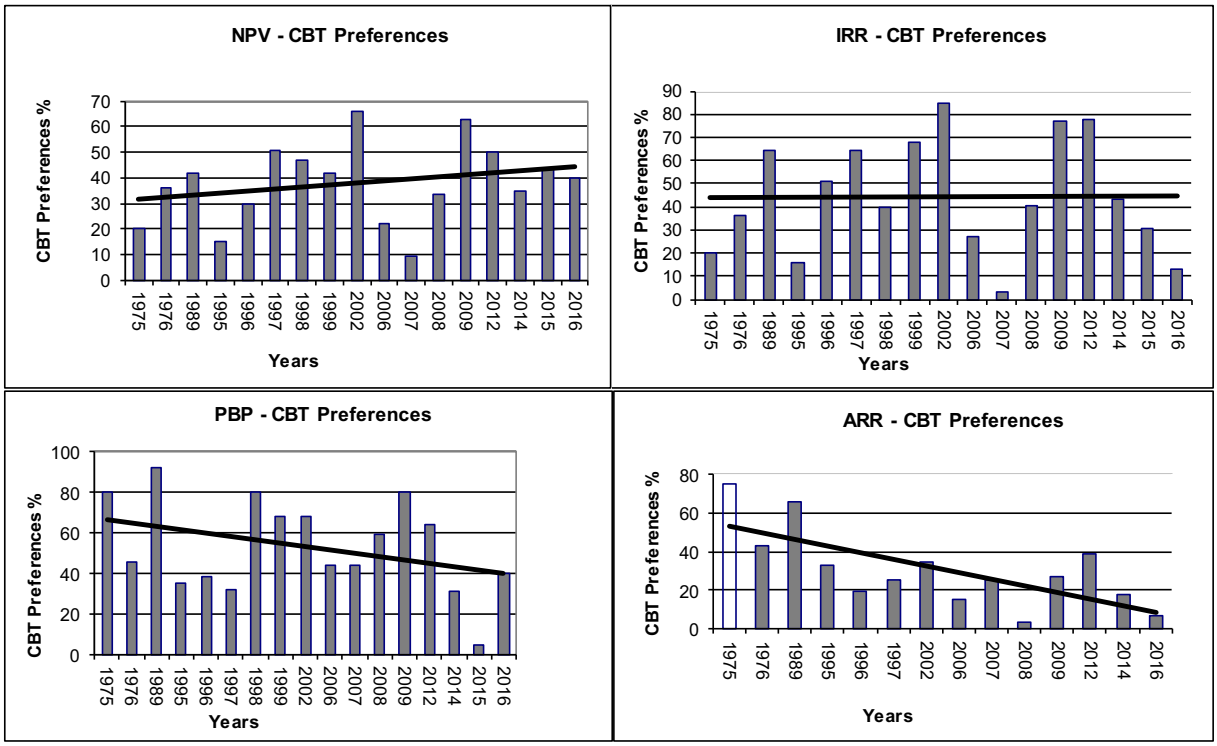

Fig. 3. Trends in Indian capital budgeting techniques.

significantly increased their use of the NPV, whereas the use of the NPV has remained fairly stable in the USA.

Using the strength of the Tau factors, this study shows that UK firms are significantly increasing their use of the NPV, which is followed closely by the IRR and then the PBP. Firms in the USA are rapidly and significantly increasing their use of the PBP, which is followed by the IRR and then the NPV.

4.1.2. Capital budgeting techniques in developing countries

4.1.2.1. Firms in India. In India, regarding non-DCF techniques, the use of both the PBP and ARR is decreasing. The decrease is more pronounced in the ARR than in the PBP. Regarding DCF preferences, the use of the NPV is increasing, whereas the use of the IRR is stable. Fig. 3 (more detailed information is provided in Appendix A - Panel A.3: India) shows the trends of CBT preferences in India. By increasing their use of DCF methods, firms in India are aligning their practices with the theory, which discourages the use of non-DCF methods and supports the use of DCF methods, particularly the NPV.

4.1.2.2. Firms in South Africa. The capital budgeting practices in South African firms are similar to those in India. There has been a decrease in the use of the PBP and ARR but an increase in the use of the NPV, as shown in Fig. 4 (more detailed information is provided in Appendix A - Panel A.4: South Africa). Further analysis of the use of DCF methods reveals that South African firms are increasingly using the NPV and decreasingly using the IRR. This development is in line with the theory, which favours the use of the NPV over the IRR.

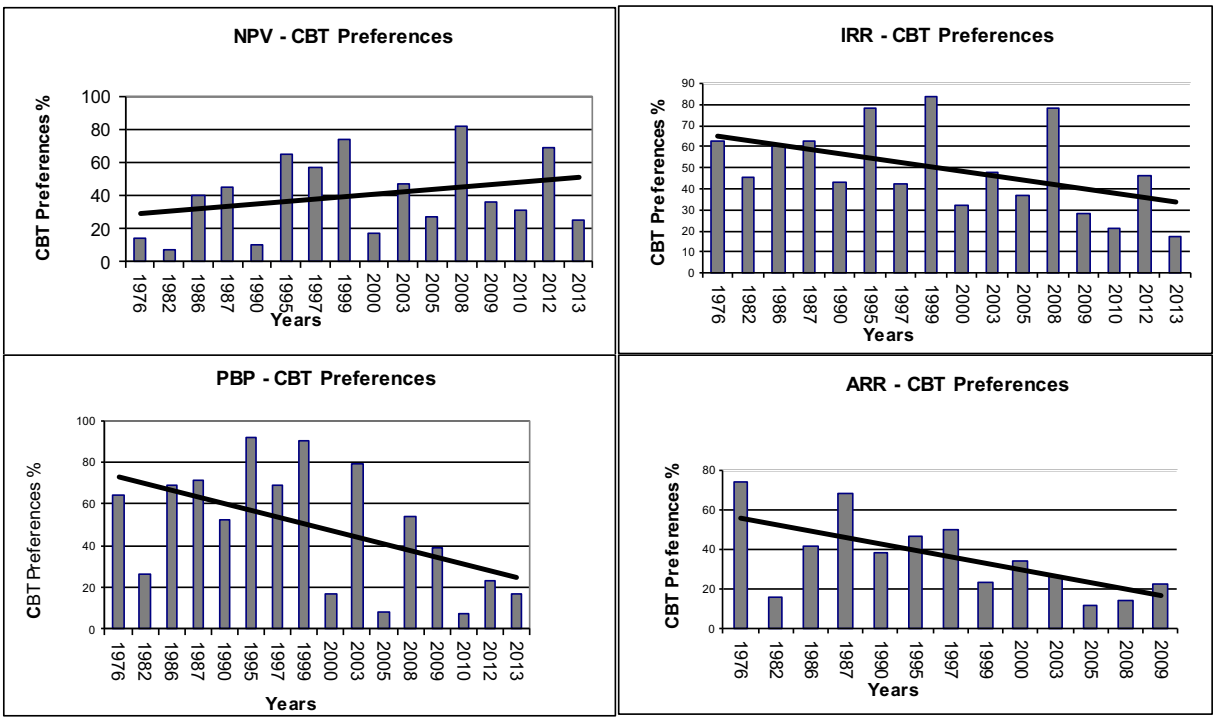

Fig. 4. Trends in South African capital budgeting techniques.

Table 8
Capital budgeting trends in developing countries.

Country	Metric	NPV	IRR	PBP	ARR
India	Tau	0.0571	0.0667	−0.2667	−0.3810
India	|Tau critical @ 0.05|	0.1544	0.1544	0.1544	0.1815
India	Coefficient of Variation	0.4432	0.5209	0.3520	0.7395
India	Trend	Stable/no trend	Stable/no trend	Sig. Decreasing	Sig. Decreasing
South Africa	Tau	0.3167	−0.3917	−0.3833	−0.3167
South Africa	|Tau critical @ 0.05|	0.1544	0.1544	0.1544	0.1794
South Africa	Coefficient of Variation	0.5807	0.3728	0.5694	0.7236
South Africa	Trend	Sig. Increasing	Sig. Decreasing	Sig. Decreasing	Sig. Decreasing

4.1.2.3. Significance of the capital budgeting trends in developing countries. Regarding their use of non-DCF methods, firms in India and South Africa are conforming to the theoretical principles, which discourage the use of non-DCF methods. There has been a significant decrease in the use of both the PBP and ARR by South African and Indian firms. However, firms in the USA and the UK have only decreased their use of the ARR. The use of the PBP in developed countries is significantly increasing, even though the theory advises that non-DCF methods should not be used. While the theory supports the increased use of the NPV compared to other CBTs, firms in

Table 9
P-values for the comparison of the capital budgeting technique preferences across countries.

		South Africa				India			
		NPV	IRR	PBP	ARR	NPV	IRR	PBP	ARR
UK	NPV	0.638				0.181			
	IRR		0.78				0.332		
	PBP			0.018**				0.05**	
	ARR				0.2				0.037**
USA	NPV	0.428				0.518			
	IRR		0.522				0.277		
	PBP			0.058*				0.023**	
	ARR				0.113				0.375

NB: If the p-value is greater than the significance level, alpha, one cannot reject the null hypothesis that there is no difference in the use of that CBT in the two countries being compared. The starred *p*-values are significant at the 5% (**) and 10% (*) significance levels.

India and South Africa increasingly using only the NPV, thereby inadvertently limiting the scope of the available information for evaluating capital projects. Table 8 shows the significance of the CBT preference trends.

Although firms in India and in South Africa have significantly decreased their use of non-DCF methods, their use of DCF methods diverges. South African firms are increasingly using the NPV and significantly decreasing their use of the IRR. Use of NPV rather than IRR techniques is supported by the theoretical principles that were discussed in various studies (Bierman & Smidt, 2014; Kengatharan, 2016; Lander & Pettengill, 2007; Verbeeten, 2006), especially when appraising mutually exclusive capital projects. The NPV theoretically possesses robust discount rate (re-investment rate) assumptions and it also provides explicit shareholder value-enhancing criteria. The continued CBT preference trends in South Africa, *ceteris paribus*, result in the use of the NPV as the main technique. Although the use of the NPV is encouraged, South African firms, unlike firms in the UK and the USA, rely on limited information to evaluate investment projects. By comparison, not only have UK firms increased their use of the NPV, but they have also increased their use of the IRR and PBP, thus broadening the scope of the available information for decision making. Notwithstanding their significantly decreased use of non-DCF methods, Indian firms still do not use DCF methods to a significant degree. Perhaps firms in India are gradually evolving towards a reliance on both the NPV and IRR.

4.2. Capital budgeting technique tendencies in developed and developing countries

Firms in the UK and the USA are increasing their use of DCF methods, particularly the IRR and PBP techniques, whereas firms in India and South Africa are increasing their use of the NPV method. Although the theory advocates using the NPV over the IRR, using a single CBT may disadvantage firms in developing economies because doing so would reduce the scope and breadth of the information that would be available for decision making purposes. There is a high likelihood that firms using limited information may make sub-optimal capital investment decisions, which may have negative impacts on their operations and, in turn, on their growth and profitability.

The use of the ARR and PBP techniques is significantly decreasing in both South African and Indian firms, whereas in UK and US firms, only the use of the ARR is significantly decreasing. The use of the PBP method is significantly increasing in UK and US firms. Firms in developed countries have thus not excluded the use of all non-DCF methods, but they are increasingly using the PBP technique when evaluating capital investment decisions. These developments imply that firms in developed countries have increased their use of DCF techniques and continue to use non-DCF techniques, particularly the PBP method. In contrast, firms in developing countries, specifically India and South Africa, have decreased their use of non-DCF methods in favour of the theoretically superior NPV technique.

The results of the Mann-Whitney test are summarised in Table 9.

4.2.1. Firms in South Africa

In South African firms, the use of the NPV is increasing and that of the IRR and ARR is decreasing. However, there is no significant difference between the use of these techniques by firms in South Africa or firms in the UK and USA. However, the level of use of the PBP method in South African firms and those of UK and USA firms differ.

The p-value of 0.018 (<0.05, which is the significance level) for PBP use in the UK and South Africa shows that there is a significant difference between the use of the PBP method by the firms in these two countries. Further analysis of the summary statistics and the Mann-Whitney test results regarding the use of the PBP in the UK and South Africa yields the results in Table 10.

In essence, UK firms tend to use the PBP method more than South African firms. The current study found a significantly higher use of the PBP in UK firms than in South African firms. This study did not find significant differences between the use of other techniques, such as the NPV, IRR and ARR, by South African or UK firms.

The p-value of 0.058 (<0.10) means that there is a difference in the use of the PBP by US firms and South African firms, although this difference is not statistically highly significant. The summary statistics are provided in Table 11.

Despite the fact that there has been a significant increase in the use of the PBP in the USA and a significant decrease in the use of the PBP in South Africa, firms in South Africa still use the PBP more than US firms. Perhaps the observed trend, where the use of the PBP is increasing in the USA and decreasing in South Africa, indicates that firms in both countries are adjusting towards moderate use of the technique.

4.2.2. Firms in India

The use of DCF methods (the NPV and IRR) in Indian firms does not differ from the use of DCF methods in the UK. However, UK firms display a higher use of non-DCF methods than Indian firms. The use of the PBP in India and the UK is summarised in Table 12.

Based on Table 10, one can state that UK firms use the PBP more than Indian firms. Similarly, UK firms' use of the ARR is higher than the use of the ARR in Indian firms. The summary statistics are provided in Table 13.

While firms in India are conforming to theoretical principles, which advocate the increased use of DCF methods, there is the likelihood that excessive dependence on DCF methods may limit the scope of the available information for decision making.

Although Indian firms underuse all non-DCF methods compared to UK firms, they do use the PBP method more than US firms. Regarding the use of the ARR, there is little difference between firms in the USA and firms in India. The summary statistics for the use of the PBP in the USA and India are presented in Table 14.

The p-value 0.023 (<0.05) for the PBP use implies that Indian firms prefer to use the PBP more than US firms.

In summary, Indian and South African firms are similar in two respects. First, there is no significant difference between their use of the NPV and IRR and that of firms in developed countries. Second, they use the PBP less than UK firms, but they use this technique more than US firms.

Table 10
Mann-Whitney test results for UK and South African firms' use of the PBP.

Variable	Minimum	Maximum	Mean	Median
UK_PBP (%)	27	92	74	78
SA_ PBP (%)	7	92	49	54

Mann-Whitney test/two-tailed test	
U	259.500
p-Value (two-tailed)	0.018
Alpha	0.05

Table 11
Mann-Whitney test results for US and South African firms' use of the PBP.

Variable	Minimum	Maximum	Mean	Median
USA_PBP (%)	1	80	32	19
SA_PBP (%)	7	92	49	54

Mann-Whitney test/two-tailed test	
U	156
p-Value (two-tailed)	0.058

Table 12
Mann-Whitney test results for Indian and UK firms' use of the PBP.

Variable	Minimum	Maximum	Mean	Median
UK_PBP (%)	27	92	74	78
India_PBP (%)	4	92	53	46

Mann-Whitney test/two-tailed test	
U	245
p-Value (two-tailed)	0.052

Table 13
Mann-Whitney test results for Indian and UK firms' use of the ARR.

Variable	Minimum	Maximum	Mean	Median
UK_ARR (%)	28	56	42	43
India_ARR (%)	3	75	31	26

Mann-Whitney test/two-tailed test	
U	171.500
p-Value (Two-tailed)	0.037

Table 14
Mann-Whitney test results for Indian and US firms' use of the PBP.

Variable	Minimum	Maximum	Mean	Median
USA_PBP (%)	1	80	32	19
India_PBP (%)	4	92	53	46

Mann-Whitney test/two-tailed test	
U	135
p-Value (two-tailed)	0.023

4.3. Anticipated trends in capital budgeting technique preferences

The results of this study suggest that developments regarding the use of CBTs vary by country. Firms in the USA, the UK, India and South Africa have uniquely evolved in the ways in which they align practice with theory.

Based on the trend lines in Fig. 3 (see Section 4.1.2), UK firms are likely to continue to use multiple CBTs for appraising investment projects. It may be expected that the IRR and NPV will continue to be the primary techniques that are used by UK firms when evaluating capital investments. The PBP and ARR techniques are likely to remain widely used as ancillary methods.

Firms in the USA may be expected to increase their use of DCF methods, but they may continue to place a higher emphasis on IRR methods over NPV methods. The PBP is also expected to remain a relevant tool for assessing capital projects. However, the use of the ARR is expected to diminish in significance, in line with the theory, which discourages the use of DCF methods. The increased use of the IRR is expected to crowd out other CBTs. This effect may occur because the IRR is mainly used in private equity firms, which are beginning to dominate in the USA.

South African firms may be expected to increase their use of the NPV. The increased use of the NPV will largely be associated with the decreased use of the PBP and ARR methods, which will then be relegated to the role of secondary CBTs. NPV users are likely to continue to first use the PBP as an additional CBT to increase the available information for investment decisions. As the decreased use of the ARR is more pronounced than that of the PBP, it is expected that the ARR will become a secondary choice.

Indian firms show a decreased use of non-DCF methods, but it is expected that the use of DCF methods will remain stable. Firms in India may be expected to alternate between using the IRR and NPV.

5. Conclusions and recommendations

This study analysed the use of CBTs in the USA, the UK, India and South Africa based on surveys that were published from 1966 to 2016. Cross-sectional survey data must be drawn from the same population to achieve effective survey comparisons. A longitudinal analysis of the developments in CBTs was undertaken to identify CBT evolution trends. Despite the limitations of longitudinal studies, such studies remain useful to practitioners and academics for comparing past survey results and to infer long term trends.

Although a number of CBTs are detailed in the theory, only the selected techniques are commonly used in practice. The most widely used techniques that are identified in this study are non-DCF methods (the ARR and PBP) and DCF methods (the IRR and NPV). Alternative methods are the least preferred and used CBTs, probably due to their complexity and the shortage of human capital with the required skills and knowledge to apply them. Although the ROI is the second least preferred technique that was used in the period under review, it is of growing significance in the UK, followed by the USA, South Africa and India. More research is needed to understand the use of real option techniques in capital budgeting by firms in both developed and developing countries. Similarly, studies on the use of other theoretically robust techniques (such as the CAPM, EVA, modified internal rate of return, discounted payback period and decision trees) in capital budgeting remains sparse.

Firms in developed countries, using the USA and UK as representatives, are increasingly using DCF methods (in particular, the IRR and NPV) rather than non-DCF methods (such as the ARR and PBP) for making capital investment decisions. The increased use of DCF methods is congruent with finance theory, which stresses the need to incorporate the time value of money in financial decision making. Similarly, firms in developing countries, using South Africa and India as representatives, are increasingly using DCF methods (in particular, the NPV method) rather than non-DCF methods (such as the ARR and PBP) for making capital investment decisions. While there is limited information regarding the use of alternative CBT methods, it is possible to say that there has been a general increase in the use of DCF methods in both developed and developing countries. However, the use of non-DCF methods varies. Firms in developing countries have significantly decreased their use of non-DCF methods (the PBP and ARR). By contrast, firms in the USA and the UK have decreased only their use of the ARR. The preference for the PBP increased significantly both in UK and US firms.

The combination of the increased use of DCF techniques and decreased use of non-DCF methods in firms in developing countries suggests that firms in developing countries are evolving towards a greater reliance on DCF methods. The use of CBTs is thus evolving from less effective (or less sophisticated) non-DCF practices into superior DCF practices, as recommended in finance theory. In developed countries, there is an increased use of DCF methods (the IRR and NPV) and varied use of non-DCF methods. The increased use of DCF methods, in the light of the varied use of non-DCF methods, suggests that DCF methods are becoming the primary CBTs for assessing capital investment projects, with non-DCF methods assuming a secondary role. When there are mutually exclusive projects, non-DCF methods may be useful for ranking potential projects when making capital budgeting decisions.

Numerous studies have shown that practitioners' use of CBTs is increasingly aligned with finance theory, with a shift towards greater use of DCF methods than non-DCF methods. However, there are still unexplained differences between the theory and practice.

There are four main recommendations for future research. First, more research is required to explore the continuing importance of the IRR over the NPV. Moreover, there is a need to validate the assertion that the use of the IRR is prevalent in private equity firms. Second, there are few studies that explore the use of advanced alternative CBTs, such as real options, Monte Carlo simulations, the EVA and the modified internal rate of return in capital budgeting. Third, the literature emphasises issues relating to the selection phases of the capital budgeting process, but future research could focus on the control phases of capital investment.

Fourth, the findings of this study suggest that firms are increasingly using DCF methods. It is not sufficient to conclude that firms are simply adhering to theoretical principles. There should be a visible notable performance difference when firms choose to embrace certain methods over others, justifying the relevance of the adopted CBTs. Therefore, there is a need to explore the impact of adopting (or not adopting) DCF methods on firms' performance. Further research is needed to ascertain the relative performance of companies that have adopted DCF methods compared to companies that use non-DCF methods.

Other recommended future areas of research are CBT practices in high-risk business environments and sectors, such as technology companies. Suggestions for studying the use of CBTs by firms operating in high risk business environments include countries such as Zimbabwe and Syria.

Author statement

John Hall: Conceptualization, Validation, Supervision, Project administration, Funding acquisition, Writing - Review & Editing
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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

Table 9
The development in capital budgeting techniques.

Panel A.1: UK

Author(s) (year)	NPV (%)	IRR (%)	PBP (%)	ARR (%)
Alkaraan and Northcott (2006)	70	62	67	42
Block (2005)	38	39	76	28
Brounen et al. (2004)	47	53	69	38
Arnold and Hatzopoulos (2000)	65	80	89	41
Geddes (1999)	48	58	78	
Sekwat (1998)	52	56	66	
Drury and Tayles (1996)	43	57	63	41
Ballantine, Galliers, and Stray (1995)	31	28	70	52
Wilkes, Samuels, and Greenfield (1996)	68	75	92	43
Drury et al. (1993)	53	80	86	28
Pike (published 1996) (1992)	31	45	27	50
Klammer, Koch, and Wilner (1991)	38	54	79	
Sangster (1993)	16	16	67	31
Mills (1988)	51	68	78	44
Mills and Herbert (1987)	52	55	68	20
Pike (published 1996) (1986)	68	75	92	56
Mclntyre and Coulthurst (1985)	36	28	82	33
Pike (published 1996) (1980)	38	54	79	51
Pike (published 1996) (1975)	32	42	71	51
Carsberg and Hope (1976)	16	16	67	

Panel A.2: USA

Author(s) (year)	NPV (%)	IRR (%)	PBP (%)	ARR (%)
Danielson and Scott (2006)	30	30	19	14
Hogaboam and Shook (2004)	18	52	18	18
Ryan and Ryan (2002)	50	45	19	5
Graham and Harvey (2001)	75	76	57	20
Block (2005)	12	16	43	22
Burns and Walker (2009)	73	84	73	21
Shao and Shao (1996)	17	40	25	14
Trahan and Gitman (1995)	81	80	67	60
Gilbert and Reichert (1995)	85	82	63	46
Bierman (1993)	60	87	28	9
Ken and Cherukuri (1991)	33	66	5	7
Cooper et al. (2001)	13	57	20	4
Reichert, Moore, and Byler (1988)	83		76	59
Gitman and Maxwell (1987)	24	48	1	14
Ross (1986)	25	42	33	

(*continued on next page*)

Table 9 (*continued*)

Panel A.2: USA

Author(s) (year)	NPV (%)	IRR (%)	PBP (%)	ARR (%)
Cubbage and Redmond (1985)	5	54	5	18
Stanley and Block (1984)	16	65	5	11
Moore and Reichert (1983)	68	66	80	58
Kelly and Philippatos (1982)	14	36	18	27
Oblak and Helm (1980)	14	60	10	14
Kim and Farragher (1981)	19	49	12	8
Schall et al. (1978)	56	65	74	58
Gitman and Forrester (1977)	10	53	9	25
Kim and Farragher (1981)	26	37	15	10
Petty, Scott, and Bird (1975)	15	41	11	31
Fremgen (1973)	76	76	14	
Baker and Beardsley (1972)	44	47	65	55
Fremgen (1973)	4	38	14	22
Klammer (1972)	29	29	12	26
Robichek and Macdonald (1966)	31	25	65	47

Panel A.3: India

Author(s) (year)	NPV (%)	IRR (%)	PBP (%)	ARR (%)
Sharma (2016)	40	13.3	40	6.7
Umair (2015)	44	30	4	
Batra and Verma (2014)	35	43	31	18
Singh et al. (2012)	50	78	64	39
Verma et al. (2009)	63	77	80	27
Shah (2008)	33	41	60	3.2
Gupta, Batra, and Sharma (2007)	9	3	44	25
Irala (2006)	22	27	44	15
Anand (2002)	66	85	68	35
Parashar (1999)	42	68	68	
Jain and Kumar (1998)	47	40	80	
Bhattacharya (1997)	51	64	32	25
Cherukuri (1996)	30	51	38	19
Dhankar (1995)	15	16	35	33
Pandey (1989)	42	64	92	66
Porwal (1976)	36	36	46	43
Chandra (1975)	20	20	80	75

Panel A.4: South Africa

Author(s) (year)	NPV (%)	IRR (%)	PBP (%)	ARR (%)
Kedige (2016)	83	62	58	
Hall and Mutshutshu (2013)	25	17	17	
Maroyi and van der Poll (2012)	69	46	23	
Hall and Millard (2010)	31	21	7	
Brijlal and Quesada (2009)	36	28	39	22
Correia and Cramer (2008)	82	79	54	14
Du Toit and Pienaar (2005)	27	37	8	11
Gilbert (2003)	47	48	79	26
Hall (2000)	17	32	17	34
Napier (2000)	74	84	90	23
Matundu (1997)	57	42	69	50
Coltman (1995)	65	78	92	46
Parry and Firer (1990)	10	43	52	38
Andrews and Firer (1987)	45	63	71	68
Andrews and Butler (1986)	40	60	69	41
Lambrechts (1976)	14	63	64	74

Source: Author's review of the literature.

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