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Perception of risk and uncertainty and non-usage of discounted cash flow techniques by UK listed firms

Abstract

This paper presents the findings of a questionnaire-based survey of UK financial managers' perception of risk and uncertainty as well as non-usage of discounted cash flow (DCF) techniques in investment appraisal. It is found that although most financial managers perceive risk as a project's cash flow volatility, managers that do not use DCF techniques perceive risk asymmetrically as loss. In addition, financial managers are perceptive of company-specific rather than economy-wide uncertainty. It is also found that one in five respondent companies does not use DCF, arguably because of its perceived irrelevance in evaluating short-term projects and its atheoretical demeanor. Overall, these findings confirm that the theory-practice gap still exists in terms of the perception of risk and uncertainty and non-usage of DCF by financial managers of listed companies in the UK.

Keywords: risk and uncertainty, discounted cash flow techniques, UK.
JEL Classification: G31, G32.

Introduction

An integral element of evaluating capital investment projects is to assess the notion of risk and uncertainty. However, empirical studies conducted to identify capital budgeting practices used in private firms (e.g., Drury and Tayles, 1996; Arnold and Hatzopolous, 2000; Gitman and Vandenberg, 2000; Mclaney et al.., 2004) have not generally investigated how risk and uncertainty are perceived prior to decision making. In addition, existing survey-based studies do not explain the relationship between financial managers' perception of risk and uncertainty and their non-usage of discounted cash flow (DCF) techniques.

Thus, this paper aims to fill the two gaps in the literature. First, the paper seeks to understand through a postal based survey how UK listed non-financial firms perceive risk and uncertainty when screening new capital investments. In analyzing the responses, we seek to determine whether key variables like firm attributes, listing, industry sector and usage of discounted cash flow techniques are influenced by risk and uncertainty perception. Second, we aim to interpret the characteristics and motivation behind firms which prefer not to adopt discounted cash flow techniques in appraising their capital investments.

The remainder of the paper is organized as follows. Section 1 reviews the definitions and perceptions of risk and uncertainty. In section 2, the sample selection procedure is discussed, together with the profile of the respondents. In section 3, we analyze the responses on risk perception and uncertainty using descriptive statistics and regression analysis. This is followed by an analysis of respondents' usage of DCF techniques and a discussion of their reasons for non-DCF usage, in section 4. The last section summarizes the paper and offers some concluding remarks.

1. Literature review

1.1. Definition and perception of risk. The importance of understanding the nature of risk is well established in decision theory (Knight, 1921; Arrow, 1965), strategic management theory (March & Shapira, 1987; Bettis & Thomas, 1990; Ruefli et al., 1999) and in finance theory with the development of the SLB Model (Sharpe, 1964; Lintner, 1965; Black, 1972). However, there are differences in the way risk is perceived and operationalized from the decision, strategic management and finance theory perspectives (Winfrey and Budd, 1997).

The Knightian distinction between risk and uncertainty is that the former refers to 'measurable uncertainty' where the decision maker can assign a priori and statistical probabilities to randomness in situations, whereas the latter refers to situations where randomness is unmeasurable. But Holton (2004) argues that Knight's risk definition does not address the issue of circumstances where the decision maker would care about the outcome. For example, in the Knightian world, an ongoing investment may not be considered risky even though the investment is expected to continue to generate losses because its outcome (losses) has little or no variance. Similarly, a firm producing profitable returns would not be considered risky even though its profitability might be considerably less than that of its competitors. A strategic approach to risk under such circumstances would place a high degree of importance in terms of an

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investment's relative performance rather than as the probability of the performance itself.

March and Shapira (1997, p. 1407) argue the strategic perspective definition of risk allows managers to see risk in ways that are both less precise and different from risk as seen from decision theory. First, uncertainties about positive outcomes are not seen as an important aspect of risk. They suggest that most managers associate risk with negative outcomes when asked. Baird and Thomas (1990) supported their findings when in a survey of 670 financial analysts they found that the frequency of the definition of risk was in the following order: 1) size of loss, 2) probability of loss, 3) variance, and 4) lack of information. Second, risk for these managers is not primarily a probability concept. Instead risk is viewed in terms of size or magnitude of loss rather than moments of the outcome distribution or the probability of loss. For example, a manager would consider a million pound project as risky; a project costing one pound bears no risk. This tendency to focus on the size of loss is defined as loss aversion (Kahneman and Tversky, 1979; Thaler et al., 1997) rather than risk aversion. Third, decision theory suggests risk can be quantified in terms of a single number representing a probability. However, MacCrimmon and Wehrung (1986) study found most executives perceive risk as multidimensional and were reticent to reduce risk to a single quantifiable construct. Shapira (1995) reinforced this finding that risk is multidimensional.

In modern financial theory, the importance of risk has been widely acknowledged with the development of risk-return models such as CAPM (Black, 1972) and the introduction of financial products to manage risk (Miller, 1992). The risk dimension from a modern finance perspective was first developed from portfolio theory (Markowitz, 1952). Markowitz's portfolio theory was further extended and developed into the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965; and Black, 1972). Risk under CAPM is split into two dimensions: systematic and unsystematic risk. Firm specific or unsystematic risk is not relevant to investors holding widely diversified portfolios of securities. The only relevant risk is systematic risk which cannot be reduced or diversified away as it is associated with economic wide factors and hence affects all securities. In a CAPM world, investors are concerned only about systematic risk (beta) defined as the covariance of the returns to the security with those of the market portfolio, divided by the variance of the market portfolio. Beta represents a firm's risk premium (cost of equity) which is used as discount rate by widely diversified investors to compute a firm's net present value. Beta thus uses expected variance derived from historical returns as a measure of risk. Note that CAPM does not actually define risk; it merely offers a way to operationally define some specific aspect of perceived risk.

Following Machol and Lerner (1969) paper, Joy and Barron (1974) attempt to describe risk that may be used in capital budgeting decisions. They view risk as the probability of loss and concluded that the investment decision becomes a chance constrained problem where projects are rejected if the probability of 'failure' is larger than some prescribed level. Their conclusion offers a glimpse into a less formalized pre CAPM risk analysis world where the 'hurdle rate' employed is the probability of loss.

The usefulness of CAPM as a risk-return model offering the beta as a risk metric in investment appraisal is questionable on three grounds. First, academic researchers have noted that CAPM's simplifying assumptions do not reflect reality. For example, CAPM assumes investors are compensated only for systematic risk (beta) because they own widely diversified investments. In reality, Chatterjee et al.. (1999) questioned whether investors care about firm-specific risk because many of them especially retail investors' portfolios are not fully diversified and the financial markets are not as perfect as CAPM assumes. Second, beta is an ex post measure of risk. However, risk should be conceptualized in an ex ante fashion to reflect the fact that in investment appraisal, risk is the '*uncertainty … that exists before the commitment rather than afterwards*' (Bowman, 1982). Finally, CAPM theory is based on traded financial assets whereas decisions on capital investments are about real assets. Thus managers may question the usefulness of beta and instead rely on their own judgments when evaluating investment projects.

In the context of the above, our survey seeks to find out whether risk perceptions by respondents influence their approach to risk in capital budgeting practices.

1.2. Definition and perception of uncertainty. In capital investment appraisal, uncertainty normally exists because the future outcome of investment decisions is uncertain as information is incomplete at the time the decision is made (Verbeeten, 2005). Thus when evaluating capital investments, quantifiable variables affecting them represent risks whereas qualitative factors affecting decision-makers' confidence represent uncertainties (Alessandri et al., 2004). Given the vary-

ing levels of risk and uncertainty that can affect an investment decision, Courtney et al. (1997) suggest that as uncertainty rises, more qualitative tools are employed. Alessandri (2003) too found that managers resort to judgment and experience as uncertainty increases even though they continued to go through the process of undertaking quantitative analysis. This implies that when high uncertainty and lack of data exist, managers should employ a more qualitative approach to bolt onto the financial analysis. Miller and Waller (2003) propose that in developing an integrated risk management tool, a firm should identify the full range of uncertain contingencies affecting business performance. The exposure to uncertainties can be classified under three broad levels namely general environmental, industry and firm specific. Once managers have identified the relevant uncertainties, they can assess the degree of their integration and relevance on business performance.

General environmental uncertainties refer to factors that affect all firms in the business environment such as changes in government, economic wide policies and regulation. Industry level uncertainties come from unpredictability relating to factors affecting specific industries like suppliers, buyers and changes in consumer tastes. Firm specific uncertainties relate to a firm's activities like operational changes, future legal liability and environmental impact costs.

In our survey, we attempt to identify the key uncertainties under each broad level and analyze how they affect the choice of capital budgeting practices.

2. Research methodology and respondent profile

2.1. Research design. Our questionnaire-based survey instrument focuses on perception of risk and uncertainty and relevance of discounted cash flow techniques in investment appraisal.

We reviewed the existing literature before designing a draft survey instrument which was circulated to a small group of finance professors for feedback. The questionnaire was then sent to a manager responsible for surveys in a research consultancy firm for comment on its design in order to improve the response rate. Based on the feedback received, the revised questionnaire was piloted to twelve UK listed firms. Changes were then made to the structure of the survey instrument to minimize biases and maximize the response rate. The questionnaire consists of structured multiple choice questions with the final section providing space for respondents to add their comments.

We used the Hemscott financial database, which lists the universe of all UK listed firms, to identify firms that form the population of our survey. Specifically, we extracted all non-financial Main and Alternative Investments Market (AIM) firms listed on the London Stock Exchange and headquartered in UK. We excluded financial firms because they focus on financial investments rather than real capital investments. The Main market has rigorous listing requirements including at least 25 percent shares in public ownership, a minimum three years trading record and a minimum market capitalisation. The AIM market, launched with ten firms ten years ago, is seen as the junior market for small and growing firms. It now lists fourteen hundred UK and International firms with nine hundred new firms admitted within the last two years. In 2005, 387 firms joined AIM compared with just 66 flotations on the Main Market. Clearly, AIM market is now the preferred listing route to the London stock market for most firms. AIM's listing rules are attractive: no requirement for a minimum size, trading record or having publicly held shares prior to listing. AIM firms merely have to be vouched for by a nominated adviser.

To account for the size effect, we split our respondent firms into small, medium and large ones based on the number of employees. Under the UK Companies Act 1985, the number of employees is used as a criterion to determine the size of a firm; a small company has 50 or less employees, a medium sized firm has not more than 250 employees, while a large firm has more than 250 employees.

2.2. Questionnaire delivery and results. The questionnaire was sent out in December 2005 to 610 Main and 576 AIM UK registered non-financial firms. In order to encourage senior finance executives to respond, the questionnaire was addressed to the finance director of each company.

Although each questionnaire instrument identified the respondent firm, the finance directors were assured complete anonymity to improve the response rate and the reliability of the responses. Identifying respondent firms improves the survey in at least three ways. First, it implicitly increases the integrity of the survey for the respondents identifiable with the replies received. Secondly, it facilitates sending out reminder letters to firms which have not responded when first contacted.

Finally, company specific data can be identified and extracted for analysis purposes.

Sixty two questionnaires were returned to sender giving a reduced total sample of 1,124 firms. Of these, 159 (14%) useable replies were received. This response rate compares favorably with similar recent surveys, notably by Graham and Harvey (2001) and Brounen et al. (2004) which had 9% and 5% response rates, respectively.

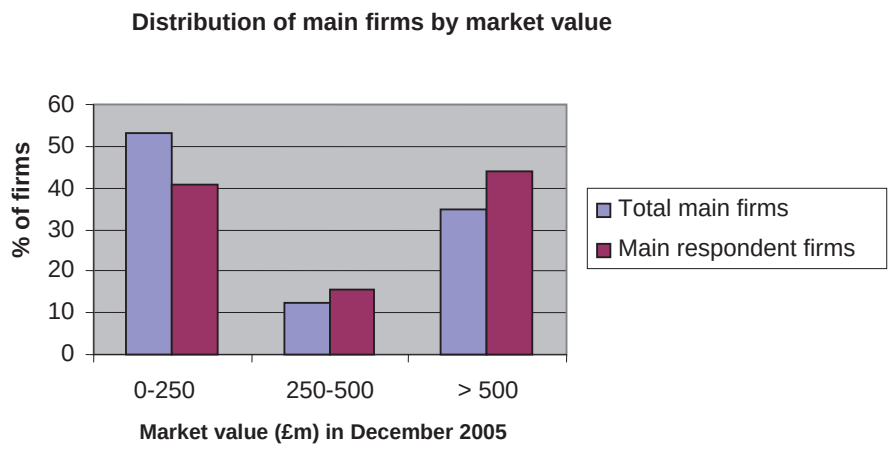
Table 1 represents summary information about firms in our sample. Ninety one replies were from Main listed firms with the remaining sixty eight firms from AIM. The firms range from small (16% of the sample firms have less than 50 employees) to large (61% have more than 250 employees). Approximately 90% of the respondents hold the position of company finance director (75%) or chief financial officer (15%), which indicates a high relevance of the respondent's views.

Table 1. Number of employees in respondent companies

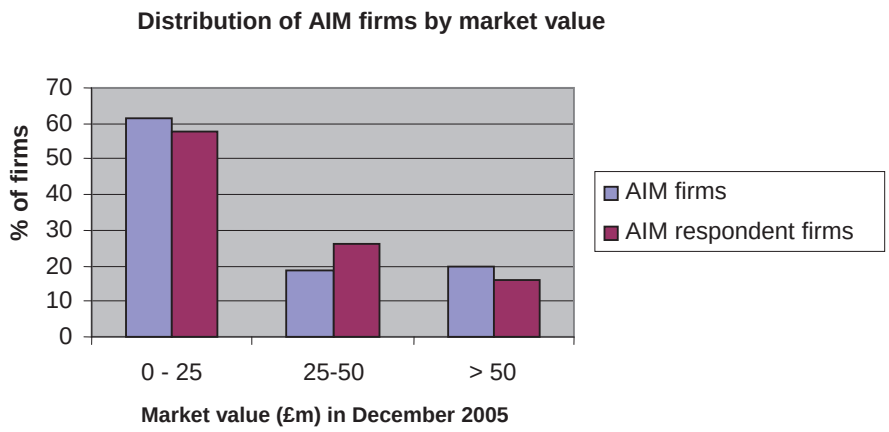
Size by number of employees	Main firms Number (N)	%	AIM firms Number (N)	%	All firms Number (N)	%
Up to 49 employees	4	4	22	32	26	16
50-249 employees	11	12	25	37	36	23
More than 250 employees	76	84	21	31	97	61
Total	91	100	68	100	159	100

In terms of distribution of market value, 41% (compared with 53% on Main market) of our respondent Main firms, have a market capitalization of less than £250m, whilst 44% (compared with 35% on Main market) are valued at above £500m (See Figure 1A below). The market capitalization of our respondent AIM firms ranges from 58% (compared with 61% of firms listed on AIM) having a market value of less than £25 million to 16% (20% on AIM) valued at more than £50 million (see Figure 1B below).

Panel A. Main companies market value (£m)



Panel B. AIM companies market value (£m)



Panel C. Respondent firms by industry classification

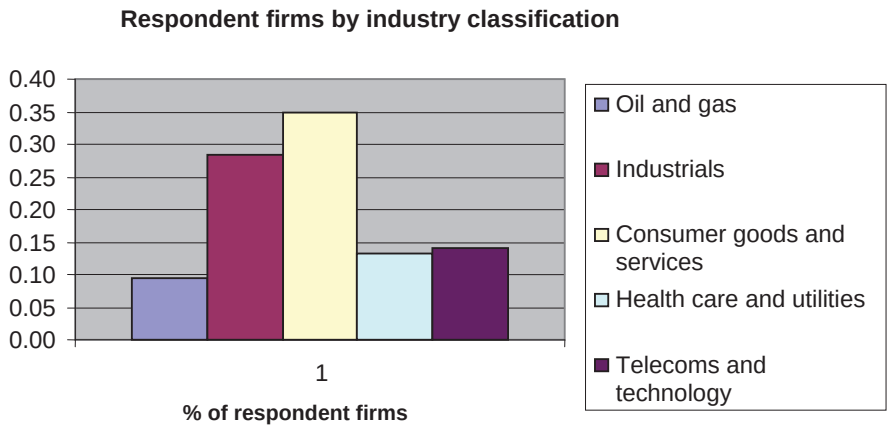


Fig. 1. Firm characteristics

Based on the International Classification Benchmark (ICB) industry classification, the largest proportion (35%) of our respondent firms are in the consumer goods and services industry followed by industrials (28%), as in Figure 1C.

3. Perception of risk and uncertainty: data analysis

The firm's perception of what risk represents prior to considering investing in capital projects provides valuable insight into the determination and usage of risk measures. This section investigates how risk is perceived and analyzez the importance of uncertainty variables during the planning stage of capital budgeting.

3.1. Preliminary data analysis. We used and extend Baird and Thomas's risk definitions in our survey question. The first two definitions focused on the semi-variance risk variable represented by the magnitude and probability of loss. The following two descriptions split the definition of risk variance into fluctuations in profits and fluctuations in cashflows to discriminate between accounting (profits) and cash (cashflows) concepts, following Chatterjee, Wiseman, Fiegenbaum and Devers (2003). The final definition, lack of information, was added to capture a firm's preference to qualitatively express their risk perception. An important caveat here is that although we stressed in the survey form that the respondent should define risk from the firm's perspective, it is not possible to verify whether their risk definition is from their firm's viewpoint or a personal perspective.

Our innovations in terms of questionnaire design are twofold. First, we inquire into the managers' perception of risk when considering capital investments, an issue not investigated in published postal surveys on capital investment appraisal. Second, we investigate the manager's perception of the source of uncertainty when the company is planning new capital investment activities. Specifically, we offer a menu of uncertainty sources including political (e.g., change in government), macroeconomic, market-specific and firm-specific.

The results reported in Table 2 show that the most common risk description is fluctuations in cash flows (43% all respondent firms) when considering capital investments. One in three of all respondent firms describes risk either as potential size or probability of loss with a fifth of them suggesting variance in profits as their risk definition. Only a small minority of respondents (3 %) attribute lack of information when describing risk. This finding suggests respondent companies are able and willing to distinguish the notion of what risk represents from uncertainty. It also indicates respondent companies predominantly view risk perception as a quantifiable variable with a 2:1 ratio preferring variance to semi-variance as their risk definition.

Table 2. Survey responses to the question: From your company's perspective, how is risk best described when considering capital investments?

	All firms	Firm listing		Firm size			Usage of DCF technique		
	(N = 156) %	Main (N = 89) %	AIM (N = 67) %	Small (N = 26) %	Medium (N = 36) %	Large (N = 94) %	Primary (N = 73) %	Secondary (N = 48) %	No usage (N = 35) %
Potential size of loss	22	23	21	23	22	21	21	21	26
Probability of loss	12	15	9	15	6	14	14	2	23

Table 2 (cont.). Survey responses to the question: From your company's perspective, how is risk best described when considering capital investments?

	All firms	Firm listing		Firm size			Usage of DCF technique		
	(N = 156) %	Main (N = 89) %	AIM (N = 67) %	Small (N = 26) %	(N = 156) %	Main (N = 89) %	AIM (N = 67) %	Small (N = 26) %	(N = 156) %
Fluctuations in profits	20	19	21	11	25	20	8	31	29
Fluctuations in cash flows	43	42	43	46	39	44	53	44	20
Lack of information	3	1	6	4	8	1	4	2	3

Note: There were 3 non-useable replies for this question.

Apart from less AIM respondents viewing risk as the probability of loss (9% of them compared with 15% of Main respondents), firm listing does not appear to be a significant factor when respondents perceive risk. In addition, from Table 2 we see that fluctuations in cash flows are the most commonly cited risk definition across all companies and by firm listing category with probability or size of loss as the second most common definition. Our findings are in contrast to March and Shapira (1987) suggestion that managers are more concerned about adverse outcomes when conceptualizing risk. On the whole, fluctuations in cash flow are more important than volatility of profits by a ratio of approximately 2:1 irrespective of firm listing or size. Thus, senior managers of respondent companies seem to support finance theory which advocates cash flow based measures over profit based ones.

However, when controlling for size, small companies are more likely to regard risk as probability or size of loss with respondents from medium and large companies choosing fluctuations in cash flows as their main risk definition. It is interesting to note respondent companies that do not use DCF techniques in their investment appraisal, selected probability or size of loss to cash flow volatility as a risk definition by a ratio of over 2:1. It suggests these companies show a reluctance to undertake riskier projects requiring DCF analysis or prefer projects with short payback periods.

Table 3. Survey responses to the question: 'When planning for your company's new capital investment activities, how important are the following uncertainties?'

Uncertainty variables	All firms (N = 159)		Firm listing		Firm size		Usage of DCF Technique	
	% Highly Important	Mean	Main (N = 91)	AIM (N = 68)	Small/Medium (N = 62)	Large (N = 97)	Primary/Secondary (N = 124)	No usage (N = 35)
Political	14	1.76	1.82	1.68	1.77	1.75	1.78	1.69
Government policy	33	2.24	2.29	2.18	2.19	2.27	2.27	2.11
Macroeconomic policy	26	2.07	2.19	1.92**	2.00	2.12	2.07	2.09
Input market	31	2.06	2.10	2.01	2.05	2.07	2.06	2.09
Product market	50	2.32	2.23	2.44*	2.26	2.36	2.32	2.31
Operations	44	2.28	2.23	2.35	2.35	2.24	2.26	2.37
Legal	26	2.01	1.99	2.03	1.95	2.04	2.05	1.86
Environmental	21	1.85	1.97	1.71**	1.74	1.93	1.89	1.74

Note: Means marked with *, ** are significantly different at a 10% and 5% confidence level from the mean in the preceding column, using a standard differences of means test.

Table 3 reports the survey results about managerial perception of the sources of uncertainty. It shows all companies highly rate uncertainty as originating from the product market (50%), operations (44%) or government policies (33%); the other possible sources of uncertainty are not accorded high importance. This finding is upheld even when Main companies as well as AIM companies are analyzed separately. Even when the companies are categorized by size, the results show that size does not matter: small and medium companies like large companies, conceptualize similar sources of uncertainty. Moreover, the same finding is upheld even when companies are classified by the usage of DCF technique into primary users, secondary users and no-users. Overall, therefore, the managerial perception of the main sources of uncertainty places heavy weight on the product market, operations and government policies.

3.2. Regression analysis. *3.2.1. Data and sample.* We further investigated the significance of the uncertainty and company specific variables on the use of discounted cash flow approach by respondent companies. Starting with the respondent sample companies' sample, we obtained company accounting data extracted from DataStream for the year 2004. Thirteen companies whose accounting data were either incomplete or unavailable were omitted leaving one hundred and forty-six companies in the resulting sample.

3.2.2. Description of empirical variables. Two definitional types of dependent variables were examined, namely capital budgeting practice and discounted cash flow usage. Capital budgeting practice variable is defined as respondent companies using either primary or secondary DCF usage. These companies were given a value of 1 with those not using DCF assigned a value of 0. Discounted cash flow usage variable splits usage into three categories, that is, primary, secondary and no usage companies and they were assigned values of 1, 2 and 3 respectively.

As a company's capital budgeting practice is likely to be influenced by factors in addition to its perception of risk and uncertainty, several control variables were introduced to capture the factors that may contribute towards its use of the discounted cash flow approach. The control variables included in this study are company type, firm size and the level of capital investment

The company listing hypothesis suggests that Main listed companies are more likely to use some form of DCF technique than AIM listed companies as more detailed market listing requirements and a higher presence of institutional investors are found in the Main market. The company size hypothesis posits that large companies are more likely to employ DCF approaches due to relatively more complex, larger and longer investment horizons. The number of full time employees and net sales variables act as proxies for company size. The level of capital investment hypothesis suggests that companies with a higher proportion of capital investment are more likely to embark on non-routine projects requiring some degree of sophistication to indicate risk as represented in a DCF model. We use the capital expenditure as a percentage of net tangible assets to proxy for this control variable.

We employ industry sector dummy variables to allow for the potential effect of using a cross-sectional industry variation. The sample firms are divided into five broad industry sectors based on the ICB adopted by the London Stock Exchange.

The following general regression model was used to examine the link between DCF usage and perception of uncertainty.

$$CBP_i = \lambda_0 + \sum_{j=1}^{n} \alpha_j UNC_j + \sum_{k=1}^{n} \beta_k X_k + \mu_i \,, \qquad (1)$$

where *CBP* = capital budgeting practice; *UNC* = vector of all uncertainties; and *X* = vector of control variables.

The above regression model was expanded to produce the following capital budgeting equation:

$$\begin{aligned} CBP_i &= \lambda_0 + \lambda_1 UPOT_i + \lambda_2 UGOV_i + \lambda_3 UMAC_i + \\ &+ \lambda_4 UINP_i + \lambda_5 UPM_i + \lambda_6 UOP_i + \lambda_7 ULEG_i + \\ &+ \lambda_8 UEN_i + \beta_1 COTY_i + \beta_2 FTE_i + \beta_3 NS_i + \beta_4 CX_i + \\ &+ \beta_5 OGM_i + \beta_6 IND_i + \beta_7 CG_i + \beta_8 HCU_i + \beta_9 TT_i + \mu_i . \quad (2) \end{aligned}$$

The above regression model was again expanded to produce the following discounted cash flow equation:

$$\begin{aligned} DCF_i &= \alpha_0 + \alpha_1 UPOT_i + \alpha_2 UGOV_i + \alpha_3 UMAC_i + \\ &- \alpha_4 UINP_i + \alpha_5 UPM + \alpha_6 UOP_i + \alpha_7 ULEG_i + \\ &+ \alpha_8 UEN_i + \tau_1 COTY_i + \tau_2 FTE_i + \tau_3 NS_i + \tau_4 CX_i + \\ &+ \tau_5 OGM_i + \tau_6 IND_i + \tau_7 CG_i + \tau_8 HCU_i + \tau_9 TT_i + \mu_i , \quad (3) \end{aligned}$$

where CBP_i = capital budgeting practice (1 for primary or secondary DCF usage, 0 for no DCF usage); DCF_i = discounted cash flow (1 for primary DCF usage, 2 for secondary DCF usage and 3 for no DCF usage); *UPOT* = political uncertainty; *UGOV* = government uncertainty; *UMAC* = macroeconomic uncertainty; *UINP* = input market uncertainty; *UPM* = product market uncertainty; *UOP* = operations uncertainty; *ULEG* = legal uncertainty; *UEN* = environment uncertainty; *COTY* = company listing; *FTE* = full time employees; *NS* = net sales; *CX* = capital expenditure as a % of net tangible assets; *OGM* = oil/gas/basic materials sector; *IND* = industrials sector; *CG* = consumer goods and services sector; *HCU* = healthcare/utilities sector; *TT* = telecoms/technology sector and μ_i = error term.

3.2.3. Regression results. Table 4 depicts the descriptive statistics for the dependent and explanatory variables. Government, product market and operations uncertainties, on average, are seen as more important than political and environmental uncertainties. Three out of five respondent companies are listed on the Main market. The average level of capital investment expenditure is rather low at less than 0.3% of a company's net tangible assets. The industry sectors are broadly represented especially by consumer goods and services companies within the sample.

Table 4. Descriptive statistics (146 observations)

Variables	Mean	Std. dev.	Min.	Max.
Capital budgeting practice (CBP)	0.8356	0.3719	0.0000	1.0000
Company type (COTY)	0.6164	0.4879	0.0000	1.0000
Political uncertainty (UPOT)	1.7602	0.6879	1.0000	3.0000
Government uncertainty (UGOV)	2.2397	0.5908	1.0000	3.0000
Macroeconomic uncertainty (UMAC)	2.0822	0.6696	1.0000	3.0000
Input market uncertainty (UINP)	2.0822	0.7382	1.0000	3.0000
Product market uncertainty (UPM)	2.3151	0.7679	1.0000	3.0000
Operations uncertainty (UOP)	2.2739	0.7289	1.0000	3.0000
Legal uncertainty (ULEG)	2.0274	0.7234	1.0000	3.0000
Environmental uncertainty (UEN)	1.8767	0.7324	1.0000	3.0000
DCF usage (DCF)	1.6575	0.7468	1.0000	3.0000
Full time employees (FTE)	7986	23234	3	209000
Net sales (NS)	1005436.96	2988038.42	0.0000	2.0359D+07
Capital exp. as a % of net tangible assets (CX)	0.2820	0.7772	-0.7380	5.0511
Oil/gas/basic materials sector (OGM)	0.0890	0.2858	0.0000	1.0000
Industrials sector (IND)	0.2808	0.4509	0.0000	1.0000
Consumer goods and services sector (CG)	0.3425	0.4762	0.0000	1.0000
Healthcare/utilities sector (HCU)	0.1438	0.3521	0.0000	1.0000
Telecoms/technology sector (TT)	0.1438	0.3521	0.0000	1.0000

Table 5 shows how the variables are correlated. Notice that usage of DCF approach in investment appraisal is moderately positively correlated with a company's listing. Political and government uncertainties are highly correlated which is expected. Full time employees' variable is highly negatively correlated with DCF usage indicating the larger the respondent company is, the more likely it will use DCF technique.

Table 5. Correlation matrix (n = 146)

	CBP	COTY	UPOT	UGOV	UMAC	UINP	UPM	UOP	ULEG	UEN	DCF	FTE	NS	CX	OGM	IND	CG	HCU	TT
CBP	1.00																		
COTY	0.22	1.00																	
UPOT	0.09	0.11	1.00																
UGOV	0.12	0.11	0.50	1.00															
UMAC	-0.03	0.20	0.07	0.16	1.00														
UINP	-0.05	0.03	0.05	-0.06	0.01	1.00													
UPM	0.04	-0.15	-0.23	-0.06	0.07	0.28	1.00												
UOP	-0.01	-0.07	-0.05	-0.01	-0.12	0.16	0.25	1.00											
ULEG	0.09	-0.07	0.01	0.13	-0.03	0.18	0.23	0.31	1.00										
UEN	0.08	0.16	0.26	0.26	0.09	0.11	-0.01	0.22	0.25	1.00									
DCF	-0.80	-0.25	-0.15	-0.14	0.11	0.05	0.01	-0.02	-0.07	-0.21	1.00								
FTE	0.14	0.26	0.14	0.16	-0.01	0.06	-0.02	-0.03	-0.03	0.19	-0.22	1.00							
NS	0.13	0.26	0.12	0.22	-0.01	0.05	0.01	-0.02	-0.04	0.16	-0.21	0.85	1.00						
CX	0.09	0.09	-0.03	0.03	-0.09	-0.06	0.03	0.08	0.06	0.00	-0.11	0.01	0.04	1.00					
OGM	0.14	-0.05	0.32	0.12	-0.15	-0.10	-0.19	0.11	-0.05	0.35	-0.28	0.11	0.01	-0.04	1.00				

Table 5 (cont.). Correlation matrix (n = 146)

IND	0.03	0.15	0.04	-0.05	0.08	0.12	-0.04	-0.07	-0.09	0.06	0.02	0.04	0.00	-0.01	-0.20	1.00			
CG	-0.11	0.01	-0.17	-0.10	0.32	-0.16	0.06	-0.21	-0.09	-0.19	0.23	-0.08	-0.10	-0.07	-0.23	-0.45	1.00		
HCU	0.08	-0.04	0.06	0.10	-0.23	-0.02	0.06	0.11	0.04	-0.06	-0.18	0.00	0.12	-0.04	-0.13	-0.26	-0.30	1.00	
TT	-0.08	-0.12	-0.14	-0.00	-0.20	0.17	0.06	0.17	0.23	-0.04	0.06	-0.03	0.00	0.19	-0.13	-0.26	-0.30	-0.17	1.00

Note: The abbreviations are as follows: capital budgeting practice (CBP), company type (COTY), political uncertainty (UPOT), government uncertainty (UGOV), macroeconomic uncertainty (UMAC), input market uncertainty (UINP), product market uncertainty (UPM), operations uncertainty (UOP), legal uncertainty (ULEG), environment uncertainty (UEN), DCF usage (DCF), full time employees (FTE), net sales (NS), capital exp. as a % of net tangible assets (CX), oil/gas/basic materials sector (OGM), industrials sector (IND), consumer goods and services sector (CG), healthcare/utilities sector (HCU), telecoms/technology sector (TT).

Not surprisingly, companies in the oil, gas and basic materials sector show a high positive correlation with DCF usage suggesting that the approach is appropriate to account for the risky nature, size and potential length of the investment period. The strong positive correlation between political and environmental uncertainties certainly highlights the environment in which these companies operate. Potetial worries about market interest rate fluctuations meant that consumer goods and services companies report macroeconomic uncertainties as their most important concern. On the other hand, telecoms and technology companies are much more concerned with legal uncertainties indicating their concerns with issues such as product liability and copyright legislation.

Table 6. Regression results with capital budgeting practice and discounted cash flow as the dependent variables

Explanatory variables	Capital budgeting practice (A)	Discounted cash flow	
		(B)	(C)
Constant	0.585 (5.845)	2.113 (11.447)	1.995 (9.885)
Company type	0.180 (2.928) ***	- 0.396 (- 3.385) ***	- 0.400 (-3.454) ***
Operations uncertainty			0.040 (0.508)
Legal uncertainty	0.060 (1.450)		
Environmental uncertainty		- 0.078 (- 0.925)	
Capital exp. as a % of net tangible assets			- 0.110 (-1.511)
Oil/gas/basic materials sector	0.203 (1.935) *	- 0.691 (-3.182) ***	- 0.859 (-4.295) ***
Consumer goods and services sector		0.163 (1.260)	
Healthcare/utilities sector		- 0.417 (-2.440) **	- 0.509 (-3.139) ***
R-squared	0.085	0.214	0.211
R-squared (adj)	0.065	0.185	0.183

Notes: a) The regressions are performed using ordinary least squares (OLS) specification. Numbers in parentheses are obtained standard errors robust to heteroskedasticity. For brevity, variables which produce no results are not reported. b) Column A above corresponds to Equation (2), while Columns (B) and (C) correspond to Equation (3) in the text. c) *** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Table 6 presents the results of the regression of DCF usage on uncertainty and control variables. Of the uncertainty variables, only operations, legal and environmental uncertainties bear the correct sign but the coefficients are not significant at the 10% level. The control variables, on the other hand, produce some interesting findings. The company listing variable shows coefficients which are significant at the 1% level, suggesting this variable has a significant impact on DCF usage thus supporting the company listing hypothesis. The size effect does not appear to be relevant as both proxies for size (full time employees and net sales) produce no significant results, indicating that size does not affect DCF usage. The proxy variable for the level of capital investment shows a negative coefficient implying a moderate association with DCF usage. This finding suggests that companies with higher levels of capital investment tend to use DCF as a main quantitative evaluation tool in investment decisions. There are highly negative coefficients with at least 5% level of significance when companies in Oil/Gas/Basic Materials and Healthcare/Utilities industries are investigated using the respective dummies in the regression. This result suggests companies in these sectors tend to adopt a DCF approach in investment appraisal.

The reported results may be affected by potential omitted variables, such as age and raising debt finance for capital investments. For example, companies which raise debt finance invariably will be required to produce discounted cash flow forecasts. However, this study focuses on cross-sectional rather than time series data and in doing so, the findings may be specific for the period concerned.

4. Use of discounted cash flow techniques: data analysis and results

In theory, companies should use DCF methods when selecting between investment alternatives. This section asks companies whether or not they use DCF techniques in capital budgeting. If they do, they were asked to indicate which DCF techniques are employed to account for risk in capital investment appraisal. Previous studies have focused on the usage of specific DCF evaluation methods like the internal rate of return (IRR), net present value (NPV) and payback. We choose to focus on the processes in using DCF such as adjusting discount rate and cash flows instead because the evaluation methods follow on from these processes.

Table 7 reports the results on the use of DCF as a quantitative tool. 22% of all respondents mentioned that DCF techniques were not employed. When analyzed by firm listing, over a third of AIM companies (37%) do not use DCF techniques compared with less than 11% of Main companies. Firm size appears to be a significant factor in the DCF usage. We find that most large companies employ DCF, which is consistent with previous studies (Arnold and Hatzopolous, 2000; Pike, 1996; and Graham and Harvey, 2001). However, the percentage of small and medium sized companies using DCF appears to have fallen when compared with Arnold and Hatzapolous' findings. This is rather puzzling because the wide availability and low cost of financial software packages should encourage more companies to use DCF, unless such companies find the assumptions underlying NPV rule impractical or are making suboptimal decisions (Arnold and Hatzapaulos, 2000, p. 609).

Table 7. Survey response to the question: Does your company use DCF techniques for capital investment appraisal?

Answers	All frms (N = 159) %	Firm listing		Firm size		
		Main (N = 91) %	AIM (N = 68) %	Small (N = 26) %	Medium (N = 36) %	Large (N = 97) %
Yes, as the primary quantitative tool	48	58	34	46	39	52
Yes, as a secondary quantitative tool	30	31	29	8	33	35
No, we do not use DCF	22	11	37	46	28	13

We ask firms to indicate their reasons if they do not use DCF in their investment appraisal. All respondents from the 34 non-DCF usage firms did and their reasons may be grouped under four main categories. First, they prefer a non-DCF risk measure like payback or return on income. Those respondents who said so, mentioned their rationale is to avoid risk and invest in short-term projects yielding quick or high returns. For instance, a respondent replied, 'Our investments are short-term quick payback and therefore DCF is of little or no relevance.' Secondly, a number of respondents said discounted cash flow model assumptions and technique may be unnecessarily too sophisticated and their investment decisions do not require that level of complexity. For example, a respondent's comment was, 'DCF is too theoretical and unnecessarily complex.' Another said, 'because the main variable in investment appraisal is sales, and this is very difficult to predict, a very large margin is used to determine whether an investment is worthwhile. Discounting cash flows by a rate of say 10% would not affect the outcome.' A third respondent mentioned that 'their investments were too complex to model sometimes which meant decisions have to be more intuitive and reliant on shorter range call plan.' The third group of respondents argued that their capital investments were too minimal or specialized in nature to warrant the use of DCF approach. For example, one respondent replied, 'we have little tangible capital expenditure other than IT. Most of the time, this capex is a must and so investment appraisal is academic.' Another said, 'development company needs equipment whatever the DCF might be.' Finally, other respondents suggested their surplus cash position and low market interest rates meant DCF approach is not appropriate. For instance, one respondent commented that, 'interest rates are so low that DCF is not deemed relevant, it is just cash flow (re: ignore the D).' Another respondent mentioned 'it is the policy to hold cash on 90 days deposit (low risk) and use the cash to pay for capex.'

From these reasons cited, we may make the following inferences from the non usage of DCF techniques. First, these companies have relatively higher loss adverse propensity than their DCF usage counterparts as evidenced by their risk perception (See Table 2). As a result, they choose to invest in relatively low risk projects that have short investment horizons. Secondly, some practitioners have no faith in DCF models either because they find it unreliable or complicated. It suggests a gap exists between theory and practice despite the widespread popularity of teaching DCF approach in investment appraisal in business schools. Thirdly, respondents' ignoring the relevance of DCF approach when their capital investments are minimal or essential implies a preference for simplicity as found in naïve approaches like the payback method. Finally, companies with cash surpluses are not expected to raise finance for their capital investments in the short term. Therefore, as the opportunity cost of surplus cash is low, they may find it unnecessary to account for risk as required in DCF analysis.

In general, the DCF approach appears to be adopted by large firms with a significant number of small/medium sized firms preferring non-DCF methods like payback and ROCE. It seems that some smaller firms still prefer to resort to rules of thumb such as payback even though its deficiencies are well documented.

Firms that use DCF (124 in total) were asked to indicate which DCF techniques are used to account for risk in their capital investment. The summarized Table 8 reveals around two-thirds of firms irrespective of size or listing, prefer to apply sensitivity analysis or adjust their discount rate to account for risk in their investment appraisals. Adjusting cash flow for risk came third across all companies. It is somewhat surprising to find scenario analysis used less frequently although more large companies say they use it than small or medium sized companies. Given the ease in using the scenario analysis tool found in popular spreadsheet packages, it appears many smaller companies find this tool much too sophisticated for the type of investments undertaken. These findings are consistent with Arnold and Hatzopolous (2000) and Pike (1992) studies. However, our survey found that considerably less number of companies use decision trees (only 5% of all companies) to that of Arnold and Hatzopolous (2000) and Pike (1992) studies. This anomaly may be caused by terminology differences (probability analysis term used by them instead of decision trees) or the different characteristics of our respondents.

Table 8. Survey response to the question: When using DCF techniques, how does your company account for the risk in capital investment?

	Adjust discount rate %	Adjust cash flows %	Apply sensitivity analysis %	Apply scenario analysis %	Use decision trees %	Other %
All firms (N = 124)	64	39	70	23	5	2
Main firms (N = 81)	67	40	69	25	8	3
AIM firms (N = 43)	58	37	72	21	0	0
Small / Medium (N = 40)	65	40	63	20	8	0
Large (N = 84)	63	38	74	25	4	4

Overall, the empirical findings, based on the regression results in Table 6, are that the capital budgeting practices adopted by the firms in our sample are influenced mainly by company type and to a less extent by the membership of the company in the oil, gas and basic materials sector. In addition, the non-usage of DCF by firms can be reliably attributed to company type, the membership of the company in the oil, gas and basic materials sector, and membership of the health care and utilities sector. In sum, whether the question is one of non-usage of DCF or one of capital budgeting practice, the most influential determinant is company type. Hence, the type of company matters for non-usage of DCF and company budgeting practice.

Conclusions

This paper presents the findings of a survey of risk perception and capital budgeting practices used by a sample of 159 UK companies listed on Main and AIM markets. Our survey indicates the most common description of risk is a project's cash flow volatility. This is reassuring for it and confirms the theoretical relevance of cash flow based measures over profit based measures in capital budgeting. However, it is interesting to note that companies that do not use DCF techniques are more averse to the risk of loss rather than fluctuations in cash flow or profits. A possible behavioral reason could be that they are highly risk averse and will only accept projects with short payback periods, such that there is no necessity to use DCF techniques. It is notable that a significant number of AIM companies do not use DCF analysis. As the majority of AIM companies were listed over the last two years, and thus have recently raised new finance, it is reasonable to suggest that they currently have substantial cash reserves on tap, thus avoiding the need to perform DCF analysis in the short term.

Our survey results find that the larger the size of the firm is, the more likely it will use DCF techniques, which is consistent with published survey studies. The results also indicate that larger companies, especially on the Main listing tend to employ relatively more sophisticated techniques such as scenario analysis and decision trees. Overall, these findings suggest that the theory-practice gap still exists in terms of the perception of risk and uncertainty and non-usage of DCF by financial managers of listed companies in the UK.

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