Determinants of the use of capital investment appraisal methods: Evidence from the field
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Authors: Paulo Afonso (Assistant Professor) and Jorge Cunha (Assistant Professor)

Affiliation: Department of Production and Systems
University of Minho
Campus de Azurém
4800-058 Guimarães
Portugal

E-mail address: psafonso@dps.uminho.pt (corresponding author)
jscunha@dps.uminho.pt

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ABSTRACT

In this paper, it is argued that there are specific contingencies that explain why firms use and do not use specific capital investment appraisal methods; namely, the pressure of competitive environment, firm's strategy, production technologies and firm's age. Several studies on the impact of such variables on management systems can be found in the literature (Abernethy and Lillis, 1995; Langfield-Smith, 1997). Nevertheless, there is little empirical evidence on the factors that explain the use of capital investment appraisal methods (CIAM) by firms. A questionnaire was designed to collect empirical evidence on the use of capital investment appraisal methods in the larger 500 Portuguese non-financial companies. It is expected that, in practice, CIAM could be regarded not only as an ad hoc usage of more or less sophisticated techniques, but characterised by different levels of sophistication and completeness. In this paper, we present an appropriate questionnaire for the analysis of CIAM in practice. Moreover, some research hypotheses for further analysis are presented. Further work using different statistical approaches, different samples and case study research is expected.

Keywords: Capital investment appraisal methods, decision making process, large firms, contingent variables, survey data.

INTRODUCTION

Capital investment appraisal methods or "capital budgeting practices" are tools for decision making and have been defined in the literature as the methods and techniques used to evaluate and select an investment project (Verbeeten, 2006). Some of these methods are very simple (e.g. payback period) while others are particularly sophisticated and complex (e.g. Net Present Value, Real Options Reasoning). Simpler methods do not take into account the time value of the money and do not include the risk dimension. All these methods are well documented and explained in the literature. However, there is little empirical evidence on the factors that explain the use of the different techniques by firms. Thus, this paper is focused on the use of capital investment appraisal methods (CIAM) in practice. Particularly, it analyses whether there are specific contingencies that explain why firms use and do not use specific capital investment appraisal methods.

Traditionally, the use in a systematic manner, on one hand, and of more sophisticated capital investment appraisal methods, on the other hand, has been identified with larger firms. Nevertheless, since the 1990s that organisational change and the democratization of information technologies (Sangster, 1993) may have contributed to change such status quo. Therefore, this research work seeks to show which internal and external variables influence and explain the use of CIAM namely, the pressure of competitive environment, firm's strategy, production technologies and firm's age. Several studies on the impact of such variables on management systems can be found in the literature (Abernethy and Lillis, 1995; Langfield-Smith, 1997). For example, using data from a survey, Baird et al. (2004) found that activity based management practices are particularly associated with unit size, innovation, outcome orientation and tight versus loose control.

In this research project, it was collected information on the use of capital investment appraisal methods in the larger 500 Portuguese non-financial companies through a survey. The survey was designed to gather information on the use of several capital investment appraisal methods. Moreover, it also permits to evaluate the influence of several variables on such use. A translated version of the questionnaire is presented in appendix. The first group of questions permits to identify the drivers of the use of capital investment appraisal methods (e.g. environmental uncertainty, firm's strategy) and also to define control variables (e.g. size, industry). The second group of questions is on the use of several capital investment appraisal techniques. These questions allow us to produce compounded variables that represent the level of sophistication and completeness of CIAM in practice. Factor analysis can be used to produce these underlying variables. The third group of variables is devoted to capture the level of effectiveness and resistance to change associated to the use of CIAM. The majority of the questions were measured using a five-point Likert scale. Likert scales are particularly useful to measure the level of use of each technique.

The data was collected through an electronic questionnaire. The use of electronic questionnaires (e-quests) through the web is particularly stimulated by their low cost, the fastness of the answers and the quality of the collected data as an input for statistical software packages. An electronic questionnaire and a mysql database were specifically designed for this research project. The preliminary analysis of findings highlighted that several internal and external contingencies should be taken into account when we intend to interpret the use of CIAM. On the other hand, the results obtained suggested that, in practice, CIAM is not only an ad hoc usage of more or less sophisticated techniques. In practice, CIAM should be viewed as characterised by different levels of sophistication and completeness. In this paper, we present a preliminary analysis of the data and suggest some research hypothesis for further analysis. Further work using more powerful statistical analysis, different samples and case study research is expected. Particularly, research based on case studies may reveal how and why companies can be considered more sophisticated in their capital investment appraisal approaches.

Accordingly, the paper is structured as follows. Firstly, it presents a literature review on capital investment appraisal methods, explaining concepts and recent research on this topic. Furthermore, based on the management accounting literature, the potential internal and external determinants of the adoption and use of CIAM are listed. Secondly, the structure and the design process of the questionnaire is presented and explained. The different approaches for the analysis of results are presented in the following section. Finally, the last section presents the conclusions and the opportunities for further work.

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LITERATURE REVIEW

Capital investment appraisal methods

Capital investment appraisal literature is based on the assumption that the objective of a firm's manager is to maximise firm value, that is, the wealth of its shareholders. Therefore, capital investment appraisal and cost of capital estimation are major decisions that the financial manager has to make. In this process, it is crucial that management use accurate methods that will result in the maximization of shareholder wealth (Ryan and Ryan, 2002). In fact, managers should undertake capital investment projects only if they add to the value of the firm, which means that managers should identify and undertake all projects that add value to the company so as to maximise shareholder value (Gilbert, 2005).

"Profitable capital investment leads to the growth and prosperity of an economy. If profitability is low, investment will shrink. The investor needs tools to predict the profitability of proposed investments" (Remer and Nieto, 1995a). Over the last four decades, the academic community has been proposing several methods that can improve the capital investment decision making process of companies (Farragher *et al.*, 2001).There are many methods and techniques available to help the investor to make wise economic decisions. For a comprehensive review of the capital investment appraisal methods see Remer and Nieto (1995a,b). In the following paragraphs only a brief summary of the main methods (or the ones that have been used more for longer time) is presented, distinguishing between those that do not take into account the time value of money from those who do. Additionally, a brief reference to more sophisticated methods will be done.

In the first group (non-discounting cash flows methods) one can identify two criteria: the payback period (PBP) and the accounting average rate of return (ARR).

The payback period is based on the idea of how much time is needed for the project to generate cash flows sufficient to recover the initial amount invested. It can be also used as a criterion for acceptance or rejection of projects in the case that the payback period is above or below a certain number of years previously defined.

The main advantages of this method are: ease of understanding; simplicity of implementation; provides an idea of the degree of liquidity and risk of the project; and in times of huge instability, the use of this method is a way to increase the security of investments.

Despite these advantages, the payback method has two important drawbacks. First, it ignores the cash flows occurring after the payback time, which can lead to the rejection of profitable projects that require a longer recovery period. Second, the payback period, in its original version, does not consider the time value of money in calculating the cash flows. This is inconsistent with the basic principles of financial mathematics. One way of overcoming this problem is to calculate the payback period by discounting (at the appropriate discounting rate) the expected future cash flows, as proposed by Longmore (1989).

The accounting average rate of return (ARR) is computed as the ratio between the project's estimated average profit and the average accounting value of the investment (Brealey and Myers, 1998). This ratio is compared with the firm's accounting rate of return or other benchmark external to the firm (e.g. the industry average value).

The main advantages of this method are its simplicity of understanding and usage, given that the figures used in calculations are those provided by accounting reports. However, this method presents some important weaknesses. First, it does not take into account the time value of money. Second, being based on accounting earnings and not on the project's cash flows, it is conceptually incorrect. Finally, there is the need to set a target rate of return as a prerequisite to apply ARR as an appraisal method (Akalu, 2001).

In the second group of methods (discounting cash flow methods, DCF) one can distinguishing between the net present value (NPV) and the internal rate of return (IRR).

The net present value (NPV) method is based on the discounting of expected future cash flows of a investment project. More specifically, it states that the present value of the project's inflows (or benefits) must exceed the present value of its outflows (or costs) if a project is to be selected. The cash flow stream includes all the payments and receipts associated with the investment project during its economic life, and it should be discounted at the opportunity cost of capital, which should reflect the risk of the project and the financing mix (Damodaran, 2001).

This criterion for evaluating projects presents the following set of advantages. First, the NPV is based on the concept of cash flow. Second, in its computation all the cash flows generated by the project are included. Finally, the cash flows are discounted at the appropriate rate of return. However, this method of investment appraisal has some drawbacks. First, it requires the *a priori* determination of the discount rate (which sometimes is difficult especially due to the determination of the risk premium). Second, in the presence of mutually exclusive projects, if

they have a different economic life and/or initial investment amount, the NPV may lead to different decision rules (Akalu, 2001). That is, the values obtained for NPV are not directly comparable. Finally, the NPV criterion is indifferent regarding the amount of initial investment needed.

The internal rate of return (IRR) is a method for evaluating investment projects widely used because it employs a percentage rate of return as the decision variable (Steiner, 1996). The IRR is determined by calculating the discount rate for which the NPV is zero. The criterion for a decision on the acceptance or rejection of a proposed investment is by comparing the IRR with the opportunity cost of capital. Thus, one should only accept to undertake a project for which the IRR exceeds the opportunity cost of capital.

According to Akalu (2001), the IRR has the advantage of being simple to interpret (as it shows percentage benefits from the given investment) and it is easier to apply than other discounted cash flow methods given that the discount rate need not be computed in the application.

On the other hand, Brealey and Myers (1998) highlight the following problems that arise with the use of IRR. First, for non-conventional cash flows (i.e. positive cash flows mixed with negative ones), there is the problem of multiple IRR. Second, in the case of mutually exclusive projects, NPV and IRR methods can lead to different conclusions about what project should be accepted. Finally, in the calculation of the IRR is the underlying assumption that the cash flows that are being generated by the project during its economic life are reinvested at the IRR. However, this seems a rather unrealistic assumption, particularly when high values are obtained for the IRR.

Given the uncertainty that involves the capital investment decision process and some shortcomings of the NPV method (deriving from some underlying hypothesis), there is a growing body of theoretical developments (see, for example, Dixit and Pindyck, 1994, and Trigeorgis, 1993) claiming for the adoption of the same reasoning as in financial options. These more sophisticated methods for project evaluation are known as real options models. In this context, an investment can be seen as a future option, which entails rights but not obligations to take some action in the future (Dixit and Pindyck, 1994). In spite of these theoretical developments, there is, however, a small usage of these more sophisticated methods by firms.

Regarding capital investments decisions practices followed by firms, in the empirical literature several studies can be found, mainly for U.S. firms (e.g. Ryan and Ryan, 2002, Graham and Harvey, 2001, Farragher *et al.*, 2001, Moore and Reichert, 1983, and Gitman and Forrester, 1977) but also for other countries, such as U.K. (Akalu, 2003, and Pike, 1984), Sweeden (Sandahl and Sjogren, 2003), Netherlands (Verbeeten, 2006), among others.

From these studies some conclusions can be highlighted. Firstly, discounted cash flow (DCF) methods are generally preferred over non-DCF (Ryan and Ryan, 2002). Secondly, there has been a shift from the use of the internal rate of return method to the net present value criterion methods, and a decrease in the use of the payback period method (Remer and Nieto, 1995a). Thirdly, the trend of applying ARR in major projects is declining (Akalu, 2001). Therefore, one can say that the analytical techniques used by executives have increased in terms of sophistication (Hermes *et al*., 2006). Or, as pointed out by Pereiro (2006: 163), "the constant preaching of financial economists on the advantages of discounting valuation techniques has paid off: while such techniques were used by only a minority of practitioners in the 1970s, they are now employed by a majority of corporations and advisors". Fourthly, survey results also show that even though over time the use of the PB method has declined as a primary tool for project evaluation, it remains to be an important secondary instrument CFOs use (Hermes et al., 2006). Fifthly, larger firms are more likely to use DCF methods (Graham and Harvey, 2001, and Ryan and Ryan, 2002). Sixthly, there are some differences among industries in the degree of usage of more sophisticated capital investment appraisal methods (Moore and Reichert, 1983). Finally, it has been observed that when DCF methods are used, they are used in conjunction with other techniques that are both theoretically deficient and redundant (Gilbert, 2005).

Internal and external determinants

According to Luthans and Stewart (1997) an organization should be defined as "a social system consisting of subsystems of resource variables interrelated by various management policies, practices and techniques which interact with variables in the environmental suprasystem to achieve a set of goals or objectives." Therefore this section is devoted to present the potential internal and external drivers of the adoption and use of capital investment appraisal methods.

In the past, there was a universalistic approach to management control derivate directly from the scientific management theory, which advocated that it is possible to maximize efficiency through the best one way design of organizational structures and procedures. However, this idea of universal solutions for management practices which can be applied to all organizations, in all contexts, has been contradicted by several studies during the 1970s. In fact, there is no universal satisfactory management control system for there are too many interacting variables (Tricker,

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1976). The adoption and use of management practices are influenced by the specific circumstances in which the organization finds itself (Haldma and Laats, 2002), i.e. the organizational internal and external context of each company. Thus, CIAM are sensitive to the milieu where they are implemented and their design and implementation must attend the organizational context specificities to improve their effectiveness. Contrasting to the classical scientific and universalistic theories that support "one best way" of managing, empirical evidence has been suggesting that the best management practices are dependent upon a set of internal and external elements that describe the context in which management control practices are applied. Consequently organizational structures and procedures should be appropriate (fit) to the internal and external characteristics facing the organization.

The environmental variables can be a large set of external factors that affect the company but the most common characteristics analysed in the literature are the following: industry specificities, competitive aspects and economy characteristics. Furthermore, there are internal characteristics which may be also taken into account namely, firm's strategy, production technologies and firm's age. Apparently, organizations under the same environmental characteristics and characterised by the same internal characteristics should have similar organizational structures. To organize the research process all these variables should be grouped. For example, Fisher (1998) grouped them in five different categories: uncertainty (task and environmental), technology and interdependence, industry/firm, strategy and observability factors. According with the option took in this research, these variables will be grouped in two generic dimensions: internal and external to the organization.

The following internal variables were studied: company's size, strategy, organizational structure and technologies adopted. Firstly, the traditional variables of size (i.e. number of employees, sales turnover) were complemented with other potentially significant variables such as the percentage of exports, the firm's age and the use of venture capital (Davila, 2005). Age has been found to be associated with the likelihood of survival, where older firms are more likely to survive than their younger counterparts. In the entrepreneurship literature to explain the level of professional management in growing firms is the presence of professional funding in the company's financial structure and, in particular, venture capital. Venture capital is a dummy variable that takes the value of one if the company has venture capital financing and zero otherwise. Secondly: firm's strategy. In spite of alternative classifications (e.g. Davila, 2005), we opted to consider Miles and Snow's (1978) and Porter's (1980) typologies. Strategy is probably one of the most important topics covered by academic research. Usually the literature presents three types of organizations according to its strategic orientation: defenders, prospectors, and analysers (Miles and Snow, 1978). Miles and Snow's (1978) typology is focused on the rate of change in products and markets. Defenders are those that have a narrow product range and undertake little product or market development; their critical functions to achieve success are finance, production and engineering. Prospectors are continually searching for market opportunities, being creators of change to which their competitors must respond. For them, marketing and R&D are the most important functions and maintaining industry leadership in product innovation is more relevant than efficiency and profit performance. Analysers combine the strongest characteristics of defenders and prospectors. On the other hand, the classification of Porter (1980) suggests three generic strategies: cost leadership, differentiation and focus. This means that, generically, firms can pursuit the objective of become the lowest-cost producer in its industry; they can opt to provide products with attributes that are highly valued by costumers; or, finally, firms can dedicate itself to a segment of the market that has special needs that are poorly served by the other competitors. Thirdly: organizational structure. The innovation literature (e.g. Damanpour, 1987) distinguishes organizational structures in two generic types: "organic" and "mechanistic" based on three major dimensions which are the levels of centralization (measured by the concentration of decision-making authority), vertical differentiation (measured by the number of hierarchical levels below CEO) and formalisation (measured by the degree of standardisation of the jobs within an organisation). Burns and Stalker (1961) suggested that "organic" structures are less standardised, less vertically differentiated and less centralised than "mechanistic" organisations. Fourthly: technologies. It was followed the classification of Kotha (1991, 2000) which groups the various advanced manufacturing technologies into four groups: product design technologies, process technologies, logistics planning technologies and information exchange technologies.

On the other hand, the following external potential determinants of the adoption and use of CIAM were tested in this research: environmental uncertainty, competition and type of industry. Firstly, seven questions were used to recognize the level of environmental uncertainty. This approach followed closely Nicolaou (2002). Secondly, to analyse the level of competition they were considered the percentage of sales being exported and the five competitive forces of Porter's model. The level of exports was taken into account based on the assumption that competition is higher for companies facing foreign markets. Porter's model defines competition according to five different dimensions: the level of barriers to entrants, the risk of product substitution, the bargaining power of buyers, the bargaining power of suppliers and the existent level of competition between market players. Thirdly, a generic classification was used to group the firms according to the industry.

Based on the above observations, this study analyses the following research question: which internal variables (e.g. company's size, strategy, organizational structure and technologies adopted) and external variables (e.g. environmental uncertainty, competition and type of industry) have a major influence on the capital investment appraisal methods (CIAM) usage by firms, namely in terms of the sophistication of procedures adopted and the variety and sophistication of methods employed.

RESEARCH METHODOLOGY

Questionnaire structure

Surveys are based on data usually collected through mail questionnaires and analysed by statistical techniques. The results of a survey have a static dimension but subsequent surveys can be used to prove changes over time. If the survey has an appropriate sample size and a correct structure, the findings obtained can be generalised. This method is often used because it is time and cost-efficient. In fact, surveys are efficient because they allow a large quantity of data to be obtained at a lower cost. On the other hand, the replication of questions is possible and permits the identification of patterns which can be compared and analysed. Generally, the data obtained through a survey is suitable for statistical analysis (Afonso, 2008).

However, the interpretation of survey data presents some limitations (Ryan and Ryan, 2002). Firstly, the responses are the opinion of one individual and thus may not fully reflect the firm's position. Secondly, survey participants may not be representative of the defined population of firms and survey questions may be misunderstood by some participants (Graham and Harvey, 2001). Finally, there is also potential concern about a non-response bias (Ryan and Ryan, 2002). Nevertheless, the survey technique has been generally accepted as a reasonable proxy given the time and personal constraints in large corporations. Moreover, surveys provide information that cannot be readily gleaned from financial statements. In particular, surveys can shed light on how firms make investment and financing decisions, and why they use these approaches (Danielson and Scott, 2006).

The questionnaire used in this research project was designed to gather information on capital investment appraisal methods adopted by the largest Portuguese non-financial companies. Furthermore, it also permits to assess the influence of several variables on the adoption of those methods, as explained in the previous section. The questionnaire also has a space for comments at the end. Respondents were invited to insert their comments. Finally, there is also a space for respondents to insert their email address in order to receive a report with the main results of the survey. The majority of the questions were measured using a five-point Likert scale. Likert scales are particularly useful to measure the level of use of a technique. The following subsections present each group of questions in more detail.

Table 1- Questionnaire structure

Group	Window	Variables	Total variables	Total questions
Group 1	General information about the firm	venture capital, industry, age, size, exports, invest. Expenditures, competition	8	12
Group 2	Analysis of external environment	environmental uncertainty	1	7
	Analysis of external environment (II)	competition	1	5
Group 3	Analysis of internal environment	strategy, org. structure	2	7
Group 4	Technologies	technology	4	4
Group 5	Investment appraisal procedures	sophistication of procedures	1	5
	Investment manual		3	4
Group 6	Capital invest. appraisal methods (CIAM)	PBP, IRR, NPV, PI, EVA,…	12	12
	Cost of capital estimation	CAPM, APT, Gordon Model, ARE	6	6
	Risk/uncertainty models	IMP, Sens., Monte Carlo simulation, …	10	10
	Level of satisfaction with CIAM	CIAM	1	1
	Comments			

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As shown in Table 1, the survey has six main groups of questions. Some of them are divided into several individual items and others are presented by using simple statements. The first group of questions relates to the general information of the firm. The second group of questions was designed to describe the external environment facing the firms, whereas the third group relates to the analysis of internal environment. The fourth group intends to give an idea of the type of technology used/adopted by firms. The fifth group of questions relates to the formal aspects of the investment decision, including information about the firm's investment manual. The sixth group concerns the use and relevance of the methods for investment appraisal (i.e. capital appraisal techniques, the cost of capital estimation, risk/uncertainty models, and the level of satisfaction with CIAM). The questionnaire is presented in detail below.

Window 1: General information about the firm
    (a) Responder position in the firm:
    (b) Venture capital: the company has or had venture capital financing?
    (c) Number of employees:
    (d) Annual sales (approx. in millions euros):
    (e) Exports (% of annual sales, approx.):
    (f) Industry:
    (g) In the last five years, the average annual capital investment expenditures have been (in millions euros):
    (h) Percentage of tangible investments:
    (i) In the last five years and relatively to the average of the industry, define the position of the firm in the following items: Sales growth / Earnings growth / Return on equity growth
    Responses on each item are measured on a five-point Likert scale: ''very below the average''—'below the average''—''on the average''—''above the average''—''very above the average''.

Window 2: Analysis of external environment

(a) How many new products and/or services have been marketed during the past 5 years by your industry?
        Scale endpoints: none and many.
(b) How would you classify the market activities of your competitors during the past 5 years?
        Scale endpoints: becoming more predictable and becoming less predictable.
(c) During the past 5 years, the tastes and preferences of your customers have become much easier/harder to predict. *Scale endpoints: much easier to predict and much harder to predict.*
(d) During the past 5 years, the legal, political and economic constraints surrounding your firm have remained about the same/have proliferated greatly.
Scale endpoints: remained about the same and proliferated greatly.
(e) How often do significant changes in product/process technology occur in your industry?
        Scale endpoints: seldom and frequently.
(f) How intense is each of the following in your industry? Bidding for purchases of raw materials / Competition for manpower / Price competition.
        Scale endpoints: of negligible intensity and extremely intense.
(g) How stable/dynamic is the external environment facing your firm? Economic / Technological.
        Scale endpoints: very stable (changing slowly) and very dynamic (changing rapidly).

All responses were measured on five-point Likert scales. Source: Nicolaou (2002).

Window 3: Analysis of external environment (II)
    (a) It is easy for new entrants to start to compete.
    (b) It is easy a product or a service to be substituted.
    (c) Buyers have a strong position.
    (d) Suppliers have a strong position.
    (e) There is a strong competition between the existing players.
Responses on each item are measured on a five-point Likert scale between: ''completely disagree'' to "totally agree". Source: Porter (1985).

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Window 4: Analysis of internal environment
In your company:
  (a) The product development rate is very high.
  (b) The functions of marketing and R&D are more critical for the organization success than financial, production and engineering functions.
  (c) Maintaining industry leadership in product innovation is more relevant than efficiency and profit performance.
  (d) The decision-making is concentrated in a few people.
  (e) There are many hierarchical levels.
  (f) The employees have very defined and standard jobs.
Responses on each item are measured on a five-point Likert scale between: ''completely disagree'' to "totally agree". Source: Miles and Snow (1978) and Gosselin (1997).
Select the statement that defines better the strategic positioning of your firm:
  (a) The organization aims to become the lowest-cost producer in its industry.
  (b) The organization aims to provide products with attributes that are highly valued by costumers.
  (c) The organization aims to dedicate itself to a segment of the market that has special needs that are poorly served by the other competitors in the industry.
Source: Porter (1980).

Window 5: Technologies
In your firm the following technologies are used:
(a) *Product design technologies*: computer-aided design/manufacturing (CAD/CAM), computer-aided engineering (CAE) and other focused on product definition and design-related information processing functions.
(b) *Process technologies*: flexible manufacturing systems (FMS), numerically controlled (NC) machines and programmable controllers that focus on the process aspects of manufacturing.
(c) *Logistics planning technologies*: technologies for controlling and monitoring the material flow from the acquisition of raw materials to the delivery of finished products and related counter flows of logistical information. It includes production scheduling systems, shop floor control systems and materials requirements planning (MRP systems, i.e. Use of computers and computer modules for controlling the entire manufacturing system from order entry through scheduling, inventory control, etc.).
(d) *Information exchange technologies*: technologies that facilitate the storage and exchange of information among process, product and logistics. Technologies such as common databases, system translators, data transfer protocols, and intra- and inter-factory networks (linking plant to subcontractors, suppliers, and/or customers).
Responses on each item are measured on a five-point Likert scale between: ''completely disagree'' to "totally agree". Source: Kotha (2000).

Window 6: Investment appraisal procedures
In your firm:
  (a) Investment projects are elaborated following a formal procedure.
  (b) Investment projects are subject to ex-post control.
  (c) Investment projects derived from identification of new business opportunities and not as a reaction to competitors.
  (d) The process of preparation and decision about investment projects is characterized as being fully centralized.
Responses on each item are measured on a five-point Likert scale between: ''completely disagree'' to "totally agree". *Source*: Gitman and Forrester (1977) and Segelod (1997)

Window 7: Investment appraisal procedures II
Do you have an investment manual in your firm?
Yes or no response. *Source*: Segelod (1997)

Window 8: Investment manual
Characteristics of the investment manual
  (a) Approximate number of pages.
  (b) Date of production/last revision of the manual

The manual applies to:
   (a) Replacement investments;
   (b) Expansion investments;
   (c) Innovation/modernization investments;
   (d) Strategic investments;
   (e) Other investments.
The firm follows a specific manual for investment in:
   (a) Fixed assets;
   (b) Research and development;
   (c) Information and communication technologies;
   (d) Human resources qualifications
   (e) Acquisitions.
The content of investment manual:
   (a) Definition of the formal process for the preparation of the investment project.
   (b) Definition of the formal process of decision.
   (c) Definition of the hierarchical authority.
   (d) Definition and estimation of cash flows.
   (e) Definition of capital investment appraisal methods.
   (f) Determination of the hurdle rate.
   (g) Effects of taxation.
   (h) Treatment of inflation.
   (i) Ex-post control of investments.
   Responses on each item are measured on a five-point Likert scale between: ''Not included'' to "Very detailed". *Source*: Segelod (1997).

Window 9: Capital investment appraisal methods (CIAM)
Capital investment appraisal methods used in your firm
   (a) Average accounting rate of return.
   (b) Payback period.
   (c) Discounted payback period.
   (d) Net present value.
   (e) Internal rate of return.
   (f) Modified internal rate of return.
   (g) Profitability index.
   (h) Earnings multiples approach.
   (i) Economic value added.
   (j) Real options.
   (k) Others.
Responses on each item are measured on a five-point Likert scale between: ''Never used'' to "Always used"
detailed". *Source:* Ryan and Ryan (2002), Graham and Harvey (2001), and Sandahl and Sjogren (2003).

Window 10: Cost of capital estimation
In cost of capital estimation the firm uses:
   (a) The capital asset pricing model (CAPM).
   (b) The multi-factor CAPM model.
   (c) The arbitrage pricing theory.
   (d) The dividends growth model.
   (e) Average historical returns on equity.
   (f) Other.
Responses on each item are measured on a five-point Likert scale between: ''Never used'' to "Always used"
detailed". *Source:* Graham and Harvey (2001).

Window 11: Risk/uncertainty models
To address the problem of uncertainty/risk associated with the investment decision, the firm uses the following methods:

    (a) Imposes a limit for the payback period.
    (b) Sensitivity analysis.
    (c) Adjusts the discount rate.
    (d) Adjusts the cash flows by the certain-equivalent method.
    (e) Uses criteria for the treatment of uncertainty (e.g. MaxMin).
    (f) Do not consider the salvage value of the investment.
    (g) Scenario analysis (probabilities).
    (h) Monte Carlo simulation.
    (i) Decision trees.

Responses on each item are measured on a five-point Likert scale between: ''Never used'' to "Always used" detailed". *Source:* Ryan and Ryan (2002)

Window 12: Level of satisfaction with CIAM
In general, how would you classify your degree of satisfaction with the procedures and methods used in your firm to evaluate investment projects?
        Scale endpoints: completely unsatisfied and *totally satisfied.*

Collecting the data

       Prior to the collection of the data, it was necessary to design the structure of the survey, to produce the questionnaire - including an electronic version - to collect the contacts of the firms and to test the web-based data gathering system. Contacts were obtained mainly from a database of the 500 largest Portuguese non-financial companies in the year 2007.

       An electronic questionnaire was used to gather the empirical evidence. Web-based surveys are displayed on the World Wide Web (WWW). Electronic questionnaires are surveys that can be displayed on the WWW or through another electronic interface. The design of this type of questionnaire has some issues that are common to traditional paper-based surveys (e.g. the ordering and wording of questions) but also includes new features such as screen layouts and navigational issues. The use of electronic questionnaires through the web has a number of important advantages, namely the low cost, the speed with which answers are received and the possibility of using the data collected as a straight input for statistical software packages. In this research, the option was to present the questions grouped in different windows. The organisation of the questions in independent screens allows respondents to have a higher focus on each particular issue, as they are not distracted by other questions. Moreover, the use of several screens reduces the perceived length of the questionnaire. The use of a multi-window questionnaire is useful to ensure the validation of the answers in the data collection process. Multiple-page e-questionnaires permit validation of the responses before final submission of the questionnaire results in the database. Multi-window questionnaires can even be adaptive. The answer to a particular question can drive the order or evolution of subsequent questions. In this case it happen with the question "Do you have an investment manual?". Who answered "yes" was redirected to the next window, the others did not see that window with specific questions on investment manuals characteristics. Finally, the electronic questionnaire was connected to a mysql database.

       The final sample was composed by 420 contacts. The data collection has begun in May 2009. A short email message was sent to all the firms briefly explaining the purpose of the project and its relevance. A link to the electronic questionnaire was attached. A series of reminders were sent during the next weeks. A total of 12 valid responses were received, representing a very low response rate of 3%. Thus, an ongoing process of telephonic contacts was initiated in order to obtain more responses.

ANALYSIS OF RESULTS

General analysis

       From the collected data about capital investment practices of the firms belonging to the sample, the initial task is to present some statistics that might help to characterize firms. In this regard, several features can be analysed

(see, for example, Sandahl and Sjogren, 2003, Ryan and Ryan, 2002, Graham and Harvey, 2001, Moore and Reichert, 1983, and Gitman and Forrester, 1977), namely:

- The percentage of firms that use and do not use discounted cash flow techniques;
- Whether this usage is influenced by firm size or industry at which they belong;
- Whether firms use a variety of capital budgeting techniques or, otherwise, they concentrate in a small number of methods;
- What is the percentage of firms that follow a formal decision process regarding investment expenses and if these percentage is affected or not by the type and/or dimension of the investment project;
- Who is the person/department responsible for preparing the investment proposal and who is responsible for its approval;
- What percentage of firms has an investment manual and what are the main items included in it;
- What are the techniques used to estimate the cost of capital and the procedures used to address the problem of uncertainty/risk associated with the investment?

Factor analysis

Given that the purpose of the study is to relate CIAM usage with its drivers (e.g. company's size, strategy, organizational structure, technologies adopted, environmental uncertainty, competition and type of industry) and that to measure these drivers a survey was used, which included a great number of questions/variables, it is necessary to use factor analysis to identify the latent variables. Such variables are factors that explain the pattern of correlations within a set of observed variables.

For example, the measurement of CIAM usage is based on questions related to: (a) formal features and procedures regarding the preparation of investment proposals; (b) whether the firm has or not an investment manual, and what type of information is included in the manual; (c) what capital budgeting methods the firm uses; (d) how is the cost of equity estimated in the firm; and (e) what are the techniques/models used by firms to address the problem of uncertainty. Therefore, factor analysis is used to extract the underlying variables. That is, to identify whether CIAM usage is well represented by a single factor or by multiple factors (it could be, for example, three factors: F_1: the sophistication of procedures adopted; F_2: the variety of methods employed; and F_3: the sophistication of methods used). In the following paragraphs, a brief description of the factor analysis is presented.

Thus, as there are a large number of variables, the survey data needs to be reduced to a limited number of factors through factor analysis. This data reduction method is used to identify underlying variables or factors that explain the pattern of correlations within a set of observed variables. Factor analysis examines the correlations between the items or questions surveyed and it shows if there is a significant overlap amongst various subgroups of items. As a result, a small number of factors that explain most of the variance observed in a specific phenomenon are computed. Factor analysis implies the existence of a smaller number of non observable variables (factors) which explain the behaviour of the original variables. In the end, a reduced amount of data is expected, without loss of too much information. The application of factor analysis implies that there is a significant correlation between variables. If the correlation between the initial variables is not significant, it is improbable that the variables will present common factors. For examples on the use of factor analysis, see Geigger and Itnner (1996), Laitinen (2001), Ittner et al. (2003), Dunk (2004) and Pizzini (2006).

The most frequent method used for extraction of the factors is the principal components analysis method. This method is a statistical multivariate method that makes it possible to transform a group of initial variables correlated between themselves (x1, x2, ..., xp) into a new group with a reduced number of uncorrelated variables (orthogonal) and designated by principal components (y1, y2, ..., yp). These new variables reduce the initial complexity of data and enhance its interpretation. By making uncorrelated linear combinations of the observed variables, this method forms successive components which progressively explain smaller portions of the variance. Thus, the first component has the maximum variance.

Following Afonso (2008), the method of principal components analysis can be described as follows. Coefficients aij (i= 1, …, p; j=1, …, p) define each of the new variables and ensure that principal components explain the maximum variation in the original data.

y1 = a11 x1 + a12 x2 + … + a1p xp

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y2 = a21 x1 + a22 x2 + ... + a2p xp

...

Yp = ap1 x1 + ap2 x2 + ... + app xp

Principal components analysis is used to obtain the initial factor solution. Furthermore, different methods of rotation which enhance the meaning of the extracted factors can be used. These methods of rotation by reducing intermediate values, transform high coefficients into higher coefficients and low coefficients into lower coefficients.

In this research project, the SPSS software package will be used to extract the factors. SPSS package offers five different methods of rotation namely, varimax, direct oblimin, quartimax, equamax, and promax. Varimax is an orthogonal rotation method that minimises the number of variables with high coefficients or loadings in each factor, simplifying the interpretation of results. In general, coefficients higher than 0.5 are considered significant.

The number of main components that is needed to describe the data can be obtained through one of the following procedures. Firstly, the Kaiser-Meyer-Olkin (KMO) criterion can be used. In this case, all the factors with eigenvalues higher than one are extracted. Kaiser-Meyer-Olkin (KMO) is a statistic that is a measure of sampling adequacy and it is used to check the quality of the correlations between variables. Values of KMO close to 1 indicate that the factor analysis is significant; very good if it is higher than 0.9 and good for values between 0.8 and 0.9. For values lower than 0.5, the factor analysis is not significant, because there is not a strong correlation between the variables. Furthermore, and in general, factor analysis is assumed to be appropriate if KMO is higher than 0.6. A second criterion for factor extraction consists of keeping those components that explain at least 60% of the total variance. Usually, similar results are obtained in both criteria.

After the KMO test, it is necessary to test the fidelity of the new variables (factors) by analysing the Cronbach's α (alpha) of each factor (Cronbach, 1951). Cronbach's α ▢▢is one of the most used measures to verify internal consistency within a group of items (e.g. Cagwin and Bouwman, 2002: 21). Cronbach's α is a measure which assesses the extent to which a set of items can be treated as measuring a single unobservable or latent variable. Cronbach's α is defined as the mean correlation across the items which comprises an extracted factor, adjusted upward by the Spearman-Brown prediction formula by k. It can take values between 0 and 1. The Cronbach's α will be high if the proportion of the variance due to individuals is also high. The formula for the standardised Cronbach's α is presented below. The number of items is represented by N and the average inter-item correlation amongst the items is represented by r.

$$\alpha = \frac{N \cdot \bar{r}}{(1 + (N - 1) \cdot \bar{r})}$$

As a rule of thumb, it is assumed that a coefficient value higher than 0.7 reveals an internal consistency between the reasonable and the very good. Values higher than 0.9 mean that the factor's internal consistency is very good. Analysis of the Cronbach's α can also be used to identify variables that should be eliminated in order to improve internal consistency of factors.

Regression analysis

After conducting the factor analysis in order to identify the underlying variables related to CIAM and its drivers, a multiple regression analysis is conducted to examine how CIAM usage is associated with each one of these drivers. Regression analysis is a statistical tool for the investigation of relationships between variables. When it is assumed that the dependent variable depends on more than one independent variable, one refers to multiple regression analysis. Multiple regression is a technique that allows additional factors to enter the analysis separately so that the effect of each can be estimated.

To test the effect of internal and external variables on CIAM usage, it is proposed to run the following multiple regression model, assuming that CIAM usage can be represent by only one factor:

CIAM = β_0 + β_1Size + β_2 Strategy + β_3 Technology + β_3 Uncertainty + β_5 Competition + ... + ε

In the case that factor analysis suggests that CIAM usage would be better represented by three factors (one related to the degree of sophistication in procedures, other representing the variety of methods used, and the last one related to the complexity of methods used), we proposed to run the following three regression models:

$$CIAM_{sophistication} = \beta_0 + \beta_1 Size + \beta_2 Strategy + \beta_3 Technology + \beta_3 Uncertainty + \beta_5 Competition + \ldots + \varepsilon$$

$$CIAM_{variety} = \beta_0 + \beta_1 Size + \beta_2 Strategy + \beta_3 Technology + \beta_3 Uncertainty + \beta_5 Competition + \ldots + \varepsilon$$

$$CIAM_{complexity} = \beta_0 + \beta_1 Size + \beta_2 Strategy + \beta_3 Technology + \beta_3 Uncertainty + \beta_5 Competition + \ldots + \varepsilon$$

To further explore the relationship between CIAM and the satisfaction and firm performance, two additional regression models are proposed in order to examine the association between CIAM usage satisfaction and firm performance with the three dimensions reflecting CIAM usage:

$$CIAM_{Satisfaction} = \beta_0 + \beta_1 CIAM_{sophistication} + \beta_2 CIAM_{variety} + \beta_3 CIAM_{complexity} + \varepsilon$$

$$FIRM_{Performance} = \beta_0 + \beta_1 CIAM_{sophistication} + \beta_2 CIAM_{variety} + \beta_3 CIAM_{complexity} + \varepsilon$$

CONCLUSIONS AND FURTHER WORK

This study is on the adoption and use of capital investment appraisal methods (CIAM). More particularly, on the internal and external variables that have a major influence on CIAM usage by firms. However, the research question proposed in this paper asks for the design of appropriate research tools and available empirical data. Thus, this paper presents and explains an instrument and a methodological research approach for such purpose. In this context, a questionnaire was designed in order to collect the necessary empirical evidence. The research project undertaken is still in progress because the data collection resulted in a very hard task. It was argued that there are specific contingencies that explain why firms use and do not use specific capital investment appraisal methods. Furthermore, it was added that CIAM usage should be viewed from three (potentially different) perspectives which are the sophistication of procedures adopted and the variety and sophistication of methods employed.

Internal and external variables will explain the adoption and use of CIAM in its three-dimensional nature. There is not empirical evidence on the factors that explain the use of capital investment appraisal methods from these three perspectives (i.e. the sophistication of procedures adopted, the variety of methods employed, and the sophistication of methods employed).

A research instrument (i.e. the questionnaire proposed in this paper) is now available and it can be used to understand this phenomenon. The data obtained must be explored through factor and regression analysis. It is our conviction that, in practice, CIAM is not only an ad hoc usage of more or less sophisticated techniques. Instead, in practice, the use of CIAM may be characterised by different levels of sophistication and completeness. This questionnaire has a set of variables that permit the analysis of CIAM from multiple points of view. Thus, some hypothesis can be formulated and tested resulting in an important contribution to the literature. In this paper, we present some research hypothesis for further analysis. On the other hand, further work using different statistical approaches, different samples and case study research is expected.

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