

Abstract of Doctoral Dissertation

Capital Budgeting Decisions Under Fuzzy Environment*

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Introduction

CAPITAL BUDGETING DECISIONS of firms are of strategic importance for the overall growth of an economy as such decisions commit its limited productive resources to its production system and also for firms as they strengthen and renew their resources. They consist of allocation of a firm's resources with plans for recouping the initial investment plus adequate profits (or other returns) from cashflows (or other benefits) generated during the economic life of an investment. Such decisions are hard to reverse without severely disturbing an organization economically and otherwise. Therefore, a Capital Budgeting Decision needs systematic and careful analysis. But, such analysis is a many-sided activity which includes among others the estimation and forecasting of current and future cashflows and the economic evaluation of alternative projects. Since in reality the cashflows estimation takes place in a non-deterministic environment, full of complex interplay of conflicting forces, an exact description about cashflows is virtually impossible. Therefore, a firm has to take such decisions in fuzzy environment and this work makes an attempt to develop procedures and techniques so as to equip decision analyst to achieve a meaningful economic evaluation of projects.

The whole edifice of the discipline of capital budgeting decisions is built on Knight's three way classification of a decision making environment - certainty, risk and uncertainty. Hence, all techniques that are already existing for capital budgeting decisions are meant for only these three decision making environments. Also, this classification has dominated so much the theory of Finance that an implicit assumption prevails in Finance that it is completely exhaustive of all possible decision making environments under which a firm has to operate. Consequently, fuzzy environment is not recognized in the literature and hence, no tool is developed to process fuzzy information for capital budgeting decisions. It is precisely this reason that provides main motivating force behind this work.

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Motivation

The main objective of the present work is to develop necessary techniques and methods to equip a finance manager with suitable tools to process fuzzy information such that financial decision making becomes more efficient and effective. To achieve this main objective, we have framed the following issues for which satisfactory answers have to be searched :-

1. Is the present system of classification of a decision making environment into certainty, risk and uncertainty in the theory of Finance capable of recognizing fuzzy environment in which a firm has to operate?
2. What is fuzzy environment? What is its nature and what kind of data is available in such environment?
3. If a firm faces fuzzy environment then - What could be possible approaches to process fuzzy data for capital budgeting decisions?
4. Are some tools available to evaluate a project based on Fuzzy Set Theory? If yes, are they sufficient?
5. Are some non fuzzy tools available to evaluate a project with fuzzy information ? If yes, are they sufficient?
6. Does there exist a relation between possibilistic data and probabilistic data? If yes, what is that relation and how a finance manager can exploit it to convert possibilistic data into probabilistic data as to take maximum advantage of rich structure of the Probability Theory?
7. How can fuzzy mathematical programming techniques help the management to take a capital budgeting decision under fuzzy objectives and fuzzy constraints?
8. How can a finance manager help the top management to process information for those capital budgeting problems where constraints are of possibilistic nature ?
9. How can a finance manager help the top management to process information for those capital budgeting decision problems where constraints are of possibilistic nature as well as of probabilistic nature?
10. How can one find a meaningful solution in cases where a decision making environment is very complex consisting of capital budgeting decision problems with constraints of possibilistic nature, constraints of probabilistic nature with fuzzy and non fuzzy parameters and constraints of possibilistic as well as probabilistic nature?

The Approach Followed in This Work

In this work, our approach to handle above mentioned issues is neither normative nor descriptive. Also, we realized that a comparative study of existing tools meant for non-fuzzy environment and proposed tools meant for fuzzy environment is totally unwarranted as both are the best in their respective environment. Further, no empirical survey is conducted as the nature of the problems and of present conditions (as discussed in the Thesis in detail) does

not enable us to undertake it. Therefore, we are forced to concretize our research problem as thus - 'Assuming that the available information for capital budgeting decisions is fuzzy and relevant, how can one process such information effectively and efficiently to arrive at desirable decisions? Since the theory of Finance does not have such tools, we make a search for possible tools available in various disciplines like Fuzzy Set Theory, Possibility Theory, O.R., Inter Analysis etc. and see whether they can be of any use in processing fuzzy information for capital budgeting decisions.

Organization of The Work

The work is organised into nine chapters including the first one which discusses introduction, review of the relevant literature, motivation and issues and planning of the work. Chapter-2 consists of preliminary and necessary definitions, concepts and results. Chapter-3 attempts to know first, why Knight's classification has failed to characterize completely all possible decision making environment is and what is its nature, and third, what are various causes of fuzziness in an environment. Chapter-4 tries to know the nature of data available under fuzzy environment. Chapter-5 examines the possibility of using Fuzzy Set Theory and the development of a useful mathematics of Finance. Chapter-6 provides some simple non-fuzzy techniques to process fuzzy information for capital budgeting decisions which are non-probabilistic in nature while Chapter-7 exploits possibility/probability consistency principle to convert possibilistic data into probabilistic data so that techniques based on the Probability Theory can be employed. We devote Chapter-8 to fuzzy mathematical programming models to enable a decision analyst to process fuzzy objectives and fuzzy constraints to arrive at a suitable decision. The last chapter i.e. Chapter-9 summarizes the work with suitable discussion and conclusions and lists prospective research problems.

V. Summary and Conclusions

We define fuzzy environment as that perceived environment in which the available information about a decision problem is either vague as modelled by fuzzy set theory or ambiguous as modelled by possibility theory or both. We also identify that no one classification of decision making environments can provide complete characterization rather a number of classifications are needed as shown below :

Classifications of Decision Making Environment

Basis	Kinds
1. Predictability	: Certainty and Uncertainty
2. Description	: Fuzzy and Non-Fuzzy
3. Completeness	: Complete and Incomplete
4. Determinacy	: Determinate and indeterminate
5. Controllability	: Controllable and uncontrollable

Also, the following possible sources of fuzziness are identified in a decision making environment:

1. Complexity
2. Subject's awareness of possibility of errors
3. Communication of and thinking about uncertainty
4. Soft information
5. Natural language
6. Ill-defined concepts
7. Intended flexibility
8. Economics of information

Once we understand about fuzzy environment, we make further attempts to develop some tools and methods to process fuzzy information available under fuzzy environment for capital budgeting decisions have resulted in various approaches, methods and techniques well illustrated in the work are summarized as below :-

Approaches to Capital Budgeting Decisions under Fuzzy Environment

