SOME QUANTITATIVE MODELS FOR PROJECT EVALUATION AND CAPITAL BUDGETING

ABSTRACT

This dissertation presents some quantitative models for capital investment decisions. The contributions are related to two aspects of capital investment planning: (i) evaluation of an investment under various uncertainties and (ii) selection of the best set of projects from a competing lot in a capital rationing situation. The dissertation is organized in five chapters.

Chapter I gives a comprehensive review of capital budgeting literature related to the theme of the dissertation.

Chapter II is concerned with the evaluation of an investment under uncertainty, mainly in a multiperiod capital asset pricing model (MPCAMP) framework, while considering (i) the prospects of future abandonment options, both deterministic and probabilistic, (ii) the cash flows generated from the investment to be random and (iii) correlation amongst cash flows. Firstly, dynamic programming recursive relations have been developed in a MPCAPM context to evaluate the mean and variance of the net present value (NPV), when the life of the project is deterministic. Secondly, the project evaluation methodology is extended to incorporate the uncertainty in project

life. Thirdly, investor's risk aversion behaviour has been explicitly considered to evaluate a project in a MPCAPM format. Fourthly, when abandonment options are not taken into account, simpler mathematical expressions have been developed to evaluate the mean and variance of the NPV for both certain and uncertain project life in a MPCAPM framework. Finally, following discounted cash flow (DCF) method, dynamic programming models are presented to evaluate an investment by (i) explicitly considering the investor's risk aversion behaviour and (ii) assuming the life of the project to be stochastic.

Chapter III presents mathematical programming models for capital budgeting incorporating future investment opportunities and abandonment options under capital rationing. The models utilize the mean-variance form of utility function, reflecting the risk-return trade-off of the investor. The models also consider various inter-dependencies amongst (i) cash flows and (ii) projects. Further improvement in the treatment of risk is incorporated through chance constraints. Another extension to the mathematical programming models considers the uncertainty in the life of the projects. Procedures are suggested to incorporate probabilistic abandonment.

Chapter IV deals with multiple objectives in capital budgeting. Three different methods - goal programming (GP), global criterion method and interactive method - have been used. In GP area, first a typical capital budgeting model with two objectives has been presented. The model considers future

life. Thirdly, investor's risk aversion behaviour has been explicitly considered to evaluate a project in a MPCAPM format. Fourthly, when abandonment options are not taken into account, simpler mathematical expressions have been developed to evaluate the mean and variance of the NPV for both certain and uncertain project life in a MPCAPM framework. Finally, following discounted cash flow (DCF) method, dynamic programming models are presented to evaluate an investment by (i) explicitly considering the investor's risk aversion behaviour and (ii) assuming the life of the project to be stochastic.

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investment opportunities and abandonment options. Another application of GP technique in capital budgeting is presented through a chance constrained goal programming model. Following global criterion method, a FORTRAN programme MOGC (multiple objective global criterion), which solves large multiple objective zero-one linear programming problems with less computational effort, has been developed. A sensitivity analysis is also done for MOGC. The interactive procedure uses the Step-method (STEM). A comparative study of the three methods - goal programming, global criterion method and interactive method - has been presented.

While chapters III and IV are devoted exclusively to the investment activities of a firm, chapter V presents an integrated corporate financial palnning model which considers interaction of three important functional areas of a firm - investment, finance and production. The decisions are related to: (i) investment area - selection of investment projects, (ii) finance area - amount of debt outstanding, amount to be invested on liquid assets, new equity issues and dividend to be paid, in each period and (iii) production area - annual sales, regular production, overtime production and inventory level in each period.

Numerical results are presented to illustrate the models developed in the dissertation.