CHAPTER 2

RELATED LITERATURE SURVEYS

2.1. INTRODUCTION

Petroleum chemical manufacture represents that segment of the Chemical Industry which produce chemical products from raw materials of petroleum. origin (18).

The main characteristics of the petrochemical industry is as follows.

(1) The petrochemical industry of today is characterized by the wide variety of its products and their end uses, the complexity of production, the alternative routes of production processes to final products and the flexibility in the choice of feedstocks.

(2) Another characteristic of the mature petrochemical industry is the small number of producers involved in petrochemical production, the bulk of the industry's output being consumed in the form of intermediate products by an equally small number of industries.

The modem petrochemical industry was developed around the oil-processing industry, both of which grew rapidly with the development of the fluid catalytic cracker's technology and the expansion of the oil-refining capacities after the Second World War (4). Asia has rapid growth and development over the last decade, a massive increase in demand for petrochemical products, 37% of the world's new demand. The newly developing Asian countries of China, Malaysia, Indonesia, and Thailand are boosting their investments in this industry in order to become self-sufficient in petrochemicals.

Capacity has been increasing rapidly throughout the 1970s as a result of the changing structure of production costs of basic petrochemicals brought about by oil price increases and the internationalization of the industry as the process technology of theses products was becoming mature and increasingly available to developing countries under license from oil companies or chemical engineering films.

Growth in demand for light products - gasoline and jet kerosene in particular - at a time of declining consumption of heavy fuel oil has been a feature of oil markets worldwide since the mid-1970s. As marketplace dynamics and product demands change, it is the refining industry that must be flexible enough to accommodate new requirements. Time for crude oil refiners to develop strategies and adapt operations to produce reformulated gasoline is growing short.

The supply/demand balance and the achievement of mandated gasoline qualities will be the two most critical issues associated with reformulated gasoline. It is likely that capacity rationalization throughout the industry will be the eventual result (10).

Projects are usually initiated by desired outcomes related to production, marketing, or regulated concerns. In considering a project evaluation, consider its impact on the whole plant (8).

In practice, there are many methods for project evaluation. Generally, these can be divided into two kinds: qualitative method and quantitative method.

Qualitative method makes general description and logic inferences about the investment nature, investment environment and investment profit situation according to the knowledge and work experience of the evaluation personnel.

According to the large amount of economic data and the relationship between project and influence factors, quantitative method calculates the needed index and data, and makes judgments by comparison and analysis.

Quantitative methods are used in many projects, which are discussed briefly in the following sections.

2.2 COST BENEFIT ANALYSIS

Historically, the development of CBA has witnessed a movement from a purely financial to economic approach. This movement started by applying a more rigorous definition to the costs and benefits incorporated in the calculation of the project's real worth. More recently, emphasis has turned to the correct valuation of project inputs and outputs. In addition, attention is now being paid to the transition from economic to social CBA.

CBA is a method of appraising and selecting investment activities for the generation of future benefits, the implementation of which requires the utilization of scarce resources. When correctly applied, it ensures that that no project is approved unless the sum of its discounted benefits exceeds the sum of its discounted costs. The means by which projects are selected can be approached from three principal viewpoints, reflecting alternatives and hence criteria by which projects are judged. Value judgments by the analyst should be kept to the minimum and, where required, should be described explicitly. In any form of appraisal, the costs and benefits which enter the project's cash flow must be identified, quantified and valued in line with the objectives pursued (5).

2.2.1 Financial Analysis

The financial approach is chosen to appraise projects by considering their contribution to profits or some other measure of their objective, which are project-specific rather than national. This kind of analysis is sometime referred to as "commercial" or "private" analysis though it can be applied to non-commercial or public projects as well. The essential feature of such appraisals is that costs and benefits are valued at market prices. For this type of analysis the following assumptions must be made (1):

(1) All cost and benefits included in the financial analysis are true economic costs and benefits;
(2) The absence of any external costs and benefits;
(3) The absence of any public goods;
(4) The existence of perfect competition in all markets.

2.2.2 Economic Analysis

The economic impacts of a project are referred to as effects on the national economic development objective which may be measured as change in GDP etc. These effects lead to changes in the value of the outputs of goods and services and consequent changes in national economic efficiency.

The economic aspects of project analysis require a determination of the likelihood that a proposed project would contribute significantly to the development of total economy and that its contribution will be great enough to justify using the scarce resources it will need. The point of view taken in the economic analysis is that of the society as a whole.

In economic analysis, the project is assessed by measuring the contribution of its net discounted benefit to national income. This requires that project inputs are identified and valued at their real opportunity costs which is the true economic cost to the economy and outputs by their contribution to real income. This in turn requires the identification of a wider set of costs and benefits, known as externalities, than is required for financial analysis; it also necessitates the valuation of all costs and benefits at shadow rather than market prices. Often market price distortion cannot be removed through basic economic policy changes because of powerful political forces with a vested interest in status quo. Under such circumstances, one way of improving economic efficiency and equity is to make economic decisions on the basis of shadow prices that reflect the true value to the country of its resources. These shadow prices may be "national parameters" (e.g. the shadow price of foreign exchange) or they may be specific to a given sector, region and/or project (e.g. the shadow wage rate for labor).

The financial and economic analysis are thus complementary. The financial analysis takes the viewpoint of the individual participants and the economic analysis that of the society. As in financial analysis, the relevant costs and benefits in the economic appraisal must be set out in a cash flow scheme. Standard discount techniques are then applied in the same manner. The difference between the two types of analysis are the necessary adjustments made to the structure of the cash flow. They relate to the identification of the relevant costs and benefits to be included and, once they have been quantified, the method of their valuation. The latter includes the problem of valuing over time, or the appropriate choice of a discount rate.

2.2.3 Social Cost-Benefit Analysis

CBA presenting only the economic costs and benefits which will be given a dollar valuation cannot be taken as encompassing all the effects of a project. The project produce some "social impacts" which are the effects on the distribution of income as well as on the psychological, social and physical well-being of the individuals affected by a project. The incorporation of this social aspect into the analysis amends the cost-benefit analysis and the overall approach of analysis carried out in this way is called "social CBA". Such an approach involves some form of interpersonal comparisons of income either between different income groups, or by comparing average incomes today with expected future level. The distribution between economic and social appraisal is of importance, since the latter involves the use of value judgments concerning weights to be applied to various income groups, while such value judgments are, or should be, absent from an economic analysis (12).

Despite serious efforts in this field of study, a number of problems remain. In particular, research is still underway to find the most appropriate methods of estimating the parameters necessary for social analysis in a way that reduces judgments to a minimum value.

The discussion on the various aspects of CBA would be incomplete if the "environmental impacts" of projects are not discussed here. These result in changes in our physical and biological surroundings as they are perceived to effect the quality of life, their valuation, and sometimes even identification, is very difficult. Therefore, these are no included in the CBA in qualitative form.

2.3 PERPETUITY RATE OF RETURN (PRR)

Suppose the present value of the cash-out flow of a project is I, the capital opportunity cost is k and cash-in flow is Ai (i=1, 2, 3,..., n), then the present value of cash-in flow is:

$$PV = \frac{A_1}{(1+k)} + \frac{A_2}{(1+k)^2} + \ldots + \frac{A_n}{(1+k)^n} \qquad \text{Equation 2.1}$$

By changing this n period cash-in flow into unlimited period equal amount, suppose annual equal amount is R, the following derivation can be obtained:

$$PV = \frac{1}{k} \cdot R, \qquad i.e. R = k \cdot PV$$ Equation 2.2

k . PV is the annual fixed revenue. Perpetuity rate of return is defined as:

$$PRR = \frac{annual\ fixed\ revenue}{present\ value\ of\ investment} x100\% = k \cdot PV / I x100\%$$ Equation 2.3

PRR is the annual fixed revenue generated by project unit investment (Fu Guizhen, 1994).

The rules of PRR method is as follows:

(1) If PRR is equal to or greater than k, then the project is economically feasible.
(2) If PRR is less than k, then the project is not economically feasible.

As known from equation 2.3, if PRR is greater than k, then

- PV is greater than I
- NPV of the project is greater than zero, because NPV = PV - I

The project is economically feasible. On the contrary, if PRR is less than k, NPV must be less than zero the project is not economically feasible.

From PV = I + NPV, the following result can be obtained:

$$PRR = k(I + NPV) / I$$ Equation 2.4

From equation 2.4, it is seen that PRR is linear function of NPV. When NPV= 0, PRR = k, project get to the minimum acceptable level. If the project is profitable, then PRR must be greater than k, i.e. NPV is greater than zero.

Compared with IRR, PRR method is simple and convenient, and in some situation, IRR may have no root or multiple-root.

2.4 ADJUSTED RATE OF RETURN

Adjusted rate of return is the sum of the interest **i** and the ratio of **net average annual worth to the investment**, the formula for the adjusted rate of return is:

$$R(i) = i + \frac{NAW(i)}{\sum_{t=0}^{m} k_t}$$ Equation 2.5

k_t is the investment of year t, m is the period of investment.

When i is equal to i_0, adjusted rate of return is defined as first time adjusted rate of return, R_1 equals R (i_0). When i is equal to R_1, adjusted rate of return is defined as second time adjusted rate of return, R_2 equals R (R_1).

If R_1, is equal to or greater than i_0, then the project is feasible, on the contrary, it is not feasible.

The following conclusions can be made:

(1) Both IRR and adjusted rate of return are dynamic index using the relative value for project evaluation. When adjusted rate of return is adjusted after one or two times it tends to equal IRR.
(2) Adjusted rate of return is simpler than internal rate of return. They all have the same effects on project evaluation. Adjusted rate of return can substitute for internal rate of return in project evaluation.

2.5 CAPITAL ASSETS PRICE MODEL (CAPM)

CAPM is first raised by W.F.Sharp and J.Linter, used in investment analysis of capital market. With CAPM development, its application field expands, now it can be used in project evaluation. Its original formula is:

$$R_i^{*} = R_f + (R_m - R_{f)}) \cdot \beta_i$$ Equation 2.6

where
R_i^{*} : required cut-off rate for investment on the i^{th} bond
R_f : risk free interest rate
R_m : expected rate of return of bond market
β_i : risk degree index of the i^{th} bond

If replace equation 2.6 with

$$R_i^* = X / V - 1 \qquad \text{Equation 2.7}$$

the following formula can be obtained:

$$NPV_i = -I_0 + \sum_{t=1}^{n} \frac{\overline{X}_t^*}{(1 + R_{f)}^t} \qquad \text{Equation 2.8}$$

X is investment recovery value of final period, V is present value, among which:

$$\overline{X}_t^* - \overline{X}_t = -I_{t-1}(\overline{R} - R_f)$$

$$I_t = I_{t-1}\ (1 + \overline{R}_i) - X_t \qquad \text{when } I_t \text{ is greater than } X_{t-1}$$

$$I_t = 0 \qquad \text{when } I_t \text{ is equal to or less than } X_{t-1}$$

I_0 is the initial investment; X_t^* is the actual cash in flow of period t; R_f is risk free interest rate; R_i is the average rate of return; X_t is the nominal cash in flow of period t; I_t is non-finished compensation value for the initial investment.

There are many differences between using equation 2.8 and traditional IRR method when calculating NPV. It is difficult to say which method is better. Normally, if only simple profit comparison among several projects is made, the traditional method is an easy way. If the opportunity cost of the investment capital and the re-investment profit rate are considered, the CAPM method is more rational, because the discount rate is not a single value, and also the gradual compensation for the initial investment and probability of re-investment are considered.

L., Fred raised a revised formula for the CAPM method under the condition of inflation (cited by Fan Xu and Fan Min, 1990). The formula is as follows:

$$R_i = R_f + \sigma_{jp} + \left[\frac{E(R_m - R_f - \sigma_{mp})}{\sigma_m^2 - \frac{\sigma_{mp}}{a}} \right] (a_{jm} - \frac{\sigma_{mp}}{a} \qquad \text{Equation 2.9}$$

where
- π : inflation rate
- α : ratio of risk assets to the capital market
- σ_{xy} : covariance between X and Y

Although CAPM is a new method, it has shown many merits in project analysis.

2.6 INFLATION

Inflation is no longer a speculative issue, but today a fact; and it may be with us for a while. This has recently led to concern about how inflation should be accounted for, if at all, in engineering economic analysis (3).

2.6.1 Inflation Rate

Most economic studies require estimations that depend on expectations of future inflation rates. The determination of these future inflation rates should be based on the trends of historical rates, predicted economic conditions, judgment, and the other elements of economic forecasting, like the estimation of future cash flows. The accurate prediction of future inflation rates is a difficult endeavor.

Many studies use an average annual inflation rate when the projected life of the investment is long. This approach requires the estimation of a single average rate that represent a composite of the individual yearly rates.

In general

$$CPI_t(1+\bar{f})^n = CPI_{t+n} \qquad \text{Equation 2.9}$$

$\bar{f}$: the average annual inflation rate

CPI_t : the index of consumer prices at the end of year t

The concept of the average annual inflation rate facilitates inflation calculations. In most instances, the estimation of individual yearly inflation rates is time consuming, and using this rates usually is no more accurate than using a single composite rate (16).

2.6.2 Representing Cash Flows in Actual or Constant Dollars

Cash flows can be represented in terms of either actual dollars or constant dollars. Actual dollars represent the out-of-pocket dollars received or disbursed at any point in time. This amount is measured by totaling the denominations of the currency paid or received. Constant dollars represent the hypothetical purchasing power of future receipts and disbursements in terms of the purchasing power of dollars at some base year.

A cash flow can be expressed in terms of actual dollars either by direct assessment in actual dollars or by conversion of a constant-dollar estimate to actual dollars. Similarly, if it is desired to express the cash flow in terms of constant dollars, these dollars can be directly estimated, or the estimate can be made in actual dollars and then converted to constant dollars.

The conversion of actual dollars at a particular point in time to constant dollars (based on purchasing power n years earlier) at the same point in time is a common requirement. When inflation has occurred at the annual percentage rate of f, this conversion is expressed as

$$constant\ dollars = \frac{1}{(1+f)^n}(actual\ dollars) \qquad \text{Equation 2.11}$$

Constant dollars approach provides a consistent means of comparison and is most suitable for before-tax analysis, when all cash flow components inflate at uniform rates. The actual dollars approach is most appropriate for the after-tax analysis (9).

It is often desirable to compute equivalents in either the actual-dollar or the constant dollar domain, making it important to understand the relationships between these domains.

The inflation rate f is required to transform dollars from one domain to the same point in time in the other domain. The market interest rate i is used to calculate equivalencies in the actual dollar domain. The inflation-free rate P is used to calculate equivalencies in the constant-dollar domain.

Relationship between i, i' and f is as follows:

$$i' = \frac{1+i}{1+f} - 1 \qquad \text{Equation 2.12}$$

2.6.3 Inflation and Project Evaluation

In the practice of project evaluation, there are a variety of methods for handling inflation. The four popularly used methods are: 1) constant price, 2) mixed-price, 3) simplified current price and 4) detailed current price methods. All of these four methods are based on the premise that inflation exists. The details of these methods are as follows:

1. Constant Price Method

In this method, inflation is assumed to have the same effects on all prices. So, the same evaluation results can be obtained by using either constant price or current price. Thus, the constant price method is adopted for calculation.

The advantages of this method are as follows:

(1) As this method avoids the problem of forecasting inflation rate in the period of the project life, it makes the calculation easy.

(2) The evaluation index obtained by using constant price in the project life period cannot be affected by the factor of price changing. So, this method is easy to compare projects, and also, it is convenient for comparing the rate of return of a project with the required rate of return. which doesn't consider about inflation. In fact, the constant price method is normally used all over the world.

The disadvantages of this method are as follows:

In the situation of high inflation rate, all the costs and expenses planned according to the constant prices can't reflect the necessary funds needed in the construction period and operation period, it makes that fewer funds are raised than actually needed. Also, the profit, interest and taxes can't be reflected accurately. So, if necessary, inflation reserve funds should be prepared to raise enough funds for construction period.

2. Mixed-price Method

It is assumed that inflation can have either the same effect or different effect on all prices. Two sets of prices are adopted in calculation. In the construction period, current prices with the uniform inflation rate is used. In the operation period, constant price is used.

The advantages of this method are as follows:

As inflation is considered in the construction period, enough funds can be raised for the construction period.

The disadvantages of this method are as follows:

(1) Two sets of prices are used in the project life period, but the investment and the loan for the construction period should be repaid using the profit of operation period. So, this method has some weak points in theory.

(2) If the construction period is long, it is difficult to forecast the inflation rate.

(3) The IRR calculated according to this method is neither the nominal nor real IRR.

3. Simplified Current Price Method

The current price is used in project life period, assuming inflation has the same effects on all prices and the uniform inflation rate is used.

The advantages of this method are as follows:

(1) This method overcame the disadvantages of the constant price method and mixed-price method. It can reflect the actual revenue and expenditure through the whole project life.

(2) In the view of data availability and workload, this is an easy method compared to the detailed current price method.

The disadvantages of this method are as follows:

Inflation rate is difficult to forecast in the project life period. Normally, in the view of project evaluation, it is not necessary to use this method. Compared with the constant price method, the evaluation results for after tax are not the same, although the results for before tax are the same.

4. Detailed Current Price Method

For this method, it is assumed that inflation has different effects on various prices, and that inflation rates are different.

The advantages of this method are as follows:

(1) Different prices have different inflation rates, this is easy to understand and be correct in theory.

(2) This method completely reflects the real world situation.

The disadvantages of this method are as follows:

(1) The calculation is very complex, because the real value of no inflation is converted from nominal value with inflation.

(2) If the forecasted inflation rates are not correct, then the real net cash flow can't express the real value accurately, this will lead to a wrong conclusion. Even for the international authorized organization, it is difficult to forecast inflation rates accurately.

To summarize, the first three methods make simplified hypothesis on inflation, i.e. inflation has the same effects on all prices and the uniform inflation rate is assumed. In the fourth method, different inflation rates are assumed, this is correct in theory, but difficult to use in reality.

It should be pointed out that, no matter which method is adopted, sensitivity analysis should be done for the effects of changing prices on the evaluation index.

Sun Hang (1990) demonstrated how to use NPV (Net Present Value) method on the condition that inflation exists. Because inflation has marked effects on both cash flow and discount rate, it is necessary to consider inflation when using NPV method provided inflation exists.

Under inflation, currency is devalued, prices rise and interest rates rise also. So, inflation results in the improvement of the discount rate and the depreciation of the cash flow amount, and improves the requirement for the cash flow amount. Sun Hang suggested two methods for NPV analysis:

(1) Using constant cash flow and real discount rate
(2) Using nominal cash flow and nominal discount rate

Net present value for project analysis is the same no matter which way is applied.

Joseph M. Sulock (1989) (29) listed some projects related with inflation. For some projects, different inflation rates are used for different items in evaluation. For other projects, inflation is not considered in financial evaluation, but sensitivity analysis is done for this factor, and when making decision, it is considered. This is the same view as Asian Development Bank.

Bryan Kefford (1995) (27) noted that the determination on cash flow and discount rate has a close relationship with the inflation rate. If inflation cannot be handled correctly, it will affect decision-making. In reality, inflation can be classified into two kinds: neutralized inflation and non-neutralized inflation. When inflation has the same effects on all prices, they can offset, this is called neutralized inflation. When inflation has different effects on all prices, they can't offset, this is called non-neutralized inflation. When the situation of non-neutralized inflation occurs, different inflation rates should be considered, and the calculation is complex.

John S. Dunkelberge (1992) (29) stated the relationship between inflation and pay back period. Recently, in Thailand, because of the existing inflation, the currency depreciates. This makes the investment budget lower than the actual expenses, and thus the pay back period shorten, which can't reflect the real effect of investment.

The depreciation fund doesn't increase with inflation, resulting in a fictitious increase in profit, and affecting the accuracy of the pay back period. And also, depreciation fund can't reflect the actual needed fund for renewal of fixed assets. It is suggested depreciation fund should be calculated according to the price of re-purchasing fixed assets. This makes sure that the calculation and use of the depreciation fund can reflect the reality better, and eliminate the defects of project evaluation.

Raymond E. Perry (1989) (33) suggested that when inflation exists, the depreciation fund should be calculated as follows:

actual depreciation fund = fixed assets * depreciation rate * price index

W. Steve Albrecht (1995) (32) stated that 8% inflation rate is adopted by some international organizations and finance organizations when provided loans to Thailand, considering about the endurance and development trends of inflation. He suggested that 6% inflation rate can be used within 5 years and 8% inflation rate can be used after 5 years.

To sum up, inflation is a very complicated problem in project evaluation, we should pay attention to this factor.

2.7 TECHNIQUES FOR MEASURING RISK

A number of techniques to handle risk are used by managers in practice. The following are the popular, non-conventional techniques of handling risk in capital budgeting (WESTON AND BRIGHAM 1990) (20) and (PANDEY 1995) (21):

(1) Sensitivity Analysis
(2) Scenario Analysis
(3) Monte Carlo Simulation
(4) Risk-Adjusted Discount Rate
(5) Certainty Equivalent
(6) Risk-Adjusted Discount Rate versus Certainty-Equivalent

2.7.1 Sensitivity Analysis

Sensitivity analysis is a risk analysis technique in which key variables are changed and the resulting changes in the NPV and the rate of return are observed. The more sensitive the NPV, the more critical the variable. (20).
The decision-maker allows to ask "what if" questions. For example:

- What is the NPV if volume increase or decreases?
- What is the NPV if a variable cost or fixed cost increases or decreases?
- What is the NPV if the selling price increases or decreases?
- What is the NPV if the project is delayed or outlay escalates or the project's life is more or less than anticipated? (21)

Sensitivity analysis locates the variable having the greatest impact on the project's NPV. An error in estimating a highly sensitive variable would have more impact on the project's NPV than similar error with a variable having a lesser impact. Sensitivity analysis shows where to focus attention and which variable would require a closest monitoring after acceptance. (22)

2.7.2 Scenario Analysis

Scenario analysis is a risk analysis technique in which "bad" and "good" sets of financial circumstances are compared with a most likely, or base case, situation.

Scenario analysis considers both the sensitivity of NPV to changes in key variables and the range of likely variable values. (20)

The decision-maker, while performing sensitivity analysis, computes the project's NPV (or IRR) for each forecast under three assumptions (21):

(a) pessimistic (or worst) case,
(b) expected (or best guesses) case, and
(c) optimistic (or best) case.

Instead of doing only one analysis of project cash flows using expected values, we can use scenarios in which, thing generally go wrong (a pessimistic scenario) or go right (an optimistic scenario). The pessimistic scenario provides some ideas of the project's down side potential. On the bridge side the optimistic scenario indicates the best that can be expected. For example under these three scenarios we can analyze a project's cash flows and for evaluation purpose we can use those cash flows to get NPV, IRR, PB, and PI. Then we can see the feasibility of the project with each scenario. Depending on the situation pessimistic scenario may result not to accept the project while others signal to accept. Whether or not we should accept the projects depends on intuition of the judgment. Interpretation of assumptions accompanying the pessimistic case and the other two cases helps to guide the decision. (22)

Despite its shortcomings, scenario analysis provides more information than doing analysis of only the most likely case. It forces the financial manager to consider the possibility of variables gone awry and to plan for contingencies. (22)

Scenario analysis examines the impact on net present value of simultaneous changes in a number of variables, sensitivity analysis focuses sequentially on percentage changes in one variable at a time, holding the rest constant. (22)

2.7.3 Monte Carlo Simulation

Monte Carlo simulation is a way of risk analysis technique in which probable future events are simulated on a computer, generating estimated rates of return and risk indexes. However, simulation requires a relatively powerful computer, coupled with an efficient financial planning software package, whereas scenario analysis can be done using a PC with a spreadsheet program or even using a calculator.

The first step in a computer simulation is to specify the probability distribution of each uncertain cash flow variable. Once this has been done, the simulation proceeds as follows:

1. The computer chooses at random a value for each uncertain variable based on the variable's specified probability distribution For example, a value for unit sales would be chosen and used in the first model run.

2. The value selected for each uncertain variable, along with values for fixed factors such as the tax rate and depreciation charges, are then used by the model to determine the net cash flows for each year, and these cash flows are then used to determine the project's NPV in the first run.

3. Step (1) and (2) are repeated many times, say 500, resulting in 500 NPV's, which make up a **probability distribution.** (20)

Limitation of Scenario and Simulation Analysis

- Monte Carlo simulation has not been widely used in industry. One of the major problems is specifying the correlation among the uncertain cash flow variables.
- However, it is not easy to specify what the correlations should be. Indeed, people who have tried to obtain such relationships from the operating managers who must estimate them have eloquently emphasized the difficulties involved.
- Both scenario and simulation analysis is that even when the analysis has been completed, no clear-cut decision rule emerges.
- However, the analysis provides no mechanism to indicate whether a project's profitability as measured by the expected NPV is sufficient to compensate for its risk.
- Finally, scenario and simulation analyses ignore the effects of diversification, both among projects within the firm and by investors in their personal investment portfolios.
(20)

2.7.4 Risk-Adjusted Discount Rate

The use of risk-adjusted discount rate is based on the concept that investors demand higher returns for more risky projects. The more uncertain the returns in the future, the greater the risk and the greater the premium required. If the time preference for money is to be recognized by discounting estimated future cash flows, at some *risk-free rate, to* their present value, then to allow for the risking, of those future cash flows a *risk premium* rate may be added to risk-free discount rate. The risk-adjusted discount rate accounts for risk by varying the discount rate depending on the degree of risk investment projects. A higher rate will be used for riskier projects and a lower rate for less risky projects. The net present value will decrease with increasing k, indicating that the riskier a project is perceived, the less likely it will be accepted. (21)

Risk-adjusted discount rate = Risk-free rate + Risk premium

2.7.5 Certainty Equivalent

The certainty equivalent approach involves a direct attempt to allow the decision-maker to incorporate his utility function into the analysis. We can simplify this calculation as follows. Define the certainty equivalent co-efficient (α_t) that represent the ratio of the certain outcome to the risky outcome, between which the financial manager is indifferent. In equation form, α_t can be represented:

$$\alpha_t = (certian\ cash\ flow_t)/(risky\ cash\ flow_t)$$

Thus the certainty coefficient can vary between 0, in the case of extreme risk, and 1, in the case of certainty. Then by multiplying the certainty equivalent co-efficient (α_t) times the expected but risky cash flow, we can determine an equivalent certain cash flow.

Once this risk is taken out of the project's cash flows, those cash flows are discounted back to the present value or calculated the profitability index. If the IRR is calculated, it is then compared with the risk free rate of interest rather than the firm's required rate of return in determining whether or not it should be accepted or rejected.

When multiplying risky cash flow by the at, the degree to which the risky cash flows are scaled down, that is size of the value of the at will depend on:

- The risk of the cash flow. The more risk mean the lower the value of α_t.
- Decision-maker's feeling about the attractiveness of the distribution form. The more attractive the distribution the higher the value of α_t.
- To what extent the random variations in the annual cash flows from this project are canceled out with variations in flows from other projects. The more variations that canceled out, the higher the value of α_t. (22)

2.7.6 Risk-Adjusted Discount Rate versus Certainty-Equivalent

The primary difference between the certainty equivalent approach and the risk adjusted discount rate approach involves the point at which the adjustment for risk is incorporated into the calculations. The certainty equivalent approach cash flows, adjusts downward the value of the expected annual after tax, which results in a lower net present value for a risky project. The risk adjusted discount rate, on the other hand, leaves the cash flows at their expected value, adjusts the required rate of return upward to compensate for added risk. In either case the project's net present value is being adjusted downward to compensate for additional risk. (22)

2.7.7 Decision Tree.

Financial managers often use decision trees for analyzing projects involving sequential decisions. Any cash-flow forecast rests on some assumption about the firm's future investment ad operating strategy. Often that assumption is implicit. Decision trees force the underlying strategy into the open. By displaying the links between today's and tomorrow's decisions, they help the financial manager to find the strategy with the highest net present value. (24)

2.8 ECONOMIC EVALUATION OF RENOVATION AND EXPANSION PROJECT

Renovation and expansion project is very important to enterprises in all countries. It has many economic advantages: making use of the potential of existing workshop and equipment, saving investment and land, shortening construction time, taking advantage of production experience and shortening the time of getting to full capacity.

Renovation and expansion project is constructed on the basis of the existing enterprise. Compared with a new project, it has the following features:

(1) It uses the existing assets and resources in different degrees, improving the efficiency of the existing amount by using the incremental amount, and obtaining relatively large incremental profit by using relatively small incremental investment.

(2) The existing enterprise is running and still will have some change, so the calculation of the project profit and expenses is quite complicated.

(3) Construction and production are going on simultaneously in the construction period.

(4) It has some relationship with the original enterprise as well as differences, the analysis range from some problems needed to be extended from project to enterprise.

In view of these features, the economic evaluation of renovation and expansion project should have some specific rules, except the methods for new projects.

The objectives of different renovation and expansion projects are not the same. Their benefits can be reflected in one or some of the following aspects: increasing output, extending variety, improving quality, decreasing energy consumption, putting resources to rational use, improving the level of technical equipment, improving working condition, reducing labor intensity, protecting environment and utilizing comprehensively. Their expenses include not only the incremental investment, the removing expenses of the original fixed assets, but also the losses brought about by production stopping and reduction in the construction period.

In economic evaluation, the boundary line of the renovation and expansion project should be chosen to illustrate the project benefit and expenses.

All the benefit and cost should be reflected in the economic evaluation. For those benefit and cost which is difficult to calculate quantitatively, qualitative analysis should be given.

The economic evaluation of renovation and expansion projects should adopt the incremental method, i.e. to calculate the incremental benefit and the incremental expense. Based on the incremental indexes, the evaluation indexes can be calculated, which are NPV, IRR, B/C. The incremental index should be calculated according to different situation:

(1) If the incremental amount can be separated from the original enterprise, then the renovation and expansion project can be considered as a new project, e.g. a new workshop or a production line, and then the incremental amount can be obtained directly.

(2) If the incremental amount is difficult to separate from the original enterprise, then the amount for before and after the project should be calculated. and the difference is the incremental amount.