Cost of Capital for Central Sector Utilities

Report for Discussion Purpose

Crisil Advisory Services

A Division of CRISIL

April 13, 2000

DISCLAIMER

CRISIL does not guarantee the accuracy, adequacy or completeness of any information presented in this report and is not responsible for any errors or omissions or for the results obtained from the use of such information. Neither CRISIL nor any director, representative or employee of CRISIL can accept liability for any direct or consequential loss arising from the use of this report or its contents. This report should be used in its entirety and shall not be reproduced in any form without prior permission from CRISIL.

This study envisaged application of the Cost of Capital Formula to Central Sector Utilities (CSUs) to simulate their returns for the past and future five years and also testing for impact on the debt service coverage ratio (of the CSUs) and other indicators that are used by banks and financial institutions to finance capital investments. However, the data required for carrying out this analysis has not been made available to CAS. As a result, it has not been possible to carry out such an analysis. This analysis is an important step to be able to arrive at logical conclusions and make definitive recommendations.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AM	Arithmetic Mean
APM	Arbitrage Pricing Model
BSE	Bombay Stock Exchange
CAPM	Capital Asset Pricing Model
CAS	Crisil Advisory Services
CERC	Central Electricity Regulatory Commission
CoC	Cost of Capital
CoE	Cost of Equity
CSU	Central Sector Utility
D	Amount of debt investors' funds in the Company
D/E	Debt to equity ratio
DGM	Dividend Growth Model
DSCR	Debt Service Coverage Ratio
$E(r_m)$	Expected rate of return on market portfolio
E	Amount of equity investors' funds in the Company
Equity Beta (β_e)	Coefficient reflecting the volatility (risk) of an individual stock relative to the market
ERC Act	Electricity Regulatory Commission Act
ESA	The Electricity (Supply) Act, 1948
GM	Geometric Mean
GoI	Government of India
IPP	Independent Power Project
NEEPCO	North East Electric Power Corporation
NHPC	National Hydro Power Corporation
NLC	Neyveli Lignite Corporation
NSE	National Stock Exchange
NSEWDM	National Stock Exchange Wholesale Debt Market
NTPC	National Thermal Power Corporation
OFFER	Office for Electricity Regulation
P/E	Price / Earning Ratio
PGCIL	Power Grid Corporation of India Limited
PPA	Power Purchase Agreement
PTC	Power Trading Corporation
RBI	Reserve Bank of India
r_e	Expected rate of return on equity
r_f	Risk-free rate of return
S&P	Standard & Poors
WACC	Weighted average cost of capital

ACKNOWLEDGEMENTS

This report has benefited from the valuable comments that CRISIL Advisory Services (CAS) has received from various domestic and international experts on issues related to cost of capital and regulation of power sector.

CAS would like to thank all the experts that attended the meeting on April 6, 2000 to debate the draft discussion paper circulated by CAS. CAS would like to express its gratitude to Mr. Pradip Roy (IDBI), Mr. R P Mangla, Prof. I M Pandey (IIM, Ahmedabad), Mr. G V Jagannatha Kumar (ICICI Limited), Mr. Oliver Blackaby (N. M. Rothschild & Sons), Mr. Anand Jagannathan (Dresdner Kleinworth Benson), Mr. V. Namasivayam (Pricewaterhouse Coopers), Mr. Rahul Roy (Arthur Anderson), Mr. K B Gopalakrishnan (SBI Capital Markets) and Dr. T.K.N.Nair (NCAER).

A number of experts have contributed to the draft discussion paper by providing inputs on specific issues with respect to the practices followed in their environment. Special thanks are due to Ms. Sarah Voll (NERA, Washington DC), Mr. Andrew Kosnaski (New Hampshire Public Utility Commission, USA), Mr. Rahul Mathur (ANZ Investment Bank), Ms. Parvati Banati (Warburg Dillon Read), Mr. Peter Suozzo (Warburg Dillon Read), Ms. Sabita Mehra (Standard & Poors, Hong Kong) and Mr. Tobias Hsieh (Standard & Poors, New York). Profound thanks are due to Mr. Ian Alexander (World Bank) for sharing his expertise in Cost of Capital studies and for the valuable time he spent with the CAS team in discussing the issues in the Indian context.

We would also like to thank the staff of CERC for the stimulating discussions and insightful inputs at various stages of the preparation of this report.

While the above persons have significantly contributed to this report, they do not necessarily subscribe to the facts, opinions and conclusions in this report. The conclusions in this report have been made by CAS based on its professional judgement and expertise.

CHAPTER I: INTRODUCTION

1. CERC's Objective

The ERC Act of 1998, which established CERC, requires it to promote competition, efficiency and economy in the electricity industry. The Act defines the functions and ambit of the CERC in section 13 as follows:

"13) The Central Commission shall discharge all or any of the following functions, namely: -

a) to regulate the tariff of generating companies owned or controlled by the Central government;

b) to regulate the tariffs of generating companies, other than those owned or controlled by the Central Government specified in clause (a), if such generating companies enter into or otherwise have a composite scheme for the generation and sale of electricity in more than one state;

c) to regulate the inter-State transmission of energy including tariff of the transmission utilities;

d) to promote competition, efficiency and economy in the activities of the electricity industry;

e) to aid and advise the Central Government in the formulation of tariff policy which shall be-

- *fair to the consumers; and*
- *facilitate mobilisation of adequate resources for the power sector;*

f) to associate with the environmental regulatory agencies to develop appropriate policies and procedures for the environmental regulation of the power sector;

g) to frame guidelines in matters relating to electricity tariff;

h) to arbitrate or adjudicate upon disputes involving generating companies or transmission utilities in regard to matters connected with clauses (a) to (c) above;

i) to aid and advise the Central government on any other matter referred to the Central Commission by the Government"

Cost of capital being an important component of the overall tariff, the CERC's decision in respect of the cost of capital will have significant bearing on the tariffs. One of the functions of CERC (as outlined above) is to aid and advise the central government in the formulation of tariff policy, which shall be fair to the consumers and facilitate mobilisation of adequate resources for the power sector. Thus while determining the capital-related costs, CERC's primary endeavour would be to balance its twin objectives of providing a stream of income to investors sufficient enough to attract investment into the industry while ensuring fair deal to the consumers.

With the above objectives in mind, CAS has been mandated to carry out a study on the optimum cost of capital, which would be used for tariff determination for central sector power utilities. This report has been prepared by CAS to provide input for a debate on various issues involved in estimating the optimum cost of capital for central sector power utilities.

2. Introduction to Cost of Capital

The level of return that is required by the financial markets to finance an asset is called the Cost of Capital. The Cost of Capital is usually calculated as a weighted average of the cost of debt and equity finance. The post tax weighted average cost of capital (WACC) can be calculated using the following formula:

$$WACC\ (Post\ tax) = [(1-g) * r_e] + [g * r_d\ (1-T)]$$

where:

g	is the level of gearing or leverage in a company, i.e. the proportion of debt in the total capital structure (i.e. debt + equity)
r_d	is the cost of debt finance (pre-tax)
r_e	is the cost of equity finance (post-tax)
T	is the marginal tax rate

The ***Cost of Debt*** is estimated by considering the premium to the risk free rate at which the company is likely to raise debt in current market conditions. Since debt is a contractual obligation between the utility and its lenders, the cost of debt could be determined. The most straightforward calculation for debt would be to examine the amount outstanding and annual cost of each debt issue. The amount outstanding is the initial issue reduced by any repayment. The annual cost of the issue is the sum of the yearly interest payment and any annual costs associated with the issue, such as hedging instruments for foreign exchange rate risk, plus the issuance costs amortised over the life of the issue. The sum of the annual costs divided by the sum of the amounts outstanding provides a weighted average Cost of Debt.

Where debt is usually a straightforward arithmetical calculation, the Cost of Equity is a contentious element in any tariff proceeding. The goal is to estimate a rate of return for the utility business comparable to returns earned on investments in enterprises of similar risk. It is the opportunity cost for investors in a situation where the country, the sector and the utility must compete for, against alternative investment opportunities, to attract equity capital. The question for regulators is, 'given the alternatives', what level of return do investors require in order to provide the capital to the utility. This report seeks to find an answer to this question.

Other than calculating the Cost of Capital, this report also attempts to identify the Rate Base[1] on which the Cost of Capital should be applied in the computation of tariffs. It is assumed that the Availability Targets set by CERC are realistic, and are neither excessively easy to overachieve nor excessively difficult to achieve. Therefore, the Rate determined based on this report should be permitted to the power companies at the target availability level rather than attempting to reward a portion of it through the Incentive component of the tariff. This report does not attempt to examine the appropriateness of the existing level of incentive for generation beyond the target level. This report also does not discuss whether the Tax should be a separate component of tariff, or should a Pre-tax Return on Equity be prescribed.

[1] In cases of a change in regulatory regime, perhaps coupled with privatisation, the initial rate base is itself revalued in some cases. Privatisation of Power Distribution in Orissa is an example. This report does not discuss whether the initial rate base of the CSUs needs to be changed.

3. Approach

The approach to the assignment was designed considering certain characteristics of the assignment - large scope for debate, first attempt by an independent regulator in India, large amount of theoretical and empirical work done elsewhere, and data intensity.

1. Identification of issues: Various issues in the approach to estimation of cost of capital as well as in its manner of application were identified through internal discussions, discussions with the CERC Staff and through a survey of literature[2] on the subject.
2. Study of precedents: USA has a long history of power sector regulation in a transparent manner. The regulatory bodies in UK and Australia have also examined the issues in Cost of Capital in their price reviews. Various discussion papers prepared by these regulators were studied to develop an appreciation of the manner in which these issues have been debated and addressed in these countries.
3. Discussion with experts[3]: The various issues and possible solutions were intensely debated within CRISIL by senior management, capital market experts and power sector experts. Various rounds of discussions were also held with the CERC Staff. Specific inputs on "best practises" were sought from regulatory community, academicians and investment community. Based on various inputs, a draft discussion paper was circulated to a set of Experts, and a meeting was held on April 6, 2000, to discuss the paper with the Experts. This report has been subsequently finalised based on the discussion held on April 6, 2000.

4. Structure of this Report

This report has been structured in three chapters. First chapter discusses the CERC's objectives and introduces the concept of cost of capital. In the second chapter, various issues in estimation of Cost of Capital for Central Sector Utilities (CSUs) have been discussed, and CAS' recommendations on these issues have been presented. The third chapter reviews the approaches to estimation of Cost of Equity, describes the assumptions and practical difficulties associated with each approach, and presents CAS' recommendation on the approach to be adopted along with the calculation of Cost of Equity based on different methods. In addition to this the issue of rate base and time period for the review of cost of equity have also been discussed in the third chapter.

This report has been structured so as to facilitate discussion. The focus has been to document various arguments. With respect to each issue, the key discussion points and CAS' suggestion with respect to the issue have been provided separately (in a shaded box) at the end of the discussion on each issue.

[2] See Bibliography

[3] The names of the experts have been mentioned in the Acknowledgements. The key issues discussed in the meeting have been summarised in Annexe 5.

5. Existing method for computation of "Cost of debt" and "Cost of equity" elements of tariff

Issues	Existing Method
Cost of Equity or Cost of Capital approach	Cost of Equity approach. Cost of debt at actuals (subject to approval by CEA for capital investment for CSUs beyond a notified limit)
Distinction in level of return: at sub-sector, company or plant level	No distinction
Computation of "cost of equity" and "cost of debt" components of tariff: at company level or plant level	At plant level
Differentiation on account of vintage of assets: New vs. Old	No Differentiation
Foreign exchange rate protection for debt providers	Full foreign exchange rate protection provided
Foreign exchange rate protection for equity investors	Full foreign exchange rate protection provided upto 16% (prescribed level) of Return on Equity
Impact of nature of ownership, Public vs. Private, on level of return	Not considered
Non-core businesses	Not considered
Level of return to equity investors	16% for all the CSUs (earlier 12%) at target availability level
Rate Base for Return on Equity computation	• Fixed as a certain percentage of the approved capital cost of the plant / project • Will remain same over the operating life of the plant/project
Time period for review of level of cost of equity	Not specified

CHAPTER II - ISSUES IN ESTIMATION OF COST OF CAPITAL

1. Estimation of Cost of Equity only or Cost of Capital

1.1. Issues

The CERC has two options:
Option 1 - Cost of Capital (CoC) Approach: The Cost of Capital is estimated based on *benchmark* Cost of Equity, Cost of Debt, Gearing and Tax rate, and is not determined by using the *actual* gearing or cost of borrowings.
Option 2 - Cost of Equity (CoE) Approach: The Cost of Equity alone is estimated (either pre-tax or post tax). The Cost of Debt and the Gearing is considered as actually contracted by the firm (subject to tests of prudence and usefulness[4]).

The general formula for Cost of Capital and the two approaches, are illustrated below:

$$CoC = CoE * E/(E+D) + CoD_{adjusted\ for\ tax} * D/(E+D)$$

	CoE	CoD	Debt-Equity Mix	Examples
CoC Approach	Estimated	Estimated	Normative	UK, Australia
CoE Approach	Estimated	Actuals (Subject to Prudency & Usefulness Tests)	Actuals (Subject to Prudency & Usefulness Tests)	US

1.2. Precedents

In U.K, the regulator has been calculating the Cost of Capital to be permitted. A minimum investment grade credit rating is assumed to calculate the benchmark Gearing and Cost of Debt. The regulator in Victoria, Australia; has also considered a similar approach in its discussion paper while seeking comments on issues such as the debt market in Australia not having sufficient depth.

In USA, in most states, the cost of debt used in determining the Cost of Capital is the actual cost of debt, i.e. the annual interest costs plus amortisation of issuance expenses expressed as a ratio to the net proceeds of the debt issuance. The actual debt equity mix of the utility is normally used in the calculation. However, if the utility's capital structure seems "unusual" in some regard - say the under utilisation of leverage - the regulator would do one of the two things:

1. "Impute" a hypothetical capital structure.
2. Reduce the "indicated" cost of equity to reflect the greater financial safety of a utility with little leverage.

1.3. Discussion

The CoC approach has a strong basis in economic theory. The "Modigliani-Miller Proposition 1" states that a firm cannot change the total value of its securities just by splitting its cash flows into different streams: the firm's value is determined by its real assets, not by the securities it issues. Thus capital structure is irrelevant as long as the

[4] US regulatory commissions apply two tests to determine whether costs should be included in the calculation. A prudence test asks whether the investment or expense was prudent (least cost) given what the decision-maker knew, *or should have known,* when the investment was made. The used and useful test asks whether the investment or expense was (and is) necessary for the provision of supply. A commission may disallow any expense/expenditure that fails *either* test.

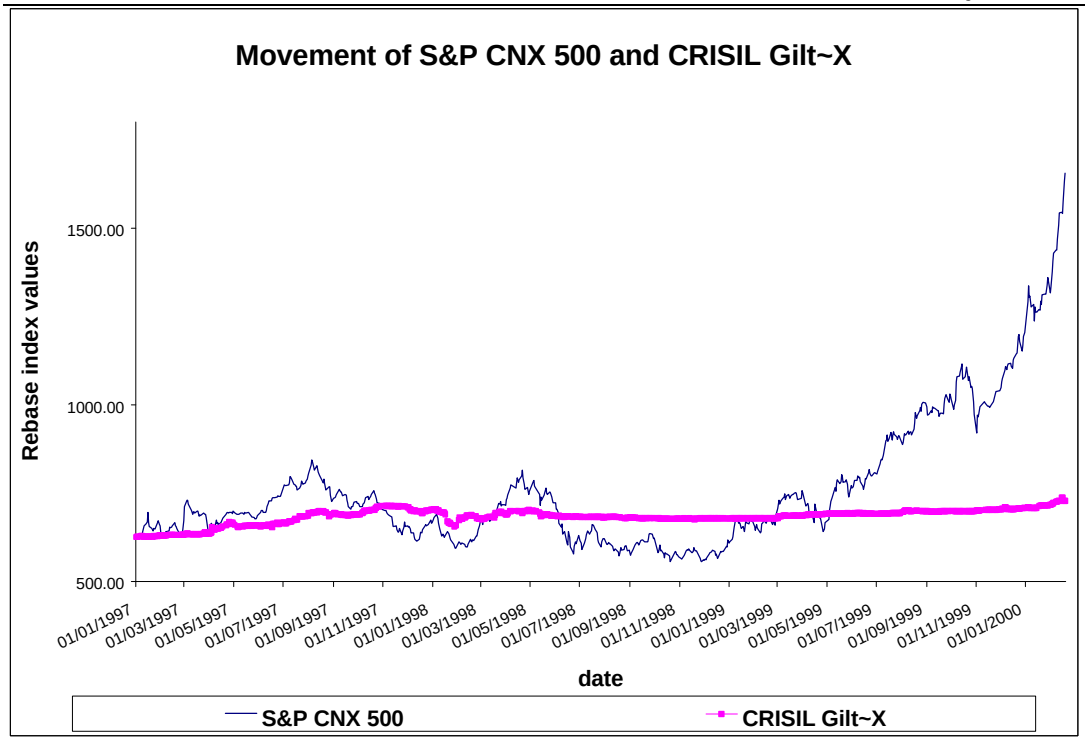
firm's investment decisions are taken as given. (Financial literature also points out that imperfections not accounted for in the proposition include taxes, costs of bankruptcy, cost of writing and enforcing complicated debt contracts, imperfect markets, etc.). From the consumer point of view, the argument would be that the tariff should not change due to changes in the capital structure alone.

The CoC approach is also consistent with the "incentive regulation" or "performance based regulation". CERC would not be required to "micro manage" and examine the prudence of the financial managers' decision on gearing on a case to case basis. Further, the utility would have incentive for financial engineering, refinancing, etc., only if it is permitted to retain some of the benefit. Also, with development of hybrid instruments, it could become increasingly difficult to classify these instruments as debt and equity.

In the Indian market, it would not be appropriate to assume that the CoC is independent of the actual gearing. While the CoC approach is theoretically sound, there are a number of implementation issues in its application. The Modigliani-Miller Proposition assumes a "perfect market" - which doesn't exist - though some studies show that the proposition does hold within a reasonable range of gearing. In the Indian context, the high levels of corporate taxes, relatively shallow debt market, etc., are further imperfections. Trading in corporate debt is very thin in India while trading in government paper is large. Following table shows the number of trades for corporate debt of different credit rating categories on National Stock Exchange Wholesale Debt Market (NSEWDM) in 1999.

Rating categories	No. of trades
AAA	18
AA+	47
AA	2
AA-	5
A+	0
A	0
A-	1
BBB+	3
Below BBB+	0
Total	76

As may be seen from the above table, trading in corporate debt has been shallow. Further, the recent behaviour of debt market and equity market does not show strong correlation to suggest that there is a smooth flow of funds between the two markets. The graph below tracks the movement of S&P CNX 500 index and CRISIL Gilt~X since 1st Jan 1997 and shows no visible correlation between the debt index (CRISIL Gilt~X) and the equity index (S&P CNX 500) in the past three years.



Developing a benchmark Cost of Debt would be difficult in view of the uncertainty on future interest rates. The RBI / GoI has managed to keep inflation at relatively low levels in the recent past and has also reduced the interest rate on government borrowings. However, the future direction and extent of change of interest rates is uncertain. One option would be to stipulate the benchmark as a premium over the risk free rate (i.e., a floating rate) rather than as a fixed number.

A commercial benchmark Cost of Debt may be higher than the actual Cost of Debt of the CSUs: The Central Sector Utilities (CSUs) at present have access to relatively cheaper debt from the Government and from multilateral / bilateral lending agencies. There have been significant changes in the mix of commercial and developmental capital of CSUs in the recent past, and therefore the past would not appropriately reflect the future. Table below illustrates the difference in cost of debt for the CSUs as also the change in cost of debt for certain CSUs in the recent past. Further, the interest rate of CSU borrowings is typically lower than that for similar rated private sector corporates on account of the larger sources of funds (LIC, etc) available to CSUs. A CoC approach could inherently assume commercial interest rates for debt (perhaps based on the credit rating). Assuming that the cheaper debt is intended to benefit the consumers (and not the equity investors of the companies), it may be preferable to continue to consider the Cost of Debt at actuals until non-commercial funds are available to the sector[5].

Effective Interest Rate on Avg. Loans (% p.a.)

[5] On the other hand, if it is argued that the Government, as the owner of the CSUs, desired the concessional debt to benefit the companies (so that they could generate additional funds for creation of assets), there would be a case for taking commercial cost of debt in the calculation of cost of capital. Diametrically opposite arguments arise due to the government having multiple roles - owner, regulator, facilitator - in the past. The argument made in this footnote may have been stronger if the government, in its regulatory role in the past, had demonstrated such intention in its tariff setting methodology.

For the year	**1997- 98**	**1996-97**	**1995-96**
NTPC	13.6	11.0	9.8
PGCIL	13.3	11.0	10.5
NHPC	8.55	5.5	5.56
NLC	13.5[6]	14.3	N.A.
NEEPCO	5.9	4.1	4.0

(Refer Annexe 1 for additional details)

It would be difficult to prescribe a benchmark D/E mix: Considering the different risk profiles of the CSUs, the optimal debt-equity (D/E) mix could differ from company to company. Also, the risk profiles of projects vary over time, as well as from project to project.

High level of interest coverage combined with relatively low interest costs indicates that CSUs can borrow substantial amount of funds for future investments without materially increasing the overall cost of capital.

Comments are invited on the following:

1. Should CERC follow a CoC approach or a CoE approach?
2. Should benchmark Cost of Debt be prescribed? What would be an appropriate method for developing a benchmark Cost of Debt?
3. Should benchmark D/E mix be determined? What would be an appropriate method for developing a benchmark D/E ratio?

The Cost of Capital approach is the preferable approach. However, CAS does not advise use of a normative Cost of Debt at present for the following reasons:

1. *The present interest cost of some of the CSUs is significantly less than even the risk free interest rates. Application of a normative Cost of Debt would result in significant additional returns to the equity investors (as profit on debt).*
2. *It is difficult to predict a Cost of Debt for a long time period[7] considering that the corporate debt market is relatively shallow, and the future interest rates are uncertain.*

It is suggested that CERC adopt a Cost of Equity approach at present. A cost of capital approach may be adopted at the next review, after examining whether the above issues have been addressed.

The approach suggested by CAS is based on the Cost of Equity approach, but it incorporates the merits of Cost of Capital approach to some extent. The suggested approach is as follows:

1. *The Cost of Equity permitted for a Company should vary with the Debt: Equity ratio of the Company. This would ensure that the variations in D/E ratio do not significantly affect the Cost of Capital, and therefore the tariff[8]. The effect of such a scheme on investors and consumers is similar to that in a Cost of Capital approach. Lower levels of leverage imply lower financial risk to equity investors, and therefore lower cost of*

[6] Has reduced to about 8% in 1998-99 with repayment of loans

[7] As discussed in Chapter III of this report, it is suggested that the Cost of Capital formulation should remain applicable for a time period of 5 years to reduce the uncertainty to investors.

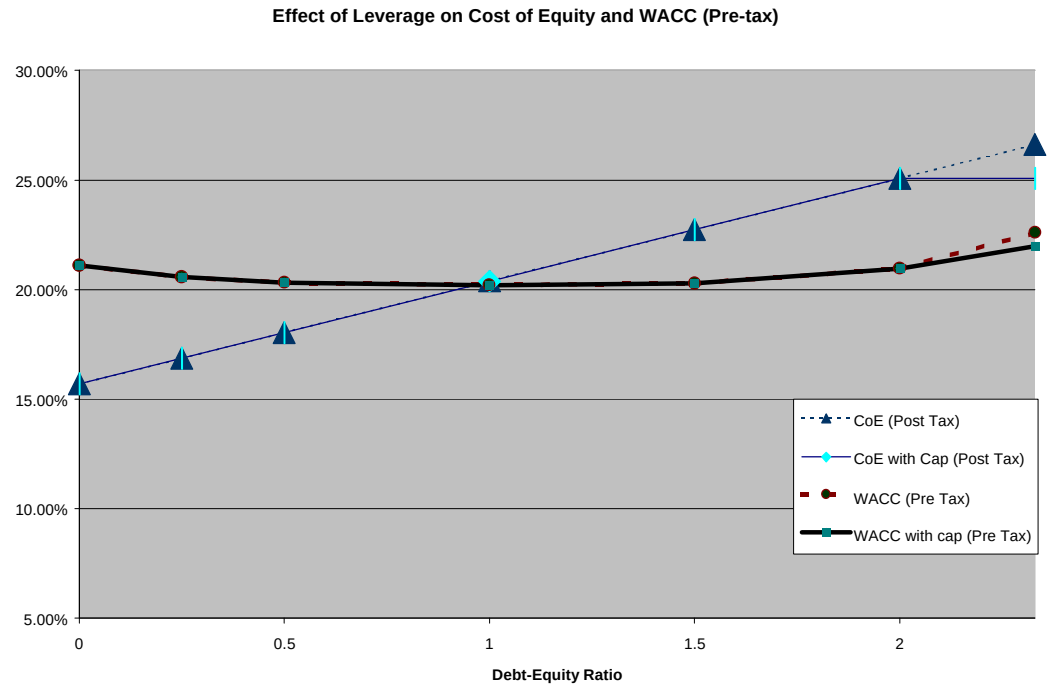
[8] The pre-tax Weighted Average Cost of Capital determines the combined effect of Cost of Equity and Cost of Debt on the tariff.

equity. This mechanism would also incentivise investors to optimally leverage[9] the equity so as to maximise the investment in the sector. (The mechanism is illustrated in the graph below).

2. *One drawback of this approach is that at high levels of D/E ratio, the Cost of Equity, and the Cost of Capital appear to be increasing significantly. Therefore, a maximum D/E ratio of 2 has been suggested for the calculation of Cost of Equity. No minimum value of D/E ratio is being suggested because it is felt that the low level of return on equity would itself disincentivise investors to operate at low D/E levels.*
3. *The Cost of Debt would be determined from the loan documents and could be easily calculated as the annual interest costs plus amortisation of issuance expenses expressed as a ratio to the net proceeds of the debt issuance.*

It is suggested that a prudency test on cost of debt should be applied by the agency approving the project cost (including financing plan)/tariff of any new investment after taking into consideration the prevailing cost of debt for a minimum investment grade (BBB) credit rated company. Alternately, the "benchmark" cost of debt could be determined at the beginning of each quarter or half year for all debt to be contracted in the next three months or six months. The prudency test could be based on the interest rate predictions of an appropriate agency[10].

Illustration of Cost of Equity mechanism



[9] An equity amount of Rs 100 crore could be utilised in two ways. (a) Investment in a Rs 100 crore project; (b) Investment in two Rs 100 crore projects by investing Rs 50 crore in each project, and raising debt of Rs 50 crore for each project. The proposed mechanism would incentivise (b).

[10] Crisil Research and Information Services (CRIS, a division of CRISIL), predicts interest rates for various credit ratings every week.

The graph above shows the assumed linear relationship between the D/E ratio and the Cost of Equity. The effective pre-tax Weighted Average Cost of Capital (assuming tax rate at 34.5% and varying debt costs at different D/E ratios) has also been shown. It may be observed that the pre-tax WACC (which is the factor that impacts tariff) does not change significantly over a large range of D/E ratios. For companies having a D/E ratio greater than 2, it is proposed that the Cost of Equity permitted in tariff computation should be kept at the same level as at a D/E ratio of 2 (as illustrated in the graph). This would prevent excessive increase in Cost of Capital, since the Cost of Debt would also increase in this range. (The dotted lines show the WACC and COE if the cap on D/E ratio of 2 was not applied)

Therefore, the Cost of Equity approach, with cost of equity being a function of the debt equity mix of the company and a cap on D/E ratio, incorporates the merits of the Cost of Capital approach to some extent.

2. Risk and Return Analysis with respect to Plants, Company or Industry sub-sector

2.1. Issues

The various generation and transmission assets that would be subject to CERC regulations are as follows:

1. Existing assets of the Central Sector Utilities (CSUs)
2. Capacity addition by the CSUs
3. Capacity addition through separate company with negotiated tariffs (e.g. Hirma project)
4. Capacity addition through separate company (public sector, joint sector or private sector) with tariffs decided through competitive bidding (e.g. Pipavav Mega Project being pursued by PTC, or Independent Power Transmission Companies to be pursued by PGCIL)

The issue before CERC is, whether to determine the appropriate cost of capital:

1. for each plant considering different risks in different plants, or
2. for each Company considering the risks at the company level, or
3. for each sub-sector (such as thermal generation, hydel generation, etc.) considering the risks at sub-sector level.

2.2. Precedents

There are no well known examples of generation alone being regulated by an independent regulator. In the USA, vertically integrated utilities are subject to regulation. Differential risks in terms of fuel mix for generation are generally not considered for vertically integrated utilities, unless the utility in question has an unusually large degree of nuclear generation exposure. Transmission and distribution companies are considered to be less risky than generation or vertically integrated utilities, and hence their expected return on equity is lower. In estimating the cost of equity to a utility, regulatory bodies rarely use data on that utility alone. Rather, samples of similar utilities[11] are analysed, and by

[11] Factors such as size, extent of diversification of service area / consumer types, etc. are considered in selecting the sample.

choosing an appropriate sample, the risks of the sector are taken into account for arriving at the cost of capital for the company.

The regulator in UK recognises that risks in transmission, distribution & supply businesses are different, and makes appropriate adjustments in the cost of capital calculation for this difference. Once cost of capital is established for one sector (such as distribution), it is applied to all the distribution companies irrespective of their specific risks.

2.3. Discussion

Determining the optimal cost of capital based on differentiation of type of fuel or type of project would be quite practical since the other normative costs are also likely to be decided for each type of plant, and the tariffs would be determined for each plant. This approach is also favoured by the argument that in case of divestment of certain plants or set of plants, the return being permitted would continue to reflect the risks.

On the other hand, determination of cost of capital for each regulated Company would better reflect the behaviour of investors. Plant level or sub-sector level returns will not be meaningful as investors making investments in the company would be taking their decisions based on the risk perception of the company (and not on the basis of risk perception of a specific project). This would also broadly be in line with the precedents discussed above.

Comments are invited on:

1. The appropriate level at which the risks and returns should be determined by CERC?

It is suggested that the Business Risks, and therefore the returns, be considered the same across all CSUs. However, the financial risks are different considering the different level of gearing of each CSU. The Cost of Equity be considered different for each CSU only on account of different levels of gearing.

The reasons for this suggestion are as follows:

1. *CAS has carried out a business risk analysis of various plants, and examined the aggregate risk for each of the five CSUs. The analysis does not show any clear differentiation between the generation sub-sector and the transmission sub-sector.*
2. *The various approaches to determination of Cost of Equity and their limitations have been discussed in Chapter III. Given the limitations, it is felt that there is some degree of error in estimation at the sector level itself. Further differentiation at the sub-sector or company level could increase the error beyond justifiable limits.*
3. *Some of the intuitive risk differences (geological surprises and siltation in case of hydel plants, delay in completion of power project in case of a project linked transmission line, etc.) are best addressed in the Rate Base or Operating Parameters rather than in the Rate i.e. level of return. For example:*

- *In case of Hydel projects*

(a) *permitting higher project cost in the Rate Base could compensate for increase in project cost due to geological surprises*[12].

(b) *The effect of siltation could be reflected in the Design Energy calculation.*

[12] This would apply only to risks which are beyond control of any party. The controllable risks would anyway be passed on to the EPC contractor and a premium corresponding to the risk would be included in the EPC price.

- *Risk on transmission service provider due to the linked power plant getting delayed could be addressed by including the Capital Work in Progress in the Rate Base[13] or through contractual arrangements between transmission service provider and other counter parties to the Transmission Service Agreement.*

3. Should returns for new projects be different from those for existing assets? Should there be differentiation based on manner of financing?

3.1. Issues

Should the CERC consider the following differences in determining the cost of capital:

1. Considering the development period and construction period risks, new projects are considered riskier than existing projects.
2. Also, risk perception of investors is different for balance sheet financing and for project financing.

3.2. Precedents

The above do not appear to be significant issues for other regulators. In the USA, since Cost of Debt is considered at actual, the actual interest rate of any debt is 'passed through' in the tariff. However, it is not clear whether any corresponding adjustment to cost of equity is also made. With respect to the returns as applicable to the distribution licensees in India, there seems to be some parallels in terms of 'new assets' earning a different a level of return as compared to the older ones (Schedule VI of ESA 1948).

3.3. Discussion

Considering the additional risks in development of new projects, the return expectation of investors in new projects is usually higher than that in existing projects. Since ensuring investments into the power sector would be one of the important objectives of CERC, the Cost of Capital should adequately reflect risks faced by investors in such projects. At the same time, permitting higher returns to existing assets may not be fair to the consumers. Another argument is that the cost of capital prevailing at the time that the asset was created, should be permitted. The returns for new assets (i.e., returns as required for new investments) and existing assets should therefore be different, reflecting the different risk levels.

The case for not differentiating between new assets and existing assets is that CERC should be permitting the Marginal Cost of Capital on all investments. Also, such differentiation would increase the complexity in the tariff making process, requiring all assets to be tagged by the date of their creation. The Availability Based Tariff notification, for example, does not differentiate the target availability for plants of different age.

A possibility is to pass on the construction period risk to the consumer rather than provide a premium for the risk. This implies that valid increases in project cost (e.g. due to geological uncertainties in case of hydel projects) be recognised in the rate base.

13 The manner of inclusion of CWIP in the Rate Base has been discussed in Chapter III

The risks to debt investors and to equity investors are different if new projects are financed on the strength of their cashflows alone (project financing) vis-à-vis a situation where the strength of an existing cashflow generating balance sheet is available. The ability of CSUs to raise relatively cheaper debt on their balance sheets would benefit the consumers if the cost of debt were considered differently for the two financing situations.

In case the Cost of Debt is being permitted at actuals[14], and the cost of equity is same for the two financing modes, project financing may appear more attractive to the CSUs. While this appears possible in theory, in practice the CSUs have continued to create new assets on their balance sheet even though the debt cost has been reimbursed on actual and the permitted equity returns have been same as for other new projects. Most private sector corporates venturing into power generation have been reluctant to offer support of their existing balance sheet to the power projects. However lenders have insisted on limited recourse, especially during construction period.

This issue should be seen in conjunction with the previous issue on the level at which returns should be determined as the two issues are interlinked.

Comments are invited on:
1. Is it appropriate to permit higher returns to new assets?
2. Should mode of financing be considered in determining returns?

If returns are estimated at the company level (as discussed in the previous section), then the need for permitting higher returns to new assets or the need to consider mode of financing is obviated. The risks at the Company level reflect the risk of the entire life cycle of a project, and not of operations period alone.

4. Should returns for foreign investment be protected for foreign exchange variations?

4.1. Issues

1. Should returns to foreign investors (debt and equity) be protected for foreign exchange variations?
2. Should higher returns be permitted to foreign investors to compensate for the foreign exchange variation risk?
3. Would real returns (i.e. protected for inflation) compensate for the foreign exchange variation risk?

4.2. Precedents

This is clearly not an issue for regulators in UK and USA. The UK regulator does calculate the real cost of capital. However, the reason for this is that the tariffs are linked to inflation (RPI-X regime).

4.3. Discussion

Foreign Exchange Rate risk protection is necessary to attract foreign capital

There is an urgent need to attract foreign capital into the power sector since the domestic funds are likely to be inadequate to meet the requirements of the sector. Protection of risk of variations in the foreign exchange rate (foreign exchange rate risk) appears to be necessary to attract foreign capital - debt & equity. Certain states that undertook

[14] Subject to tests of prudency and usefulness

competitive bidding process, and did not provide foreign exchange rate risk protection on equity, could not attract any foreign investors. Most South East Asian countries provided foreign exchange variation protected tariffs to attract foreign investors, and this has also been the policy of the Government of India. Though Thailand was an exception to this, it had a sovereign credit rating of "A" when such a policy was formulated. Further, after the sudden devaluation of the currency during the East Asian currency crisis, foreign exchange rate risk protection has been included in the PPAs. On the other hand, though the PPAs in Indonesia provide for foreign exchange rate risk protection, the power purchaser has been unable to honour the commitment, and the tariff payments are being attempted to be made at a pre-crisis exchange rate.

One typical argument is that foreign direct investments in other sectors are being made without returns being protected for foreign exchange rate risk. A fundamental difference in the two situations is that in the non-power sectors, the investors are able to undertake strategic marketing, pricing and costing decisions, while investments in the power sector are significantly controlled. The higher risks (credit quality, government intervention, etc.) necessitate that certain other risks be mitigated to make the project viable. The private sector investors in the power sector have preferred a non/limited recourse mode of financing as opposed to recourse financing as observed in other sectors[15].

Recognising that the foreign exchange rate risk is a significant concern of foreign investors, it could be compensated by higher (unprotected) return. The argument is that the investors having exposure to many countries are better positioned to manage the risks rather than the power purchasers. While it is certainly possible, the premium required could be significantly high, making the tariffs impractical.

Real rate of return would address forex risk

Protection for Indian inflation, rather than foreign exchange rate variation, may be able to achieve some balance between the interests of the consumers and the investors. The underlying assumption would be that interest rate parity exists between Indian and other markets, and that the foreign exchange rate reflects the differential inflation. The assumption is unlikely to apply to foreign exchange regimes with transfer restrictions (which is the case with Indian Rupee). Also, the time period over which appropriate corrections occur may be longer than the investors' consideration timeframe[16]. While using real rate of return might mitigate the issue of foreign exchange rate risk protection, it can create wide fluctuations in the tariff if the inflation rate fluctuates. The fluctuation in inflation rate is not very unlikely considering the prevailing condition of the Indian economy.

Foreign Exchange Rate Risk protection for a finite time period

While making investment decision, the equity investors would look at a finite timeframe for IRR calculation, and the level of returns beyond a certain time period would not significantly affect the investment decision. Therefore, the foreign exchange rate risk protection should also be for a similar timeframe, and risk of foreign exchange rate variations need not be borne by the consumers after such a period.

[15] Even the strongest developer like Edison Mission is rated only around A, while most developers would fall in the BBB or BB range. As a result, the kind of security that is demanded for these specialised structures, in order to attract financing, becomes higher; including assurances of dollar protected returns. *Source: Indian Infrastructure, February, 2000.*

[16] For example, the Indonesia Rupiah is out of parity right now, but not many analysts are expecting that a reversion to parity would occur soon.

Different returns for different currencies

It is acknowledged that a number of investment opportunities are available to foreign investors across various countries and various sectors. The return requirement of different currency investors may be different because the risk free return in each currency is different (for example, in Japan, the risk free rate is around 1%). Therefore, return for investments in a particular currency should be linked to the risk free rate of that currency. However, considering that the developed country markets are well linked, the currency flows would be expected to effectively balance such arbitrage opportunities, and the effective return expectation of a global investor investing in a country like India may not depend on the origin of the investor.

Comments are invited on:

1. Whether foreign exchange rate risk protection needs to be provided to foreign investment?
2. Can a reasonable level of premium compensate the forex risk?
3. Would real return be appropriate to still attract foreign investors?
4. Does the level of return need to be different for different currencies?

Exchange rate risk protection needs to be provided to foreign currency denominated equity invested in greenfield power projects for a finite time period*. It is suggested that the risk premium corresponding to foreign exchange rate risk should be subtracted from the optimal Rupee return to calculate the appropriate Dollar return and therefore, the protected Dollar return should necessarily be lower than the optimal Rupee return. The foreign currency denominated debt should be given full exchange rate risk protection over the term of the debt.*

5. Impact of Government Ownership on risks and returns

5.1. Issues

Should the return on government equity capital be different from the return on private sector equity capital?

5.2. Precedents

Some of the Federal government owned utilities in USA (such as Tennessee Valley Authority) operate on "not-for-profit" basis. Other precedent of such differentiation are not known.

5.3. Discussion

It is argued that the return expectation of the Government is lower than that of a commercial investor, hence the return on government capital should be lower. Another argument is that the assets have been created out of the tax payers' funds, and charging a commercial rate of return would be akin to taxing oneself in some sense (assuming that the tax payers and the electricity rate payers are the same set of people).

The benefit of concessional debt from the government would be passed on the consumers if the cost of debt is considered at actuals. With respect to cost of equity, considering the objective of making the sector financially self - reliant, CERC should be permitting commercial returns to the investors in the sector. Investors earn returns from a portfolio of investments such that the risk weighted return matches their expectation. The return from

a particular investment therefore cannot be differentiated based on the return expectation of the investors. The CERC needs to focus on the returns that the company assets can provide and not on the return expectations of the equity investors, which could vary depending on the risk averseness of the investors and the risk profile of the rest of their investment portfolio. Also, a commercial rate of return would ensure realistic valuation of assets in case of disinvestment of government ownership thereby allowing an appropriate level of return on the tax payers' funds invested in these companies.

Another argument is that government ownership and operation is typically associated with poor performance, resulting in higher return expectation of a commercial investor. However, the companies would feel the impact of operational inefficiency by incurring higher costs than those considered prudent by CERC. Considering this as a risk, and therefore allowing higher return, would be counter to the purpose of determining the prudent level of costs.

Comments are invited on:

1. Is there any strong reason for permitting different returns on government equity and private sector equity?

It is suggested that the nature of ownership i.e. whether Public (Government) or Private, should not be a consideration in cost of capital calculation.

6. Should returns and risks of non-core businesses of the CSUs be considered by CERC?

6.1. Issues

Some of CSUs earn a small proportion of their revenue from non-core businesses (consultancy income, income from sale of lignite, etc.), and some entities have plans to diversify (telecom venture of PGCIL). The issue is whether the risks of such businesses be considered by the CERC in determining the cost of capital.

6.2. Precedents

The issue has been faced by the UK regulator in the context of the telecom venture of National Grid Corporation. It is understood that the regulator does not include the risks, nor the revenues, of the telecom business in determining the transmission tariffs. The telecom business is conducted in a separate company that pays a "lease rental" to the transmission company. The "lease rental" has been determined through market forces, and therefore reflects the reasonable value of the facility provided by the transmission company to the telecom company. The transmission users benefit to the extent that the lease rental is subtracted from the revenue requirement of the transmission company in determination of transmission tariffs.

6.3. Discussion

The risks and returns of non-core business of the regulated entities should not impact the consumers. The regulated business should certainly not subsidise the non-regulated business, and preparation of divisionalised accounts may be essential to ensure this. To the extent that the non-regulated business is being provided any facility/service by the regulated business, it would be reasonable for such facility/service to be priced and charged to the users of the non-regulated business in a fair manner. The manner of determination of appropriate transfer pricing could vary from situation to situation.

Comments are invited on:

1. Is there any strong reason for considering the risks of non-core businesses of the CSUs in determination of the cost of capital?

It is suggested that risks in non-core business should not be a consideration in cost of capital calculation.

CHAPTER III - ESTIMATION OF COST OF EQUITY

It has been suggested in Chapter II that the Cost of Equity approach be used for determining the Returns to CSUs. Various approaches are available for estimation of cost of equity, such as the Dividend Growth Model, Price-earnings ratio model, Risk Premium model, the Arbitrage Pricing Model and Capital Asset Pricing Model (CAPM). Some of these methods have been discussed below along with the assumptions involved and applicability for the purpose of estimating the cost of equity for CSUs.

1. Approaches to Estimation of Cost of Equity

1.1. Dividend Growth Model (DGM)

The DGM is based on the premise that the value of a stock is equal to the present value of the future dividend stream from that stock. The cost of equity is assumed to be the discount rate, which equates the stock's current market value with the present value of the stock's dividend stream. The general simplified formula for DGM is:

$$r_e = D_1 / P_0 + g$$

where:

r_e is the cost of equity

D_1 is the expected dividend

P_o is the current share price (which can be taken as book value of share for unlisted companies)

g is the expected rate of growth in dividends

Dividend growth model requires projection of future dividends, which will involve not only projections of cash flows for the company but also prediction on how much of cash flow to equity will be distributed as dividend to shareholders. These projections will require a number of assumptions, including taking a view on the management's future dividend strategy. This is considered to be a major limitation of DGM. The use of book value instead of market value of share price to calculate dividend yield for unlisted companies would also introduce some error.

1.2. Price / Earning Ratio (P/E)

The price/earning ratio methodology involves capitalising the estimated future maintainable earnings of the business at a price/earning multiple, which is appropriate to the risks and prospects of the business. The inverse of the P/E ratio would be the rate of return. This method is commonly used in practice by the investor community and is generally used for established businesses with a financial track record and smooth earnings flows but is unlikely to be useful to a regulator in determining the appropriate returns to be allowed to the investors in the utilities. The primary reason for this is the difficulty in arriving at the correct P/E value to be used.

1.3. Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM) approach is a generally accepted methodology for determining the Cost of Equity. CAPM is based on the portfolio theory of finance in which risks are classified into:

- Systematic risk - risk applicable to the market as a whole, such as inflation, tax rises, interest rates, etc.
- Specific risk - residual risk unique to an individual firm or a small group of companies that form a subset of the market.

The theory stipulates that specific risks can be eliminated through diversification and hence, only systematic risks determine the return expectation of investors. The basis of CAPM is the relationship between risk and return. Whilst there has been considerable debate on the strength of the risk/return relationship, evidence indicates that there is a strong linear and positive relationship over the long term, which can be expressed by the following formula

$$E(r_e) = r_f + Equity\ Beta * [E(r_m) - r_f]$$

where:

$E(r_e)$	is the expected rate of return on equity (cost of equity)
r_f	is the risk-free rate of return (e.g. return on government bonds)
$E(r_m)$	is the expected rate of return on a market portfolio[17]
Equity Beta (β)	is the coefficient reflecting the volatility (risk) of the stock relative to the market, which measures the systematic risk of the stock

Critics, often question the underlying assumptions in CAPM, such as existence of riskless returns, fully informed investors, etc. Further, CAPM requires substantial information on stock prices and requires that shares of the company be traded in a well-functioning stock market where risk and return are appropriately valued. This poses implementation difficulties in the application of CAPM, especially in the context of developing markets such as India.

1.4. Arbitrage Pricing Model (APM)

The APM can be viewed as a multifactor CAPM. It assumes that each stock's return depends partly on pervasive macroeconomic influences or "factors" and partly on "noise" - events that are unique to that company. Accordingly, the return is assumed to obey the following simple relationship:

$$Cost\ of\ Equity = r_f + b_1\,[E(F_1) - r_f] + b_2\,[E(F_2) - r_f] + \ldots\ldots\ldots\ldots + b_k\,[E(F_k) - r_f]$$

Where:

$E(F_k)$	is the expected rate of return on a portfolio that mimics the k^{th} factor and is independent of all other factors
b_k	is the sensitivity of the stock return to the k^{th} factor.
r_f	is the risk-free rate of return (e.g. return on government bonds)

Use of APM requires:

- identification of the macroeconomic factors affecting the stock
- measurement of the risk premium for each of these factors $[E(F_k) - r_f]$

[17] Market portfolio refers to a well-diversified portfolio that is assumed to reflect the behaviour of the market as a whole.

- measurement of the sensitivity of the stock to each of those factors (b_k)

Empirical evidence from the developed markets confirms that the APM explains expected returns better than the single-factor CAPM. In addition APM can add insight into the type of risk that is relevant. However, the application of APM in valuation exercises is rare due to the complexity in implementation.

Regulators, even in the developed countries, where a lot of research has already been carried out on APM, have not favoured it. For a country like India where the amount of research on APM is limited, an attempt to apply APM will require significant amount of additional research efforts.

1.5. Risk Premium Model

The Risk Premium method is an appropriate method for cost of equity determination where information about stock prices is not available or reliable. This method involves deriving a company's cost of equity capital based on the return on equity for a sample of 'comparable companies' in a foreign country after adjusting it for the country risk premium. Such a methodology may be particularly applicable in determination of cost of equity for foreign investors.

It is possible to calculate the required return on equity for the electricity sector in the US or UK, and then estimate the premium required for the country risk associated with an investment in India. Thus the required return on equity for an investment in the Indian power sector would be:

R_e (for an Indian company) = R_e (for a foreign company in a similar business) + country risk premium for India

Alternately, the following formula can also be used assuming that the Country Risk Premium is measured as the difference of the risk free rates in the two countries:

*R_e (for an Indian company) = R_f (India) + {Beta of foreign company * Foreign Market Risk Premium}*

Return on equity for foreign companies can be estimated by the market rate of return on equity for listed power sector utilities in other countries.

Country risk premium is normally calculated as the difference between the risk free rates between two countries. The argument against using risk free rates (i.e. yield on long term government bonds) is that in Indian context these rates are not freely determined by the market forces alone. An alternative would be to consider returns from stock markets of the two countries, which would be free from direct government control and truly market determined as foreign institutional investors' fund inflow and outflow is possible.

The advantage of this method is that it utilises information from a developed market, where the assumptions of CAPM may be believed to hold well. The disadvantage is that this method assumes that the relative sector risk position of power sector in the economy is same for the two countries and the maturity level of power sector is also same in the two countries. *Clearly these assumptions do not hold good if we try to take a developed country like USA/UK and use the information from their power utilities for Indian utilities. Using a developing country will not be useful, as it will have the same problems as India.*

Argentina's gas regulator, Ente Naal Regulador de Gas, has used this model in its 1996-97 gas price review. It used USA as the reference country and calculated the return

requirement for gas companies there and then applied a risk premium equal to the difference between the rate of return on a foreign currency-denominated Argentine bond and USA Treasury bond.

Comments are invited on:

1. Which of the above methods is to be used for determination of the cost of equity capital for CSUs?

The Cost of Equity has been the most contested component of tariff in most countries where tariffs are determined by regulators through a transparent process of public hearings. As discussed above, each method has advantages and disadvantages with respect to justification ease and implementation ease. The Arbitrage Pricing Method is has strong basis in theory, but is very difficult to implement. On the other hand, the Dividend Growth Model and P/E ratio models are simple to implement, but involve a high degree of subjectivity, which could be difficult to justify. Though the Risk Premium approach has a good balance of theory and implementation ease, it could be debatable considering the different status of the economy in general and the power sector in particular in India and in the developed countries.

***It is suggested that Capital Asset Pricing Model be used for determination of cost of equity**. The major advantage of CAPM is that it achieves a good balance between theoretical basis and implementation ease. It does have some difficulties in implementation in a situation where companies are not listed and traded on the stock exchanges. These have been discussed in the next section. The CAPM has widespread support and is widely used by the investment community in valuation of assets. A very strong argument in support of CAPM is its acceptability among regulators in various countries including UK and Australia. Dependence of CAPM on market data fulfills one of the major objectives of the regulators, i.e. to mimic the market in the absence of a well functioning market.*

2. Application of CAPM

The essential elements in establishing a required return for a specific stock using CAPM are:

1. Estimation of the risk-free rate ($\mathbf{r_f}$).
2. Estimation of the expected risk premium for the market as a whole ($\mathbf{r_m - r_f}$).
3. Estimation of the stock's risk relative to that of the whole market (β).

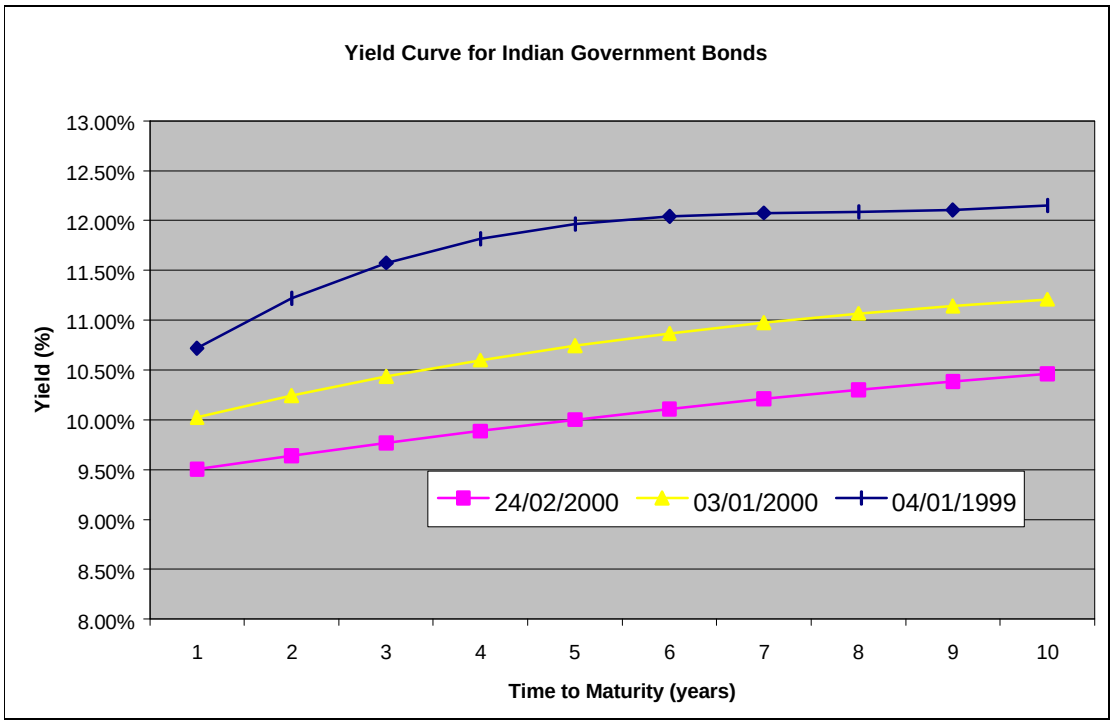
Establishing the values for each of these items is relatively straightforward for companies quoted on a stock exchange, when a developed capital market exists. In developing countries such as India, some approximations and adjustments might be required.

2.1. The risk-free rate (r_f)

The risk-free rate of return is a benchmark figure against which all investments in an economy should be measured. Being risk-free requires the removal, or minimization, of repayment risk. The table below gives the behavior of some important benchmark rates in the Indian economy.

Year	Bank Rate (%)	SBI PLR (%)	PLR of 5 major PSU banks (%)	Deposit rates of 5 major PSUs (%)	Risk free rate (10 year rate)- (%)
1994-95	12	15	15	11	11.6-12.2
1995-96	12	16.5	16.5	13	13-14
1996-97	12	14.5	14.5-15	12.5-13	13.4-14
1997-98	10.5-12	14	14	11.5-12	10.7-13
1998-99	10.5-8	12-14	12-13	10.5-11.5	11.8-12.3
1999-2000	8	12	12-13	10.5-11.5	10.2-12

Secondary market yield on Indian government debt offers the best proxy for a riskless rate of return. The graph below provides yield on Indian government securities for different maturities at different point of time.



Choice of the risk free rate for the application of CAPM raises a number of issues, which include:

- The term of security that is used as a proxy for the risk free rate; and
- Whether the current value of risk free rate should be used or some projected value for the regulatory period, should be used.

a) Choice of Term of Security

As an upward sloping yield curve is the norm, the selection of the 'term' of the risk free rate will affect the level of the measured risk free rate. There has been some debate over the appropriate term for the risk free rate. Some researchers suggest that, as the CAPM is a one period model, short-term rates are the more applicable proxy for the risk free rate. Short-term debt instruments also carry less risk than long-term instruments and so these rates are often argued to provide a better proxy for the risk free rate. Against this, as short-term rates are more volatile than long term ones, longer-term rates are often used in practice. Regulators in other countries have been using a value between five to ten years for estimating the risk free rate. For example, the UK regulator uses the average

redemption yield on securities with maturities of five years or more. Australian regulators have recommended a term of ten years whereas regulators in New Zealand prefer five years in the absence of any significant difference in the 5-10 year span.

An important factor that may influence the selection of the risk-free rate is *the frequency of regulatory determinations* for which CAPM is applied. Some argue that an appropriate term for calculating the risk free interest rate for CAPM is the term between pricing reviews. The interest rate risk associated with holding a fixed interest security increases with the time remaining to maturity. It may be argued that to use a long term bond rate such as a 20 or 30 year bond rate as a proxy for the risk free rate would over-compensate utility investors for an interest rate risk which they do not bear. Another argument is that the term of the risk free rate should be *consistent with the methodology used to measure the market risk premium*.

The time period for which the investment is being made could be an indicator of the term of security to be considered. This implies that investors generally have an expectation that they will be compensated for making long term investments over the economic life of the asset. Thus, it is argued that when determining expected returns, consideration needs to be given to the *investors' planning horizons*. However, it may also be argued that *financing decisions can be for shorter time* periods than investment decisions. The investors, especially equity investors, have the option of shifting their investment from one asset to another in the stock market. In line with this argument, some academicians and practitioners suggest a risk free rate as short as 90 days.

Another important issue in selecting the term of the security is the *liquidity* of that security in the debt market. In the Indian debt market, the liquidity in government securities with residual term of 10 years or more is relatively less. The Indian government has only recently started issuing securities with term more than 10 years. Therefore a trade off between the liquidity and term of the security needs to be made. In this regard Indian government securities with 8 years of time to maturity gives sufficient liquidity to assume that the yield is correctly depicting the market expectation of the long term risk free rate.

b) Current Value or a Forecast Value

The benefit of using a current measure of the risk free rate (as measured by the Yield to Maturity on government bonds) is that the value is readily measurable. Using an average value over the recent past (say four months) for a fairly long term security, captures the most recent information and views on inflation, while minimizing the distortion that can be caused by use of information for a particular day.

In certain situations, it may be felt that the market determined rate might be lower or higher than the "appropriate" interest rate due to some temporary factors. Since the return determined by the regulator would continue to apply for a longer time period, it may be preferable that the regulator should recognize the imperfection and apply an appropriate correction rather than using the market information as it is. For example, the UK regulator, in a recent distribution price control review, has based the calculation on expert opinion that the then prevailing interest rate levels were unrealistically low, and has used an average of last three years' interest rates instead.

Comments are invited on the following:
1. Use of current or some projected value of risk free rate.

2. Appropriate term of government security to be used for estimating expected risk free rate.

It is suggested that CERC use the latest three to four month average of Yield to Maturity on government securities with a residual time to maturity of 8 years as the risk free rate of return. *Since the Yield to Maturity is determined through trading in the secondary market, it does factor in the expectation of the market players on inflation and future interest rates, and a subjective prediction of interest rates is not required. Selecting securities which have a residual time to maturity of 8 years would provide a good balance of long term and sufficient liquidity.*

The term of 8 years can be reviewed at the time of any subsequent cost of capital review and should be based upon the government security with longest possible residual time to maturity and having sufficient liquidity in the secondary market.

2.2. Market risk premium

The market risk premium, as measured and applied in practice, is the premium above the risk-free rate of return that investors expect to earn on a well-diversified portfolio of equities.

a) Use of historical market risk premium

There is considerable debate about the validity of the estimates of the market risk premium that are derived from historical evidence. At a theoretical as well as practical level, many researchers in the developed countries have pointed out that the market risk premium as calculated from historical data may overstate the forward-looking premium[18]. In the recent past regulators in the UK have adopted measures of the market risk premium that are significantly less than the premium that is derived from an analysis of historical returns. For example, OFWAT has stated that it considers the market risk premium (to be used for regulatory purposes) to lie between 2.75 and 3.75 per cent whereas the real equity returns have averaged between 7 and 8.3 per cent in UK implying that the market risk premium is in the range of 3.2 to 4.8 per cent[19].

Professor Kevin Davis has suggested an alternative approach, which involves applying the dividend growth model to the market as a whole to derive the implied required rate of return. Some regulators use this method as a check on the market risk premium calculated from historical data. Some researchers like Prof. Aswath Damodaran have categorized the countries on the basis of economic fundamentals like variance in the economy, political risk, structure of the market, etc., and predicted a market risk premium to be used for countries in each category. For a developing country such as India, a value of 7.5% has been predicted.

[18] For example, Dr. Jenkinson of Oxford University has argued that the high measured equity premium in the past has been the result of very poor returns on bonds, which would not be expected to continue in the future in more liberal financial markets: Jenkinson (1998), 'The Equity Risk Premium: Another Look at History', The Utilities Journal, April.

[19] OFWAT, Prospects for Prices: A Consultation Paper on Strategic Issues Affecting Future Water Bills, October 1998.

b) Choice of statistical averaging technique

The historical market risk premium is generally calculated over a number of years. Opinions differ on as to whether the geometrical mean (GM)[20] or the arithmetic mean (AM)[21] is the appropriate measure. The arithmetic mean estimates the "expected returns" by assuming that the returns in each year are independent of each other. The geometric mean treats the observed historical path as the single best estimate of the future, and calculates the "most likely outcome".

Some financial economists strongly recommend use of geometric average risk premium. It is argued that the arithmetic averages are biased by the measurement period as they estimate the rates of return by taking a simple average of the single period rates of return. The arithmetic average depends on the interval chosen (i.e. whether daily or monthly). Geometric average, being a single estimate for the entire time interval, is invariant to the choice of interval. The argument in favor of arithmetic mean is that arithmetic averages are unbiased estimators of expectations.

Apart from these two methods, there is another method based on the Systematic Investment Plan (SIP) that is used by many long-term investors like Mutual Funds. Using this method, return on a market index can be calculated by estimating the cumulative returns on a stream of fixed amount of money invested periodically (say at the beginning of each month) in the index. Following table illustrates the calculation using some sample values.

Period	Index Value	Amount Invested every period (cash flow)	Index Units received
1	100	-1000	10.00
2	110	-1000	9.09
3	115	-1000	8.70
4	120	-1000	8.33
5	130	-1000	7.69
6	135	Total units	**43.81**
Total value of investments at the end of estimation period			**5915**
Cumulative return i.e. IRR on above cash flows (Market Return)			**5.65%**

The advantage of this method is its ability to remove the impact of short-term volatility, which makes it robust.

[20] The usual justification given in favor of geometric average is as follows: suppose annual returns are equally likely to be -50% and +100%. After two years the most likely outcome from investing $1 is a terminal wealth of $1. This is consistent with the geometric mean return per year of 0, i.e., $1 (1 + geometric mean)^2 = $1(1 + 0)^2 = $1 By contrast the arithmetic mean return per year of {(-50 +100)/2} i.e. 25% is not consistent with terminal wealth of $1, i.e., $1(1.25)^2 = $1.5625

[21] In the above example, the full distribution of possible outcomes after 2 years (and probabilities) is:

$1(1+1)*2 = $4 (.25)
$1(1+1)*(1–.5) = $1 (.25)
$1(1–.5)*(1+1) = $1 (.25)
$1(1–.5)*2 = $.25 (.25)

So the most likely terminal wealth is indeed $1, and this is consistent with the geometric mean return per year of 0. However, the expected wealth after 2 years is $1.5625 because the $4 outcome is farther from the most likely outcome of $1 than the $.25 outcome. As noted $1.5625 is consistent with an expected return per year of 25%, and use of this is demanded by the CAPM.

c) Choice of stock market index

In calculating market risk premium, it is usual to use an established stock market index as a proxy for the market portfolio. In India, a choice of possible indices are available - BSE 30, BSE 100, S&P CNX 500, Nifty, etc.

Often the choice is between an 'all-share' index and one that is only made up of the largest or most frequently traded companies i.e., between breadth and depth. The broader market indices like S&P CNX 500 represent most of the market and thus should be reflective of how the whole market is moving. But the argument against using such an index is that the stocks comprising of a large part of these indices are not traded very frequently and thus are taking the index away from the efficient market hypothesis of the CAPM model. This implies that the market risk premium calculated using broader market indices will give skewed results due to the weight of the not frequently traded shares.

The argument in favor of using smaller indices like BSE 30 is that they represent the most efficient face of the Indian stock market and thus are in line with the assumptions of the CAPM model. However, the drawback is that all the sectors of the economy are not properly represented since stocks are included in the indices based on their market capitalization. This would imply that these indices are not correctly representing the whole market.

Choice of stock market index will also be considerably influenced by the availability of historical data. In this regard, BSE 30 has the advantage of having the longest history and data is available for 20 years. The data on other indices, viz. S&P CNX 500 and Nifty, are available only since 1991.

d) Time period for market risk premium calculation

The simple averaging processes over a long time period imply that the population mean is unchanged over the estimation process. This in turn implies that risk aversion of investors, risk (i.e., market volatility) and personal taxation have not changed over that period, since the mean reflects these factors.

Ideally one should use historical data pertaining to the longest possible time period to cover all phases of the economy. However, post 1991, the Indian economy is fundamentally different from the past. Similarly post 1995, due to the advent of NSE with electronic trading, the stock market structure has changed significantly. Further, 1992 may be considered a freak year due to the stock market scam and should be excluded, as it is not expected to be repeated in the near future. In theory, it may be argued that the nature of probability distributions is such that, occasionally, rare events happen. Use of a sufficiently long time series (like 20 years or more) hopefully leads to their frequency matching their probability.

Comments are invited on the following:

1. Use of historical data to determine the equity risk premium.
2. Use of appropriate time period, index and averaging technique in estimating historical equity risk premium.

It is suggested that CERC uses market risk premium based on BSE 30 data for last 20 years (Jan 80 to Dec 99) and calculated using Systematic Investment Plan approach.
It is important to select a time period that is long enough to include various phases of the economy and various types of investors who have been active in the market at different

points in time. The BSE 30 is the only index that has tracked the Indian stock market for a 20-year period. The 30-share index also reflects that end of the Indian stock market, which witnessed maximum trading over the long time period. The Systematic Investment Plan is preferable to the AM and GM since it eliminates the effect of excess volatility. There is significant change in the GM and AM if a few data points are excluded, while the SIP displays a higher degree of robustness. Investors in India and abroad extensively use the SIP.

2.3. Equity beta

Equity Beta is the measure of the expected volatility of a particular stock relative to a well-diversified market portfolio. It measures the systematic risk of a stock, i.e. the risk that cannot be eliminated in a well-balanced, diversified portfolio. The beta of an equity is calculated as the covariance between its return and the return on a well-diversified market portfolio, divided by the variance of the return on a well-diversified market portfolio.

$$\text{Equity Beta } (\beta_e) = \text{Covariance } (\mathbf{r}, \mathbf{r_m}) / \text{Variance } (\mathbf{r_m})$$

where:

r is the return from the equity investment in a single stock

$\mathbf{r_m}$ is the return from the equity investment in the well-diversified market portfolio

The measured equity beta for a particular firm relates to the unique capital structure of that firm and that a change in the capital structure will change the degree of financial risk borne by the equity holders and hence the equity beta. A common practice to allow equity betas to be compared across firms with different capital structures is to adjust the estimated equity beta into the equivalent asset beta (which is the equity beta that would apply if the assets were financed wholly with equity) using the following formula:

$$\beta_a = \beta_e / \{1+ (1- \mathbf{T})*(\mathbf{D} / \mathbf{E})\}$$

where:

β_a is the Asset beta or unlevered beta of the firm

β_e is the Equity beta or levered beta of the firm

T is the marginal tax-rate of the firm

D / E is the debt-equity ratio of the firm

As an asset beta is purged of the financial risks associated with gearing, it can be compared with other asset betas derived from different capital structures. The asset beta can then be adjusted into an equity beta that is consistent with the target firm's level of gearing and compared, say, to equity betas that can be estimated directly from the market.

As CSUs are not listed, conventional method of using historical stock price data cannot be applied to determine their equity betas. Following paragraphs will discuss a number of alternative approaches that can be used to determine equity betas for CSUs and the issues associated with each one of them.

a) Proxy / Reference Company Betas

Where a company is not listed, conventional practice is to use other companies or sector averages as proxies. However, there is practically no listed Indian company which is

directly comparable with the central sector electricity generation and transmission companies. The alternative is to identify reference companies from other industries or other countries.

Choosing an appropriate reference company: A reference beta can be applied when:

- reference companies have the same characteristics as the regulated business and operate in similar regulatory environment
- risk profile of the reference stock during the measurement period is the same as the regulated business

Although in theory, there exists a possibility of finding exactly comparable companies to select proxy beta from, in practice it is very difficult. For our purpose, finding a comparable company that is similar to individual CSUs is almost impossible. The next best approach can be to identify an industry, which is comparable to the power generation and transmission business and then use the average asset beta from this industry to estimate the equity betas for CSUs. Another approach can be to look at foreign power sector utilities with an exact "match" for CSUs.

(i) Proxy Beta (Indian)

This approach tries to identify an industry, which is closer to power sector in terms of the systematic risks it faces and which can be used as a proxy industry. For this purpose various industries need to be analysed and compared on quantitative as well as qualitative parameters. The following risk analysis framework has been designed to assess various industries to evaluate the systematic risk an industry faces:

Risk Parameters		Weightages	Score (on a scale of 1 to 6[22])
Market related Risks	Demand-supply gap/growth potential		
	Regulation/government policy		
	Extent of Competition		
	Entry/Exit barriers (Economies of Scale, etc.)		
Input related risks (raw material, etc.)			
Customer related risks (credit quality and bargaining power of customers)			
Technology related risk			

The Annexe 2 at the end of this report gives the risk scores and the squared deviation from power sector on each parameter for a number of industries. The risk scores and weightages have been arrived at after consulting individual analysts in CRISIL Research and Information Services tracking the relevant industry.

Some industries, which come closer to power in terms of the quantitative risk evaluation (as given in Annexe 2) as well as a qualitative comparison are refining, shipping, and

[22] 1 indicates highest risk and 6 indicates the lowest risk

fertiliser. Following table gives asset beta values for some of these industries[23]. A detailed list of the beta values for companies in the above industries are given in Annexe 3.

Industry	Industry Asset Beta (β_a)
Power	0.54
Refining	0.60
Fertiliser	0.47
Shipping	0.56
Cement	0.51

(ii) Proxy Beta (Foreign)

The other approach would be to find proxy beta from a foreign country. We can take USA or UK as reference countries and look at the power utilities to find an exact match for CSUs. An exact match is unlikely since generation is not regulated in these countries. Another approach can be taking the industry average of asset beta of power sector in the USA or UK. Direct adaptation of asset beta of USA or UK power sector would not be appropriate considering the differing level of maturity of power sector and different relative risk position of power sector in the economy of proxy country and India.

b) Fundamental Beta

This approach combines industry and company fundamental factors to predict betas. Betas of publicly traded firms are regressed against the financial fundamentals, such as earnings variability, dividend yield (or payout), debt-equity ratio, EPS growth, total assets, degree of operating leverage, etc. and the relationship between betas and these variables is used to predict betas for unlisted companies. In USA, a number of researchers have examined the relationship between betas and fundamental variables and believe that fundamental betas can be better predictor of the future as compared to the historical betas.

The biggest drawback of this approach is the large data requirement and rigorous statistical analysis involved because of the interdependence of many of the fundamental variables[24]. A simplification of this approach is the Pogue's method.

Pogue's Method: This method is a subset of the above method and assumes that accounting rate of return captures all factors relevant to the earning potential of the firm. It postulates that business risk of a company can be measured in two ways:

- From historical market data - the variability of the market returns of the stock, as measured by the unlevered (asset) beta of the stock
- From historical accounting data - the variability in the accounting rate of return of the firm[25].

Since both are measures of the same risk, they should have a direct relationship, i.e. unlevered beta of any company should be a function of the variability (as measured by coefficient of variation) of the accounting rate of return which can be expressed as:

[23] Calculated by unlevering Industry betas for one year time period (Data source: India Index Services and Products Ltd. (IISL)

[24] Agencies like Barra do calculate the Fundamental Beta for companies in various developed markets. However, such an attempt for stocks in Indian markets is not known.

25 Accounting rate of return is calculated as the ratio of operating profit (as measured by EBIT) and capital employed.

Beta (unlevered) = f (variability of accounting rate of return)

The advantages of this method are (i) its relative simplicity and ease of application, and (ii) the fact that it does not use absolute value of any accounting information and is not affected by imperfections in the accounting data. In spite of these advantages, instances of use of this method by regulators or investors are not known.

A note on the calculation of Cost of Equity for the CSUs using the Pogue's method is attached under Annexe 4.

Comments are invited on the following:

1. Which of the above method is appropriate for estimation of the equity betas for CSUs

It is suggested that CERC use Proxy beta from power and refinery industries in India. *Adaptation of asset beta of USA or UK power sector may not be appropriate considering the differing level of maturity of power sector and different relative risk position of power sector in the economy for the proxy country and India. The Pogue's method is appealing due to its relative simplicity and objectivity. However, the application of Pogue's method to data in India does not show a strong correlation between the Beta and the Variability of Accounting Returns for the top 100 Indian companies[26] (Refer Annexe 4). The equation has a large constant term, which effectively implies that application of the equation to unlisted companies would tend to show Betas that are close to the average Beta of the 100 companies. It is felt that the use of Proxy Beta (Indian) method to identify the specific industries having similar risks would result in a better estimate of Beta for CSUs rather than an average of the Betas of 100 companies.*

In selecting proxies, it is preferable to select industries rather than individual companies to reduce the estimation error by some degree of averaging. An analysis of various possible industries on a common framework shows that listed power companies and the refinery industry are the best available proxies.

The listed power sector companies represent generation as well as distribution & supply end of the business. There are two key issues in treating these as proxy for the CSUs - (i) the credit quality of customer, and (ii) difference in size.

While the credit risk faced by the CSUs is certainly not similar to that faced by the listed companies, it is felt that attempting to compensate this risk through the Return could be counter productive. The risk premium corresponding to the risk could be so high as to make the tariffs unreasonably high. It is suggested that the payment security issue is not a pricing issue and should not be addressed through the pricing mechanism. The CERC has stated in its earlier discussion paper that it is evolving a solution to the problem of non-payment / delayed payment.

Some of the CSUs are certainly much larger than the listed power sector companies, and therefore have the advantage of diversity of operational location, customers, etc. It is felt that this issue is addressed to some extent by inclusion of refinery companies in the set of proxies.

[26] It is concieveable that the usefulness of the results of Pogue's method could be improved by introducing more variables in the equation. This would make the equation tend towards the Fundamental Beta discussed earlier.

The Indian oil refining and distribution sector has a number of similarities to the power sector. The sector is capital intensive, and is dominated by large players. It is highly regulated and Government policy plays a significant role. The sector is undergoing significant reforms, including introduction of private sector participation. In line with the recommendations of the Nirmal Singh Committee, it is expected that the government would set up a regulatory body[27] to ensure fair competition among players. The pricing has been "cost plus" with an assured post tax return until April 1998. Although, the Administered Pricing Mechanism has been dismantled, the government currently assures offtake of five key products. The pricing of marketing of five key products continues to be under a "cost plus" regime. All new projects of the state owned companies with an outlay of more than Rs 1 bn and all replacements or renewals costing more than Rs 1 bn require Central Government approval and have to pass through a three stage clearance process.

3. Cost of Equity Calculation for CSUs

As described earlier, we require following three parameters for each CSU to estimate the required return on equity:

1. Risk-free rate ($\mathbf{r_f}$) = 11% (as calculated by taking average yield on 7.5-8.5 years residual time to maturity Government of India securities for all the transactions recorded between 1st December 1999 and 8th March 2000)
2. Market risk premium ($\mathbf{r_m - r_f}$) = 8.2% (based on BSE 30 data for last 20 yrs and calculated using Systematic Investment Plan approach)
3. Equity Beta (β) for each CSU: Equity beta for each CSU is estimated by levering the asset beta (arrived at using the three methods discussed in the previous chapter) using the following formula

$$b_e = b_a * \{1 + (1 - T) * (D / E)\}$$

Where D/E is the actual debt-equity ratios (with a maximum value of 2 as discussed below) of the utilities and T is the actual effective tax rate of the utility[28]. Thus for power sector utilities

$$b_e = b_a * \{1 + (D / E)\}$$

The cost of equity for CSUs will be estimated using the following formula

$$r_e = r_f + b_e * [r_m - r_f]$$

Following paragraphs illustrate the calculation of the Cost of Equity using various methods of estimating betas.

[27] Since the prices are to increasingly reflect imported price, the regulator is likely to oversee prices rather than to set prices. However, the CERC having a similar role in the future, at least with respect to generation prices, cannot be ruled out.

[28] The effective Tax Rate needs to be included in the formula for conversion of Asset Beta to Equity Beta to reflect the tax impact of gearing on equity returns. However, in case of CSUs, the tax amount being a pass through, does not impact the equity returns. The tax rate, for the purpose of conversion of Asset Beta to Equity Beta, has therefore been taken as zero. This is also the practise followed by some US regulators who consider the tax at actual.

3.1. Using Proxy Beta (Indian) Method

Following tables illustrate the calculation of required return on equity for CSUs using market capitalisation weighted average asset beta for **Power** sector[29] and **Refining**[30] sector as the proxy asset beta for all the CSUs.

The equity Betas for each CSU has been calculated using the following formula

$$\beta_e = \beta_a * \{1+(D / E)\}$$

where:

β_a = *0.54 (Market capitalisation weighted average asset beta for listed Power sector companies in India)*

= *0.60 (Market capitalisation weighted average asset beta for listed Refining sector companies in India)*

D/E = *Actual debt-equity ratio of the CSU*

CSUs	Debt/Equity	Using Indian Power sector as Proxy		Using Indian Refining sector as Proxy	
		Asset Beta	Equity Beta	Asset Beta	Equity Beta
NLC	0.19	0.54	0.64	0.60	0.71
NTPC	0.49	0.54	0.80	0.60	0.89
PGCIL	1.16	0.54	1.17	0.60	1.30
NHPC	1.24	0.54	1.21	0.60	1.34
NEEPCO	0.78	0.54	0.96	0.60	1.07

The return on equity for each CSU has been estimated using following formula

$$r_e = r_f + \beta_e * [r_m - r_f]$$

CSUs	Risk Free rate (r_f)	Market Risk Premium [r_m - r_f]	Using Power sector as Proxy		Using Refining sector as Proxy	
			Equity Beta (β_e)	RoE (r_e)	Equity Beta (β_e)	RoE (r_e)
NLC	11%	8.2%	0.64	16.3%	0.71	16.9%
NTPC	11%	8.2%	0.80	17.6%	0.89	18.3%
PGCIL	11%	8.2%	1.17	20.6%	1.30	21.6%
NHPC	11%	8.2%	1.21	20.9%	1.34	22.0%
NEEPCO	11%	8.2%	0.96	18.9%	1.07	19.8%

3.2. Using Proxy Beta (Foreign - USA) Method

Following table illustrate the required return on equity estimated using the market capitalization weighted average asset beta for Electricity utilities comprising the S&P Electric Power Utilities Index[31] as the proxy asset beta for CSUs.

[29] Refer to Annexe 3 for details
[30] Refer to Annexe 3 for details
[31] Betas for 29 US power utilities that make up the S&P Electric Power Companies Index. The Asset Betas were calculated by unlevering the equity betas for each company using the current debt-equity ratios and effective tax rates. Source: S&P's Stock reports as on 12th February 2000

CSUs	Debt/Equity	Asset Beta (b_a)	Equity Beta (b_e)	RoE (r_e)
NLC	0.19	0.07	0.08	11.7%
NTPC	0.49	0.07	0.10	11.9%
PGCIL	1.16	0.07	0.15	12.2%
NHPC	1.24	0.07	0.16	12.3%
NEEPCO	0.78	0.07	0.12	12.0%

3.3. Using Fundamental Approach (Pogue's Method) for Beta

Using Pogue's method to estimate the asset beta[32] gives the following equation for estimating asset betas for CSUs

*Unlevered or Asset Beta = 0.55 + 0.05 * (coeff. of var. of accounting rate of return)*

Return on equity can be calculated with the help of following equations using the asset betas for CSUs estimated as above:

$$b_e = b_a * \{1+(D / E)\}; \text{ and}$$

$$r_e = r_f + b_e * [r_m - r_f]$$

CSUs	Debt/Equity	Asset Beta	Equity Beta	RoE
NLC	0.19	0.56	0.67	16.5%
NTPC	0.49	0.56	0.83	17.8%
PGCIL	1.16	0.55	1.19	20.8%
NHPC	1.24	0.57	1.27	21.4%
NEEPCO	0.78	0.57	1.01	19.3%

3.4. Comparison of Return on Equity for CSUs using various methods

CSUs	Debt / Equity	RoE using Proxy (Indian)[33]	RoE using Proxy (Foreign - USA)[34]	RoE using Pogue's Method[35]
NLC	0.19	16.5% - 17.0%	11.5%	16.5%
NTPC	0.49	17.5% - 18.5%	12.0%	18.0%
PGCIL	1.16	20.5% - 21.5%	12.0%	21.0%
NHPC	1.24	21.0% - 22.0%	12.5%	21.5%
NEEPCO	0.78	19.0% - 20.2%	12.0%	19.5%

4. Return on What? - Rate Base

Rate base on which the above rate of return would be applied is an equally important issue. CAPM computes market return on equity, which is an indicator for cost of equity, where equity is, interpreted as “net worth” of the company i.e. all the capital belonging to the shareholders of the company. The manner of application of rate of return on the rate

[32] Refer to Annexe 4 for details
[33] Rounded to the nearest 0.5%
[34] Rounded to the nearest 0.5%
[35] Rounded to the nearest 0.5%

base should ensure that all the capital that is financing the "useful[36]" assets of the company is appropriately serviced. Two methods of application of rate of return on the rate base have been discussed below. The following simplified balance sheet for a plant / project is used to illustrate the two methods.

Figures in Rs crores

Liabilities		Assets	
Description	**Amount**	**Description**	**Amount**
Net Worth	60	*Net Fixed Assets related to the regulated business (NFA_r)*	42
Total Long Term Debt	30	Net Fixed Assets not related to the regulated business (NFA_{nr})	6
Total Short Term Debt	10	*Capital work in Progress related to the regulated business ($CWIP_r$)*	10
		Capital work in Progress not related to the regulated business ($CWIP_{nr}$)	2
		Investments required by statute (I_s)	5
		Other Investments not required by statute (I_{ns})	5
		Current Assets - according to norms (CA_n)	20
		Excess Current Assets - above norms (CA_e)	10
Total	100	Total	100

4.1. "Useful" assets

The following discussion regarding "useful" assets is relevant before discussing the methods for determining the rate base.

1. Net Fixed assets: The calculations from the asset side should start from the Net Assets, i.e. *net of depreciation*. The investors should earn returns for capital that is employed in the business. If post-tax cashflows were reinvested into the business, the investors would continue to earn returns on such funds. However, if such cashflows are returned to the capital providers (as dividend, principal repayment, equity buy back, etc.) or invested in assets not required for electricity business, they would not earn returns through electricity tariff. Besides being conceptually sound, this method will also incentivise investments in the productive (generation/transmission) assets.
2. Capital Work-in-Progress (CWIP): The rate of return is being calculated based on the returns that investors in other businesses would expect to earn through investments in the stock market. Therefore, these are returns on the investments made in the company, irrespective of whether the assets created by the investment have started generating cashflows or not. It is therefore felt that for a like-to-like comparison, the CWIP should be included in the rate base. However, since the tariffs for generation and transmission are to be determined at the project level, including CWIP in the rate base would pose implementation difficulties. It is therefore suggested that the returns that the equity investors would have earned during the construction period be capitalised and included in the Rate Base itself. (This is similar to the Interest During Construction approach for the Debt component of capital, and is permitted by a

[36] "Useful" assets are those necessarily required for business of power generation / transmission. These would be determined by the "usefulness" tests applied at the time of investment approval. *The assets considered "useful" have been shown in italics in the balance sheet used for illustration of the two methods.*

number of regulators in USA in the form of Adjustment for Funds Utilised During Construction (AFUDC)[37]).

3. Excess receivables: The current assets in excess of norms have not been shown as "useful" in the above example. However, the Receivables in excess of those included in Working Capital norms merit discussion. It is felt that the high level of receivables of the CSUs does not reflect inefficiency of the CSUs but they reflect a more fundamental problem of the sector itself. Since these appear to be an unavoidable part of business assets at present, it is felt that such assets should also be allowed to earn a rate of return. However, inclusion of these assets in the Rate Base could result in (a) the relatively more creditworthy consumers also having to pay for those consumers who do not pay on time, and (b) double counting of some sort since a Delayed Payment Charge (DPC) is recoverable on the receivables not paid on or before the due date of payment. It is therefore suggested that these assets be serviced through the DPC alone, and should not be included in the Rate Base. It is understood that CERC is making efforts to find a solution to the issue of delayed payments/non-payments. It is suggested that the solution be such that the CSU actually realizes the DPC from the consumers (i.e. SEBs).

4.2. Methods for Calculation of Rate Base

To illustrate the two methods for calculation of rate base, the following assumptions are made in addition to the simplified balance sheet shown above:

Effective Cost of Long term debt = 16%
Effective Cost of Short term debt = 16%[38]
Pre tax Cost of Equity = 20%[39]

Method 1: Aggregated Rate Base and application of WACC

Calculation of Rate Base:

1. Total Assets of the plant/project = 100
2. Subtract, assets that are not "useful"
   $NFA_{nr} + CWIP_{nr} + I_{ns} + CA_e$
   = 6 + 2 + 5 + 10 = 23
3. ***Rate base*** = (1) - (2)
   = 100 - 23 = ***Rs. 77 crore***

Calculation of Weighted Average Cost of Capital (WACC)

WACC (pre tax) = Pre-tax cost of equity * Proportion of Equity + Weighted average cost of debt (long term and short term) * Proportion of debt (long term and short term)
= 20% * (60 / 100) + 16% * ((30+10)/100) = ***18.4%***

[37] In case it is decided to include CWIP explicitly rather than as AFUDC, and Interest During Construction is also being capitalised, appropriate adjustments in the rate base calculation would need to be made to avoid double counting of assets.

[38] The interest rate on short-term debt and long term debt has been assumed same to keep the calculations simple. These could be different, and the cost of different long-term debts, could also be different. A weighted average cost of debt would need to be computed for the calculations.

[39] The Pre-tax Cost of Equity has been assumed for the illustrations to keep the calculations simple. In practice, depending on whether Tax is a separate component of tariff or not, the post-tax or pre-tax value of Cost of Equity should be used.

Capital cost related component of tariff:

(a) Return on Rate Base = Rate Base * Return
= 77 * 18.4% = ***Rs. 14.2 crore***
(b) Interest on Long Term Debt = 0 (already included above)
(c) Interest on Working Capital = 0 (already included above)
(d) Capital cost related component of tariff = (a) + (b) + (c) = ***Rs 14.2 crore***

The proposed method is relatively simple in application. However, it departs from the present practise of calculating Interest on Debt and Interest on Working Capital components of tariff. The method is based on the assumption that all assets are financed in the same proportion of Debt and Equity as reflected in the liability side of the balance sheet, and it is not possible to match which assets have been created from which liabilities.

Method 2: Disaggregated Rate Base and application of COE

Calculation of Rate Base:
1. Total Net Fixed Assets related to the regulated business of the utility = 42
2. Add, Capital work in progress related to the regulated business of the utility = 10
3. Add, Investments required by statute[40] = 5
4. Subtract, Long Term Loans = 30
5. ***Adjusted Networth (ANW)***= (1) + (2) + (3) - (4)
= 42 + 10 +5 - 30 = ***Rs. 27 crore***

Capital cost related components of tariff:
(a) Return on Equity = Adjusted Networth * Cost of Equity
= 27 * 20% = ***Rs. 5.4 crore***
(b) Interest on Long Term Debt = Total Long Term Debt * Cost of Long Term Debt
= 30 * 16% = ***Rs. 4.8 crore***
(c) Interest on Working Capital = Current assets as per norms * Cost of Short Term Debt
= 20 * 16% = ***Rs. 3.2 crore***
(d) Capital cost related component of tariff = (a) + (b) + (c) = ***Rs 13.4 crore***[41]

The benefit of method 2 is that it is closer to the present method of calculation, whereby the Return on Equity, Interest on Long Term Debt and the Interest on Working Capital are separate components in the tariff. This approach rewards various components of capital employed separately as is being done now with only cost of equity being calculated on Adjusted Networth.

4.3. Implementation issues

The implementation of both methods require that plant / project level balance sheets are prepared in a manner such that they aggregate to the Company level balance sheets. It is felt that this needs to be ensured before adopting the method of calculation of Cost of Equity and Rate Base as proposed in this report. Considering that method 2 is closer to the

[40] In both methods, 1 and 2, since a return is being provided on statutory investments through the tariff, any revenue earned on these investments would need to be subtracted from the expenses allowed to be recovered through tariff.
[41] The total Capital Cost component of tariff could be higher or lower than that in method 1 depending on the specific numbers taken in the example. The calculations have been provided to illustrate the mechanism, and the results of this example alone should not be used to compare the mechanisms.

present method of computation of Rate Base and would therefore require fewer changes, it may be preferred initially.

5. Time over which the Cost of Equity would be reviewed/ changed

The cost of equity would change over time due to changes in the risk free rate, market risk premium, and systematic risk (equity beta). Therefore, the frequency of review of cost of equity for CSUs is an important implementation issue that needs to be addressed.

The regulators in UK and Victoria, Australia, review the tariffs every five years. In the US, at the time of utility filing its annual report, the Return on Equity (ROE) is computed for that year. In case this is higher than the permitted ROE or the ROE that the current market conditions would demand, the utility is "called in for a rate case", and its cost of equity is reset. Typically, the specialists determine a reasonable range of ROE, and if the actual ROE is not materially different from the range, the utility is not called in for a rate case.

It is suggested that the cost of equity for CSUs is determined using a formula, which will vary only with debt-equity ratio of the company (subject to a ceiling of 2.0) till the next full review at the end of a block of five years. The change in Cost of Equity resulting from change in debt-equity ratio would also be done only when it is felt that the change would have a material effect. Any review of the cost of equity would need to ensure that the cost of equity to be set after the review [42]

a) would not lead to financial ratios poorer than those typically observed in case of debt instrument with at least an investment grade credit rating, and
b) would not result in sharp increases in the tariff .

The above suggestion serves the objective of both, investors and consumers, with regard to the reasonableness and stability of returns and tariffs respectively.

[42] estimated using tariff stream and normative level of expenses for all the plants

CHAPTER IV: SUMMARY OF RECOMMENDATIONS

The Cost of capital being an important component of the overall tariff, the CERC's decision in respect of the cost of capital will have significant bearing on the tariffs. While determining the capital-related costs, CERC's primary endeavour would be to balance its twin objectives of providing a stream of income to investors sufficient enough to attract investment into the industry while ensuring fair deal to the consumers. With the above objectives in mind, CAS has been mandated to carry out a study on the optimum cost of capital that would be used for tariff determination for central sector power utilities. This report has been prepared by CAS to provide input for a debate on various issues involved in estimating the optimum cost of capital for central sector power utilities. CAS has examined regulatory practises in other countries, carried out a detailed literature survey, held discussions with a wide range of experts and applied its professional judgement and expertise in the preparation of this report.

Issues in Estimation of Cost of Capital

1. A Cost of Capital approach, which does not examine the actual Cost of Debt and gearing level of a company, is the preferable approach. However, considering the issues in adoption of a benchmark Cost of Debt, a Cost of Equity approach (with Cost of Debt at actuals subject to tests of prudency and usefulness) has been suggested. The computation of Cost of Equity has been related to the gearing level of the company, which incorporates the merits of the Cost of Capital approach to some extent.
2. It is suggested that the Business Risks, and therefore the returns, be considered the same across all CSUs. However, the financial risks are different considering the different level of gearing of each CSU. The Cost of Equity be considered different for each CSU only on account of different levels of gearing.
3. Differentiation in rate of return on account of vintage of assets (existing assets or new assets), ownership of assets (public or private), and mode of financing (balance sheet or project finance) has not been suggested.
4. It is suggested that Foreign Exchange rate risk protection be provided to foreign currency denominated equity invested in greenfield power projects for a finite time period. The risk premium corresponding to foreign exchange rate risk should be subtracted from the optimal Rupee return to calculate the appropriate Dollar return and therefore, the protected Dollar return should necessarily be lower than the optimal Rupee return. The foreign currency denominated debt should be given full exchange rate risk protection over the term of the debt.
5. It is suggested that risks in non-core business should not be a consideration in cost of capital calculation.

Estimation of Cost of Equity

6. The Cost of Equity has been the most contested component of tariff in most countries where tariffs are determined by regulators through a transparent process of public hearings, since there is no foolproof methodology for estimation of cost of equity. It is suggested that Capital Asset Pricing Model (CAPM) be used for determination of cost of equity because it achieves a good balance between justification ease and implementation ease.
7. In the application of CAPM, it is suggested that the latest three to four month average of Yield to Maturity on GoI securities with a residual time to maturity of 8 years be

considered as the Risk Free Rate of Return. Market risk premium be estimated using past BSE 30 index data for last 20 years and using Systematic Investment Plan approach. The business risk of the CSUs be considered similar to the business risks in the listed Power sector companies and Oil & Refining companies in India, for selection of a range of Asset Beta. The Cost of Equity of the CSUs using this approach has been shown in section 3 of Chapter III.

8. The Rate base on which the rate of return would be applied is an equally important issue. In line with the Cost of Equity approach, and considering the Cost of Equity is calculated based on CAPM, it is suggested that the Cost of Equity be applied on the Adjusted Networth to compute the Return on Equity component of tariff. The Adjusted Networth would be calculated as the Net fixed assets employed in the business (including Capital Work in Progress) plus Statutory Investments minus Total Long Term Debt.
9. Preparation of proper balance sheets at the plant / project level, such that they aggregate to the Company level balance sheets, is a prerequisite to adopting the method of calculation of Cost of Equity and Rate base as proposed in this report.
10. It is suggested that a complete CAPM formula based review of the Cost of Equity be undertaken every five years. However, the Cost of Equity level could change from year to year due to changes in gearing, subject to the required change being material. Any review of the cost of equity would need to ensure that the cost of equity to be set after the review would not lead to financial ratios poorer than those typically observed in case of debt instrument with at least an investment grade credit rating, and would not result in sharp increases in the tariff.
11. This study envisaged application of the Cost of Capital Formula to Central Sector Utilities (CSUs) to simulate their returns for the past and future five years and also testing for impact on the debt service coverage ratio (of the CSUs) and other indicators that are used by banks and financial institutions to finance capital investments. However, the data required for carrying out this analysis has not been made available to CAS. As a result, it has not been possible to carry out such an analysis. This analysis is an important step to be able to arrive at logical conclusions and make definitive recommendations.

Comparison of Existing and Proposed method for computation of "Cost of debt" and "Cost of equity" elements of tariff

Issues	Existing Method	Proposed Method
Cost of Equity or Cost of Capital approach	Cost of Equity approach. Cost of debt at actuals (subject to approval by CEA for capital investment for CSUs beyond a notified limit)	Cost of Equity approach. Cost of debt at actuals [subject to tests of prudence and usefulness to be applied by the agency approving the project cost (including financing plan) / tariff as applicable]
Distinction in level of return: at sub-sector, company or plant level	No distinction	• No sub-sector level distinction in the Cost of equity • Company level distinction on account of different business risks of different CSUs not made • Company level distinction made only on account of gearing (i.e. financial risks)
Computation of "cost of equity" and "cost of debt" components of tariff: at company level or plant level	At plant level	At plant level
Differentiation on account of vintage of assets: New vs. Old	No Differentiation	No differentiation
Foreign exchange rate protection for debt providers	Full foreign exchange rate protection provided	Full foreign exchange rate protection provided
Foreign exchange rate protection for equity investors	Full foreign exchange rate protection provided upto 16% (prescribed level) of Return on Equity	Provided for limited period on greenfield investments at a lower (than rupee return) level of return
Impact of nature of ownership, Public vs. Private, on level of return	Not considered	Not considered
Non-core businesses	Not considered	Not considered
Level of return to equity investors	16% for all the CSUs (earlier 12%) at target availability level	• Estimated using CAPM (see detailed calculation in chapter III of this report) to be provided at Target Availability Level • Varies with debt-equity ratio of the CSUs
Rate Base for Return on Equity computation	• Fixed as a certain percentage of the approved capital cost of the plant / project • Will remain same over the operating life of the plant/project	Adjusted Net Worth computed for each plant using the plant level balance sheet, and therefore would vary from year to year
Time period for review of level of cost of equity	Not specified	• A complete CAPM formula based review every 5 years. • However, Cost of Equity level could change year to year due to change in gearing, subject to the change being material

List of questions/issues on which comments are invited

1) **Estimation of Cost of Equity only or Cost of Capital**
   a) Should CERC follow a CoC approach or a CoE approach
   b) Should benchmark Cost of Debt be prescribed? What would be an appropriate method for developing a benchmark Cost of Debt?
   c) Should benchmark D/E mix be determined? What would be an appropriate method for developing a benchmark D/E ratio?

2) **Risk and Return Analysis with respect to Plants, Company or Industry sub-sector**
   a) The appropriate level at which the risks and returns should be determined by CERC?

3) **Should returns for new projects be different from those for existing assets? Should there be differentiation based on manner of financing**
   a) Is it appropriate to permit different returns to new assets?
   b) Should mode of financing be considered in determining returns?

4) **Should returns for foreign currency investment be protected for foreign exchange variations?**
   a) Whether foreign exchange rate risk protection needs to be provided to foreign currency investment?
   b) Can a reasonable level of premium compensate the forex risk?
   c) Would real return be appropriate to still attract foreign investors?
   d) Does the level of return need to be different for different currencies?

5) **Impact of Government Ownership on risks and returns**
   a) Is there any strong reason for permitting different returns on government equity and private sector equity?
6) **Should returns and risks of non-core businesses of the CSUs be considered by CERC?**
   a) Is there any strong reason for considering the risks of non-core businesses of the CSUs in determination of the cost of capital?

7) **Approaches to Estimation of Cost of Capital**
   a) Which method is to be used for determination of the cost of equity capital for CSUs?

8) **Time over which the Cost of Capital would be reviewed/ changed**
   a) Which of the above mechanisms, or any other mechanism, is best suited for review and reset of cost of capital determined by CERC?

Annexes

Annexe 1: Past Financial Performance of Power Sector Utilities

	NTPC	**PGCIL**	**NHPC**	**NLC**	**NEEPCO**	**TEC**	**GAIL**	**BSES**	**AEC**	**BPCL**
	31.3.98	*31.3.98*	*31.3.98*	*31.3.98*	*31.3.98*	*31.3.97*	*31.3.96*	*31.3.97*	*31.3.97*	*31.3.97*
Size and Capital Structure										
Operating Income (Rs. mn)	123996	14232.9	9972.9	17289	3210.5	23735	43800	18570	7120	99390
Asset Turnover (times)	0.51	0.18	0.15	0.4	0.21	0.53	1.2	0.66	1.01	2.5
Total Debt/ Total NW (times)	0.50	1.13	1.55	0.2	0.79	0.5	0.84	0.8	0.76	0.58
Debt Servicing										
PBDIT/ Interest and finance charge (times)	4.18	3.18	1.79	16.2	2.7	4.8	11.8	3.9	2.9	10.6
Net Cash Accruals/Total Debt (times)	0.38	0.12	0.07	0.92	0.03	0.22	0.36	0.23	0.25	0.56
Profitability										
RoCE (%)	13.2	6.92	7.0	14.3	3.8	13.1	15.8	11.5	17.0	5.3
RoNW (%)	12.04	6.84	5.32	13.8	2.9	8.5	24.7	13.4	9.0	20.7
Effective interest cost(%)	13.6	13.3	8.55	13.5	5.9	8.98	NA	11.99	13.53	NA
WACC(%) #	17.87	16.45	13.04	18.92	13.78	16.33	NA	16.44	17.21	NA

Using cost of equity as 20%

Annexe 2: Industry Risk Analysis of Some Select Industries

Industry	Risk scores on individual Parameters				Weighted Average Risk Score	Sum of sq. dev. from Power on each parameter
	Market related risks	Input related risks (raw material, etc.)	Customer related risks	Technology related risk		
Power	4	5	2	6	3.95	0.00
Refining	4	2	6	4	3.85	0.13
Shipping	3	4	3	4	3.50	0.15
Construction	4	6	2	3	3.50	0.26
Pharmaceutical	3	5	4	4	3.60	0.30
Steel	3	3	2	3	2.85	0.35
Aluminum	4	5	4	4	4.05	0.35
Fertilizer	3	3	5	5	3.15	0.54
Sugar	3	2	6	4	2.70	1.16
Hotels	4	6	6	6	3.80	1.91

All risk scores are on a 1 to 6 scale, with 1 signifying highest risk and 6 signifying lowest risk. The risk scores and weightages have been arrived at after consulting individual analysts in CRISIL Research and Information Services tracking the relevant industry.

Annexe 3: Beta Values for Indian Companies in Select Sectors

Industry	Company Name	Equity Beta[43]	Asset Beta
Cement	Raasi Cement Ltd.	0.24	0.12
Cement	Hyderabad Industries Ltd.	0.61	0.28
Cement	Madras Cements Ltd.	0.83	0.39
Cement	India Cements Ltd.	1.29	0.41
Cement	Chettinad Cement Ltd.	1.23	0.49
Cement	Gujarat Ambuja Cements Ltd.	0.99	0.59
Cement	Associated Cement Companies Ltd.	1.37	0.60
Fertiliser	Dharamsi Morarji Chemical Co. Ltd.	0.34	0.17
Fertiliser	Southern Petrochemicals Industries Corporation Ltd	0.76	0.19
Fertiliser	Oswal Chemicals & Fertilizers Ltd.	0.56	0.22
Fertiliser	Chambal Fertilizers & Chemicals Ltd.	0.77	0.28
Fertiliser	Nagarjuna Fertilizers & Chemicals Ltd.	0.76	0.32
Fertiliser	Zuari Industries Ltd.	0.83	0.34
Fertiliser	Deepak Fertilisers & Petrochemicals Corp. Ltd.	0.60	0.40
Fertiliser	E.I.D. Parry (India) Ltd.	0.97	0.50
Fertiliser	Gujarat State Fertilizers & Chemicals Ltd.	1.02	0.56
Fertiliser	Godavari Fertilisers & Chemicals td.	0.91	0.57
Fertiliser	Indo Gulf Corporation Ltd.	1.12	0.59
Fertiliser	Hind Lever Chemicals Ltd.	0.82	0.60
Fertiliser	Gujarat Narmada Valley Fertilisers Co. Ltd.	1.05	0.62
Fertiliser	Rashtriya Chemicals & Fertilizers Ltd.	1.04	0.89
Gas	Gas Authority of India Ltd.	0.95	0.67
Power	CESC Ltd.	0.83	0.11
Power	Gujarat Industries Power Co. Ltd.	0.93	0.22
Power	Ahmedabad Electricity Co. Ltd.	0.60	0.39
Power	Tata Hydro-Electric Power Supply Co. Ltd.	0.79	0.52
Power	Tata Power Co. Ltd.	0.92	0.61
Power	Andhra Valley Power Supply Co. Ltd.	0.92	0.62
Power	BSES Ltd.	1.09	0.79
Refining	Mangalore Refinery & Petrochemicals Ltd.	1.03	0.24
Refining	Essar Oil Ltd.	0.84	0.29
Refining	Indian Oil Corporation Ltd.	0.72	0.43
Refining	Bharat Petroleum Corporation Ltd.	0.92	0.66
Refining	Madras Refineries Ltd.	1.09	0.66
Refining	Cochin Refineries Ltd.	0.97	0.78
Refining	Hindustan Petroleum Corporation Ltd.	1.00	0.84
Refining	Bongaigaon Refinery & Petrochemicals Ltd.	1.07	0.98
Shipping	Varun Shipping Co. Ltd.	0.83	0.33
Shipping	Essar Shipping Ltd.	1.11	0.46
Shipping	Great Eastern Shipping Co. Ltd.	1.28	0.78
Power Industry		0.98	0.54[44]
Cement Industry		1.08	0.51
Shipping Industry		1.21	0.56
Refineries Industry		0.98	0.60
Fertiliser Industry		0.93	0.47

[43] Data Source: India Index Services and Products Limited (IISL)

[44] The asset betas for the Industries has been calculated using the Market Capitalization weighted average of D/E ratios and tax rates of the underlying companies

Beta is a fairly volatile parameter, and a careful calculation is necessary to ensure that the appropriate values are being used. The table below shows the different possible values of Beta when calculated by different methods.

		Based on S&P CNX 500 (1 year)	Based on BSE 30 (2 year)	Based on S&P CNX 500 (3 year)
As Market Capitalization Weighted average of *Asset Betas* of companies in the industry	**Power Industry**	0.62	0.20	0.66
	Refinery Industry	0.55	0.19	0.39
As Derived from *Industry Equity Betas* using Market Capitalization weighted average of D/E and Tax rates of companies in the industry	**Power Industry**	0.54	NA	0.57
	Refinery Industry	0.60	NA	0.57

The calculation method shown in shaded area has been considered appropriate for application, for the following reasons[45]:

1) **Time period**: The Indian economy in general, and the regulatory regime in power & refining sectors in particular, are undergoing significant changes. Financial experts recommend that for such economies, and for companies whose capital structure and operating environment has been changing, the time period over which beta is calculated should be small, preferably a year. This ensures that the risk profile of the company vis-à-vis the market is relatively stable over the term over which beta is being calculated. Large number of data points is an important requirement for calculation of beta, which is being met by using daily price information.
2) **Market Index**: Several indices are available in the Indian stock market. Economic theory suggests that broad based indices produce more accurate beta estimates as they are less prone to price adjustments lags. Therefore, the S&P CNX 500 is preferred over the BSE 30 for calculation of Beta.
3) **Method of averaging**: The Industry Equity Betas are calculated by IISL based on the movements of the Industry Index against the Market Index. The industry index measures the effective performance of the stocks in the industry as a whole. Use of this method is preferable over the use of individual equity betas of the companies in the industry since the estimation error in averaging is likely to be lower.

[45] More detailed discussions and examples from other countries with respect to the choice of Time period and Market Index, is available in *Alexander I., Mayer C. And Weeds H., "Regulatory Structure and Risk: An International Comparison", PSD/PPI, World Bank, January 1996.*

Annexe 4: Pogue's Method

The data pertaining to top 100 companies comprising BSE 100 index was used for establishing the following equation

Beta (unlevered) = *f* (variability of accounting rate of return)

Data Sources and Analysis

- Return on Equity: Month end closing share price data (adjusted for bonus and rights issues etc.) was used for calculating monthly return on each stock (Data source: CMIE database - PROWESS).
- Variability of accounting rate of return: This was calculated as the coefficient of variation of accounting rate of return measured by the ratio of Earnings before interest and taxes (EBIT) and Capital employed (CE) (Data source: CMIE database -PROWESS).
- The effective average tax-rate was calculated as the average of (tax paid)/PBT for the last 5 years. Similarly average of the last 5 years of debt/equity was taken as average debt-equity ratio for every company (Data source: CMIE database -PROWESS)

Using the above information, equity beta values for each company was calculated as follows

Equity (or levered) Beta$_i$ = covariance (R_m, R_i) / variance (R_m)

These equity beta values have been unlevered using the following formula:

Unlevered (or asset) Beta$_i$ = Equity Beta$_i$ / {1+ (1- effective average tax-rate)(average debt-equity ratio)}*

Pogue's Equation

Simple regression analysis has been used to establish an equation between the unlevered betas and coefficient of variation of the accounting rate of return and following equation was established with an R^2 value of 1.6 %:

*Unlevered Beta = 0.55 + 0.05 * (coeff. of var. of accounting rate of return)*

The above equation has been used to estimate the unlevered beta values for the CSUs using their coefficient of variations of the accounting rate of return. These beta values have been relevered using the current value of debt-equity ratios and effective tax rates for each of the five CSUs. This levered or equity beta for each CSU has been used to estimate the cost of equity using the general CAPM formula

*Cost of equity (r_e) = r_f + Equity beta * (r_m - r_f)*

Following table illustrates the estimation of return on equity for each CSU using the above-described method. The value of risk free rate has been taken as 11% and market risk premium as 8.2% (as detailed in the section 6.1 and 6.2 of chapter three of this report).

CSUs	Debt/Equity	Asset Beta	Equity Beta	RoE
NLC	0.19	0.56	0.67	16.5%
NTPC	0.49	0.56	0.83	17.8%
PGCIL	1.16	0.55	1.19	20.8%
NHPC	1.24	0.57	1.27	21.4%
NEEPCO	0.78	0.57	1.01	19.3%

Annexe 5: Key issues discussed with Experts on April 6, 2000

1. The Cost of Capital approach was preferred by some of the Experts, while a few Experts felt that the Cost of Equity approach is reasonable given the current circumstances. The Cost of Capital approach was preferred because it would incentivise efficiency in financing.
   While the Cost of Equity approach has been proposed in this report due to the implementation issues in the Cost of Capital approach, the mechanism that has been proposed does reflect the Cost of Capital approach to some extent.
2. It was felt that the relatively low credit quality of the power purchasers is the most significant risk for CSUs, and that it is not adequately reflected in the report. It was also opined that the return concomitant with this risk would be unreasonably high. Therefore, addressing this issue is very important and fundamental.
   The point has been recognised in the report, and it is accepted that addressing the credit risk issue through the compensation in the cost of capital would not be reasonable.
3. The rationale for recommending different equity returns to different companies was questioned, and it was felt that there is no strong reason for differentiating the risks faced by the CSUs.
   It was clarified that the CSUs are not being differentiated based on their business risks. The differentiation is based only on the Financial Risks arising out of different D/E ratios.
4. It was felt that the return on equity for existing assets could be different from the return on equity for new assets for two reasons. (i) The government owned assets have been created out of the taxpayers' money, and need not be serviced at commercial rate of return. (ii) The Cost of Capital at the time that the project was developed should be considered for the existing assets rather than the cost of capital at present.
   The counter arguments to the above, as discussed at the meeting, have been included in the report
5. The applicability of any of the methods, considering the various drawbacks mentioned in the report, was questioned by some Experts. It was also suggested that a simpler method such as a premium over corporate debt rate may be used for determining the cost of equity of CSUs.
   It was reiterated that no perfect method for calculation of Cost of Equity exists, and the drawbacks in various methods have been mentioned in the report to give a fair picture of the accuracy level of any method. CAS has suggested the best approach among those available, considering the balance between ease of justification and ease of implementation. Any simpler method would be easy to implement but could be difficult to justify.
6. It was pointed out that the tax rates considered in the draft report are based on the tax paid by the CSUs on their non-core business only. The tax on sale of power being a pass through is typically removed from the revenues and expenses side of the Income Statement.
   For the reasons mentioned in the report, the effective tax rate for the purpose of converting Asset Beta to Equity Beta has now been taken as zero.

BIBLIOGRAPHY

1. Alexander I., Estache A. and Oliveri A., "A Few Things Transport Regulators Should Know about Risk and the Cost of Capital", July 1999.
2. Alexander I., Mayer C. And Weeds H., "Regulatory Structure and Risk: An International Comparison", PSD/PPI, World Bank, January 1996.
3. Brealey R. A. and Myers S. C., "Principles of Corporate Finance", Tata McGraw-Hill Publishing Company, New Delhi, 1997.
4. Copeland T., Koller T. and Murrin J., "Valuation - Measuring and Managing the Value of Companies", Second Edition, John Wiley & Sons (1996).
5. Central Electricity Regulatory Commission, "Consultation Paper on Bulk Electricity Tariffs", September 1999.
6. Damodaran A., "Damodaran on Valuation - Security Analysis for Investment and Corporate Finance", John Wiley & Sons.
7. Gomez-Lobo A. and Foster V., "The 1996-97 Gas Price Review in Argentina", The World Bank Group: Finance, Private Sector, and Infrastructure Network, April 1999.
8. Independent Pricing and Regulatory Tribunal of New South Wales, Australia, "The Rate of Return for Electricity Distribution Networks: Discussion paper", November 1998.
9. Kolbe T. L., Read A. J. and Hall G. R., "The Cost of Capital: Estimating the Rate of Return for Public Utilities", The MIT Press (1986).
10. New Zealand Treasury, "Estimating the Cost of Capital for Crown Entities and State-Owned Enterprises", October 1997.
11. Office or the Regulator-General Victoria, "Consultation Paper no. 4: 2001 Electricity Distribution Price Review - Cost of Capital Financing", May 1999.
12. Office of Electricity Regulator (OFFER) UK, "Review of Public Electricity Suppliers 1998-2000, Distribution Price Control Review: Consultation Paper", May 1999.
13. Office of Gas and Electricity Markets (Ofgem) UK, "The Transmission Price Control Review of the National Grid Company from 2001: Initial Consultation Document", December 1999.
14. Office of Gas and Electricity Markets (Ofgem) UK, "Reviews of Public Electricity Suppliers 1998-2000, Distribution Price Control Review: Draft Proposals".
15. Voll S. P., Bhattacharyya S. and Juris A., "Cost of Capital for Privatised Distribution Companies - A working paper on a calculation for India", National Economic Research Associates, Washington USA, October 1998.