Incentive Regulation and Multi-Year Price Controls: Choice, Constraints and Calculations

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1. Introduction

In 1999 the Government of Orissa privatized the distribution assets of the Grid Corporation of Orissa (GRIDCO), selling a controlling equity share in four companies. Three of these were sold to the Bombay Suburban Electricity Supply Co. Ltd. and the fourth to a consortium lead by AES Corporation. A number of other states, including Andhra Pradesh, Karnataka and Uttar Pradesh have announced their intentions to privatize parts of their distribution systems while work is underway in other countries in the region to introduce private participation in electricity distribution (for example, Karachi in Pakistan). The Prime Minister's Economic Council has also recommended that the privatization of distribution be implemented by State Governments to reduce the high levels of theft and other non-technical losses seen today in India.

However, potential operators of these distribution assets have expressed concern at the lack of clearly defined paths for the prices that they will be allowed to charge to customers. This was recently reiterated in a press interview by Dr. Ahluwalia:

> *The system of fixing tariff year by year is not feasible by private distribution companies and one should have multi-year tariff principles where the principles of tariff order are given in advance.*
> Economic Times (India), July 27th 2001

State electricity regulatory commissions (SERCs) in India have thus far set prices on an annual basis, although some performance based incentives have been introduced. This reflects their concern that the existing information base does not support the development of sufficiently accurate multi-year tariffs, making it likely that either excess profits would be made, or companies would make high losses and ask the regulator to re-open the price control. Either of these outcomes could damage the credibility of the regulatory process. These are common concerns seen throughout the world when a change in regime is proposed – see Sappington (1996) for a discussion of these issues with respect to US telecommunications – but has not proven to be an insurmountable problem in other countries.

This paper considers the issues raised by multi-year tariffs and examples of how they have been applied elsewhere. Section 2 of this paper reviews the present legal framework and the existing approaches to price setting by SERCs. Section 3 reviews the main approaches to providing multi-year price paths. Their applicability to conditions prevailing in India is reviewed in Section 4. In Section 5, a methodology is developed around an Incentive Based Revenue and Cost Pass-Through (IBRC) concept which provides companies with incentives to reduce costs under their control, and which passes on to consumers increases or decreases in costs outside of their control. Section 6 evaluates the robustness of this approach under Indian conditions through a theoretical and empirical consideration of possible scenarios.

Section 7 then develops some guidelines, in the form of a decision tree, that regulators can follow when determining the appropriate regime to follow.

It should be noted that this paper concerns itself primarily with the issue of creating incentives within a pricing regime, it does not tackle the important issues of:

- the cost reflective nature of existing and future tariff levels; and
- the structure of tariffs.

Both of these are important issues that must be addressed and some of the key issues relating to these points are set out in Section 8, but the primary aim of this paper is to discuss the overall design of the incentive regime.

Finally, while the focus of this paper is electricity distribution the concepts that are discussed are valid in:

- the other network element of electricity, namely transmission; and
- other network monopolies such as gas transmission and distribution, telecommunications etc.[1]

[1] An example of the types of issues in other sectors is provided in Ros (2001) which discusses how incentive based regulation was introduced to the Peruvian telecommunications regulatory regime.

2. Price Regulation of Distribution in India: the legal and regulatory framework and approaches adopted to date

Prior to the Orissa privatizations, India had substantial experience with private ownership and operation of distribution systems, with private electricity companies[2], regulated as licensees under the Sixth Schedule of the 1948 Electricity (Supply) Act. In essence, this schedule sets out the following conditions:

- on a year-to-year basis the profit earned by an operator should not, as far as possible, exceed the amount of reasonable return; and
- the definition of a reasonable return is set in relation to prevailing Government interest rates and the asset base.[3]

Reform legislation from the 1990s has allowed regulators to incorporate other factors into pricing decisions to provide these incentives. The Orissa Electricity Reform Act (1995) specifies the existing legislation as one factor to be considered by the Orissa Electricity Regulatory Commission (OERC), but also includes the interest of consumers, and factors related, inter alia, to efficiency and good performance. The Act also requires the OERC to record its reasons for deviating from the Sixth Schedule in writing. The Andhra Pradesh Electricity Reform Act (1998) adopts similar wording. The Government of India Electricity Regulatory Commissions Act (1998) also allows deviation from existing legislation to promote efficiency, reflect the cost of service and safeguard consumers. The new legislation therefore explicitly allows regulators to deviate from the Sixth Schedule.

Two types of deviation from Schedule 6 have been seen thus far. The first is a disallowance of energy purchase costs based upon the ratio of reported losses to what the Commission views as reasonable losses. The second, introduced in the OERC's second tariff order in 1998, allows for the creation of a regulatory asset, reflecting the difference in revenue requirements between purchases assuming 41% losses, and those allowed by the commission reflecting loss levels of 35%. The OERC specified that this could be included in the rate base, earning a lower rate of interest than the asset base allowed under Schedule 6, once the company had surpassed the regulator's target rate of return.

These deviations from the strict application of the 6th Schedule provide some incentives for improving efficiency, as do the high loss levels which within a given year will provide increased revenues if collections and billings improve. However, the lack of a clearer path for prices and/or revenues means that efficiency improvements which require investments that have a payoff period of more than one year might be deterred. More generally, the lack of a clear multi-year price path increases the level of regulatory risk and may, as noted above, deter investors.

In practice, apart from the minor deviations noted above, SERCs have followed the format of the Sixth Schedule closely[4], but have imposed revenue requirements well below the costs incurred by the utilities (see Table 1, taken from Ahluwalia (2000))[5].

2 These are located in Ahmedabad, Kolkata, Mumbai and Surat.

3 See S. Ahluwalia, Tariff reform in India: a review of directions and issues, in Transition to a liberalized environment, ed. Srivastava and Sarkar, for a fuller explanation of the application of Schedule 6.

4 This includes the details of the calculation of the asset base and the rate of return.

5 It could be argued that Table 1 underestimates the scale of the problem. State-owned companies may well be influenced to ask for inadequate revenues to avoid the need for tariff increases, and the lack of auditing means that the out-turn is not well known.

Table 1: Reductions in Revenue imposed by SERCs (from Ahluwalia (2000)) Rs crores					
	Orissa – 1998/9	Orissa 1999/2000	Andhra Pradesh	Maharashtra	Uttar Pradesh
Revenue requested by utility	2168	2359	9681	13155	8687
Revenue allowed by regulator	1784	1843	9039	11946	7541
Total reduction in revenue	384	516	642	1209	1146
Total revenue reduction as percentage of revenue requested	17.7%	21.9%	6.6%	9.2%	13.2%

Note: revenue does not include an adjustment for non-tariff income.

There are variations in the levels of revenue reduction, sometimes explained by commitments to improve efficiency or by Government subsidies. There are also differences in the approaches taken by SERCs to adjust the revenue sought by utilities. However, the pattern of substantial adjustments is consistent, as is the reliance on annual tariff reviews. SERCs have not yet adopted multi-year tariff orders, although these have been discussed in recent tariff orders and the UPERC provided incentives based on sharing of revenues if the company were to beat a set of pre-defined loss targets. With the exceptions of the Delhi Vidyut Board and the Kanpur Electricity Supply Company, no regulated entities have asked a SERC for anything resembling a multi-year price control.

The proposed Electricity Bill 2001 may well give regulatory commissions greater freedom to develop different principles for pricing. However, SERCs will remain concerned about inadequate data leading to multi-year price controls which will be inaccurate and hence damage the credibility of the regulator. Present approaches, however, do not provide a clear picture of how regulators are going to set prices, and consequently increase perceptions of regulatory risk. Finally, the lack of a clearer path for prices and/or revenues means that efficiency improvements that require investments that have a payoff period of more than one year might be deterred[6].

In the remainder of this section we review two key issues relating to this – the quality of the information base used by SERCs in their price reviews, in particular loss levels (both commercial and technical), and the efficiency improvements generated by private distribution companies. The latter is of particular interest given concerns that a multi-year price control may prove too lax for a company, and that excess profit will be made. For this, we draw largely on experience from Orissa, which has a history of regulatory reviews of prices dating to 1997 and experience since 1999 of private management and ownership of distribution.

In their analysis of tariff filings, SERCs have focussed on the difficulty of getting good estimates of the total losses of the regulated utility. Most states see metered sales at less than 50% of total sales. In its tariff order of May 2000, the Andhra Pradesh Electricity Regulatory Commission (APERC) commented that it was not possible to estimate the level of losses and to fix an appropriate loss target, and that the only reliable target to use was the level of billing (APERC 2000). The most recent OERC tariff filings, which were completed in January 2001, still exhibit a considerable amount of uncertainty over the loss levels reported by the four distribution

[6] What is evident is that any incentive created through these performance based regime (PBR) schemes may well be of a limited duration. Almost annual price reviews means that any benefits of beating the incentives are quickly lost to consumers – forcing PBR to become more of a stick than a carrot since the benefits of the carrot only last for a year. This is true for example for schemes proposed by SERCs in India which propose sharing of revenues from beating a loss reduction target, but do not provide price or revenue projections to provide a likely monetary value for these benefits.

companies[7]. This suggests that it will be difficult in practice to use loss levels to precisely target a rate of return, particularly on a relatively low asset base.

Evidence submitted by the licensees to OERC suggests a relatively slow decline in the level of losses, due to the poor initial state of the State Electricity Board (and successor company) grids, difficulties in instilling a commercial culture in staff, and the initial low levels of metering. CESCO, one of the distribution companies, has reported a reduction of losses of around 3% per year, to a present level of around 43%. The other licensees have been reducing losses at a slower rate. However, billings and in particular collections have increased substantially faster, on average by nearly 20% over the period 1999-2000. Despite this, none of the companies have been able to reach cash break even as of this date.

This suggests that profits greatly in excess of those forecast are unlikely in the initial years of privatization in India, and that the difficulty in accurately measuring key parameters such as losses, needs to be taken into account in designing an appropriate regulatory approach.[8]

[7] The OERC comments that "The authenticity of the loss level projected by the licensee has not been supported with verifiable data." (OERC 2001 paragraph 7.3.2). The OERC then requested the licensee to perform surveys on feeders with metering of all consumers.

[8] A lack of information about losses is not unique to India. Many countries face similar problems, as do many other countries. One example of a regulator trying to tackle this problem is provided in *Initial Consultation on the Review of Price Controls for Al Ain and Abu Dhabi Distribution Companies, TransCo and ADWEC*, Regulation and Supervision Bureau, Abu Dhabi, January 2001.

3. Options

While there is a continuum of price methodology options, they are usually simply classified under two broad headings (covering the extremes of the options). These are:

- Cost plus (or rate of return) where the allowed costs are calculated on the basis of costs actually borne by the operator; and
- Incentive based (price caps, revenue caps etc) where the allowed costs are calculated, at least partly, on the basis of external information.

These basic options have been discussed in great detail in many other places (see, for example, Armstrong, Cowan and Vickers (1994), Alexander, Mayer and Weeds (1997) etc) and so this section will provide only a brief overview of the two extreme forms before focusing on some of the other factors that can be included within the basic price control. These can be split into two separate areas:

- the allocation of costs between controllable and uncontrollable elements, and the use of a pass-through mechanism for the latter; and
- variants on the basic incentive mechanism through sliding scale (profit sharing) and revenue controls.

3.1 Basic regimes

The two extreme regimes mentioned above can be presented in a stylized way. This would be:

- **rate-of-return**. At its extreme, this approach is one that guarantees a regulated utility a specific rate of return (profit) and ensures that it is earned. This is done by compensating the company for any cost changes that occur. No incentive to cut costs is brought about, although the more practical variants of this regime introduce a time lag into rate reviews which allow some incentives to be established;
- **price-cap**. In the extreme version of this regime, a price path is established which would never be altered. So, if a price path of CPI – 1 was set, prices would fall in real terms by 1% each year, forever. Again, this extreme version is not practical and rather than having instantaneous reviews, a time lag is introduced, referred to as the price control period. This is the period of time over which the price-cap operates before the X value is reset. Typically price control periods range from three to five years.

Clearly, as stated, reality means that the extreme forms of the two approaches are never followed. Equally, it is important to realize that both approaches start from the same data set, it is just the horizon over which data is being considered differs. As discussed in Section 2, Indian SERCs have focused on the rate of return approach, but have introduced some performance based regime (PBR) elements that have created some incentives for the operators.

3.2 Controllable costs

When considering a regulated company it is useful to consider the split of costs into those that the management of the company can control and those it cannot. A regulatory commission should be seeking to provide the owners and management of a company with incentives to cut costs that are under their control and to insulate them from abnormal profits and losses arising from costs that are outside their control.

There are a set of key variables that have to be considered when determining what is under the control of the company and what are outside. These variables include:

- demand;

- losses;
- major input costs, especially generation costs; and
- distribution cost drivers including:
  1. labor costs;
  2. material costs;
  3. rent and rates;
  4. depreciation;
  5. the required level of profit to meet past investments; and
  6. investment costs.

Many of these costs can be further subdivided to assess to what extent the company has control over the costs. Labor costs, for example, can be split into three aspects:

- the quantity of labor employed;
- the base unit-price for the labor and the way it increases over time; and
- the degree to which overtime is used.

A consideration of these factors shows that some are potentially under the control of the company. However, even elements that appear under the control of the company may still be outside the company's control. Consider the annual increase in wages. Although the company has some control over the increase, it has no control around the national average increase which could be an important factor in setting company specific wages. Also, the time period over which the control is being considered is important – it may not be possible to dramatically alter the degree that over-time is utilized in any one year, but over a longer period, changes to working practices could have an impact on this variable.

For these variables it is not possible to say that they are either completely or not at all under the control of the company. Rather there are degrees of company control. It is possible to suggest the degree of control that the company has, although each should be considered in detail when considering each application of any approach.

For an electricity distribution company costs are likely to be split along the lines shown in the following Table 2. This table shows all the cost elements that would be included in a final retail electricity tariff – but not all these costs are necessarily under the control of the distribution company.[9] Table 3 shows the relative importance of each type of cost element data using data from Andhra Pradesh.

The initial thoughts in Table 2 suggest that the number of areas where a company has control are limited, but there are areas worthy of further consideration, especially among the costs associated with the distribution and retail activities. When deciding whether to employ a control that incorporates these distinctions the overall importance of those elements that are under a company's control need to be evaluated – there is a cost benefit trade-off at work here since the cost of regulation will be higher but the benefits from greater confidence and increased incentives will now exist.

[9] Final retail electricity tariffs incorporate four elements: the cost of generation, the cost of transmission, pure distribution costs and retailing costs (often the third and fourth elements are combined into a single distribution cost).

Table 2 - Initial Thoughts on the Degree of Controllability		
Variable	*Degree of Control*	*Comment*
Demand (see comment on losses below)	Limited	Clearly the company can at the margin affect demand, but much will depend on general economic conditions etc. In the Indian context, the interaction with loss levels has to be considered.
Generation and transmission costs	Very limited	Depends on the market model adopted. However, under the existing conditions in India any distribution company is dependent on a single-buyer achieving efficiency in power purchase. If a multi-buyer model is adopted, greater power is passed to the company, but this may be initially limited depending on whether vesting contracts are put in place and over what period they cover.
Losses	Substantial	Assuming that the company can exercise control over employees, they should have control over this variable. As noted in the introduction, the high level of losses in the Indian power sector has lead to their special treatment by regulators.
Labour costs	Some	As noted above, this cost category can be split into several aspects. The company clearly has control over some of these aspects. Exactly how much control will depend on the conditions set at the time of 'privatization' covering issues such as staffing, pay bargaining etc.
Material costs	Some	While material costs will be partly determined by the state of the existing assets, something outside the company's control, the company controls the processes by which it purchases spare parts as well as being able to control some of the substitutability between investment and repairs.
Rent and rates	Very limited	In the short-term it is very difficult for a company to change the rent and rates bill. However, in the longer-term it is possible to shift towards low cost buildings etc.
Depreciation	Limited	Although much of the depreciation bill depends on the age of the assets and their costs, a company has the opportunity to argue that its assets should be revalued or asset lives altered. While these issues are then controlled by accountants etc, outside the direct influence of the company, experience has shown that company's can have an influence on this.
Required profit	Some	If an optimum cost of capital (or even cost of equity) position is adopted by the regulator, companies have an opportunity to beat this target by finding cheaper sources of funding, possibly through manipulation of the tax position.
Investment costs	Some	Investment can be split into several aspects. The quantity of investment will depend on several factors including demand, and quality, service expansion and environmental obligations. Most of these are outside a company's control. However, the cost of investment may be partly affected by a company's decisions, as may the timing – there may be a trade-off between some repairs and investments or some demand related investments may have some flexibility as to when they have to occur.

Determining the costs to allocate between controllable and uncontrollable is not straightforward. However, it is possible to do and as Table 3 shows, over 30% of the costs of an illustrative Indian distribution company can be considered as controllable. As such, providing incentives to reduce these costs could have a significant impact on prices.

Table 3 – Allocation between controllable and uncontrollable costs for an illustrative Indian Distribution Company			
Element	*Controllable*	*Initial cost (Rs Crore)*	*% of total costs*
Controllable opex	Yes	990.13	9.6
Uncontrollable opex	No	604.41	5.9
Investment	Yes	715.07	6.9
Required Profit (based on 16% return)	Yes	100.35	1.0
Generation and transmission charges	No	7,924.99	76.7
Electricity distribution losses[1]	Yes	2,060.50	19.9

Note: these costs are an amalgamation of individual cost items. [1] Losses are part of the overall generation and transmission charge, but are an element that the company has some control over.

For those uncontrollable costs the company can be insulated from the effect of changes in the cost element by using a cost pass-through system. This works whereby the cost charged to the

consumer is altered (say annually) to reflect the movements in the uncontrollable costs. In electricity the classic examples of this type of approach are related to the cost pass-through of generation costs (or fuel costs) when there are power purchase agreements (PPAs) with independent power producers (IPPs).

One example of a cost pass-through regulatory system can be found in Northern Ireland. The regulator, the Office for Regulation of Electricity and Gas (OFREG) is responsible for regulating the cost of power purchased by the Transmission and Distribution company (given the size of the region covered a single vertical entity for the monopoly network businesses was created) through its Power Procurement Business (PPB). Since the PPB is buying power on long term contract either from IPPs in Northern Ireland or through interconnectors with Eire and Scotland, the general approach adopted by OFREG is that of cost pass-through. The cost established in the PPAs is accepted as the cost of purchased electricity.

In Northern Ireland there is one unusual feature to this regulation of the PPB. Rather than allowing 100% of the PPA to be passed through, only 95% is allowed. The remaining 5% of the power purchase costs is based on an index of fuel costs – a yardstick introduced to give some incentives to the PPB for efficient purchase of electricity. A similar approach has been adopted in another industry in the UK. Security costs at regulated airports are treated as a cost pass-through item, given their external nature. However, to ensure that some sort of incentive is created for the airport operator to keep control over any additional security costs incurred in any year, only 95% of the costs can be recovered.[10]

3.3 Refinements to the incentive regime

A concern noted in Section 2, that excessive profits might be earned, can also be addressed through the design of the regulatory system. While we believe that this unlikely to be an issue in India in the short term, it is possible to design the regulatory system in such a way as to further minimize this. Significant debate was sparked in the UK when excess profits were seen to be earned by companies and in many cases reflected in large pay increases and bonuses to management. One explanatory factor was that initial price controls were lax, including an under-estimation of demand that subsequently benefited the companies. Another cause was a series of events outside the control of the companies leading to significant cost savings that were captured by investors rather than consumers. The lessons from this experience were that regulators had to focus more on getting the controls right and ensuring investors only benefit from actions under the control of the managers of the company.

There are several ways in which probability of excess profits can be controlled. These include:

- ensuring companies only benefit from controllable cost savings – so making uncontrollable cost movements a pass-through item;
- limiting the profits of the company through a profit-sharing/sliding scale regime;
- focusing on controllable total revenue rather than controllable cost per unit;
- placing limitations on revenue through a sliding scale regime; and
- re-basing an element of the control to capture costs diverging from levels forecast in the review.

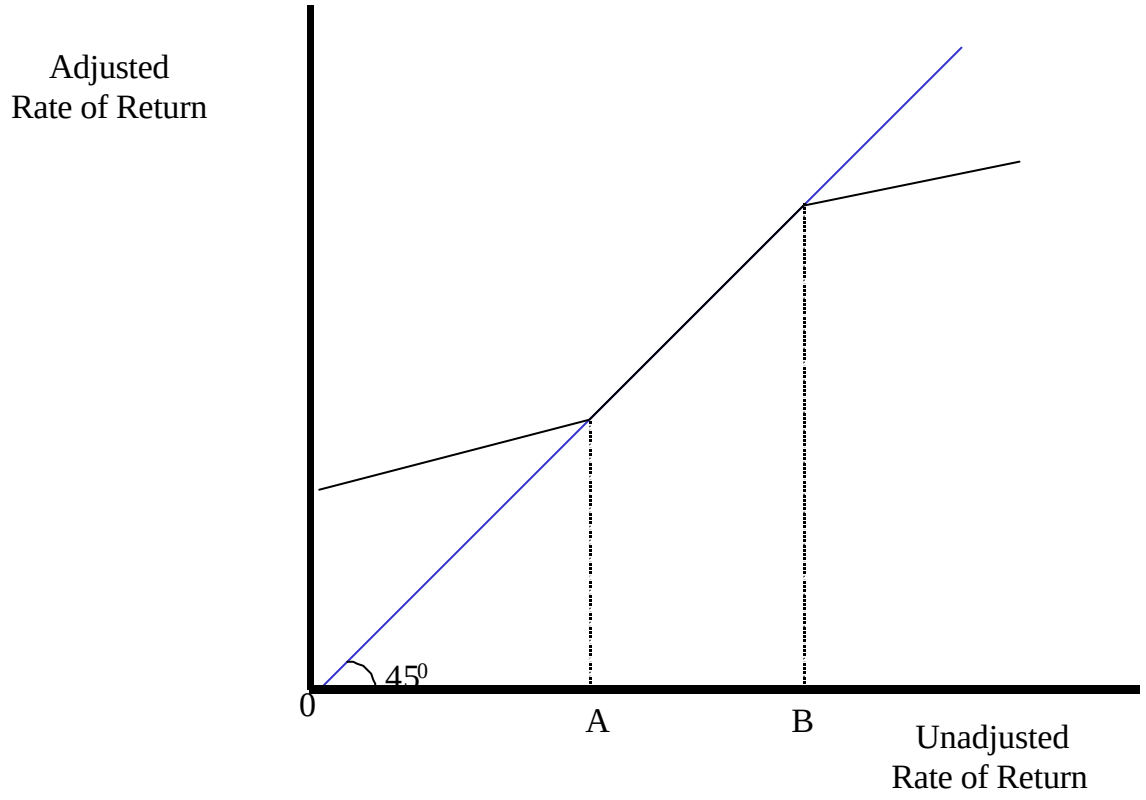
The first of these builds on the discussion in 3.2 above. The others are described below.

[10] *BAA: A report on the economic regulation of the London airports companies*, Monopolies and Mergers Commission (MMC4), June 1996.

Profit sharing. This limits the profitability of a company once it moves above or below an acceptable range. For example, the acceptable range may be 15% to 17% and then anything outside that range is 'shared' with consumers on an agreed basis. Here, if the sharing rate was 50% and the company earned 10%, then a mechanism would be needed to allow profits to increase to 12.5%. If profits were 20%, a mechanism to reduce profits to 18.5% would likewise be needed. These mechanisms can be a correction factor applied to the following years prices, as utilized in the classic profit-sharing example of New York Telephone, or a stabilization fund, as used in Hong Kong. The properties of profit-sharing have been studied in papers such as Mayer and Vickers (1996) and the case for using this approach is far from proven, and is discussed in Section 4.

Figure 1 illustrates what the pre-adjustment and post-adjustment rates of return could be for a profit-sharing system. The key variables that have to be defined are (i) A and B, the range within which the company keeps all the return it earns, and (ii) the 'rate' of sharing and whether it is asymmetric.

Figure 1: Illustration of a profit-sharing system



Revenue caps. An approach that has gained support in the UK is that of focusing on the total required revenue for a business, based on demand assumptions, and then setting this on a CPI-X based approach. This still provides incentives for cutting costs but limits the upside for management to those factors not under their control, such as unanticipated demand increases. It is still possible for a company to earn excess profits as a result of an unanticipated demand increase, but this is limited because any over or under-recovery of revenue is corrected-for the following year normally with financing costs or interest included.

Possibly the best known example of a revenue cap is that of the electricity transmission company for England and Wales, the National Grid Company (NGC). Annex 4 provides the details of the revenue cap applied to NGC.

Revenue sharing. This approach captures the revenue focus from revenue caps but then treats revenue like profits. Thus, if revenue is above a certain point some of the revenue is returned and if below, higher revenues are then allowed for.

There are few examples of this type of approach. The few that do exist are in the electricity distribution regimes in the US where several states either operate revenue sharing or hybrids of revenue sharing and price-caps.[11] What is gained from a revenue sharing approach? In some respects it is a generalized version of a revenue cap – with a revenue cap just being a revenue sharing approach with 100% sharing. If an industry does not have fully fixed costs then revenue sharing could attempt to capture this in the same way that hybrid price and revenue caps have been established in the UK for those network industries that do not have fully fixed costs.

Rebasing the control. One suggestion that has recently been put forward in the UK, as a solution to information problems, is that annual mechanistic rebasing should occur (Mayer (2001)).[12] Uncertainty regarding assumptions about the future means that even well processed regulatory decisions can lead to significant excess profits. As an alternative to reopening the whole regulatory decision, Mayer proposes a mechanical solution that maintains incentives for outperforming other companies in the sector while correcting for generic mis-assumptions. This solution depends on ensuring that the average industry market value is equal to the average industry regulatory asset base – a semi-replacement cost valuation of the assets. This ensures that the average return earned is equal to the industry cost of capital, but divergences between companies within the industry are still possible.

The way in which this type of control would work would be something like the following. Table 4 sets out the actual rate of return earned, the average and the post-adjustment rate of return for three illustrative companies. Assume that the regulator set the allowed rate of return at 8% at the price review.

Table 4: Illustration of a rebasing of rates of return approach

Company	Actual rate of return	Adjustment	Adjusted rate of return
1	11%	-2%	9%
2	10%	-2%	8%
3	9%	-2%	7%
Average	10%	-2%	8%

What the very simple example shows is that since the companies earned, on average a 10% rate of return while they were meant to only earn 8%, all companies have an adjustment of –2% to their actual rate of return (achieved through lower prices in the following period). This ensures that company 1 still earns a higher rate of return than the other two companies, so keeping its relative position, but also that it earns more than the regulators allowed rate of return – so keeping some of the absolute efficiency saving. However, on average, the industry only earns the regulated rated of return. If some companies earn above the regulated value a consequence of this type of rebasing is to mean that some will earn less than the regulated value. This should sharpen incentives for companies to outperform their peers since they can then retain some of the abnormal return. Of course, this system could impose abnormal losses on all companies if the

[11] For an overview of the approaches to regulation in US electricity distribution see Williamson (2000).

[12] See *Water: The 1999 Price Review* by Colin Mayer in *Regulating Utilities*: *New Issues, New Solutions* edited by Colin Robinson, 2001, Edward Elgar.

regulator has under-estimated the true required rate of return. However, the incentives would still exist for the relative out-performance among the companies.

Could this sort of system operate in countries in South Asia? In principle, this could provide a very robust and simple way of creating incentives and ensuring that abnormal returns are limited. The benefits that a company would gain from trying to hide or delay profits should be limited – although if one company had an advantage in being able to shift profits to another organization owned by the same shareholders then there may be some advantages to imposing costs on them that would benefit the one company more than the others. However, with adequate ring-fencing and common-ownership clauses the regulator ought to be able to control this – although that will make the regulatory regime more intrusive. These incentive issues are ones that require further thought and should be considered with respect to the specifics of any industry that a regulator is considering prior to making any decision about the applicability of this regime.

What might be a more serious concern about applying this type of approach in South Asia is the lack of good information on which to determine an estimate of the cost of capital that the regulator can then use as the allowed rate of return. Clearly, an estimate of the cost of capital has to be used when setting the allowed rate of return and, as such, regulators will have to estimate the cost of capital. So, a value will exist. However, if there are concerns about the ability to adequately estimate the cost of capital basing the whole incentive system within the regulatory regime around this element could be placing too much of an emphasis on one element of the revenue calculation. As such, while this approach could be a powerful tool, it is possibly something that should be considered once greater confidence in the ability to estimate the cost of capital has been established.

There may, however, be alternative measures that could be used for this type of rebasing. Further thought should be given to what an appropriate measure should be. Characteristics for the measure(s) include being:

- outside the direct control of the company to limit gaming opportunities for the company;
- easily and unambiguously measurable; and
- a good measure of the relative and absolute performance of a company.

This set of concerns are similar to some issues investigated in a paper by Dobbs and Elson (1999) when they considered whether rolling average based systems could achieve incentives without the problems associated with *CPI – X*.

Overall, choosing between these variations of the basic incentive approach depends on having a framework for trading off the advantages and disadvantages of each refinement, especially since many of the refinements are not mutually exclusive.

4. Framework for choosing the appropriate approach

When assessing the options and their applicability in any specific case, it is important to consider the following criteria:

(i) the incentives for efficiency savings – what are the management rewarded for and what perverse impacts might this have? This is also linked to the allocation of risk between the various stakeholders, in turn partly dependent on the cost structure of the company and the controllability question;

(ii) the incentives for regulatory gaming. Regulatory gaming is the situation whereby with-holding information, or presenting information in a specific way, will advantage the company and lead to it receiving a more favorable outcome. For example, under a price cap any growth in demand beyond that originally forecast increases profits for the company, giving it an incentive to under estimate demand growth at the time of the regulatory review (for a discussion of the various 'gaming' incentives, see Alexander & Shugart (2000));

(iii) political acceptability: although regulation is often independent of politics, the reality is that politicians may become involved if excess profits (losses) occur;

(iv) ease of implementation: this takes two forms:
- whether the regulatory body has the skills, information and resources to calculate and monitor the application of a regime; and
- whether the costs of an option are greater than the benefits. If a refinement will lead to only a small improvement in incentives yet is costly in terms of information and monitoring, then it is likely that the refinement should not be applied. Regulation should only be undertaken when the benefits are greater than the costs;

(v) what new information is required each year – price and revenue caps require less information within a price review, being restricted to that required to check where average prices and total revenues (respectively) are relative to the annual level specified in the cap. Profit-sharing requires the annual calculation of returns, and increases the level of regulatory risk because more variables can be reviewed with the possibility of investments or costs being disallowed; and

(vi) the extent to which the control formula can incorporate new data on factors outside of the control of the company.

Having established a set of criteria by which any proposal can be measured, it is now possible to determine what, in our opinion, is the appropriate solution for electricity distribution in India. Clearly any specific case should be considered on its own merits, but our overall view of the sector is given in Table 5 below.

Although profit sharing does meet some of the requirements of the criteria, it does not meet all. This is especially true with respect to the:

- potential for gaming – profit-sharing may lead to companies having incentives to (a) massage accounting numbers to lower profits (lower profits are preferable in all cases except inasmuch as investors may downgrade a company owing to low reported profits); and (b) delay efficiency savings if by smoothing gains less, or none, of the gains have to be immediately shared with consumers;

Table 5: Assessment of options against the criteria		
Criteria	***Comment***	***Viable options***
Cost allocation	For controllable costs the majority are fixed once the demand forecast for the coming period is known. When losses are considered a controllable cost these should not be considered as a fixed cost	Focus on revenue based approaches rather than price based ones.
Efficiency savings	Are possible for the majority of direct distribution costs – about 50% of the total electricity cost (once distribution losses are included as a distribution cost)	Incentive-based systems are appropriate.
Potential for gaming	Significant potential, especially in relation to losses and demand.	Focus on revenue based approaches.
Political acceptability	Need to ensure that significant excess profits are not earned.	Focus on profit sharing and revenue based approaches. Shorter periods – e.g. three rather than five years for the control an option.
Implementation	Information availability is a problem. – Existing resource base for regulators is limited making monitoring difficult.	Find systems that are mechanical once the initial multi-year tariff is set. Concern about applying profit sharing owing to the subjective nature of profits.
New information issues	Expectation that new information will become available over the next three to five years	Ability to improve estimation of future costs, especially in relation to losses suggests a shorter period might be appropriate. Profit or revenue sharing mechanisms could also be used to deal with extreme outcomes. Mechanisms for re-basing by independent review of key variables could also provide some opportunity for adjusting the values of certain parameters e.g. losses.
Impact of additional external factors	Given the nature of the state of reform in the sector it is possible that future shocks will occur.	Provided that the shocks are on the uncontrollable costs this will not be an issue if cost-pass through is adopted

- implementation – the need to directly establish profitability, the impact of uncontrollable costs on profitability and the amount to be shared will ensure that intrusive annual regulation will be required – something that will place undue pressures on the developing regulatory commissions in India and increase the amount of regulatory uncertainty in the system; and
- most distribution companies in India have very low asset bases compared to revenues and costs, given present valuation approaches based on historic costs, and historically low levels of investment. As an example, a 1% reduction in losses (translated fully into increased revenue) could lead to a near-doubling of the rate of return. A profit sharing scheme will have presentational difficulties, since the bands may appear on paper very large when expressed as a percentage of assets. Reducing the band would dampen incentives to reduce losses.

A system based on a revenue cap with cost-pass through for non-controllable costs would seem most appropriate given its stronger ability to allow real incentives for the company to remain while controlling for political acceptability. It would also appear to be more easily implemented – the only annual adjustment should be mechanical.

5. A Partial Solution – An Incentive Based Revenue and Cost-Pass Through Methodology

Given the discussion in Section 4, our preferred approach will be one that focuses on revenue, but allows uncontrollable costs to be passed through. Consequently, if revenues were forecast for five years, the only annual adjustments would be to incorporate:

- inflation;
- the efficiency savings (the 'X' value);
- over or under recovery of revenue compared to the control; and
- the mechanical correction for out-turn uncontrollable costs being different from forecast.

The control could look something like:

$$R_{t+1} = R_t \times [1 + CPI - X] - C_t - A_t$$

R is the level of revenue[13], CPI is the level of inflation, X is the expected efficiency gain in controllable costs (corrected for the fact that controllable costs are only one element of the required revenue), C is the standard revenue-cap correction for over or under-recovery of revenue (for example if demand, or the composition of demand, was different from that forecast) and A is the adjustment for uncontrollable cost elements, the elements of which are defined up front at the start of the price control.[14] The distinction between C and A is relatively arbitrary. A simpler model could be proposed where those two elements were combined. However, for the sake of clarity in the argument the model has been specified with the two separate elements.

Building on Table 3, the items that would be treated as uncontrollable, and hence subject to a pass through, would be generation costs and part of the operating costs, which account for over 80% of total costs in this example (with generation costs by far the dominant element).[15] These would be forecast forward for the length of the price control period, but changes in these costs relative to forecast values would be reflected annually through the formula given above. It should be noted that this does not assume an immediate transition to full cost recovery, which would be unrealistic given the present situation in India. An increase in revenues towards full cost recovery, based on assumptions about improvements in efficiency, would need to be incorporated in the model.

To illustrate how the model would work, we consider three scenarios:

- out-turn demand diverges from forecast demand;
- planned investment announced at the price review is not undertaken; and
- losses prove easier to deal with than anticipated by the regulator.

The first of these is the classic situation that revenue caps were designed to address. In the following year the C term adjusts revenues so that the over or under recovery of revenue is corrected for. So, while the company may appear to make exceptional gains or losses in the year of the divergence, the following year, *ceterus paribus*, a compensating level of return will be

[13] In the context of India, where billed and collected revenue are quite different, it is worth emphasizing that the target should be set on billed revenues.

[14] Both C and A should be corrected for the level of interest so that the company is no better or worse off in real terms

[15] It should be borne in mind that the tariff being considered here is the final retail tariff, which comprises generation, transmission, distribution and supply costs. If we were to just focus on the distribution and supply elements then the vast majority of costs would be controllable. However, in the Indian context it seems most appropriate to consider the final total retail tariff. Our arguments would not be changed if we just focused on the distribution and supply costs of the final tariff, all that would happen is that the equation would be written slightly differently.

made. So, if demand was under forecast and actual revenues were $100m more than expected, although the company reports an additional $100m of profit in this year, the following year will see a decline of $100m (plus an imputed return) in profits – so making the average return equal to that forecast.[16] The company will have bought more energy in bulk but will not be penalized since this is treated as uncontrollable and hence subject to an automatic pass through.

At the determination of the price control it will be necessary for the regulator to determine, with inputs from the companies and other stakeholders, what an appropriate level of investment should be. This investment should be clearly linked to levels of quality of service. The company then has an incentive to deliver the quality of service at a lower than forecast level of investment – so that it is able to earn higher profits. If it is able to do so, revenue is unchanged but profits are higher. Equally, if delivering the agreed levels of service costs more than forecast, the company will suffer lower levels of profits. Divergences in investment from that forecast are an issue that has caused significant concern to regulators. One notable case was the 'clawback' of investment undertaken by the Office of Regulation of Electricity and Gas (Northern Ireland) in the late 1990s which was subsequently supported by the appeals body in the UK, the Monopolies and Mergers Commission.[17] While the circumstances behind this action may have been unique, it does illustrate the fact that investment is an issue that must be considered carefully.

What happens if losses are reduced faster than forecast? In the simple model of the IBRC detailed above, the following outcome would occur. Since losses are lower than forecast, revenues will be higher – either because less electricity is required to meet the existing demand, or because more units are now being collected. Under the revenue cap, this increase in revenue will be corrected for in the following year through a lower allowed level of revenue. Consequently, it would appear that there is no incentive to reduce losses beyond that forecast by the regulator, placing pressure on the regulator to provide credible estimates of what is possible in what is an informationally demanding situation. This is an issue that we discuss in more detail below.

[16] Of course, the reality would be a little more complex. There would be additional uncontrollable costs that would be incurred in the first year and then corrected in the following year that will mitigate to some extent the positive impact of unanticipated demand.

[17] See Monopolies and Mergers Commission (1997).

6. Implementation issues – is the IBRC approach too simple?

One of the problems with regulatory regimes is that the devil is in the detail. While it is possible to establish what, on the surface, appears to be simple controls to ensure appropriate incentive properties, often a whole raft of additional elements of the regime are grafted onto the simple equation. While this may be appropriate in some cases, all regulators should investigate whether the refinements provide more of an addition than the costs that they impose on the regulator and the company. This sort of cost-benefit analysis of regulation is regularly undertaken in countries like Australia and provides a useful touchstone for regulators and ensures that "regulatory creep" does not occur.

Two areas of concern regarding the incentives inherent within the IBRC approach arose when considering the scenarios illustrating the operation of the system. This section of the paper considers the possible solutions to these concerns and sets out the pros and cons of making the IBRC approach more complex to overcome these concerns. It also uses a simple financial model to consider the possible impact of alternative regimes when it is possible to model them.

Any specific application of this type of model should address each of these concerns in the context of the state or country to which the model is being applied. We outline here the options that can be followed if the issue is felt to be significant enough to require correction.

6.1 Investment

Finding an approach that adequately incentivises investment is the Holy Grail of regulation. No regulator has yet achieved this situation, although some have moved closer to achieving this than others. Refinements to the simple IBRC approach to improve the positive incentives for investment without creating perverse incentives for under or over-investment must be measured against the 'deepening' of regulation that is required to establish whether investments have been delayed for appropriate reasons etc.[18] Increased intrusion would not be necessary if it was possible to determine an appropriate set of service indicators that could be accurately measured. A focus on outcomes would allow the regulator and company to agree an appropriate investment program that would deliver the desired outcomes and then give the regulator a measure of whether the company was failing to deliver its part of the bargain. Sadly, this clear link between investment and outcomes is not possible.

Some of the alternative approaches to dealing with divergences in investment are as follow:

- annual reporting of investment including an explanation of any divergence;
- detailed investigations of any divergence over the life of the price control period at the end of the price control period, with a correction to ensure that any unacceptable divergence is revenue neutral;
- shortening the price control period – making it easier to forecast the investment requirements over the period and so limit the opportunities for exploitation; and
- excluding investment from the initial price control but then rolling-up actual investment and including it with an *ex post* adjustment at the end of the period to allow the recovery of prudently undertaken investment.[19]

[18] Here, deepening should be translated as greater intrusion by the regulator on an on-going basis requiring enhanced regulatory resources and greater reporting costs to the company.

[19] This approach has been adopted in Abu Dhabi and a variant, focusing only on unanticipated investment has been utilised by OFWAT, the water regulator in England & Wales. In Abu Dhabi, to overcome some of the risk of regulatory discretion associated with the rolling-up approach, the regulator and the companies have agreed the rules for the ex post assessment of investment.

It should be noted that these approaches are not necessarily mutually exclusive and may even have complementary effects.[20]

The first approach requires greatly enhanced regulatory auditing resources. However, even this would be less intensive than present practices in India of reviewing annual investments before they are added to the rate base (along the lines of the "used and useful" concept). Similar issues arise with the fourth approach. Rolling-up investment to the end of the period also raises questions about the ability of company's to meet the financing costs of the investment prior to the recovery of costs at a later date. It also introduces another potential source of regulatory discretion. Overall, the second approach is more appropriate – reviewing the last price control period as an input to the determination of the forecasts for the next price control period is a key element of the price determination process.

A simple financial model can illustrate these points. If we use the base data from Table 3, and make some illustrative assumptions, then the information set out in Table 6 can be derived. Note, a longer description of this and other modeling undertaken in this Section is provided in Annex 4.

Table 6: Illustration of alternative approaches to investment (Rs Crore)

Year	**0**	**1**	**2**	**3**	**4**	**5**
Initial Asset base	627	627	627	627	627	627
Profit (16%)	100	100	100	100	100	100
Planned net Investment		715	715	715	715	715
New Asset base	627	1342	2057	2772	3487	4203
Profit	100	215	329	444	558	672
Rate of return		16%	16%	16%	16%	16%
Actual Investment		515	515	515	515	515
New Asset base		1142	1657	2172	2687	3203
Saved depreciation		10	20	30	40	50
Allowed profits	100	215	329	444	558	672
Actual profit	100	225	349	474	598	722
Rate of return		19.7%	21.1%	21.8%	22.3%	22.6%
Initial Asset Base	627	627	627	627	627	627
Initial profit	100	100	100	100	100	100
Actual Investment		515	515	515	515	515
Cost of Investment (depn)		26	52	77	103	129
New Asset base		1142	1657	2172	2687	3203
Realized profit		75	49	23	-3	-28
Rate of return		6.5%	2.9%	1.1%	-0.1%	-0.9%

The base information for Table 6 sets out an assumed no net new investment scenario, i.e. enough investment to meet depreciation but no net additions to the overall capital stock. Then, the assumed annual level of investment, over Rs 700 Crore, is used to determine a new capital stock and level of allowed profit (to yield a 16% return).[21]

[20] An example of this is the approach used in the electricity industry in Moldova and also the water industry in England and Wales. Predictable investment is included in the forward looking revenue calculation and reviewed at the end of the price control period. Unanticipated investment undertaken during the life of the price control, say relating to environmental standards imposed after the review and not foreseen at the time of the review, is rolled-up and then reviewed at the next price control review.

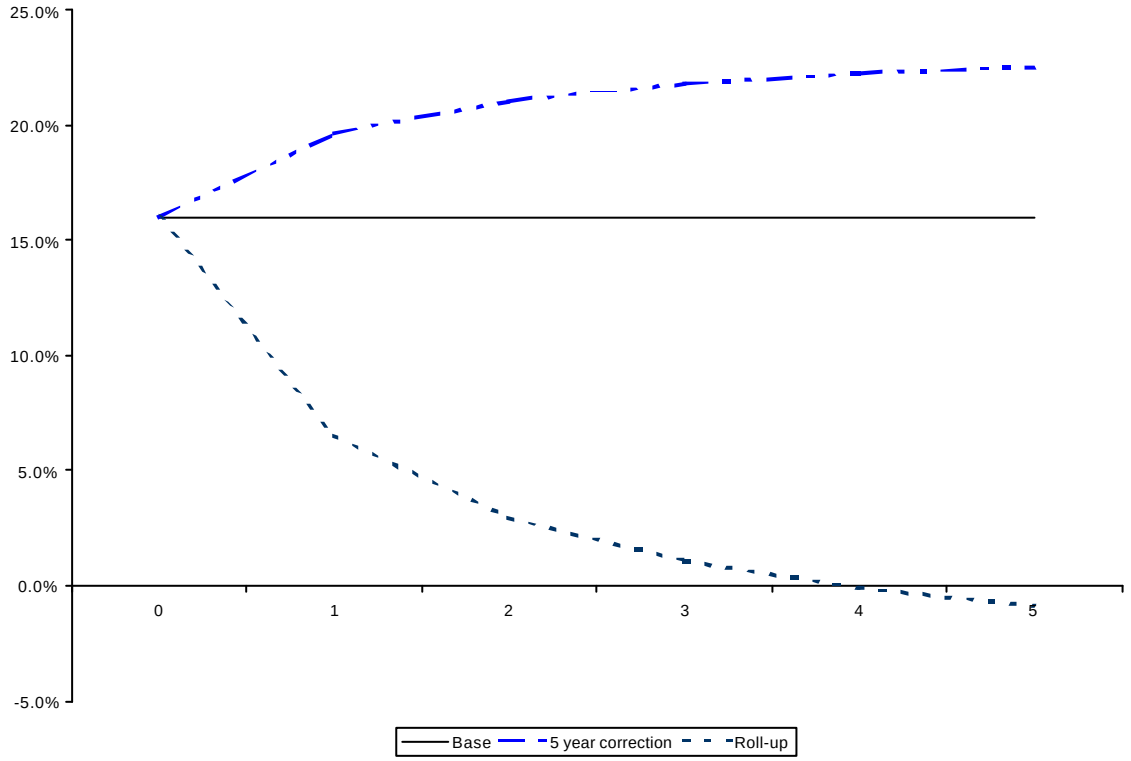
[21] For simplicity it has been assumed that the Rs 700 Crore is net investment, so depreciation is covered elsewhere.

If the company is able to under-spend on investment by Rs 200 Crore per annum, what is the impact? Two scenarios can be modeled. In the first, the under-spend is not corrected for, during the life of the price control. So, the company is able to keep the profits and depreciation (assumed to be 5%) for the investment it is not undertaking, and so able to realize a higher rate of return than the planned 16%. If, this was corrected for at the end of the price control period, over Rs 700 Crore in year 5 prices of 'profit' would have to be returned in the following price control period (assuming all the excess was captured).

If the rolling-up type approach, as used in Abu Dhabi, is applied, a different story is seen. The base level of profit is allowed each year, but from this must be subtracted the depreciation associated with the new investment. From the resulting level of profit a return must be paid to all capital – so, as can be seen from the Table, this level of return drops rapidly. However, in the following price control period the financing costs and depreciation associated with the new investment would be recaptured.

Figure 2 provides an illustration of the results of the investment approaches.

Figure 2: Illustration of the impact of alternative investment regimes during the life of the price control



This is a good example to show the concern about the rolling-up approach. Under these assumptions the company could face severe financing problems since it is earning a negative rate of return by the end of the price control period. As such, investors would need to have great faith in the regulatory system to allow future profits to compensate for this, otherwise a higher rate of return will be demanded to cover the risks inherent in this approach. However, it should be noted that the negative profits are a result of the high investment and low absolute level of profits in this scenario. Annex 4 provides an example with higher absolute initial profits and lower investment

levels that do not suffer from the same problem – so reinforcing the fact that any decision has to be situation specific.

Another impact of the alternative approaches will be the way in which prices move. Table 7 summarizes the impact under different regimes.

Table 7: Impact on prices of alternative investment regimes

Regime	During price control	During next price control
No recovery	As predicted, higher than necessary	Higher than necessary
Recovery at end of control	As predicted, higher than necessary	Lower to allow recovery of excess profits from first control period
Rolling-up	As predicted, lower than necessary	Higher to allow recovery of un-recovered investment costs incurred during the first price control period

So, the choice of approach could also be affected by the way in which regulators (and politicians) wish to see prices move. Again, there is a risk that investors will perceive a decision to postpone price increases as a lack of commitment and so penalize regulators through higher required rates of return – a factor that has to be considered when determining which approach to follow.

Acceptability of price increases is clearly an important issue in India and throughout South Asia. However, financial viability is also a real and binding constraint – price increases would be necessary even if no investment was undertaken. Yet, investment is also desperately required. As such, a rolling-up approach could deliver disastrous results and should not be applied in the region.

Finally, given the relative importance of investment, especially when compared to the desire to create incentives and the significance of losses, it is probably not appropriate to limit the price control period to, say three years rather than five. However, given that most distribution companies in the region will need substantial investments, this might be an appropriate refinement of the IBRC in some circumstances.

6.2 Losses

The losses scenario showed that the IBRC provides no incentive to reduce losses beyond those forecast by the regulator. This raises some concerns in that:

- information on losses is limited – Section 2 discussed this – and consequently regulators may find establishing credible and testing forecasts of losses difficult; and
- the lack of incentives means that improving the information database through companies striving to outperform the target will not occur.

Given the quantitative importance of losses within the financial framework of the distribution companies, the question of whether greater incentives for loss reduction should be incorporated into the formula must be addressed.

Several options are available for increasing the incentive for loss reduction. We consider two here – many others may exist, but these two serve to illustrate the approach to refining the model. These options are:

- any increases in revenue that are not associated with an increase in electricity purchases by the distributor can be kept by the company as higher profits; and
- a separate item relating to measured losses is introduced into the formula whereby losses are directly calculated and incorporated into the model.

Although both options provide incentives they do this in different ways and have different information needs.

With an approach based around the level of revenue and electricity sales, rather than having to directly measure the level of losses the focus is rather on the impact. What this approach tries to do is separate the two elements of movements in revenue, which are:

- increases or decreases in the level of demand; and
- improved collection of bills or reduction in technical losses.

To distinguish between the two revenue drivers the level of electricity purchases is used. If demand is increasing and the level of losses is unchanged, then more electricity will have to be purchased. However, if for the same level of electricity purchases greater revenue can be recovered, this must be through a reduction in losses. As such, the company can be incentivised to reduce losses by applying this correction factor.[22]

Establishing the form of such a control is relatively straightforward. Revenue can be split into four elements:

- the number of units of electricity purchased from the distribution company;
- the generation and transmission price per unit of electricity purchased;
- distribution costs; and
- losses (comprising technical and commercial).

By considering the calculation of forecast and actual revenue using these elements it is possible to get an estimate of the change in losses from those forecast. It is this impact that you would want to allow the company to retain. This estimate has to be derived from the total generation purchased information, owing to the lack of reliable metering data. Something like the following could be employed:

$$TG_t^f = \left\{\left[N_t^f \times G_t^f\right] \times \left(1 + l_t^f\right)\right\}$$

Where *TG* is the total generation cost, *N* is the kWhs collected from consumers as estimated by the company[23], *G* is the generation and transmission price per billed kWh and *l* is the proportion of losses. The superscript *f* denotes a forecast figure and there is a time subscript, *t*.

Any divergence in actual *TG* not explained by a divergence in one of these elements must be due to a change in losses, the element that we wish to isolate and incentivize the company to control.

It is possible to estimate the losses that actually occur by solving the equation:

$$l_t^a = \left[\frac{TG_t^a}{\left(N_t^a \times G_t^a\right)}\right] - 1$$

Where a denotes an actual figure. The impact of the change in losses (*L*) can then be estimated and the company rewarded accordingly:

[22] Some issues relating to the practical application of this methodology may arise if individual tariff levels are not established by the regulator. These implementation issues are not insurmountable and interact with the general revenue-cap elements of the control.

[23] Ideally one would use actual salesbut these are not readily verifiable in most states in India given low levels of metering.

$$L_t = \left(l_t^f - l_t^a\right) \times \left[N_t^f \times G_t^f\right]$$

This approach relies on information reported by the company. Incentives for loss reduction are high, since the company effectively keeps the generation cost per unit of electricity – consequently, it may be appropriate to share the impact, although this does raise issues about incentives as noted above with other sharing systems. Since it is not possible to distinguish between reducing losses and selling more, the company may also get rewarded for demand increases.

An example of how this approach could work is described below.

Suppose the information from Table 3 is used, with an assumption that losses are 50%. Then, under simplifying assumptions the following forecasts could be produced.

Table 8: Illustration of alternative approaches to losses (Rs Crore)

Year	**0**	**1**	**2**	**3**	**4**	**5**
Initial Asset base	627	627	627	627	627	627
Profit (16%)	100	100	100	100	100	100
Generation and Transmission costs	7,925	7,925	7,925	7,925	7,925	7,925
Distribution costs	1,695	1,695	1,695	1,695	1,695	1,695
Total forecast costs	9,620	9,620	9,620	9,620	9,620	9,620
1% unanticipated reduction in losses per annum (from an initial 50%)						
Generation and Transmission costs	7925	7872	7819	7767	7714	7661
Distribution costs	1695	1695	1695	1695	1695	1695
Total actual costs	9620	9567	9514	9462	9409	9356
Allowed revenue	9,620	9,620	9,620	9,620	9,620	9,620
Simple cost pass-through						
Revenue	9620	9620	9567	9514	9462	9409
Profit	100	153	153	153	153	153
Rate of return		24%	24%	24%	24%	24%
Incentive to keep losses						
Revenue	9,620	9,620	9,620	9,620	9,620	9,620
Profit	100	153	206	259	311	364
Rate of return		24%	33%	41%	50%	58%

This very simple example demonstrates the fact that a powerful incentive to cut losses can be created with a loss based correction factor rather than simple cost pass-through of all generation and transmission costs. Annex 4 provides a more detailed example where there is both unanticipated demand growth and unanticipated loss reduction.

The second approach would be to measure the losses directly. This would then allow a simple correction factor to be introduced which captured the exact change in losses. This type of approach was modeled in Alexander and Harris (2000), where losses were included analytically as a controllable cost, with reductions in losses over and above that forecast being kept by the company, and excesses above those forecast being borne by the company. This requires

reasonably accurate measures of losses, arguably something that the companies have failed to provide, including those that have been privatized.

Losses are by far the most important of the controllable costs and consequently whatever incentives possible should be provided for their reduction. Correspondingly, we would recommend that the IBRC formula be recast as:

$$R_{t+1} = R_t \times [1 + CPI - X] - C_t - A_t + L_t$$

L_t is a measure of the impact of changes in losses relative to the level of losses forecast. Initially we would recommend that the simple revenue based calculation be used. This is limited in terms of the incentives it provides but is easy to implement. If the companies can start to provide improved information on losses then we would recommend moving to a more direct measure of the change in losses which provides greater incentives for the companies – if anything, this is a good way of determining whether the investment in improved metering is worthwhile.

A third modification would be to move towards a price-cap regime, where a price per unit sold is established (with adjustments for changes in the per unit costs of uncontrollable cost inputs such as bulk power purchase costs). With a price-cap mechanism, cutting losses would have the same impact as the simple example in Table 8. However, the difference in approaches would occur when a reduction in losses is then combined with an increase in demand – say due to unmet demand arising from a lack of generation (partly caused by losses). Unanticipated increases in demand under a system when there is a price-cap leads to the company being able to earn a greater than proportionate increase in profits. This arises because some of the costs of distribution are fixed yet a price-cap allows a common distribution margin that is greater than the variable costs. As such, in a system with unmet demand, a price-cap will provide greater incentives for reductions in losses. This would of course suffer from the same deficiencies that were noted for price-caps in Section 4, especially the incentive for the company to 'game' information about anticipated increases in demand. It could be argued, however, that in the short term, it would be a possible transitional option and that as long as companies were investing to meet demand and increase sales, they should not face an incentive regime that blunts their interest to do this.

One factor that could be considered when determining which approach to follow is the degree of certainty about the level of losses. If the regulator can have significant certainty about a limited range for the level of losses then choosing a system which has a clear separate losses term might be more appropriate than in a situation where the estimate of losses involves a wide range. This issue raises some interesting questions, especially that of: Should a company's actual level of losses be included as the starting point in the revenue calculation?

Using a company's own level of losses as a starting point clearly limits the incentives for the company to cut its losses to those created by the assumed annual savings. An alternative, which could create greater incentives – but which could also call into question the financial viability of some companies – would be to use a benchmark level of losses as the starting point. Using benchmarks, or yardsticks, is clearly one solution to an information problem – as well as improving incentives. Questions which would have to be considered include:

- determining the dataset for calculating the benchmark; and
- assessing the inter-relationship between financial viability and the losses term.

In principle it would, however, be possible to use a benchmark system to overcome some of the problems perceived in South Asia. A recent paper by Williamson and Toft (2001) discusses some

of the relevant issues involved with using benchmarking in developed, transitional and developing countries.

A final consideration, again potentially relevant when there is only limited information, is to consider switching the emphasis from an 'input' like losses to something more relevant – the 'output' or quality of service received by customers. It is possible to develop incentive based systems that reward the outputs achieved by a company. For example, rather than focusing on losses it might be more appropriate to focus on:

- the number of customers connected to the system; and
- the time period over which an adequately defined service is available.

Provided the incentives for the company are sufficiently powerful, investment will be made to cut losses that then allow the company to meet its output targets – without having to tell the company what level of losses it is expected to achieve. Some of these issues are investigated in a recent research paper published by IPART (the regulatory office in New South Wales, Australia).

Although this approach appears encouraging, some further consideration of related issues should be given. For example:

- Is it possible to determine measurable outputs that are meaningful?
- Is it easier to measure these outputs than the losses input?
- Is it possible to establish a sufficiently high powered incentive regime to make meeting the output targets feasible (especially while maintaining expected financial viability)?

These are real concerns that could limit the general applicability of this approach in South Asia. That should not, however, mean that no consideration of this sort of approach should not be made.

Which of the options described above is suitable could be examined by modeling the impact of the different controls under various assumptions, including the accuracy of loss estimates as well as considering the other issues outlined in this section.

7. Policy Implications

Having considered some of the options relating to creating incentives and the impact that different situations can have on these incentives, it would now be useful to consider if some simple rules can be established to help regulators think about when each of the options could be utilized. These rules, by their very nature, have to be quite generic and the regulator will need to consider the situation faced in their country very carefully, but this could be a starting point for assessing which option should be followed in a sector or country.

When thinking about the factors that influence the regulatory decision making process, it is possible to consider both the criteria described in Section 4 and some practical issues. The practical issues are another way of stating the criteria from Section 4 but do not necessarily capture all the aspects of those criteria. Four practical issues are described below, these are not necessarily all the possible issues and may include ones that are felt to not be appropriate in some circumstances.

Generation and transmission costs relative to distribution costs. This measure is trying to establish what the impact of focusing efficiency savings on direct distribution costs will have on the final price faced by consumers and the relative importance of allowing unanticipated changes in generation and transmission to be passed-through to consumers.

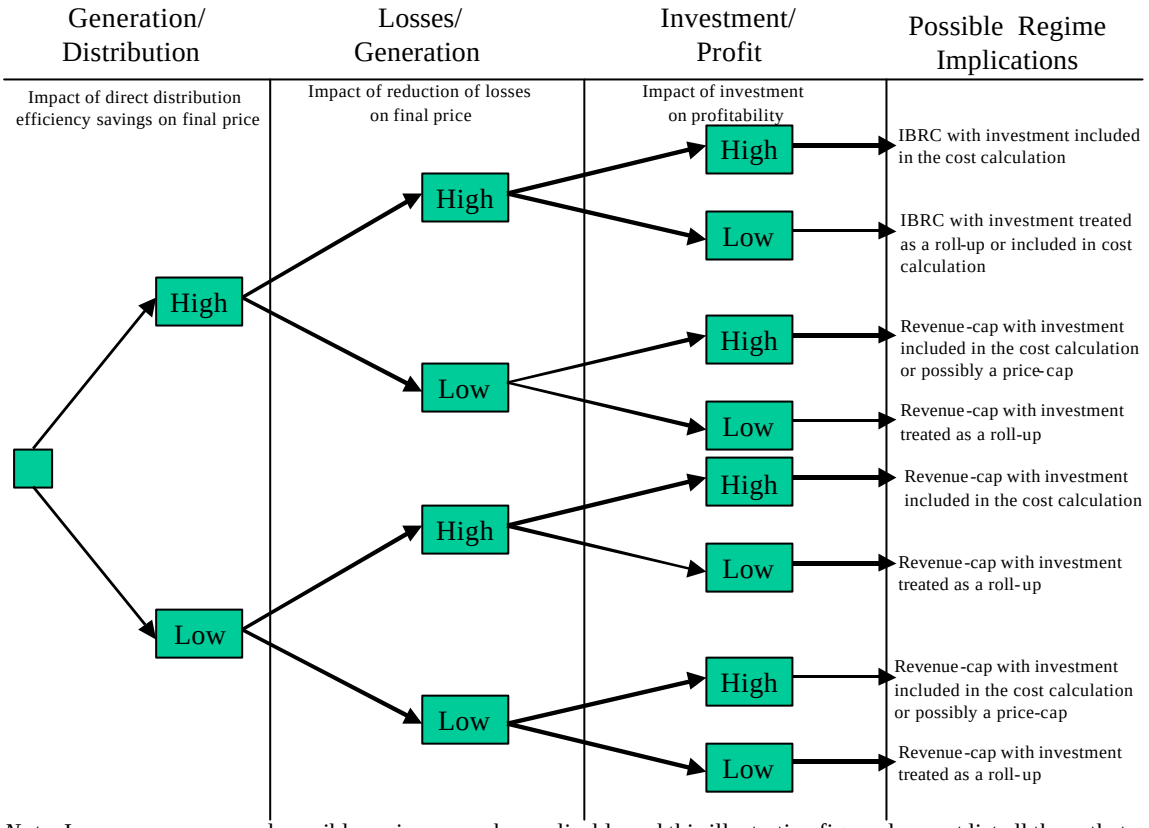
Losses relative to generation and transmission costs. With this measure it is possible to see how important it is to create incentives for reducing losses and so whether complex, simple or no incentives in this area should be established.

Investment relative to existing profits. If a company is expected to invest a significant amount relative to the existing level of profits, then it is important to ensure that financial viability will not be called into question. This would suggest that either forecast investment should be included in the calculation of allowed revenue, or, if a rolling-up approach has to be adopted, strong and binding guarantees are provided by the regulator to ensure that investors are given comfort that their investments will be compensated in the future (even though this does limit the incentives to make efficient investment decisions).

Profits relative to total costs. If profits are a small proportion of total costs, small efficiency savings that are kept by the company could have disproportionate impacts on headline profitability. While this may be important for the creation of incentives, the regulator may also wish to think about some earlier sharing mechanism, or at least sensitizing politicians and consumers to the fact that this may occur. This impact could also be captured by a measure incorporating the relationship between the asset base of the distribution company relative to the cost base. If assets are small relative to the cost base, any change in absolute profits could represent a significant change in profitability. This latter measure may be more appropriate than the former since it is employing variables different to those used in other measures.

These, and other factors, can then be combined into a decision tree. Depending on the value of each measure or factor, it is possible to plot the relative importance of creating different types of incentive (given the likely cost-benefit analysis of the impact of the incentive compared to the cost of regulation). A simple three factor illustrative decision tree is provided in Figure 3. This figure provides only a couple of options and is broad-brush, but does show how the decision process could work.

Figure 3: Illustrative choice process given three key concerns



Note: In many cases several possible regimes may be applicable and this illustrative figure does not list all those that should be considered.

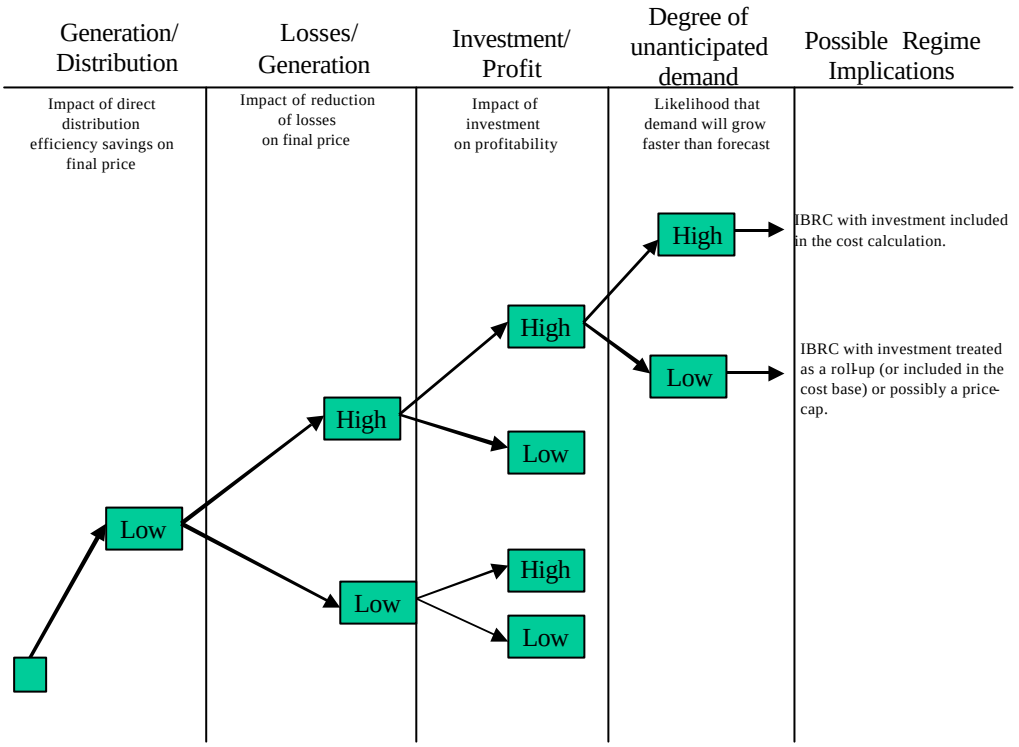
If this sort of decision tree was applied to our interpretation of the position faced by electricity distribution companies in India, or even the South Asian region, then we would propose that the value for each measure is high, so leading to the IBRC approach proposed in this document. Other readers may believe that the values are different, or that other factors are more important. That is fine, what is important is that a framework that is robust and open to discussion is established so that a clear answer can be achieved. This decision tree provides one way of achieving that, but is clearly open to re-interpretation and debate.

What is also important to stress is that the decision tree in figure 3 does not capture all the relevant factors – a key first step in this process is to determine what the significant factors are! For ease of presentation the tree was limited to only three factors. It is straight-forward to extend this type of analysis to include other factors. Again, for ease of presentation the following two figures:

- extend the analysis by only one additional factor (a different one in each case); and
- concentrate on only one branch of the tree.

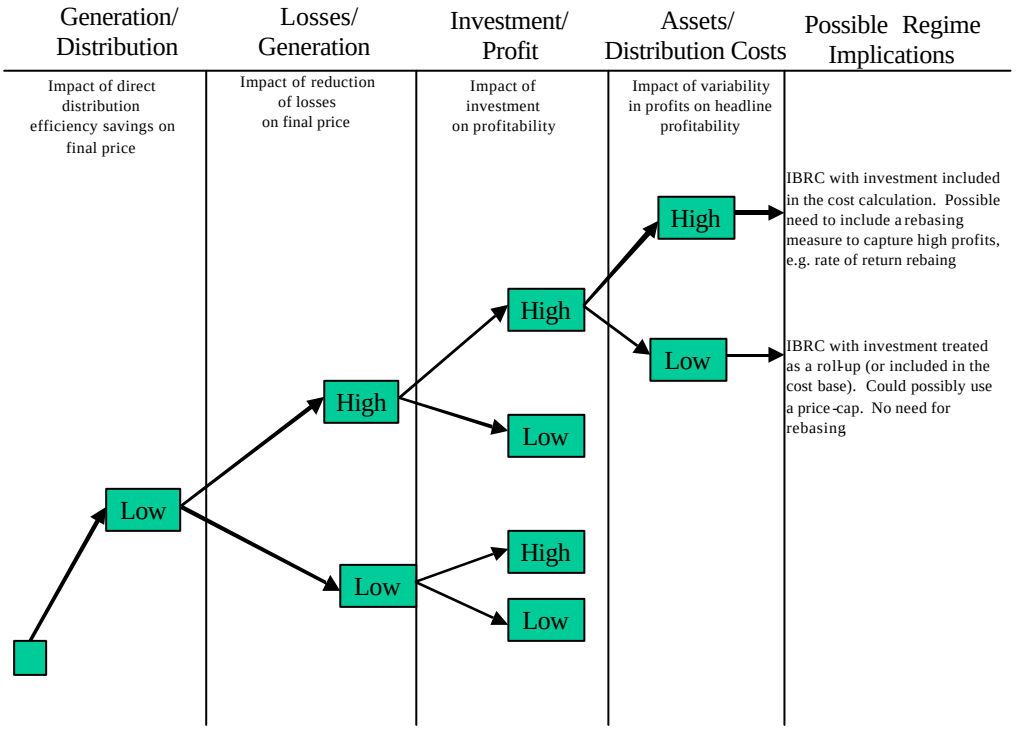
These two figures show how the process could be extended but again should be treated as illustrative.

Figure 4: Illustrative choice process extended to include unanticipated demand



Note: In many cases several possible regimes may be applicable and this illustrative figure does not list all those that should be considered.

Figure 5: Illustrative choice process extended to include a measure of variability of headline profits



Note: In many cases several possible regimes may be applicable and this illustrative figure does not list all those that should be considered.

8. Other tariff issues

While the main theme of this paper has been the choice of incentive systems to establish a tariff system that is robust, attractive to investors and acceptable to other stakeholders, there are two further, tangential, issues that should not be ignored.

Through-out South Asia utility prices tend to be:

- below cost-recovery level; and
- slanted to provide cross-subsidies from one consumer group to another.

Addressing these two issues of implicit (and explicit) subsidy and cross-subsidy to the degree that they deserve is beyond the scope of this paper. However, any regulatory decision will have to incorporate decisions on these issues and, as such, some initial comments could prove useful (and help provide a complete pricing decision approach).

8.1 Cost-reflectiveness

When prices are below cost-recovery there are significant implications for the financial viability of a company and consumption decisions (with subsequent implications for investment).[24] Now, there are several approaches that can be considered to achieving some form of cost-recovery:

- selling assets at below their true cost, so perpetuating the below true cost-recovery price but then allowing incremental cost-recovery but including all new assets and costs at their true level (this was the approach adopted in the majority of the privatizations in the UK, especially the water and sewerage industry in England and Wales, where assets were sold for a fraction of their replacement cost); and
- establishing a price-path that will lead to average prices meeting cost-recovery after some period of time, say five years or more. This will have the same impact as the first option, inasmuch as investors will not value the assets being purchased at their true cost, but the degree of under-valuation will depend on the time taken to achieve cost-recovery.

What is important is that a clear and credible commitment to a form of cost-recovery be made prior to any privatization so that investors are able to approach the sale with as much certainty about future prices as is possible.

8.2 Cross-subsidies

This paper has focused on the total revenue requirement for a company rather than the price that each customer type should face. As noted above, and in footnote 23, many consumers face costs that are either above their relative cost of service so that other consumers can face relatively low costs.

Two questions arise:

- Should regulators concern themselves with the price that each individual consumer group pays if they are regulating total revenue or average prices?
- If a regulator should be concerned, how should they be involved in the pricing decision?

[24] Clear examples of this problem can be found throughout South Asia. The provision of electricity to agricultural users at below cost (often at almost no cost) has lead to a proliferation of energy intensive working methods, e.g. pumps for tube wells to allow cultivation of crops that would not be economic if the true cost of power was charged. This then leads to greater demand for electricity than would be the case if the true economic cost of electricity was paid by the farmer and consequently greater investment in generation or rationing imposed on all consumers.

From a purely economics based perspective, the regulator should not be concerned with individual tariffs but should be concerned about the overall revenue issue. Companies should then be able to set tariffs for individual consumer groups that maximize profits, given the overall revenue control. What the regulator should be concerned with is that each consumer class is treated fairly within that class – i.e. customers within the same class face the same tariffs. By providing incentives for companies to maximize profits the regulator will find that more information is provided, so allowing better regulatory decisions to be taken in the future. This was the approach adopted in the electricity industry in the UK where several companies revised their tariff systems to maximize profits and then, at a later price review, the regulator was able to use that information to improve the average price faced by all consumers (even of those companies that did not try to maximize their profitability through innovative uses of the tariff system).

However, the world is not ruled by pure economics. There may be important social and political reasons as to why cross-subsidies are allowed, say the provision of low priced services to poor households etc.[25] How a regulator then addresses this issue should be considered – but it does drag the regulator into the detail of the company's operations, something that should always be minimized.

One solution adopted in the UK, especially in telecommunications where connection charges and fixed charges were seen to be important social issues, is to establish separate price caps (although revenue caps could also be used) for those socially necessary elements and then allow a general cap on the basket of remaining services. Again, the design of cross-subsidy mechanisms is something that needs to be addressed on the specifics of the situation being faced, but the general proposition is that as little involvement in tariffs for individual services or customer groups as is possible should be undertaken by the regulator.

If this type of solution is employed it is important that the separate price-caps be considered as to whether they should be independent – so the price-cap on the low-income tariff should not necessarily feed into the overall basket price-cap. If the price-caps are linked through the basket, there is the possibility that owing to demand constraints etc. the company will be unable to exploit the whole of the price-cap. Or, as has been the case in some countries, by allowing the basket to capture all capped services, relatively higher increases in some services may be seen in order to off-set the constraints in other services. For example, if greater than anticipated demand occurs in the low-income segment, then higher than average increases may be needed in the other segments to off-set the cross-subsidy. So, although a headline $CPI - X$ may have been announced, many customers may see higher than headline increases occur!

Again, from an economic viewpoint this is appropriate – the company is trying to maximize profits within the constraints. However, if from a political and social view this is inappropriate then separate independent price-caps should be set. Of course, the financial viability of the company could be affected by this and any such decision should be taken after careful consideration of the impact on incentives and financial viability.[26]

[25] Whether this is a good way of delivering social objectives is another question. This may depend on the country in question and the situation it faces with respect to utility coverage etc. However, the design of appropriate subsidy mechanisms is beyond the scope of this paper.

[26] A similar, but probably less acute, problem can arise with revenue-caps. If demand deviates from forecast levels there could be a need to recover revenue which would imply higher than forecast price increases. This is as relevant for the low-income group as any other covered by a revenue-cap.

9. Conclusions

This note has attempted to show that it is possible to construct a multi-year price control formula for the Indian power sector which creates incentives for companies to operate efficiently, limit the benefits enjoyed by companies to controllable cost items, so keeping the return 'fair', provide forward looking price-paths that will help provide certainty to investors;[27] and is relatively administratively light-handed. This can be done within the informational constraints that presently exist in the Indian power sector, by focusing on information that is available and can be audited, and by incorporating new information on parameters in the control formula as they become available.

Our initial IBRC model, however, is probably too simplistic. Losses are clearly an important issue and, as such, a correction for these should be introduced to provide enhanced incentives for loss reduction. This is one area where information is a constraint. Our proposal to overcome this is simple and consequently does not create as high a degree of incentive as would be achieved with good information on losses. However, the focus on a simple model makes implementation possible and also creates an incentive for the companies to improve their measurement of losses if this will be advantageous to the companies. As such it is a good model to determine the appropriate level of investment in metering that is required for each distribution company. There is no "one size fits" all answer to the problems faced by the SERCs. The solution developed in this paper is an illustration of the way in which some aspects of the problem can be considered and overcome.

In India, high transmission and distribution losses and low levels of collection efficiency mean that present tariff levels do not provide a base for covering costs. Evidence to date suggests that reductions in losses and improvements in collections will not be rapid. There will be a need to introduce price increases whilst making realistic assumptions about efficiency improvements if private management and capital is to be introduced. It is important to note that there is no regulatory approach that can get around this difficulty. Whichever approach is adopted will need to deal with these fundamentals. The advantage of the proposed approach is that it sets out more clearly the revenue path for the company, and provides incentives for improved efficiency.

There are a large number of additional issues associated with setting multi-year tariffs that this note does not touch on, and clearly a great deal of work is required to make this operational. However, one advantage of the proposed approach, as compared to present approaches, is that it frees up more time for SERCs to focus on issues such as the quality of service provided by the companies, and their responsiveness to consumers.

[27] Consumers also appreciate certainty about the price path since it allows them to plan future expenditure. Having prices that move significantly from year-to-year may make some budgeting decisions difficult for both industry and households. Providing certainty to consumers through a multi-year price path helps overcome this.

Annexes:

1. Bibliography
2. Brief review of the Moldova system
3. The National Grid Company revenue cap
4. Scenario issues

Annex 1: Bibliography

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Annex 2: The Moldova system

The National Agency for Electricity Regulation (ANRE) in Moldova has established a price regime for electricity distribution which will be:

- valid for seven years;
- a single rate for the first three years for all consumers;
- after three years a tariff structure based on consumption levels and connection voltage levels; and
- after five years a split between distribution and supply elements of the tariff.

To provide some security for the regulator, although clear rules for the seven years have been established, ANRE is required to undertake a tariff review during the second year. This review is meant to focus on the observable information – initial operating costs etc – and so provides a way of verifying that the price is on the right path. Up to the time of the review a simplified system is utilised – so allowing a stable system to be developed for investors while ensuring an implementable system exists while data is verified.

The tariff covers:

Electricity acquisition costs – this captures the cost of electricity purchased and the quantity of electricity invoiced to final consumers. An incentive is provided for distribution management through keeping electricity purchase costs.

Transmission costs – determined separately by ANRE.

Transmission losses – will be determined by ANRE is there is no clear measure of flows into and out of the transmission system.

Distribution costs – described below.

Distribution costs include:

- cost of capital;
- operating costs;
- other distribution costs.

Incentives are introduced into this system in several different ways.

External factors.
Several items, including the allowed rate of return and the level of losses, are preset based on external information. As such, the owners and management of the distribution company have an incentive to achieve a lower cost of capital and lower levels of losses.

Efficiency factors.
Preset efficiency factors, ranging between 1% and 3% per annum, were established for the operating costs of the company. These would be applied in conjunction with movements in cost indices, CPI, GDP etc., to capture the real change in costs.

Trigger points
Some downside protection is provided to operators inasmuch as if total supply costs are likely to diverge by more than 3% from the forecast level, the company can ask for an extra-ordinary tariff update. (This protection would appear to be aimed at uncontrollable costs, although representations about reasons for distribution losses can also be presented.)

Annex 3: The National Grid Company revenue cap

The NGC's transmission business has been subject to a pure revenue control since it was vested in 1990 and privatised as a part of the RECs (each REC owned equity in the NGC).

The first price control, established in 1990, set a maximum rate of increase in NGC's regulated transmission revenue per kilowatt equal to inflation (RPI-0). The second price review, which took effect three years later, tightened this control to (RPI-3).

The regulatory formula is:

$$M_t = \left[1 + \frac{RPI_t - X_g}{100}\right] \times P_{t-1} \times G_t - K_t$$

Where:

M_t is the maximum average charge per kilowatt in year t.

X_g is the annual efficiency factor.

P_{t-1} is the price in the previous period calculated as:

$$P_{t-1} = P_{t-2} \times \left[1 + \frac{(RPI_{t-1} - X_g)}{100}\right]$$

G_t is a weighting factor related to the previous system maximum average cold spell demands, and defined as:

$$G_t = \frac{Q_t + Q_{t-1} + Q_{t-2} + Q_{t-3} + Q_{t-4}}{5Q_t}$$

Where Q_t is the system maximum demand. The number of kilowatts (Q_t) used in the formula is set in advance by Offer. This effectively sets the NGC's maximum regulated transmission revenue in each year.

K_t is a correction factor that adjusts for under or over recovery of revenue in the previous year. This is calculated as:

$$K_t = \frac{Q_{t-1} \times (C_{t-1} - M_{t-1}) \times \left(1 + \frac{I_t}{100}\right)}{Q_t}$$

Note: Although the Transmission licence provides this formula, it would be easier to interpret if it was restated as:

$$K_t = \frac{Q_{t-1} \times (\tilde{M}_{t-1} - M_{t-1}) \times \left(1 + \frac{I_t}{100}\right)}{\tilde{Q}_t}$$

Where

C_{t-1} is the average charge per kW, effectively the forecast value of M_{t-1}.

Annex 4: Scenario Issues

Section 6 reported some simple scenario work to illustrate the impact of the alternative regulatory regimes. This annex reports the additional scenario work referenced in the main paper and provides more information about the scenarios.

General information

The background information used for the scenarios developed here draws on the actual data for Andhra Pradesh as given in Table 3 of the main report. This information, however, has been simplified with the following assumptions:

- all investment figures are net new investment, i.e. it is assumed that investment to meet depreciation is covered elsewhere and consequently that the initial asset base is a constant throughout the period;
- investment figures are fixed at a single per annum rate throughout the five years of the price control;
- no reason for the savings in investment are given – all that the scenarios do is show what the outcome could be under different approaches;
- depreciation is over 20 years on a straight line basis, so leading to a 5% charge per annum;
- the allowed rate of return is 16% and fixed over the life of the price control; and
- losses are initially 50%.

The figures used for the second investment scenario are purely illustrative.

The investment scenarios

Two investment scenarios are presented in this annex. They are:

- the situation facing distribution in Andhra Pradesh, i.e. profits that are low in absolute terms (and relative to costs) and investment requirements that are high relative to the existing asset base (which has a low value owing to its age and state of repair); and
- a stylized situation where absolute (and relative) profits are high and the value of investment relative to the existing asset base is low.

The first of these scenarios was provided in the main report but is reproduced here with greater explanation of the calculations.

Scenario 1

The situation the company faces is shown in Table Annex 4-1. Starting from a low initial asset base and low absolute profits, owing to the high level of investment rapid increases in both variables are forecast. Now, if the company is able to save Rs 200 Crore each year, a little under 30% of investment, what is the impact? This clearly depends on the type of regime, but two basic factors must be considered:

- the reduction in depreciation costs for the investment (since depreciation costs associated with the new investment were included in the allowed costs); and
- a reduction in financing costs, i.e. no need to earn a rate of return to meet the financing costs of the foregone investment.

Table Annex 4-1: Illustration of alternative approaches to investment when there are low profits and high investment requirements (Rs Crore)						
Year	**0**	**1**	**2**	**3**	**4**	**5**
Initial Asset base	627	627	627	627	627	627
Profit (16%)	100	100	100	100	100	100
Planned net Investment		715	715	715	715	715
New Asset base	627	1342	2057	2772	3487	4203
Profit	100	215	329	444	558	672
Rate of return		16%	16%	16%	16%	16%
Actual Investment		515	515	515	515	515
New Asset base		1142	1657	2172	2687	3203
Saved depreciation		10	20	30	40	50
Allowed profits	100	215	329	444	558	672
Actual profit	100	225	349	474	598	722
Rate of return		19.7%	21.1%	21.8%	22.3%	22.6%
Initial Asset Base	627	627	627	627	627	627
Initial profit	100	100	100	100	100	100
Actual Investment		515	515	515	515	515
Cost of Investment (depn)		26	52	77	103	129
New Asset base		1142	1657	2172	2687	3203
Realized profit		75	49	23	-3	-28
Rate of return		6.5%	2.9%	1.1%	-0.1%	-0.9%

If the underspend is not corrected for, i.e. the company can keep the savings, then the overall profits earned by the company are:

- retained at the forecast level, even though financing costs for the foregone investment are not required; and
- enhanced by the addition of the saved depreciation.

Correspondingly, the asset base of the company does not increase as fast as forecast.

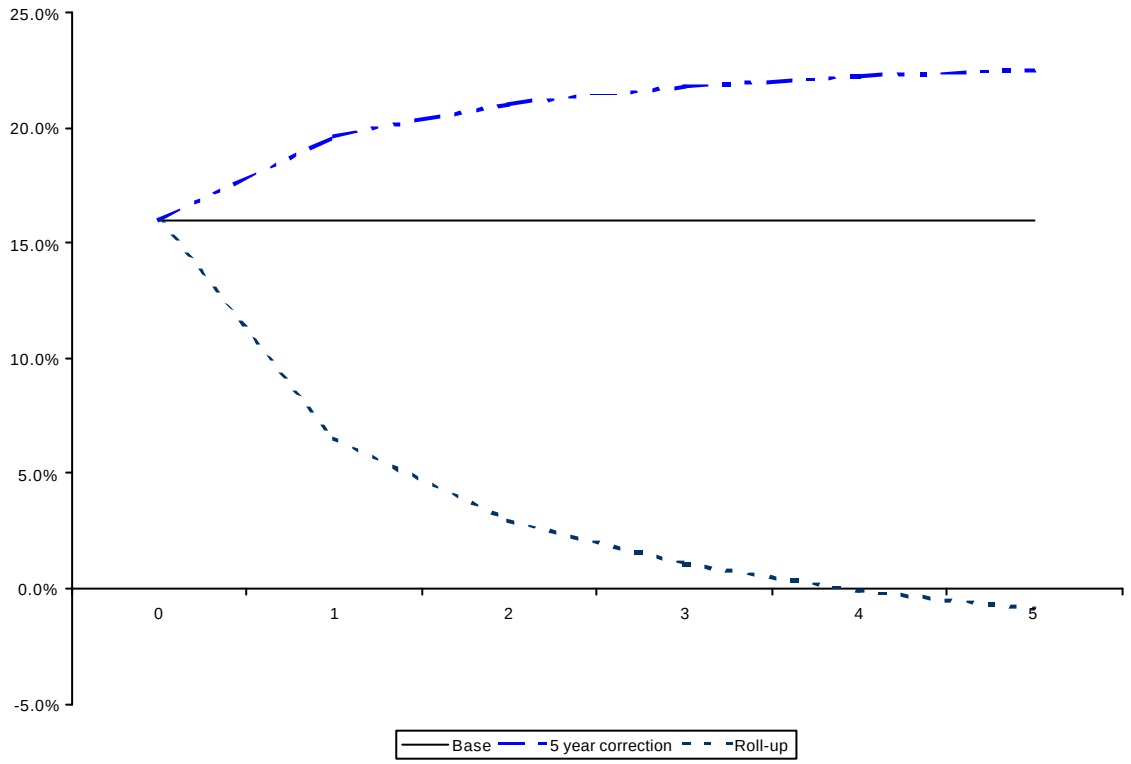
So, actual profits are higher than allowed profits and the asset base lower than forecast, both these forces help push up the headline profitability of the company (by the end of the five year price control period the impact is over 6% points).

What would happen in a regime using roll-up rather than inclusion of investment into the allowed costs? Well, no matter what the cost of investment, the required financing costs and depreciation are not included in the allowed costs. So, when the company incurs the investment it is required to meet both these costs from its existing profits – which will produce less profit to meet existing financing costs. Consequently, a lower headline profitability (and absolute profits) will be declared. This is exacerbated by the fact that the asset base is growing in this period.

Of course, the fact that the company has been able to save some of the investment costs will mean that the situation it faces is less extreme. However, the level of savings necessary to ensure that the company stays profitable would need to be higher than those modeled.

Figure Annex 4-1 provides an illustration of the results of the investment approaches.

Figure Annex 4-1: Illustration of the impact of alternative investment regimes for a low profit and high investment scenario during the life of the price control



As can be seen from the figure, the rolling-up approach has a much more significant impact on the financial health of the company than the inclusion of investment costs (and allowance for keeping efficiency savings).

Scenario 2

It should not, however, be assumed that rolling-up would never be appropriate. Consider the information presented in Table Annex 4-2. In this case, using the same two regimes, produces a less extreme result – owing to the stronger starting point. The different starting point means that:

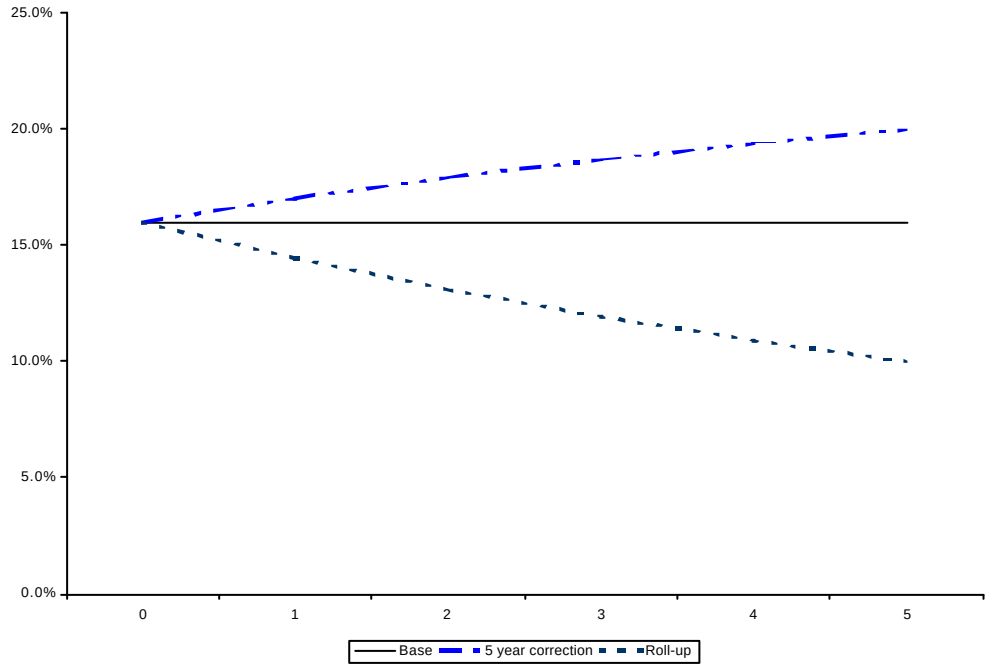
- overall a lower impact of efficiency savings on profitability is seen when investment is included in the cost calculation; and
- a smaller impact on the financial health of the company is seen when the rolling-up approach is employed – the company does not make losses and is still earning a 10% return at the end of the period.

Given this situation it then may be possible to contemplate using the rolling-up approach, although the reduced return could still have an impact on the return that investors demand such that they are willing to wait for the return to true profitability at the next price review.

Figure Annex 4-2 illustrates these results.

Table Annex 4-2: Illustration of alternative approaches to investment when there are high profits and low investment requirements (Rs Crore)						
Year	**0**	**1**	**2**	**3**	**4**	**5**
Initial Asset base	1875	1875	1875	1875	1875	1875
Profit (16%)	300	300	300	300	300	300
Planned net Investment		250	250	250	250	250
New Asset base	1875	2125	2375	2625	2875	3125
Profit	300	340	380	420	460	500
Rate of return		16%	16%	16%	16%	16%
Actual Investment		150	150	150	150	150
New Asset base	1875	2025	2175	2325	2475	2625
Saved depreciation		5	10	15	20	25
Allowed profits	300	340	380	420	460	500
Actual profit	300	345	390	435	480	525
Rate of return	16.0%	17.0%	17.9%	18.7%	19.4%	20.0%
Initial Asset Base	1875	1875	1875	1875	1875	1875
Initial profit	300	300	300	300	300	300
Actual Investment			150	150	150	150
Cost of Investment (depn)		7.5	15	22.5	30	37.5
New Asset base	1875	2025	2175	2325	2475	2625
Realized profit		292.5	285	277.5	270	262.5
Rate of return	16.0%	14.4%	13.1%	11.9%	10.9%	10.0%

Figure Annex 4-2: Illustration of the impact of alternative investment regimes for a high profit and low investment scenario during the life of the price control



The losses scenarios

As with the investment scenario, the information used for the element reported in the main report is reproduced below.

Table Annex 4-3: Illustration of alternative approaches to losses (Rs Crore)						
Year	**0**	**1**	**2**	**3**	**4**	**5**
Initial Asset base	627	627	627	627	627	627
Profit (16%)	100	100	100	100	100	100
Generation and Transmission costs	7,925	7,925	7,925	7,925	7,925	7,925
Distribution costs	1,695	1,695	1,695	1,695	1,695	1,695
Total forecast costs	9,620	9,620	9,620	9,620	9,620	9,620
1% unanticipated reduction in losses per annum (from an initial 50%)						
Generation and Transmission costs	7925	7872	7819	7767	7714	7661
Distribution costs	1695	1695	1695	1695	1695	1695
Total actual costs	9620	9567	9514	9462	9409	9356
Allowed revenue	9,620	9,620	9,620	9,620	9,620	9,620
Simple cost pass-through						
Revenue	9620	9620	9567	9514	9462	9409
Profit	100	153	153	153	153	153
Rate of return		24%	24%	24%	24%	24%
Incentive to keep losses						
Revenue	9,620	9,620	9,620	9,620	9,620	9,620
Profit	100	153	206	259	311	364
Rate of return		24%	33%	41%	50%	58%

If the company is able to reduce losses from 50% by 1% per annum what happens? Presuming that there is no change in demand (investigated in the next table) then the amount of generation and transmission that has to be purchased falls.

Two different regimes are shown in Table Annex 4-3.

In the first, a simple cost pass-through, any savings that are made in the losses are passed on to consumers, with a one-year lag. So, profits rise from 16% to 24% in the example but then stay constant since each additional saving is passed on to consumers. If the savings stopped in year 5, year 6 would see a fall in profitability well below 16% and then a return to the 16% return.

If, however, a regime is employed to create incentives to reduce losses then the profit earned by the company rises rapidly to the point where in year 5 profitability is almost 60%. This figure is extreme owing to:

- the low initial profit levels; and
- the relative size of generation costs to distribution costs.

It does, however, serve as a good illustration of the impact of efficiency savings in losses.

What happens when there are both savings in losses and an increase in demand?

Table Annex 4-4: Illustration of alternative approaches to losses when there is a corresponding increase in demand (Rs Crore)						
Year	**0**	**1**	**2**	**3**	**4**	**5**
Initial Asset base	627	627	627	627	627	627
Profit (16%)	100	100	100	100	100	100
Generation and Transmission costs	7,925	7,925	7,925	7,925	7,925	7,925
Distribution costs	1,695	1,695	1,695	1,695	1,695	1,695
Total forecast costs	9,620	9,620	9,620	9,620	9,620	9,620
1% unanticipated reduction in losses per annum (from an initial 50%) and a 1% increase in demand						
Generation and Transmission costs	7,925	7,951	7,976	7,999	8,022	8,044
Distribution costs	1,695	1,695	1,695	1,695	1,695	1,695
Total actual costs	9,620	9,646	9,671	9,694	9,717	9,739
Allowed revenue	9,620	9,620	9,620	9,620	9,620	9,620
Simple revenue-cap						
Actual costs	9620	9646	9671	9694	9717	9739
Corrected allowed revenue	9620	9620	9646	9671	9694	9717
Savings	0	-26	-25	-24	-23	-22
Profit	100	100	100	100	100	100
Realized profit	100	74	75	76	77	78
Asset base	627	627	627	627	627	627
RoR	16%	12%	12%	12%	12%	12%
Specific losses correction factor						
N*G	5283	5336	5389	5442	5495	5548
Forecast cost	7925	8004	8084	8163	8242	8321
Impact on forecast	0	79	159	238	317	396
Impact of losses	7925	7951	7976	7999	8022	8044
Impact of savings	0	53	108	163	220	277
Correction: simple	0	0	79	159	238	317
Correction: losses	0	0	133	266	401	537
Profit	100	100	100	100	100	100
Cost impact	0	-79	-159	-238	-317	-396
Simple correction	0	0	79	159	238	317
Realized profit	100	21	21	21	21	21
Asset base	627	627	627	627	627	627
RoR	16%	3%	3%	3%	3%	3%
Profit	100	100	100	100	100	100
Cost impact	0	-79	-159	-238	-317	-396
Losses correction	0	0	133	266	401	537
Realized profit	100	21	74	129	184	241
Asset base	627	627	627	627	627	627
RoR	16%	3%	12%	20%	29%	38%

In this case, the impact is less simple. Table Annex 4-4 provides three different regulatory regimes:

- a simple revenue-cap; and
- two variants of the losses formula presented in the main paper.

Under the simple revenue-cap, the two forces of higher costs and greater demand work against each other. Since base demand costs are greater than the losses the proportionate increase in revenue is more than the saving in costs, hence a negative correction factor for each year and a consequently lower rate of return.

The calculations required for the losses formula makes these relative sizes more obvious. The base cost of generation is Rs 5283 Crore. This grows at 1% per annum owing to the demand increases. Off-setting some of this is the fact that losses are reducing by 1% per annum. For example, in year 1, the increase in demand raises required generation and transmission costs by Rs 79 Crore, of which Rs 53 Crore is then off-set by the efficiency savings.

Suppose the regulatory regime corrected for the impact of the change in generation costs arising from the increase in demand but did not correct for the saving in losses? If that was the case you would then find the rate of return falling owing to the fact that the correction is delayed by one year (which would then be compensated for at the end of the price control period). This is the first case under the specific correction factor section of the table.

An alternative would be to allow the company to keep the savings arising from the increased efficiency in losses and to pass-through the costs of the increased demand. If this is the case, correction factors include the costs associated with the higher demand and the benefit of lower savings – ensuring that the company is not penalized for cutting losses. Since these are off-setting the additional costs of generation and have a one-year lag there is an initial drop in profitability which is then reversed during the life of the price control.

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