SUMICSID

Ex-post Regulation

PREPROJECT 2 – FINAL REPORT

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Disclaimer

This is a final report on a pre-project on ex-post versus ex-ante regulation, commissioned by the Norwegian Water Resources and Energy Directorate (*NVE*), delivered 2002-12-20 by the authors, professors Per AGRELL and Peter BOGETOFT for SUMICSID AB.

The contents has been subject only to a brief review from the Commissionee and expresses only the viewpoint of the authors, who exclusively bear the responsibility for any possible errors.

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Summary

One important element in a regulation mechanism is the timing of information gathering for commitment and settlement of contracts. In the purest form, we distinguish between ex-ante timing, implying that the commitment or settlement is exclusively made on information available before the production, and ex-post, which is the utilization of information revealed during the regulation period.

This report is devoted to under which criteria the revised Norwegian electricity distribution regulation could benefit from ex-post instruments in its regulatory approach, and in such case, which solution would be the most appropriate.

Somewhat simplified, the principal choice between ex-ante and ex-post instruments is derived from the role the regulator assigns himself in the market, and from the roles of the institutions and actors in the regulation approach.

The well-informed Contractor in a stable homogenous market is confident that ex-ante information will induce efficiency at a reasonable rent. Once the incentive problem is solved, the Contractor carefully monitors the moral hazard problem of stalled investments and falling service quality.

In more dynamic heterogeneous markets with private information, the regulator-Clearer renounces to make forecasts and observes instead the market evolution ex-post. The Clearer does not as much need the commitment device as the Contractor, taking a neutral and decentralized position towards the actors. Delegating the production decisions to the firms, some investment and quality problems may be solved. On the other hand, the solution of the incentive and risk allocation problem requires careful mechanism design and institutional powers to guarantee the information availability.

The report forwards theoretical and empirical evidence to describe the ex-post problem and concludes that an incremental conversion of some elements in the existing NVE regime could provide an advantageous solution. Studies that could fully assess the changes are suggested in a final chapter.

1.   Introduction

Background

1.01   The Norwegian Water Resources and Energy Directorate (NVE) is appointed regulator for the electricity distribution and transmission sectors in Norway. Currently, NVE operates an individualized revenue-cap system for electricity distribution concessionaires with five-year regulation periods. The regulatory regime will be unconditionally revised effective from 2007, which means that the regulator NVE on behalf of the Oil- and Energy Department (OED) of the Government will investigate alternative regimes until 2004, when they have to be settled. To anchor the potential reforms, the investigations are to be intensified during 2003. The Oil- and Energy Department has commissioned a study by SNF on the principles of network regulation (von der Fehr *et al.*, 2002), which will guide the further work where applicable.

1.02   Based on individual reflection and the SNF report, NVE has defined five pre-projects to be concluded in 2002 and early 2003:

1)   Degrees of freedom in the NVE choice of regime?   ECON
2)   Ex-post vs. ex-ante regulation.   SUMICSID
3)   Survey of existing evaluations of the current regime.   PW Coopers.
4)   Efficiency analysis and benchmarking in regulation.   SUMICSID
5)   Incentives for non-grid technological innovation in regulation.
       ECON, Sefas, SUMICSID.

1.03   The project committees of pre-projects 1 thru 4 consist of NVE, OED and representatives for industry and consumer organizations, for pre-project 5 the responsibility is shared by NVE and ENOVA. After the reporting of all pre-projects, the project committees may decide to launch full-scale projects in one or more areas as in 1.02.

1.04   This report is the final report on pre-project 2, commissioned by the Norwegian Water Resources and Energy Directorate (NVE) and is authored by senior associates, professors Per Agrell and Peter Bogetoft, assisted by associate consultant Henrik Olesen, Ph.D. from SUMICSID AB. The main findings of this report have been presented at a NVE seminar with the project committee in Oslo 2002-12-05. A draft of this report has been briefly reviewed by Senior Advisor Thor

Erik Grammeltvedt, NVE, whose constructive comments are acknowledged.

Objectives

1.05   In view of recent theoretical and practical advances in regulation economics and the SNF report in particular, NVE wishes to clarify the principal aspects of ex-post evaluation, i.e. a regulation regime where the principles are agreed ex-ante but where the actual terms, prices, revenue caps etc are determined sequentially and in view of additional information acquired during the regulation period.

1.06   Pre-project 2 should investigate different viewpoints concerning ex post regulation as an alternative to the current ex ante regime, in particular a discussion of criteria of evaluation of the regulatory effectiveness. Through theoretical and empirical reasoning, the study should enable NVE to assess the feasibility and attractiveness of a transition to a retrospective regulatory mode. The study should also provide NVE with a well-defined set of future projects that would operationalize concepts and methods suggested in this report.

Outline

1.07   The study begins with a principal discussion on the definition of *ex post* concept in regulation in Chapter 2. The discussion extends to an overview of the relevant dimensions in regulation mechanism design such as timing, incentive power, intrusion, purity and delegation. Based on this classification, the study proceeds with a comparative survey of the fixed price, yardstick and self-regulation regimes in Chapter 3. The principal differences between the ex post and ex ante regimes are then treated from a theoretical (Chapter 4) and empirical (Chapter 5) perspective, drawing on the information economics and international regulatory experience. The concluding Chapter 6 gives a multicriteria assessment of a transition to an ex post regime, including a sketch to institutional structural analysis for NVE. The three conceptual, theoretical and empirical streams are funneled through the concluding Chapter 7 where some relevant future projects are outlined.
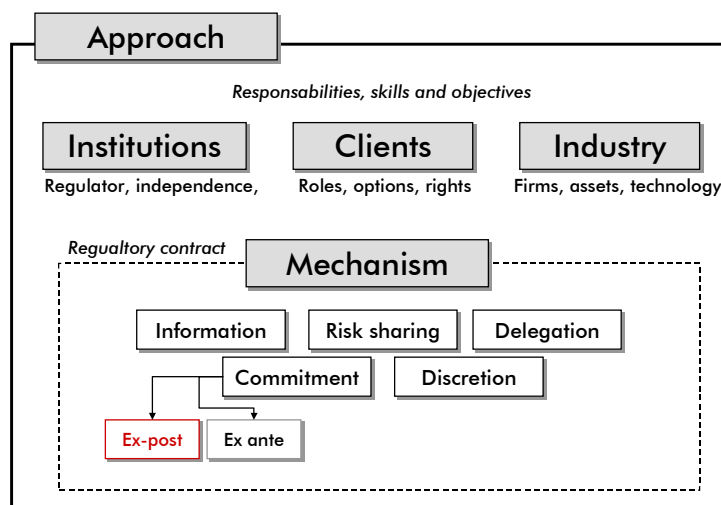
2.   Regulatory Approaches

2.01   Below, we will clarify some key elements in regulation mechanism design and how they relate to the dimensions of interest in this context: ex ante vs. ex post, incentive power, light-handedness, pure and mixed regimes, central and delegated decision making.

2.02   First, a word on the differences between *regulatory approach*, *regulation institutions, regulation mechanism* and where the choice of ex-post belongs. The concepts are illustrated in Figure 2.1 below, where the boxes delimit the definitions. Thus, by *approach* we mean an entire system consisting of a defined market (regulated clients and their roles), an industry (firms, assets, technology) and the corresponding institutions (regulator, courts, associations, etc.) that administrate the regulation. This part of the approach is called institutional design and will be discussed in Chapters 4, 5 and 6. Given a certain institutional solution, the regulator chooses a *mechanism* to define the relations between the players. The mechanism design with its elements is initiated below and extended in Chapters 3 and 4. Note that the distinction is far from self-evident, as an identical mechanism (say, a price cap) can give very different social welfare results depending on the institutional design, as will be seen empirically in Chapter 5. Now, the choice of ex-post or ex-ante is now an operational detail in the functioning of the mechanism, and below we will define which elements are concerned and then attempt to model a more normative framework in Chapter 4.

Elements in mechanism design

2.03   In new regulation economics (cf. Laffont and Tirole, 1993), the regulation system is modelled with detail that allows each stakeholder; the firm's manager, the firm's owner, the client, the regulator and the government, to outline their own dynamic strategies and to respond strategically to the actions of the other players. The "rules of the game", i.e., the actual regulation regime, are modelled as an *economic mechanism*, where it is important to clarify exactly who makes decisions, when the are made, how the

information is distributed and to which quality, and the options of the players. Here, we shall focus at five key elements: *information, risk sharing, discretion/automatics, delegation* and *commitment*.

Figure 2.1 Regulatory approach, institutional design and mechanism design.

2.04 *Information* can be classified with respect to initial distribution (public, private), observability (can it be acquired?) and verifiability (can it be contracted upon?). Regulation of networks is a classical example of private information on behalf of the firms, where the complexity of the system and the multitude of services offered put the regulator at a disadvantage when it comes to determining, e.g., the true minimal cost of operations or the optimal level of investment. However, we should not forget the private information that the regulator possesses in terms of fiscal policy and aggregated information about future demand that could be used to extract rents from the firms.

2.05 *Risk sharing* relates to how the exogenous risk (market, technology, climate) is carried by the regulator, the firms and the clients. Although network operations are considered as low-risk businesses, the distinction is meaningless without reference to the other elements in the mechanism, primarily the expected long-run rent that is left to the provider.

2.06 *Discretion/automatics* are two extremes on an interval of regulatory enforcement. A mechanism that proscribes a well-specified act for each state of nature and action by the firm is an example of a complete contract or an automat. Discretion, on the other hand, gives more or less freedom to the regulator to assess, reimburse or penalize the firm under certain conditions. Of course, regulatory

discretion introduces an endogenous risk, the regulatory risk, into the mechanism, which has two effects. First, the firm may demand a higher expected rent to participate in the mechanism, fearing arbitrary expropriation of rents. Second, a limited discretion with a predictable focus may induce less manipulation of incomplete contracts. An example could be use of a costly audit in a cooperative setting, where the members actually imposes the arbitrariness to deter fraud with a minimal cost. However, to be effective, the regulator needs to voluntarily limit the discretion of its staff, which is called bureaucracy in economic theory.

2.07   *Delegation* of decision rights is specifying who may initiate actions, e.g., deliver services, undertake investments and sign long-term contracts. In a centralized system, the regulator retains the decision rights and gives specific orders to agents how to perform the services. A classical decision right issue in network regulation in this context is *investment review* and *pricing*. As we will see, a formalized (automatics) mechanism that removes the investment risk (risk allocation) and provides the firm with a guaranteed return, such as cost-plus, is normally balanced with a centralization of the investment decision to avoid abuse. Similarly, a regulator with social (redistributive) objectives may wish to centralize the pricing decision to assure regional and social equity. Somewhat simplified, one may say that a higher decentralization of decisions increases the coordination gains due to local information, but at the potential expense of motivation costs due to asymmetric information.

2.08   *Commitment* is the term that is used to express whether the regulation mechanism is a long-term or short-term contract. As network concessions by nature are long-term relations with the regulator, short-term contracts are interpreted by the firm as a signal of upcoming renegotiations, where the acquired information in the current period may be used to extract rents. On the other hand, the regulator cannot engage in long-term contracts without possibility of renegotiation unless it had perfect forecasts of demand, technology and prices. At the very core of regulatory design we find the appropriate use of renegotiation in the mutual interest of regulator and firms.

A *small model*

2.09   Consider a general mechanism for a regulator and a firm over two periods. The regulator has the opportunity to use some information x_0 about the agent (ex ante) and/or to observe some information x_1 from

other agents in the next period (ex post). The regulator may now propose the following contract for the first period:

$$R = c_1 + \rho[c(x_0, x_1) - c_1]$$

Incentive power

2.10   In the model above, we call ρ the incentive power. For a *high-powered* contract, let's say $\rho = 1$, the firm receives $R = c(x_0, x_1)$ whatever its own costs are. Since the firm cannot affect the information that the contract is based on (it could be the regulator's own data or the competing firms), it has all interest to reduce its own costs c_1. On the other hand, if the regulator has poor information x_0 before that contract and no ability to use the later information (perhaps there are no other firms), the regulator may propose a *low-powered* contract $\rho = 0$ where the firm gets $R = c_1$, i.e., cost-plus. In this situation, the firm has no incentives to reduce cost, but the regulator is sure that the rent (profit) paid to the firm is not excessive. In theory, one may guess that c_1 would be infinite unless the regulator has some imperfect information x_1 that at least limits the inefficiency to some upper bound, which is the case in reality.

Ex-post

2.11   In an ex-post regulation, the regulator would freely use the information x_1 to decide how much to pay the firm. Depending on how x_1 is acquired and the incentive power, this may put more or less risk on the firm. E.g., an ex post cost-plus regime has $\rho = 0$ and a yardstick regime $\rho = 1$. The point is that the exact reimbursement is unknown at the time of production, but provided that the mechanism is not completely discretionary, it's structure is known. In an ex-ante regime, the regulator would promise not to use any revealed information, thus the contract would be of the kind $c(x_0, -)$. Clearly, the ex-ante regime in its pure form is only interesting with high-powered regimes, as the final cost cannot be used for the reimbursement.

Light-handed regimes

2.12   Irrespective of which structure the mechanism has (ex ante, ex post, incentive power, etc.), the regulator may delegate more or less of the decisions to the firms. In the case where the regulatory interference is minimal, we call the regime *light-handed* as does not fully hedge all

risks of manipulation in the contract. The light-handed regulator can with a low cost perhaps collect some data ex post to indicate abuse or to measure the effectiveness of the *self-regulation* that may be present in the market. So far, the principle has only been used in New Zeeland and Sweden for regulation of electricity distribution, but it is common in, e.g., anti-trust regulation. The *heavy-handed* regulator interferes in the operations of the firm in the hope to create or enforce a complete contract, even if it is low-powered. A classical example is the Anglo-Saxon regulators that in ex-ante and ex-post frameworks devote large efforts to enlarge the information set (x_0, x_1).

2.13   Extending the scope to other sectors, the light-handed regulation is analogous to the *regulation by rights* concept that is extensively used in, e.g., environmental regulation. Here, the regulator designs a mechanism under considerable uncertainty regarding the future technology in addition to the information asymmetry. Mechanisms with ex-ante rules, usually certifications and detailed instructions on the production, distribution, use and disposal of hazardous materials or processes, are extensively used in European contexts. The regulator takes a considerable risk from the firms in a trade-off between the moral hazard of asymmetric information and the risk of hit-and-run on behalf of the firms. Generally, the regulation is extensively process-oriented and suffers from problems of technology lock-in with time. The ex-post regime defines a broader set of individual and collective liabilities, specifying undesirable outcomes that, irrespective of process, may imply claims of compensation. The firms freely select their investments and operations to maximize profits while avoiding liability claims. Rather than micro-managing the firms, the regulator is now challenged with the task of monitoring the final outcomes of production and assuring that liability claims are enforced. In the American common law system, this has lead to substantial punitive damages being paid by ex-post negligent firms. However, if firms can avoid paying liabilities or pay them through taxes etc. the system cannot guarantee the optimal investment and service level. An illustration to this phenomenon is found in telecom regulation of fixed nets. If concessions are awarded based on lowest price subject to an ex-post level of service (coverage, failure rate, etc.), a hit-and-run firm can win the contract by neglecting investments and then cease to exist when the damage is observed. To limit this risk, regulators demand frequently the posting of a bond to offset the consumers' risk. In economic theory, this bond is called the *hostage* and could sometimes be substituted for shares of stock, assets or other (profitable) concessions.

Pure and hybrid mechanisms

2.14   Regulation system that only use a given set of elements, such as a high-powered contract, defined ex ante for infinite time in a heavy-handed fully centralized system, are rare or inexistent in practice. To balance the effects of information distribution and availability, risk and market structure, regulatory systems are the results of compromises between multiple socio-economic objectives. Also, the elements of the regime, the institutions and the market structure are interdependent and often endogenously decided, a fact that is often neglected in regulation studies. Thus, a strong centralized industry structure, sign of large asymmetry of information, is often combined with a formalistic institutional solution with weak incentives to limit rents without requiring much interaction. A well-balanced pool of competing firms with limited asset investments often coincide with a strong regulatory institution with short-term high-powered contracts, as the regulator can use and trust the information acquired to limit rents.

2.15   The Nordic countries have rather many and small distribution mixed-ownership monopolies with a long tradition of common objectives in the electrification of the countries. Due to a heavy dominance by publicly owned firms, the former regulation regimes were low-powered and light-handed, since the state preferred to minimize the regulatory costs and trusting the common objectives to assure optimal decentralized decisions. High-powered regimes would have been misplaced in this very homogenous context, basically leaving the regulation to the largest incumbent state-owned firm. With the deregulation and the unbundling of the electricity industry, the situation changed towards higher heterogeneity on behalf of the firms and the customers. The generators, subject to a competitive market and increasingly in private or foreign ownership, could no longer be assumed to carry implicit and complete responsibility for the market functioning. Thus, changes in one sector inevitably carries over to nearby sectors and to the expectations and objectives of the regulatory system. It is from this perspective we believe that a change of mechanics in regulation should be considered in a structured and systematic way without resorting only to simplistic two-level models.

So what do we mean by ex post regulation?

2.16   As we have seen above, a regulation is a composite and complex mechanism where each component has its impact on the final outcome. To clarify the discussion with respect to the NVE pre-

projects and the continuing work, we contrast the definition launched in Bråten (2002) with our own definition adapted to NVE's needs.

2.17 Bråten (2002) discusses ex-post regulation with the implicit hypothesis that it is combined with a light-handed approach with high decentralization and some discretionary ex-post enforcement of liability. The electricity distributors would here decide on investments, tariffs and costs, but the regulator retains the right to intervene if tariffs are excessive ex post. Referring to the delimitations in 2.02, this interpretation involves a choice of *approach* rather than *mechanism*, where the roles and instruments are redefined.

2.18 Not to confuse the timing with the level of delegation and also not to unnecessarily discuss theoretical and unrealistic regimes, we propose the following definition:

> *An ex-post regulation regime for NVE entails the ex-ante agreement of principles (mechanism) such that some future information (costs, performance, etc.) is elicited sequentially ex-post to determine the reimbursement of the regulated firm.*

2.19 With our definition, we leave it to further policy discussion to narrow the recommendation on the other regulatory elements than the *timing* of the information gathering and use. However, as we shall see, the ex-post regime in 2.18 actually offers some added flexibility with respect to the transition of regulation towards a more contestable market. Next, we will review the ex-ante vs. ex-post concepts from the criteria earlier mentioned in this chapter.

Ex post – a question of timing

2.20 Accepting that our definition of ex-post actually comprises ex-ante elements, it is vital to clarify the key elements in this mechanism. The three most important aspects here are *commitment, settlement* and *information*.

2.21 *Commitment* defines as in 2.08 when and to what degree the parties agree on the principles and instruments of the mechanism. Full commitment ex ante on an incomplete contract would block all renegotiation, which not necessarily is in the interest of the parties. Without prior commitment, the parties would rely on either discretion or renegotiation to evaluate the past performance.

2.22   *Settlement* is the moment when the parties exchange their information and make the reimbursements. An ex ante settlement has different properties from an ex post settlement, given the new information and the risk of opportunism.

2.23   *Information* revealed from the production or service process can also be analyzed from an ex-ante and ex-post perspective. When does the information become available? What type of information? How useful is it in a specific regime? The classical scenario in regulation deals with the revelation of true costs in a period under commitment not to use the information against the firm in future periods. The extortion of rents ex-post based on revealed information is called the *ratchet effect* and is of principal interest. Why reduce costs in good times if the cap is reset next time?   However, another aspect that has not been sufficiently discussed for NVE is how observable but non-verifiable information, such as distribution service quality, might be used in a regulation context.

2.24   As noted in Figure 2.2 below, we may distinguish many different types of regimes just by changing the commitment settlement and information to ex-post or ex-ante. The box furthest to the left symbolizes actions ex-ante, i.e., before production has taken place, the box in the middle stands for the information from production and the box to the far right is the ex-post action plan.

2.25   *Regime A.* If both commitment and settlement incur before the production, we revisit our pure ex-ante solution from 2.11. Typical scenarios could be price- and revenue-caps without revision, but also fixed price contracts from e.g. franchise auctioning. The scheme induces efficiency from the firm, being high-powered, and requires the regulator to define the contract carefully to avoid postponed investments and lowered quality.

2.26   *Regime B.* The other extreme is a pure ex-post scheme where both the contractual conditions and the payment are decided after the fact. This could correspond to an extreme light-handed regime, where the regulator strikes down on perceived abuse ex-post and the consequences are defined with information about the outcome, e.g., company profits. In other sectors, this could correspond to a strong monopsonistic setting with a single well-informed buyer and many sellers.

2.27   *Regime C.* Under ex-ante commitment about the regime and the valuation of future information, the regulator may make divide the

settlement in two parts. Before the production, the firm may count on receiving a fixed amount for a given production level. Should the demand change, a pure scheme like A in 2.25 would give incentives to slow growth[1]. The CPI-X and core of the NVE revenue cap contain parameters that allow for some ex-post settlement, which avoids this problem. We view this as an effort to improve upon the incompleteness of the contract (demand is unknown), while creating the commitment stability necessary for investments.

2.28   *Regime D.* The yardstick regimes that have been of our interest (cf. Bogetoft, 1994, Agrell and Bogetoft, 2001) are examples of an ex-ante agreement upon a form an ex-post competition, which mimics an open market. The arrangement keeps the low prior administrative costs of the light-handed regime, while offering the strong cost-saving incentives of the revenue-cap at a minimal cost. As opposed to C, the firm has no guaranteed revenue and has strong incentives to follow the technological progress. However, the key requirement is the establishment of the yardstick contract, not to perturb the quasi-competition with model errors.

2.29   *Regime D.* In situations where the parties cannot agree on how to handle the incompleteness of the ex-ante contract (such as demand changes or grid investments), one may also resort to a solution where the regulation starts out with simple contract that is intended to be renegotiated and settled ex-post. In other businesses, the fairly generous "satisfaction guarantees" to consumers after the purchase convinces the client to engage in a fixed-price contract for an unknown quality knowing that the conditions may be renegotiated. A more advanced scheme of this kind could also be to commit to cost-sharing ex-ante and then to open for negotiations on social welfare gains if the parties find out some appropriate way of measuring it.

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[1] France Telecom, under a pure revenue cap in 1960-70ies offered waiting times for a phone installation of 2-3 years. Crampes and Estache (1999).
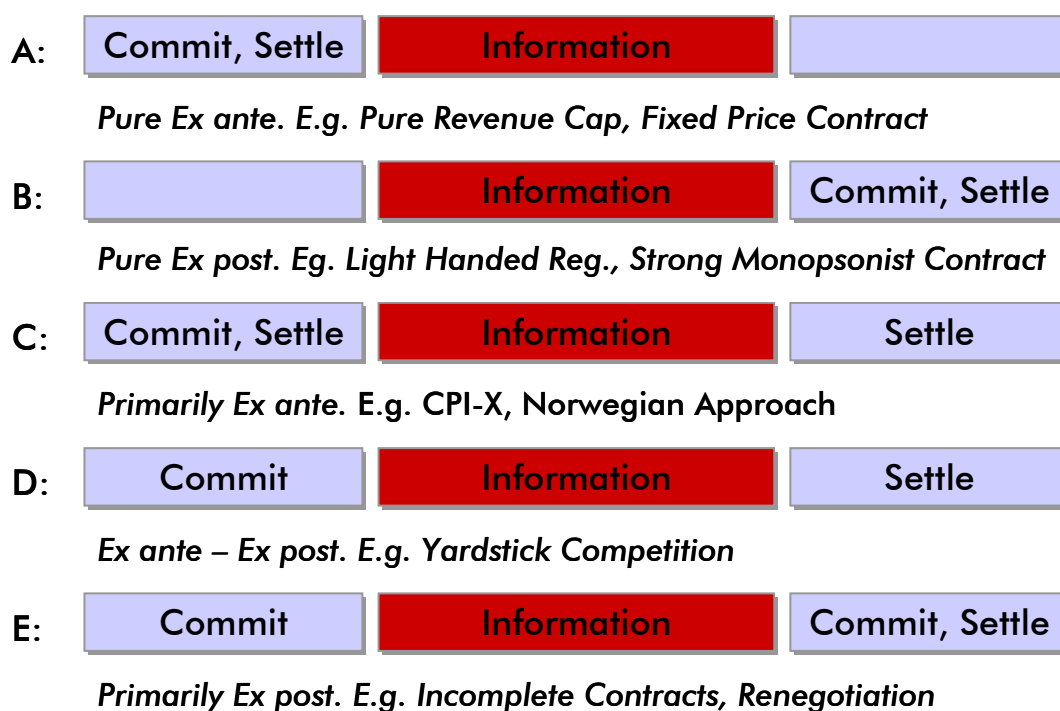
| A: | Commit, Settle | Information | |

Pure Ex ante. E.g. Pure Revenue Cap, Fixed Price Contract

| B: | | Information | Commit, Settle |

Pure Ex post. Eg. Light Handed Reg., Strong Monopsonist Contract

| C: | Commit, Settle | Information | Settle |

Primarily Ex ante. E.g. CPI-X, Norwegian Approach

| D: | Commit | Information | Settle |

Ex ante – Ex post. E.g. Yardstick Competition

| E: | Commit | Information | Commit, Settle |

Primarily Ex post. E.g. Incomplete Contracts, Renegotiation

Figure 2.2 Some combinations of ex-ante and ex-ex post elements.

Summary

2.30   Electricity distribution is an example of a network operation with high levels of specific investments. Furthermore, the universality and the dependability of the service make it particularly vulnerable to maladapted regulatory approaches. Two conclusions from this chapter help us to avoid this problem and to find a good solution.

2.31   First, regulation mechanisms consist of a number of generic elements (*information, risk allocation, discretion/automatics, delegation* and *renegotiation*) that can be analyzed from the perspectives incentive power, regulatory interference, timing of commitment, settlement and information acquisition. Although some particular combinations of the elements are present in the existing international regulation systems, such as CPI-X and cost-plus, nothing requires the regulation to apply a ready-made recipe. It is our opinion that a thorough revision should question the justification of each element in order to find a solution that corresponds better than any other to the actual institutional and market context. Chapter 6 will extend these thoughts.

2.32   Second, when regulation is more than the passive monitoring of production, care should be taken to take into account not only the "optimal" mechanism that may be conceived for the market, but also the institutional design to foresee reaction of the incumbent and entering agents during the transition from the existing regime. Regulation in this sense is more than a surveillance of a self-regulating market; it is the creation of a new market with a more or less pronounced role for itself as contracting party. Further comments on the issues to be considered in the transition between regulatory regimes are given in Chapter 7.

3.   Classical Ex ante Ex post Schemes

3.01   We have indicated above, that regulation regimes consist of a number of generic elements - information, risk allocation, discretion/automatics, delegation, renegotiation – that can be combined in numerous ways. The spectrum of ex ante ex post regimes is correspondingly wide, and the analysis of all relevant combinations is certainly beyond the scope of this pre-project. Still, to fix ideas, it is useful to outline some prototypical ex ante ex post regimes in a few more details.

3.02   In this chapter, we therefore give a more detailed introduction to the elements of some classical ex ante ex post schemes, namely the Norwegian CPI-X like system, the DEA based yardstick competition systems, and a light-handed regime with similarities to the Swedish regulation. We will here draw on reports from NVE; our previous theoretical work comparing different dynamic incentive schemes as well as our work developing DEA based yardstick schemes.

CPI-X models

3.03   In this sub-section, we recall the ideas of the CPI-X regime and we exemplify it using the incumbent Norwegian scheme.

3.04   CPI-X revenue cap regulation is a high-powered regime. It was proposed first by Littlechild (1983) and has been applied widely in the regulation of electricity distribution, cf. Figure 5.1 below.

The Norwegian Approach

3.05   Based on documents from the Norwegian Water Resources and Energy Administration, NVE, such as NVE (1997), NVE (2001) and Grasto (1997), and the independent work reported in Kittelsen (1994, 1996, 1997) we will now provide a sketch of Norwegian version of CPI-X.

3.06   The legal framework is based on the Norwegian Energy Act of 1991. Production and transmission of electric power is separated. Also, the production and sales activity was deregulated into an open market, later pooled in a joint Scandinavian power exchange with Sweden

and Denmark. The distribution remains a natural monopoly based on concession holding and delivery requirements. The distributors were subject to a rate of return regulation during 1992-1996, in January 1997 replaced by revenue cap system with an efficiency incentive. The period of regulation was (initially) a five-year period, 1997-2001 and the efficiency incentive was based on reported performance in 1994-1995. The time perspective of the regulatory regime is illustrated in Figure 3.1 below.
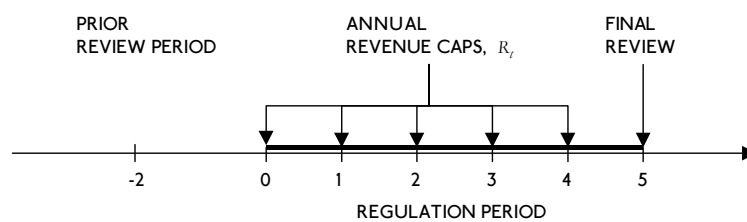
Figure 3.1 Timing of ex-ante regimes.

3.07   Two years before the start of the regulation period, the regulator assesses cost inefficiencies. During the period individual annual revenue caps are set by the regulator, based on previously assessed inefficiencies, reported costs and projected future demand. After a full regulatory cycle (5 years), the complete earnings of the distributor are reviewed. If the distributor cannot show the minimum rate of return in average over the period, overcharging of the customers is authorized during the following period. Analogously, if the maximum permitted rate of return has been exceeded, the excess profit will be distributed to the customers through tariff reductions. Direct violations of the revenue cap, windfall profits or -losses, are regulated with interest after a one-year delay. The interest rate is set to be the base rate of return for the industry, the risk free rate of return with a 2% risk premium for uncertainty regarding regulatory regime.

3.08   A revision has been undertaken in 2001 with the regulation period starting in 2002 and using data from 1996-1999.

A formal outline

3.09   The core of the regulation is thus a revenue window, which specifies the maximum, minimum and prescribed allowed revenue for the agent. The maximum revenue is given as

$$R_t \leq c_t + \gamma^{max} \bullet X^{cap}_t$$

where γ^{max} denotes the maximum allowed rate-of-return (15% in NVE (1997)), X^{cap}_t denotes the capital base of the agent at time t and c_t is the actual cost at time t. The revenue floor is analogously given as

$$c_t + \gamma^{min} \bullet X^{cap}_t \leq R_t$$

where γ^{min} denotes the minimum prescribed rate-of-return (2% in NVE (1997)). This constraint assures the economic survival of the agent and may have additional effects on the cost structure of the industry. It also serves to assure the uninterrupted distribution of power to all consumers as a mean to induce regional equity. The prescribed revenue for periods t=1,...,T is calculated as

$$R_t = PI_{t,t-1} \bullet QI_{t,t-1} \bullet (1 - \pi - \varphi \bullet G_t) \bullet R_{t-1}$$

where $PI_{t,t-1}$ is an inflation adjustment factor, $QI_{t,t-1}$ is a quantitative adjustment factor (equal to $y_{pow}^t - y_{pow}^{t-1})/2 \ y_{pow}^{t-1}$ where y_{pow}^t is the gross output of power at time t), π is an imposed cost efficiency requirement (1.5% in NVE (1997)) (a proportional revenue reduction), G_t is a measure of individual inefficiency (equal to $min\{(1-E_0)/(1-E_{min}),1\}$, where E_0 is the historical cost efficiency at time 0 in the CCR DEA model, E_{min} is the lower limit for efficiency scores (0.70 during 1999) and φ is the annual efficiency catch-up factor (3\% in NVE (1997)). Growth in deliveries is only compensated by 50% in that the CCR model utilized assumes constant returns to scale to promote mergers. The regulator purports to increase the efficiency of the operators in the natural monopoly by including an efficiency term in addition to the revenue regulation. The efficiency term reflects the balance between a prevalent inefficiency among all distributors and the individual, relative, inefficiency demonstrated by the agent compared to other agents. In this sense, the regulator mounts an effort to reduce endemic inefficiency as indicated by the empirical studies above, as well as providing incentives for frontier catch-up to individual agents.

3.10   In the 2001 revision, some of the parameters have been changed. Most notably, the maximal allowed return on capital has been increased to 20% and the individual requirements imposed on the most inefficient firms (with efficiency less than 70%) have been increased. Also, the quantity index IQ has been replaced by a normative parameter based on the increase in number of new buildings as a proxy for the number of new costumers and increase in energy delivered.

An ex ante approach with ex post elements

3.11   We see that the Norwegian mechanism is an ex ante mechanism with some adjustment for the in-period changes. The expected development of the technology as represented by the X and the desired catching up as represented by the G is fixed ex ante. On the other hand, the in-period changes in prices and quantities are at least somewhat accounted for via the PI and QI.

3.12   Observe also that the Norwegian regime, as most regimes, is not a pure regime. It is predominantly a revenue cap regime but it also contains elements of rate of return regulation, price cap and yardstick elements as well.

3.13   The use of some price and quantitative adjustments are examples of what is widely used internationally and what is sometimes referred to as *exogenous z-factors or "pass troughs"*. The idea is to refine the complete contracting by make mechanistic adjustments for foreseeable exogenous events beyond the control of the company.

3.14   The Norwegian as other systems also contains provisions – explicitly or implicitly – for more dramatic situations where the existing regulatory arrangements are no longer applicable and where ex post negotiations are called for. Such provisions are sometimes called *"off-ramps"* and may be related to force majeure events, major industry restructuring. In some cases, they are also used to deal with situations where actual returns significantly deviate from those anticipated. A 6% deviation from target return on equity triggers a rate review in Southern California Edison, for example, cf. Jamasb and Pollitt (2000b).

3.15   The Norwegian mechanism also contains – although somewhat crude – elements of so-called *"earnings sharing"* or *"sliding scales"* mechanisms. The general idea is to let the consumers benefit when a utility earns excessive rents and to let the utility benefit when the earnings are excessive low. This is accomplished by sharing the rents or lack of rents outside a certain dead-band. (The Norwegian sharing is extreme in the sense that the consumers gets all the benefits and covers all the losses when the return is above and below the 2% - 15 (20) %). The primary purpose of earnings sharing is to align company and consumer interests and to keep a company's earnings at politically and operationally acceptable levels during the plan's commitment period, cf. Sappington et al (2001). Of course, a sliding scale tend to blunt the incentives to cut costs – hence, the wider the

dead band, the greater the preservation of incentives but the greater s also the risk of restructuring.

3.16   Pass through and sliding scales are specific examples of ex ante planned ex post adjustments in a complete contracting world while the off-ramp provisions are example of incomplete contracting ex post provisions. We shall discuss the use of in-period information in these way in the next chapter.

3.17   By international standards, the Norwegian model has been quite successful and in many ways paved the road for regulation mechanism used elsewhere. Several features of the mechanism has been further refined. Thus for example, systems to cope with quality variations, mergers etc has been added.

3.18   At a theoretical level, the basic idea of a revenue cap has some attractive and some less attractive features. A useful discussion is provided in the SNF study (Von der Fehr *et al.,2002)*. Here we supplement with some observations from the regulation literature that are particularly related to the focus of this pre-project, the use of new information during and between regulation periods.

Pros

3.19   The primary advantage of a price cap is, as shown in Liston (1993), is that the that the fixed income induces cost efficiency by the firms getting incentives to minimize costs. As always, to provide proper incentives, one needs the costs and benefits of choices to go to the same entity, and this is precisely what happens when the revenue is fixed independently of the costs. In this way, the firms become residual claimants and have the right incentives to reduce costs.

3.20   A second advantage of price and revenue caps that has been suggested in the literature is that it is fairly stable and viable, c.f. Vogelsang(2002). This is ensured by the periodic reviews which enable the regulator to adjust based on the actual results of the firm.

Cons

3.21   The revenue caps must be adjusted to take account for changes in demand and costs. Otherwise the firms would either experience returns that are too low to ensure reinvestments (perhaps even direct losses) or they would obtain very large profits. Both outcomes are

politically unacceptable, see for example Weisman (2002) for a discussion of the political economy of price cap regulation.

3.22   However, if the revision of the caps is based on the performance of the firm, the incentives for cost minimization are reduced. There is a substantial literature on the strategic behavior that may result in connection with periodic review of a regulation system, cf. among other Train(1997), Sappington(1980), Weisman(1980,2002) and Diewert ad Fox(2002).

3.23   In order to ensure incentives for cost minimization, the cap revision should be based on factors external to the firm. The two key questions for the success of a price or revenue cap regulation are thus: how is the X-factor determined? And how are the caps revised?

3.24   The adjustment of price caps does not rely solely on economic arguments because the regulation is subject to political influence. Weisman (2002) argue that regulators will be subject to political pressure if the firm earns very high profit – and if the firm experiences severe losses. This is a severe problem of price and revenue cap regulation due to commitment problems. In fact, Weisman argues that "The commitment problem is the Achilles heel of price cap regulation". The regulatory opportunism undermines the incentives for cost saving under price cap regulation and brings the regulatory regime closer to traditional rate of return regulation.

3.25   If the firm reports high profits the regulator may intervene both directly and indirectly. The direct intervention occurs when the cap is revised. The review may change the parameters in the cap (e.g. the X-factor) or provide a recalibration of the underlying cost model to achieve a certain target rate. The indirect intervention can take the form of adjustments in direct payments for certain services (Weisman 2000) and excess entry (Lehman and Weisman 2000).

3.26   Empirical evidence suggests that these possible effects are not purely theoretical. Regulators in both the United States and Great Britain have repeatedly increased the X-factor in price cap plans for telecommunication carriers as a response to high profits (Weisman 2002). Similarly, Lehman and Weisman (2000) address the problem where of determining optimal access prices for telecommunication. They argue that price cap regulation suffers from incomplete contracting and finds evidence that regulators behave opportunistic, if a price cap regulated firm earns high profits. The regulator behaves

opportunistic by adopting a more liberal competitive entry policy by determining low access prices.

3.27   To avoid the ratchet effect and avoid insuring firms against low profits caused by bad performance, the regulated firm must perceive that the revision of the price cap plan is exogenous to the firm. Bernstein and Sappington (1999) formulate it in the following way: *"When the required rate of price decline is divorced from firm's realized production costs and earnings, the firm benefits financially when it reduces its operating costs"*). This is satisfied if the revision is based on data exogenous to the firm, e.g. through yardstick competition as we shall discuss below.

3.28   Weisman (2001) argues that combining price cap regulation with sharing reduces the regulatory opportunism. This regime is a combination of rate of return regulation and price cap regulation, where the firm is only allowed to retain a certain share of profits above a certain level. The earning sharing reduces the incentives for cost minimization. Therefore the first-best level cannot be achieved. On the other hand the regulator has less incentive to undermine the price cap regulation by liberal entry accommodation policies. The rate of return restrictions in the Norwegian model may be interpreted in this way – although the sharing is rather dramatic!

3.29   To summarize, we see that there are several well-known theoretical and practical problems are associated with CPI-X mechanism. The most important of these are:

- If the cap is set too tight (low), the result may be non-participation or bankruptcy

- If the cap is too loose (high), the informational rents will be excessive.

- The update of the cap encourages strategic behavior on behalf of the agents who fear being penalized in subsequent periods for productivity improvements. This is the so-called ratchet effect, cf. Freixas, Guesnerie and Tirole (1985) and Weitzman (1980)

- The cap basis lacks foundation. CPI does not necessarily have any connection to the input prices. The improvement factor X, in its turn, lacks solid specification. In setting out to combine historical performance with conjectures about future developments, industry often requires bargaining with, further aggravating the risk of strategic behavior .

- The CPI-X model does not accommodate changes in the output profile. Hereby, a pure revenue cap regulation provides disincentives to product innovation and quality development.

3.30   Part of the motivation behind the next regulation mechanism, the DEA based yardstick regime, is precisely to overcome these problems.

DEA based yardstick schemes

3.31   In this section, we introduce the yardstick idea and expand on the theory combining DEA cost models and yardstick competition. Finally, we illustrate how the DEA based yardstick scheme under special circumstance degenerate to the Norwegian CPI-X mechanism.

Yardstick competition

3.32   The yardstick competition idea first introduced by Shleifer (1985) is an interesting addition to the regulatory arsenal. Under yardstick competition the performance of a regulated firm is being compared to the performance of a reference group. In this way the firm is compensated for the costs of a group of related benchmark firms.

3.33   Several articles discuss the use of yardstick competition in regulation mechanisms. However, the practical use of yardstick competition and therefore the empirical literature is rather limited. The literature on contract theory provides analysis of the relative merits of relative performance evaluation (yardstick competition or tournaments) versus fixed performance standards. Holmström (1982) shows how cardinal tournaments can extract information about common risk. Lazear and Rosen (1981) and Green and Stokey (1983) have shown that relative performance evaluation in ordinal tournaments is valuable only when they offer information about common uncertainty. These results underline the importance of selecting a representative benchmark group. Lazear and Rosen (1981) and O'Keeffe et al. (1984) argue that tournaments have an information cost advantage over piece rate contracts. In an ordinal tournament, information about the ranking of the agents is sufficient. Piece rate contracts require absolute information about the agents' performance. It may be cheaper to obtain and report information about the ranking of the agents than absolute information about their performances.

Yardstick competition in electricity regulation

3.34   Pfeifenberger and Tye (1995) discuss various ways of introducing yardstick competition in the regulation of utilities. Yardstick competition can be used both to achieve measures of efficient cost levels and to adjust for output characteristics under rate of return regulation. For example, Mississippi Power established an incentive

mechanism that adjusts its rate of return based on utility's performance compared to price, costumer satisfaction and reliability of several utilities in the region. Massachusetts Electric proposed a mechanism that would judge the utility against a set of benchmarks: costs per kWh; number of costumers per employee; conservation achievements; service reliability; employee wage and salaries; customer satisfaction; safety and environmental performance; and asset utilization

3.35   Resende (2002) discusses the potential and difficulties associated with implementing yardstick competition in price cap regulation of Brazilian electric distribution. The industry is very heterogeneous due to very large regional differences. Large investments are required to reduce congestion. The Brazilian regulation is based on price cap regulation (CPI-X) with periodical (5 year) reviews. The purpose of the periodical review is firstly to provide a fair rate of return enabling the firms to attract capital for investments. Secondly, historical productivity data is used to update the X factor. Resende (2002) propose a new regulatory procedure, where relative efficiency scores are used to guide appropriate determination of the productivity offset X. He proposes to use DEA analysis and (i) identify efficient firms and (ii) calculate total productivity growth used to determine the X factor.

3.36   The use of DEA and yardstick elements is also investigated in connection with the revision of the Dutch regulation, c.f. Dte(2002).

DEA based yardstick competition

3.37   Applying the yardstick idea to the regulation of distribution companies involves setting an individual cost target for each distributor that equals the realized cost by other (comparable) agents in the same period. If the residual profit is retained by the distributor, and if all distributors produce the same product under the same conditions, the yardstick competition provides an optimal incentive mechanism in solving the first two of the CPI-X problems stated above. The endogenous determination of the cost norm solves the problem of arbitrariness.

3.38   The main problem of the basic yardstick model is the comparability between agents and in particular its inability to accommodate variations in the output profiles and operating conditions between the agents.

3.39   The key to effective regulation is found in the access to information. In a series of papers, we have therefore propose (a dynamic) extension of the yardstick competition model using DEA. By utilizing the maximum amount of information in a rich production model and by reducing the regulatory lag, five positive effects are obtained. First, by tailoring the revenue cap to the individual agent in a close sense, the total informational rent is minimized. Second, by reducing the time lag from evaluation to reimbursement and repeating the evaluation more frequently, the risk and the consequences of misrepresenting an agent in a yardstick sense are minimized. Third, by excluding the evaluated unit from the basis of comparison, the ratchet effect can be effectively dealt with. Fourth, by using observed production cost rather the estimated consumer prices, the arbitrariness of the CPI may be avoided. Similarly, the need of postulating a negotiated X factor may be substituted by an actually realized productivity improvement. Finally, by using the richer production description in DEA, changes in production profile can easily be taken into account.

Static Incentives with Adverse Selection

3.40   In Bogetoft(1997, 2000) we considered a regulation setting with combined adverse selection and moral hazard elements and
          • Considerable asymmetric information about the technology
          • Risk neutral firms
          • Firms seeking to maximizes both profit and organization slack, {Profit + $\rho \bullet$ Slack}.

3.41   The firms are supposed to have superior technological information. In the extreme case, they know the underlying true cost function with certainty while the regulator only knows the general nature of the cost function. Thus for example, the regulator may know that there are fixed unit costs of the different outputs but not the exact unit cost, being the firms' private information. Alternative assumptions may be made about the information available to the regulator. We may assume for example that he knows simply that the cost function is increasing and convex.

3.42   The optimal solution in this case depends on whether the actual costs, i.e. the minimal possible cost plus the slack introduced by firms, can or cannot be verified and hence contracted upon.

3.43   If the actual costs cannot be contracted upon, the *optimal* solution is to use the following *revenue cap with non-verifiable cost information*

> *Optimal Reimbursement B^i to Firm^i*
>
> $= k + C^{DEA}(y^j)$
>
> *= Lump Sum Payment + DEA-Estimated Cost Norm Based on the other firms*

3.44   The size of the lump sum payment depends on the firm's alternatives, including his profit potentials in other markets or the surplus from contracting with other regulators, say private insurance companies.

3.45   If instead we assume that the actual costs of the firm can be contracted upon, the *optimal reimbursement with verifiable costs* becomes

> *Optimal Reimbursement B^i to Firm^i*
>
> $= k + c^i + \rho \bullet (C^{DEA}(y^j) - c^i)$
>
> *= Lump Sum Payment + Actual Costs + Fraction ρ of DEA-Estimated Cost Savings*

3.46   The structure of this payment schemes can be interpreted as a *DEA based yardstick model*: Using the performance of the other firms, the regulator creates a cost yardstick and the regulated firm is allowed to keep a fraction ρ of his saving compared to the yardstick costs as his effective compensation. Figure 3.2 illustrates this reimbursement scheme.

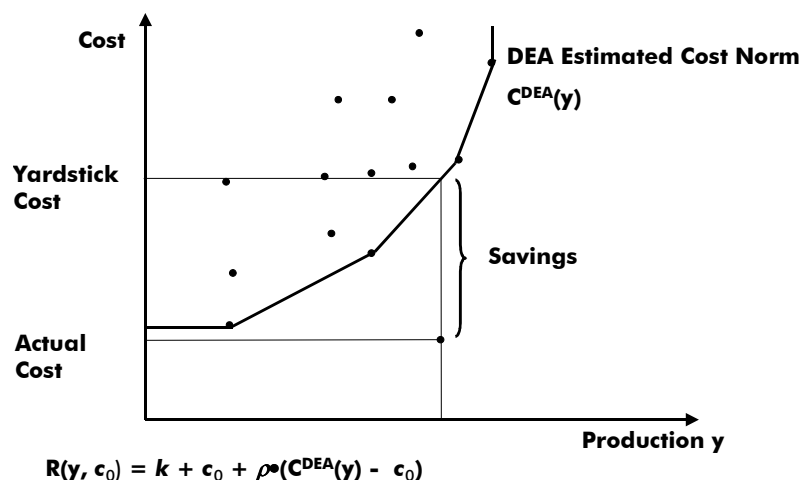$$R(y, c_0) = k + c_0 + \rho \bullet (C^{DEA}(y) - c_0)$$

Figure 3.2 The DEA yardstick model in the cost – production space

3.47   These results provides an incentive rationale for using DEA based revenue cap systems in contexts where the regulator face considerable uncertainty about the underlying cost structure.

3.48   Several extensions and generalizations of these results are provided in Bogetoft (1997,2000). In particular, it is shown how the structure of the schemes are essentially unaffected by introducing decentralized decision making (where the firms decide on the output mix) as well as participatory budgeting arrangements. Also, the impact of introducing genuine social benefit functions, alternative costs of slack reduction models, rationing etc is investigated.

Dynamic Incentives with Ratchet and Limited Catch Up

3.49   In Agrell, Bogetoft and Tind(2000a,b) we extended the above adverse selection and moral hazard context by introducing a time dimension. The dynamic perspective give rise to new issues, including
  • The possibility to accumulate and use new information
  • The need to avoid the ratchet effect, i.e. deliberate sub-performance in early periods to avoid facing too tough standards in the future
  • The possibility of technical progress (or regress)

3.50   Nevertheless, the structure of the optimal dynamic scheme is similar to the ones developed above. Thus the optimal revenue cap for a firm is found by a DEA based yardstick norm. Assuming verifiable actual costs, the optimal scheme taking into account the generation of new information, the ratchet effect and the possible technical progress becomes:

Optimal Reimbursement B_t^i *to firm^i in period* t

$= k + c_t^i + \rho \bullet (C^{DEA}_{1\text{-}t} (y_t^i) - c_t^i)$

$=$ *Lump Sum Payment $+$ Actual Costs in Period* t

$+$ *Fraction ρ of DEA-Estimated Cost Savings in Period* t
*using all the information from the other firms generated
in periods 1 through* t.

3.51   The optimality of the above scheme primarily relies on the assumptions of risk neutrality and considerable asymmetric information about the costs. The DEA yardstick is optimal by limiting the information rents from asymmetric information, by providing cost reduction incentives and by avoiding the risk of bankruptcy.

Risk and risk sharing

3.52   An immediate impact of the dynamic yardstick scheme is that the allowed revenue to a company track actual productive development rather than the expected development over for example a 5-year period.

3.53   The fact that the revenue cap cannot be foreseen and that it depends on the performance of others is a popular objection to yardstick schemes. Some consultants and companies seem to believe that this imposes excessive risk on the firms. Or even worse, it makes the correspondence between firm behavior and firm gains more random and hereby tends to reduce the incentives for cost minimization. It is important to emphasize therefore, that this is not the case. Relative performance evaluation is done precisely to allow a more precise interference of behavior. The idea is that by looking at the performance of others, we can filter out the general sector shock that the firms cannot control and hereby make a more precise linkage of payment to behavior. In other words, (appropriately designed) relative performance evaluation it actually eliminating (reducing) the arbitrariness of the payment rather than causing (exaggerating) it.

3.54   Intuitively, the advantage of the yardstick scheme is that it adapts the requirements on the firm to the development in the environment. It is not particularly fair (efficiency improving, risk reducing) to face constant payment plans when the operating conditions change. This is widely accepted when it comes to changes in economy wide prices etc – and the yardstick idea is precisely to make more of similar

adjustments to ensure that a firm does not suffer or gain from non-controllable conditions.

3.55   A further advantage of the yardstick scheme is to ensure a more direct linkage of consumer costs to underlying changes in distribution costs. This is advantageous by allowing better system wide decisions. The advantage of prices that reflects the underlying costs is that the users can better make optimal decisions, e.g. about the choice among alternative energy sources.

3.56   The optimality of the DEA based yardstick scheme is – as mentioned above - derived under the assumption of risk neutral parties. In reality, however, this may not be the case. The firms and or consumers may be *risk averse*. Intuitively, the effect of the yardstick scheme is to make the prices paid by the consumers vary more. This may appear reasonable when the firms are risk averse and the consumers - by the limited budget share used on distribution costs for example – are risk neutral. On the other hand, if the consumers are risk averse and the firms – by their investors being able to diversify – risk neutral, the yardstick scheme may appear flawed by imposing too much payment variation on consumers. Again, however, one must be careful. It is sub-optimal to make risk-sharing arrangement by making the behavioral inference less precise. This may make the payments more stable, but it comes at the cost of incentive provision and informational rents.

3.57   Risk aversion may call for alternative arrangement, e.g. *insurance arrangements* where the consumers – in addition to the distribution services - buy price guaranties from the companies. A possible practical arrangement could be that the consumers in a five year period pay according to a traditional CPI-X scheme but that the difference between their payment and the yardstick payment then is evaluated and distributed / taxed on to the consumers in the next 5 year period. This would be a relatively simple modification of the incumbent CPI-X scheme in many countries. Note also, that it is not necessarily optimal that the consumers pay according to a CPI-X scheme. They could pay according to many other schemes – and indeed it may be relevant to have different schemes that the consumers can choose from depending on their risk aversion and expectations about the future.

3.58   It is interesting to observe that the proposed scheme for the second regulatory period in Holland has some of these features although the yardstick model is a simplified version of the above, cf. Dte(2002).

Limited Catch Up

3.59   In Agrell, Bogetoft and Tind(2000a,b) we have described how to modify the schemes above to take into account also the

- Possibly limited catch-up capacity, i.e. the fact that it may take time for a DMU to learn the best practice
- Possible cost of innovation (frontier movements) and loss from dissemination (sharing) of information

3.60   It is interesting to observe that if we take the DEA based yardstick scheme, that can be shown to be optimal under the assumptions outlined above, and if we introduce a further assumption about limited catch-up capacities, we get a scheme with some resemblance to the core of the Norwegian mechanism. Indeed, if we further assumes a single dimensional output, constant return to scale, fixed relative factor prices, a constant exogenous frontier shift of π, \no difference between profit and slack value $\rho=1$, we get the Norwegian scheme as a special case.

Summary

3.61   To summarize, we see that the DEA based yardstick schemes solve many of the usual CPI-x problems, including risk of bankruptcy with too high x, risk of excessive rents with to low x, ratchet effect when updating x, arbitrariness of the CPI measure, arbitrariness of the x parameter, and inability to include changing output profiles.

3.62   Moreover, the DEA based yardstick scheme is a conceptually simple extension of the Norwegian approach. The main difference is that the DEA based yardstick scheme uses a price and quantity index, which is consistent with the estimated DEA cost structure, and that it uses the realized rather than predicted changes in the productivity. That is, the role of IQ, IP and X is essentially substituted by a comparison of $C^{DEA}_{t+1}(y^{t+1})$ with $C^{DEA}_t(y^t)$. A natural follow up study (see project A, Chapter 7) could investigate these immediate modifications and their empirical significances in more details. For an initial comparison, cf. Agrell, Bogetoft and Tind(2002). All of these modifications would be quite natural and simple yet relevant refinements. They hereby have the potential to strike a reasonable balance between the need for stability and the strive for improvements.

Light handed regulation

3.63   This section treats some of the economic and behavioral properties of
        light-handed regulation. In terms of practical regulation, and given
        the limited literature, we mainly draw on our experience with the
        regulation in Sweden. The Swedish regulation has been based on a
        light-handed and ex post regulation philosophy, and it is important to
        understand the pros of cons of this when considering if and how to
        develop the Norwegian scheme along these lines. The coverage in
        this section also provide a contrasting background to the "hard-
        handed" regulation considered above, outlining some of the inherent
        trade-offs in the choice of mechanism design.

        ### *What is light-handed regulation?*

3.64   There are – to the best of our knowledge – no coherent and
        comprehensive theories of light-handed regulation. We have tried
        therefore to use general insights from economics and the social
        sciences to develop some basic properties of the approach.

3.65   A regulatory mechanism that does not prescribe direct or automatic
        action for a defined firm behavior may be called *light-handed* or
        minimal intervention regulation. Note the distinction towards the
        concepts of *low-powered regimes* versus *self-regulated systems*. The
        regulatory incentive power is a measure of the share of cost changes
        that is carried by the firm. A light-handed regulation is normally low-
        powered, but many low powered regimes have heavy-handed
        implementations. Investment screening, mandatory formal rate
        reviews and detailed regulatory guidelines for operation are
        examples of heavy-handed regulation. The self-regulated system, as
        compared to the light-handed regulation, lacks formal exogenous
        intervention possibility. As opposed to the unregulated system, where
        the firm itself is supposed to limit its rent extraction, self-regulation is
        normally managed by some industry association.

3.66   The objectives of the regulator in light-handed regulation are often
        formulated in terms of 'promoting, supporting, protecting' etc. rather
        than the authoritative 'control, guide, direct, discipline' that
        characterizes more dominant approaches. The means to enforce the
        regulation may nevertheless be the same, affecting prices, revenues,
        licenses and organization. The key to effective light-handed
        regulation, that differs it from the non-regulated or self-regulated

scenarios, is precisely the combination of delegation and threat of punishment.

Degree of cooperativeness

3.67   The functioning of light-handed regulation depends on the nature of the firms and in particular on their tendency to be cooperative or non-cooperative. This does not imply that the degree of cooperativeness in itself forms a reliable criterion for the selection of such systems. The degree of cooperativeness simply clarifies the angle and level of the analysis. Non-cooperative analysis by necessity has to be done at the lowest level, since opportunistic strategic behavior is postulated. For a cooperative industry, some more general remarks may be made on institutions and structural development.

3.68   The industrial structure, culture and degree of cooperativeness are as much the results of as the causes of a particular regulatory structure. This interdependency between industrial structure and regulatory institutions has a fundamental impact on the possible success in implementation of any regulation mechanism. Moreover, experience shows that legislative and regulation changes that incite or promote non-cooperative or strategic behavior may have more durable effects on the cooperativeness of a sector, than the opposite scenario. An important consequence of this is that drastic changes of (endogenous) institutions in the direction of more competitive regimes should be preceded with careful analysis of the opportunistic possibilities that will open.

Cooperative analysis

3.69   If the firms are willing to cooperate with the regulator and comply with the instruments provided, several important benefits may be harvested from the light-handed approach. Rather than confronting the firms with managerial and possibly intrusive rulings in their operations, the regulator chooses to intervene only *ex post* (after the fact) and *discretionary* (not automatically). Below we will briefly discuss the information dissemination role, the industrial learning, and the delegation. Finally, the importance of the credible enforcement will be mentioned.

3.70   In such an environment, the regulator may emphasize the information dissemination and *market development* role, performing

some tasks that traditionally may have been administered by an industry association. The regulator may e.g. supply the industry with aggregated and standardized information that could not have been credibly collected and processed by a market operator. It may also clarify and explain market prices and conditions to consumers, in line with the competition authority on certain emerging markets.

3.71 The regulator may also promote the *learning* in individual firms by offering information on the service performance of other firms, perhaps even international data. Benchmarking initiatives such as DEA are excellent examples. Given that the information will not be used against the firm, a part of the problem with asymmetric information may be solved. This means that even incomplete models, that possibly would be challenged if directly used in revenue caps, may be useful for the industry development. Since the profit objectives of the firms are garbled, the regulator may put pressure on inefficient firms by providing them with concrete targets and peers. A DEA benchmarking system like *Den Ekonomiska Nätbesiktningen* developed in Agrell and Bogetoft (2000) now institutionalized with yearly evaluations may be an effective part of such an effort to learn and motivate the individual firm. This could be further emphasized by developing the recurrent evaluations using internet based, interactive benchmarking, where the firms can explore in more details different improvement strategies, e.g.Bogetoft and Nielsen (2002).

3.72 *Delegation* of production, pricing and innovation to the firms implies a large degree of freedom compared to the more intrusive cost-recovery regimes. If firms value their decision authority, their independence, the regulator may trade this freedom against private information. Active participation in common accounting systems, such as EL-BAS developed by the former Swedish Electricity Distribution Association SVEL (now Svensk Energi), is an example of a useful collaboration. Given the asymmetric information, the regulator would likely not have been able to neither formulate, nor promote such data quality instrument as effectively as SVEL. There is also anecdotal evidence of informal industry contacts where the regulatory need to detect abuse has been recognized along with the desire to be 'left alone'. Nevertheless, the trade of complete delegation against internal discipline, possibly administered by the regulator, is of dubious value. Promoting coordination and common values, the idea of collusive behavior selecting annual 'scapegoats' is not far away. Collective punishment for individual firm behavior may have the same side effect. The regulator should maintain an independent and

well-reflected policy on delegation, where the social welfare and cost of information are taken into account.

3.73 Regulation completely without enforcement works poorly in heterogeneous markets with differing ownership. Motivation and cooperation are diminished, even in an initially positive environment, if abuse and inefficiency are left unanswered. However, we know from motivational theory that *credible threats* of punishment have disciplining effects. The mere threat of a harsh penalty if discovered may discourage fraud, theft and misdemeanor just as well as complete surveillance. The strongest deterrent is achieved if the monitoring and the punitive processes are partially the private knowledge of the regulator. In the context of a cooperative setting, this prompts again at the independence of the regulator towards the industry. If the *selection criteria* for punishment are predictable, exacting punishments does not disturb the cooperative setting.

Non-cooperative analysis

3.74 In the non-cooperative perspective, the opportunist manager acts exclusively in his own interest. Thus, it is always costly for the regulator to acquire information from the firms, in one way or another. When left with the chance, rents are extracted and production is adjusted according to private interests. The setting is challenging for the light-handed regulation, which works only if the firms are unable to make collusive agreements. The key to the viability in the non-cooperative setting is in the enforcement of rulings. Not to repeat the section above on credible threats, we forward the reasoning with a more detailed comment on how DEA benchmarking may work in such an environment.

3.75 Opportunistic action is promoted when rules are incomplete, lax and/or static. Electricity distribution is clearly an activity that cannot be fully enforced by complete contracts for any possible state of the world. Hence, there are and there will always be aspects of the production that cannot be specified in a fixed contract. An asymmetrically transparent regulation may put the regulator at a disadvantage, offering additional rents to opportunistic agents. Although the agents may by and large be cooperative in the current market, the opportunistic opportunities may be exploited by market entrants that buy out cooperative agents with a share of the anticipated gain from strategic behavior. The fuzziness of the enforcement mechanism in the light-handed regulation may limit the opportunism. However, as the strategic agent anticipates the extent

and success of auditing, he may bet on the chances of an audit with some imperfect information about the regulator's resources. Unfortunately for the audited firm, the harshness of the optimal penalty will depend inversely on the resources of the regulator and the risk aversion of the firm. By focusing the resources on a few number of thorough audits, followed by fast, disproportionate rulings, deterrence may be possible even in a non-cooperative setting.

3.76   A DEA benchmarking system like *Den Ekonomiska Nätbesiktningen* developed in Agrell and Bogetoft (2000) may be an effective part of a light-handed regulation system. The measures and models of the benchmarking provide in themselves valuable information about best practice in the industry and attainable cost. However, in a light-handed regulation, the scores are not automatically translated to allowable revenues. Instead, the calculated total short-term inefficiency (score · controllable costs) may be used to prioritize the random audits in the non-cooperative market. The formulation of the model, albeit possibly incomplete, clarifies the regulatory objectives sufficiently to convey a signal of regulatory focus, without limiting the regulatory discretion to use other methods and data. Since DEA gives conservative cost estimates and the short-run model focuses on controllable costs, an audit can justly put the burden of proving additional costs on the firm. Faced with well-prepared auditing teams and possibly harsh repercussions, firms with low scores may even provide valuable industry information to avoid audits, complementing the model.

3.77   The enforcement mechanisms are earlier mentioned, but are repeated for completeness. The regulator may select any of the following instruments to discipline concessionaires:

    a.   *Revenue reductions*

    b.   *Penalties*

    c.   *Suspended concession*

    d.   *Revoked concession*

    e.   *Tender auction for concession*

    f.   *Fiduciary (tvångsförvaltning) of operations*

3.78   Due judicial practice and private property rights may limit the size and extent of the monetary penalties (a) and (b), thereby curbing the effectiveness of the light-handed regulation. The key to this dilemma lies in the separation of *concession* and *concessionaire*. Although the concessionaire may enjoy limited liability, permitting a potentially abusive behavior if scrapped on funds, the concession is only conditionally awarded to the concessionaire. Thus, the limited liability protection only applies to the assets of the firm, not to the right of operation. Neeman and Orosel (2000) show that the threat of tender auctions is an effective incentive to provide high quality service, even when the attributes of quality are non-verifiable.

3.79   The foreclosure of operations, or any other mutually costly penalty, is an effective threat only if it is credible, which may force some pre-commitment on behalf of the regulator to carry out the closure irrespective of costs. Else, the agent may convincingly show the regulator that the penalty does not increase welfare, *after the fact*, and that implementation would be mutually costly. However, this post-contractual opportunism actually jeopardizes all behavioral benefits from having a light-handed ex ante. The classical solution in economic theory is to commit to penalize using sunk costs or by irreversibly delegating the supervision. In the case of risk neutral agents, that are very tolerant to statistical risks of audits, such pre-commitment may actually be large and involve the use of bonds or financial warranties.

3.80   Further details on how the concession instrument may be used to in conjunction with a yardstick system will be given in Chapter 7.

Enforced self-regulation

3.81   Ayers and Braithwaite (1992) argue for a variant of light-handed regulation called enforced self-regulation. Following their approach, the regulator delegates to the individual firms to propose, implement and monitor a regulatory regime under the delegation and supervision of a regulatory body. As opposed to the softer self-regulation, the enforced approach prescribes disclosure of regulatory acts, public enforcement of rules, and public monitoring of the enforcement. The idea is of course to allow the better-informed party to use superior information to accomplish an agreed objective, but relieve the moral hazard in rule enforcement. The regime is applied to commercial aviation safety, where industry agreed rules are officially enforced by the Federal Aviation Administration. It has been argued that the industry has sufficient information to make detailed

and more effective regulation for each firm than the general approaches adopted by governmental agencies. The advantages are the low cost of administration, connected to a credible and effective regulation. The drawbacks are the risks of industry capture, passive industry regulators, lack of transparency and potentially costly information gathering to supervise the industrial monitors.

Horizon Problems

3.82   Varying time horizons between the regulator and the firms is a problem in the implementation of regulatory regimes. Normally, the theoretical models assume that the regulator has a shorter time horizon than the firms (and their owners) due to political tenure and public pressure. It has been shown that social welfare is lower in systems where the regulator is trying to minimize industry rents in a certain period, although this may imply higher costs in the future because of postponed investments, market exits and lack of managerial skill. The theoretical solutions to such horizon problems are (i) regulatory tenure (such as in the central banks) or (ii) industry-regulator collusion (corruption). In fact, one may also imagine solutions where clients with long-term interests, such as industrial customers, collude with the regulated firms to avoid the regulatory opportunism.

3.83   The light-handed regulation gives a behavioral solution to the horizon problem in the sense that a collaborative tradition, communication and information disclosure may limit the leeway for opportunistic regulators. A confrontational regulation, using high-powered regimes and possibly heavy strategic manipulation of information, is more at risk of regulatory capture. Empirical evidence from the revenue cap revisions in the UK shows this risk, where rents have been arbitrarily allowed and subsequently extracted, subject to political pressure.

Risks and Rewards

3.84   A common theme in regulation theory is that risks should be carried by the party that has the least cost, or analogously, that has the highest risk tolerance. Capital market theory tells us that sharing of risks, whatever exogenous or endogenous to the regulatory regime, demand a premium to be paid to the risk carrier.

3.85   Using common assumptions, the individual consumer is likely to have lower risk tolerance than the firm. In cost-recovery regimes, the cost pass-through principle reward the risk-free firm with a certain return on invested capital, hereby violating the optimal risk sharing. Occasionally, this return is derived from open market valuation models, such as the Capital Asset Pricing Model (CAPM), where risky returns are supposed be normally distributed. Clearly, the return stocks in vertically separated utilities with lower-powered regimes is at best modeled using a truncated normal distribution, since they always earn a nonnegative return. In this manner, the cost-recovery regime not only gives perverse incentives on investments and cost reduction, it also lowers welfare by excess rents and a sub-optimal risk sharing mechanism.

3.86   In an *ex ante* regulation, the full risk is theoretically carried by the firm. The periodic review of the cap, however, lowers this risk but at the cost of incentive problems. Unless constrained by some long-term agreement, the firm also runs the (regulatory) risk of having excess returns confiscated. Thus, far from a perfect risk-sharing instrument, the *ex ante* regime opens a clear field of regulatory actions and counter actions. Seen as a contract, the *ex ante* regulation lowers the regulator's ability to renegotiate when information has been revealed, whereas the *ex post* contract increases the firm's vulnerability to regulatory hold-up problems (post-contractual opportunism). An *ex post* regulation may in some sense mimic the market, since prices may be revealed after investments and production on open markets. The yardstick idea is to allocate this risk to the firms, as would be the competitive case. However, the ex *post* yardstick is a poor solution in cases where excess returns are extracted from the firms. Uncorrelated investments across firms may drive all firms out of business if they are not allowed to capture their excess rents in 'good' years, but forced to cover their losses in 'bad' years. Fortunately, the DEA dynamic yardstick limits this problem while (i) offering full returns to efficient firms, (ii) posing conservative conditions for cost norms (yardsticks), (iii) providing information on systematic industry chocks (weather, strikes, etc.) and (iv) explicitly modeling the impact of exogenous factors.

Summary

3.87   If the firms are willing to cooperate with the regulator, the light-handed approach may have important benefits. Rather than fighting over the sharing of gains, the firms and regulator may work to increase the total surplus to consumers and firms. In particular, the

regulator may support information dissemination, industrial learning, and delegation.

3.88   The light-handed regulation mechanism, in particular in combination with an ex post regime, is relatively open to post-contractual opportunism from the firms. A soft regulator, without clear a priori preferences on performance characteristics and suffering from asymmetric information on the technology, runs the risk of accepting asymmetric risk sharing, over-capitalization and non-monetary slack. Hence, it is crucial for the viability of the light-handed paradigm that the 'softness' is counteracted by a balanced policy on risks and returns. An active utilization of benchmarking methods to gauge and challenge potentially inefficient operators, combined with credible enforcement mechanisms may alleviate this danger.

4. Theoretical Differences

4.01 In this part, we discuss in more details the multiple dimensions of the ex ante - ex post dichotomy and we investigate the multiple effects of such variations in the regulatory system.

4.02 To ensure a complete coverage and theoretically sound foundation, we draw on a selective but careful reading of several lines of literature, including classical regulation literature, institutional theory, agency theory on how to provide incentives in a decentralized system, modern accounting literature on the design of information systems to facilitate incentive provision and decision making and renegotiation literature on the impact of limited capacity to make long term commitments.

4.03 Real regulation systems balance a number of conflicting objectives taking into account several aspects of the situation. Regulation theory provides useful insights but the formal models used in the theory tend to focus on a few effects in stylized environments. The risk of a partial approach is that while improving one aspect of a regulation, new and more serious problems may arise in other aspects. Practical, theory based regulatory design can therefore benefit from a more holistic, systemic approach. We develop this approach in this chapter and expand on its details as we go along.

4.04 In this chapter and with the aim of providing a comprehensive evaluation of the ex ante ex post aspects, we therefore, we start by suggesting a *systematic approach* to the choice of a regulatory system. The approach is based on the basic economic notion of rationality. The elements of this framework, viz, the objectives, the means, the contexts, as well as the performance of different means according to different objectives in different environments will then the investigated in subsequent sections and concluded upon in Chapter 6.

4.05 Having provided the framework and having covered the basic means and objectives, we investigate in more detail how they interact. We do so by discussing *10 principle concerns in regulatory design* that can be derived from the theory and practice of contracting and regulation. This systematic analysis allows us to identify several important consequences of using ex ante versus ex post regulation.

4.06   Finally we explore in more details some of the more intriguing issues, which we have identified in the initial, comprehensive analysis and which cannot be analyses from standards theory. They concern *institutional compromises* and the basic roles of the regulator in the different approaches, the use of *menus of contracts* and the use of *verifiable and non-verifiable information* acquired during a regulation period.

A Systematic Approach

4.07   To avoid the pitfall of a too partial analysis, we start by suggesting a systematic approach to the choice of a regulatory system. The approach is based on the notion of rationality as a search for the best means to accomplish ones ends in a given context.

Rational ideal

4.08   Rationality is the basis of most economic disciplines. The idea is to look at choices as the result of a systematic search for the alternative that provides the decision maker with the highest possible utility. Ideally, therefore, rational choices are the solutions to optimization problems

$$Max \; U(a,s)$$

$$s.t. \quad a \in A$$

where $U(.)$ is the utility function, a is a specific alternative, A is the set of alternatives, and s is the specific context (state) of the decision maker. Using this framework to regulation we would interpret

A = set of possible regulatory schemes

a = a specific regulatory scheme

s = a specific context

U = the social value of using regulation a in the given context s

In reality, the specific context may of course affect the overall objective as well as the set of alternatives. The technically, the latter can however be accommodated under the objective since non-feasible alternative may be toughed of as generating sufficiently unattractive objective values.

4.09   At a theoretical level, the rational choice provides an approach to chooses among alternative regulations. It also provides a approach to evaluate alternative regulations. Regulation a' is more attractive than a'' if it generates higher social value, i.e. if $U(a',s) > U(a'',s)$. Also, for appropriate social value functions U, the efficiency of regulation a' can be summarized as the actual social value compare to the highest possible social value, i.e. $U(a',s)/Max\{U(a,s)\,|\,a \in A\}$.

Rational practice

4.10   From an applied perspective, the rational choice approach provides a recipe. To make systematic, comprehensive and theoretically sound evaluations, we must identify more precisely the social value function, the set of alternatives and the context. Net we must evaluate the performance of alternative regulations according to the described values.

4.11   I an applied setting, we cannot hope to identify the ingredients in all details, but the attempt has proved useful in numerous applications. We take the first steps towards an identification of the ingredients here, and we expand our identification using different lines of theory and empirics as we go along. We summarize our (preliminary) findings is Chapter 6. It is important to emphasize, however, that the appropriate objectives and means cannot be identified in a vacuum and detached from the specific context. A refinement of our analysis would involve interaction with interest groups, most notable the regulator and the firms, in a subsequent (post-) project.

4.12   In an applied setting, the must complicating aspect to identify is usually the social value function *U* and possibly the relevant context *s*. Both difficulties can however be dealt with using a multiple criteria approach, cf. Bogetoft and Pruzan (1991).

4.13   Using multiple criteria, one identifies a list of objectives that contributes to the overall social value. This means that the set of criteria should ideally be *complete*, so as to cover all important aspects of the problem, *operational*, so as to be understandable to the stakeholders, *non-redundant* so that double counting of impacts can be avoided, and, closely related, *minimal* so that a problem's dimension is kept as small as possible. Furthermore, we would like them to be at least somewhat *independent*, so that at least the ranking of the values of one criterion is unaffected by the value of the other criteria. Observe that the criteria are usually somewhat *conflicting* in the sense that we cannot improve one criteria without deteriorating one of more of the others.

4.14   A useful list of criteria can usually be constructed by relying on theory, discussion with stakeholders etc and by organizing the criteria in a *hierarchy*. At the top, we have the overall, all-inclusive reason or reasons for caring about the problem in the first place, say to improve social value. As we move down the hierarchy, we successively clarify the meaning of higher-level objectives by

subdividing them into lower-level objectives and criteria of more detail. Also, one may look at lower objectives as the means to the higher objectives, which can be viewed as their ends. Every time we subdivide, we must be careful to have all facets of the higher level objective accounted for by one of the lower-level objectives. In this way, each level of the hierarchy ideally provides a complete, comprehensive description of the possible concerns.

4.15   We shall illustrate some of these steps below, but we emphasize that a full-scale application of this approach would require the explicit and active involvement of the relevant stakeholder, including the regulator and the firms. This may be a topic for future projects, workshop etc.

4.16   It is worthwhile to note also, that the multiple criteria approach can be used to cope with uncertainty about the specific setting. If the precise nature of the present - or future ! – context is unknown, as it usually will be, a useful approach is to identify a set of possible scenarios S and to look for regulatory approaches that are doing well in all settings. This can be formalized as seeking to maximize $U(.,s)$ for all possible s in S.

4.17   To summarize the multiple criteria approach to regulatory evaluations, Table 4.1 below is useful. The rows list the relevant criteria contributing to the overall social welfare. The first columns represents different regulations and the cells give qualitative or quantitative indications of the performance of the different regulations according to the different criteria. The final column represents the context and indicates the relative importance of the different criteria in the specific context. The aim of the regulatory design is thus to find the column that is doing rather well according to the criteria that are particularly important in the given context.

Table 4.1 Systematic multiple criteria evaluation.

	Regulatory Approach			
Criteria	Mech 1	….	Mech k	Context
Criterion 1	Good	…..	Good	Important
Criterion 2	Ok	…..	Very good	Very Important
……	…..	…..	…..	…..
Criterion n	Very good	…..	Ok	Important

Criteria

4.18   To develop a comprehensive list of relevant criteria, it is useful to think in terms of *coordination*, *motivation* and *transaction costs*. Most problems of economic design can be cast in this setting, e.g. Milgrom and Roberts (1992).

4.19   All economic systems – except simple Robinson Crusoe systems – involve several agents with conflicting interests, private information and private possibilities to act. From the point of view of specialization, one can even argue that the decentralization of information and decision-making among different agents is what gives a system the potential to operate more efficiently than a single individual. Specialization however comes at a cost. Information must be shared and actions must be coordinated. There are three aspects of this:

   Coordination: ensure that the right services are produced at the right time and place.

   Motivation: ensure that the parties have individual incentives to make coordinated decisions.

   Transaction costs: ensure that coordination and motivation are provided at the lowest possible cost.

4.20   A mechanism (cf. 2.03) must therefore coordinate the action of independent individuals, ensure hat individuals have private motives to implement their part of coordinated plan, and ensure that coordination and motivation is accomplished at least possible transaction cost.

4.21   It is well known that these overall objectives may conflict. To ensure private motivations, we may for example have to forgo the optimal coordination that is possible in a world, where all agents have the same interests. The different objectives must therefore be *balanced*, and an important task is to clarify the necessary trade-offs.

4.22   In the ECON 71/02 Pre-project "Nettregulering 2007: Intektskontroll", a series of regulatory objectives are mentioned as a prerequisite for a social optimum. They include

Short Run

- Optimal use of production capacity
- Optimal balance between electricity, other sources and carriers, and demand reduction

Long Run

- Correct net and production capacity
- Optimal balance between net investments and reallocation of consumption and production over time and space

Structural development

Appropriate return on investment

Lowest possible regulation costs

- Costs at regulator and firms of implementing the regulation
- Costs from lack of stability and strategic behavior
- Costs from changing a regulation model

4.23   We see how these criteria refer mainly to the coordination aspects in the short and long run, at the individual as well as the sector level. The motivation aspects are present in the required return on assets and the costs of strategic behavior. Finally, the transaction costs are indicated in terms of the implementation costs and the costs of changing the model.

4.24   In the regulation literature, one can find other more or less elaborate listings of properties that characterize good regulatory mechanisms. Pfeifenberger and Tye (1995), for example, discuss a number of pitfalls in different types of incentive mechanisms. They argue that a proper incentive mechanism should: (1) be simple, (2) provide proper motivation, (3) be fair, and (4) have staying power. Simplicity is required to reduce the administrative burden on regulators and to find acceptance in the public. The mechanism should induce cost minimizing behavior. To ensure fairness both costumers and utilities should perceive benefits from the mechanism. Staying power of a mechanism ensures time consistent signals.

4.25   Pfeifenberger and Tye (1995) also give a number of recommendations for regulators. Firstly, the rewards and penalties should be restricted to the operationally and politically acceptable

alternatives. Secondly, the annual rate increase should be constrained to avoid "rate shocks" that may cause public distress. Thirdly, the problem of restart and review processes should be addressed up front. This must ensure that both regulators and utilities are committed to mechanism. Fourthly, to avoid skewing management attention it is very important to design the mechanism with balanced incentives and to choose a proper measurement of outputs. For example, the output measurement should take account for the quality. Also, the output measure must take account for the multi-product character of most industries

4.26   We shall develop our own and more systematic list of important concerns and investigate how these concerns interacts with the ex ante ex post timing issues in the section on principal concerns.

Alternatives

4.27   The set of regulatory alternatives is large even when we restrict attention to the alternatives that potentially may be relevant in the Norwegian case. Several of the overall alternatives, including the choice between revenue and price cap models, are outline in the SNF report (von der Fehr *et al.*, 2002) and the ECON 71/02 Pre-project report.

4.28   Presently, we focus on the alternatives that are directly related to the ex ante ex post discussion. As discussed in Chapter 2 and 3, the ex ante ex post variation allows for differences in how and when to commit to and settle on the regulatory conditions, including the revenue cap etc.

4.29   There are several was to commit and settle on the use of (new) information. At the overall level, we can distinguish between the following up-dating approaches:

- Unilateral

- Bi-lateral

- Pre-determined

In a *unilateral* procedure, the regulator uses his discretion or the firms take actions – possibly exercising self-discipline. In a *bi-lateral* procedure, the parties (re)negotiate the terms of the regulation taking into account the acquired information. identify the following approaches. Last but most commonly, the use of new information is *pre-determined*, i.e. it has already been planned when setting up the

regulation and the regulatory formula. A variant of this is that information may have been foreseen to become available to the one of the parties and its use regulated via a menu of contracts from which the informed can choose.

4.30 The use of a menu of contracts plays a significant role in the theory of incentives. Although largely rejected in the ECON 71/02 Pre-project report, we will argue below that a menu of contracts may be advantageous, but as part of an ex post arrangement as well as more generally.

4.31 The possible uses of (new) information are at least somewhat depended on the nature of the information. A natural taxonomy distinguishes between

- Public information
- Private information

and between

- Verifiable information
- Non-verifiable information.

Information may be acquired *privately* by some of the agents involved, most notably the regulator or the firms. Alternatively, new information may become *publicly* available to all the parties involved. Such information may be verifiable in the sense that it can be documented also to a third party, e.g. in a law case. *Verifiable* information can be contracted upon directly by relying on the usual juridical system. Public (ad private) information may also be *non-verifiable* in the sense that its content cannot be verified to a third party. Such information cannot be part of a formal contract or up-dating rule. It may however be used via (re-)negotiations, via an appropriate allocation of decision rights (discretion) a priori etc.

4.32 The ways to commit and settle on the use of new information depends somewhat on the nature of the information. The obvious connections can be summarized as follows: e

Private information to regulator

- Used via discretion
- Used via menu of contracts

Private information at the firms

- Used via self-regulation

- Used via a pre-determined menu of contracts, signaling game or participatory communication procedure, where the firms shares its information with the regulator having been restrained in its possible uses of the information.

Public verifiable information

- Used via regulatory discretion

- Used via regulator – firm (re-) negotiations

- Used via a menu of contracts that the parties can choose from

Public non-verifiable information

- Used via regulatory discretion or industry self-discipline

- Used via regulator-industry renegotiations.

4.33   We shall investigate these and some related alternatives in the sections below. In particular, we shall review the basic theoretical results on the use of different types of information in contracting, and we shall provide more insight into the possible benefits of using a menu of contracts.

Context

4.34   To evaluate the importance of the different criteria and the relevance of the different alternatives, one needs a clear understand and appreciation of the specific regulatory context. Again, we shall expand on several contextual aspects as we go along. Initially, and drawing on international experience, it is useful to note a few characteristics about the

- Technology

- Preferences

- Information

in electricity distribution, and to comment briefly on the possible implications of these characteristics on the choice of regulatory alternatives.

4.35   The *technology* of electricity distribution has several characteristics that make it rather different from other industries. One is its networks character and the need to adhere to the laws of physics. Another is the need to make large, long-lived and (location) specific capital investments. A third technological property is the importance of the

climate, the topology etc, features that are relatively complicated to model using traditional production economics. These characteristics suggest that *incentive provision should be cautious*. It makes no sense and is costly to make firms revenues etc depend on aspects that the firms cannot control. This means that due attention to the laws of physics, climate etc is called for and may limit the regulators ability to make relative performance comparisons. Also, the long lived, specific investments give rise to possible hold-up problems with resulting under-investments unless the *regulatory regime is rather stable* – or that the regulator at least has a reputation of fair and independent evaluations.

4.36   Turning to the *preferences* it is worthwhile to note the existence of a mixture of cooperative and non-cooperative attitudes, of social capital (in the form of firms' social responsibility, the professional pride of the technical staff etc), as well as a mixture of ownership structures (private companies, public companies, coops with consumer interests etc). This has several implications. Regarding the basic ex ante ex post issues. First of all, the existence of cooperative attitudes and social responsibility suggests that the use of new information via industrial self-discipline and bilateral (re-) negotiations may be quite useful. At the same time, the existence of different owner ship structure with associated different internal motivations, incentives problems etc suggests that it may not be optimal to regulate all firms by the same formula. A more elaborate approach with a menu or spectrum of regulation models may be useful.

4.37   Lastly, regarding the informational characteristics, we may note that there are several asymmetries. The regulator has private information about future regulation, commitment etc, the firms presumable have private information about costs, plans, quality of product etc, the managers in the firms has superior information about costs and technology etc, and the consumers have private information about their future demand, valuation of quality etc. Again, this may call for elaborate menu of schemes and allowance of in period communication, signaling and adjustments (unilateral, bilateral or formula based) to new information. To the extent that the context is somewhat uncertain, such adjustments should ideally not be postponed to the next review period. An important issue to investigate further is therefore, how stable the conditions are at the regulator, the firms and the consumers. In case of stable conditions, the necessary adjustments can be coped with periodically while volatile conditions call for mere frequent up-dating.

Principal Concerns in Regulatory Design

4.39   The literature on mechanism design provides useful insights into the trade-offs between the different aspects of coordination, motivation and transaction costs using the variety of tool available. However, the formal models used in the theory tend to focus on a few effects in very stylized environments. Real contracts and more specifically, real regulatory systems, must balance a number of conflicting objectives taking into account several aspects of the situation.

4.40   A recent attempt to combine the theory and practice of contracting is Bogetoft and Olesen(2002). Drawing on a careful reading of the contracting theory and a study of numerous actual contracts, they arrive at a checklist with 10 different rules of thumb that can support such an approach. The 10 rules covers what they have found to be particularly important aspects of coordination, motivation and transaction accost considerations.

4.41   Following a similar route, we offer here a list of ten principal concerns in regulatory design as given in Table 4.2 below:

Concern	Focus
1. Coordinate production	Coordination
2. Balance the pros and cons of decentralization	
3. Minimize the costs of risk and uncertainty	
4. Reduce the costs of post-contractual opportunism	
5. Reduce the costs of pre-contractual opportunism	Motivation
6. Do not kill cooperation	
7. Motivate long-term concerns	
8. Balance the pros and cons benefits of renegotiation	Transaction costs
9. Reduce direct costs of contracting	
10. Use transparent contracts	

Table 4.2 Ten rules of contracting

4.42   In Table 4.2 we have grouped the ten rules in three categories corresponding to the overall objectives of coordination, motivation and minimization of transaction costs. This categorization is not unique. The grouping simply reflects the primary intention of the

(class of) tools considered. We emphasize that all tools have implications for all objectives. That is, when a given tool is applied, it will almost always have (adverse) effects on the other objectives. An incentive scheme to improve motivation may for example at the same time be costly from the point of view of coordination and transaction costs as it may lead to sub-optimal risk-sharing as well as costs of writing and administrating the contract. We will emphasize the trade-offs in the discussions below, where we investigate how these concerns interacts with the different tools available to a regulator - and in particular the regulators possibility to rely more or less on ex ante and ex post schemes.

Coordinate activities

4.43   Perhaps the most important role of regulation is to coordinate the actions of independent decision-makers. After all, the reason to cooperate is to create values through joint actions. Coordination must ensure that the production and investments are optimized throughout the entire production chain. Lack of coordination leads to sub-optimization where decision-makers "optimize" their own decisions without considering all the consequences they have, for other decision makers in the production chain. Coordination can generally be achieved using instructions, or price signals or some combination of the two. It is often attractive to coordinate qualitative aspects as well as matching and synchronizing problems via instructions and quantitative aspects via prices. See Milgrom and Roberts (1992) for detailed discussions of the coordination aspect in contracts.

Balance the costs and benefits of decentralization

4.44   The allocation of decision rights is a key aspect of a regulation. A regulation of distribution may be more or less centralized with more or less decisions undertaken by the regulator. Theory suggests, however, that the parties should aim for to have decisions made by the most informed party. Following this principle, there are two immediate benefits of decentralized decisions. It reduces the risk of important information being neglected and the need for costly communication. On the other hand, a decentralized organization may increase the risk of uncoordinated decisions making and may create matching and synchronizing problem.

4.45   Decentralizing the decisions may create motivation problems. If a contract delegates the decision rights to the firms, the contract must

design the incentives to alleviate the moral hazard problem. On the other hand, centralized decision-making can promote opportunistic behavior by the regulator, e.g. hold-up problems. The costs and benefits of decentralized decisions are summarized in Table 4.2 below. A plus (+) in this table indicates that the choice (decentralization or centralization) has a positive impact on the problems listed in the first column.

Table 4.2 Pros and cons of decentralization.

Problem	Decentralization	Centralization
Use all important information	+	
Reduce costly communication	+	
Coordination		+
Information requirement	+	+
Moral hazard		+
Hold-up	+	
Reduce information rents		+

4.46   The coordination and decentralization aspects should not be underestimated. Much of modern regulation theory stresses the incentive problems and the limitation of informational rents via relative performance evaluation etc. In our view, these issues are still only (important) side constraints to the overriding task of making sure that the different agents take individual decision that work together appropriately. This means that one of the more important aspects to investigate is the allocation of decision rights and design of information flows that facilitates a reasonable systems wide behavior. (The debriefing in connection with exercise 1 was an illustration of this – perhaps more on this ??).

4.47   The choice of a more or less centralized regulation also interacts directly with the question of ex ante versus ex post regulation. To the extent that a centralized solution is called for, for example because of the need for synchronization, the existence of system synergies and externalities, sequential use of information via an ex post regime will be less attractive. Indeed, recent insights in capital budgeting, where multiple projects compete for scarce resource, suggests that periodic, holistic adjustments may be attractive, cf. Antle et al. (2000). Smaller adjustments to local variations are more suitable for sequential use of new information.

Minimize the costs of risk and uncertainty

4.48   Risk is prevalent in the distribution sector as in most parts of the economy. The companies and consumers are subject to external risk from weather, labor markets, capital markets etc. In addition, the parties are subject to behavioral risk, as they do not know the behavior of the other parties. We normally consider economic agents as risk adverse such that an uncertain revenue (payment) is considered less valuable (more costly) than a certain payment with the same expected value. The parties can reduce this cost of risk and uncertainty in two ways. They can minimize the risk and they can share the risk between them.

4.49   They can minimize the risk and uncertainty in different ways. One way is to choose a robust payment plan that leads to reasonable outcomes even if the initial assumptions do not hold true. Information collection (monitoring) is another way. Also, the parties can reduce the measurement errors through refined measurement techniques and statistical analysis.

4.50   Risk sharing depends on the relative risk aversion of the parties and interacts with incentives. If the companies are risk averse and the consumers — by the small budget used on distribution anyway - are risk neutral, the efficient way to share risk is to place all the risk on the consumers so that the companies basically gets a fixed payment. However, to motivate the distributors to take unobservable actions, the payment must depend on the output. An efficient contract balances the costs of risk bearing against the incentive gains, cf. Holmström(1979). On the other hand, if the companies are risk neutral and the consumers are risk adverse, the consumers should ideally pay a fixed amount. Again this may conflict with motivation since the consumers will now have no incentive to adjust their behavior. In general, we note that there is no trade-off between incentives and the sharing of common risks affecting all producers equally. By using relative performance evaluations rather than absolute ones, one can eliminate common risk from the payment to the companies, cf. Holmström(1982).

4.51   Risk sharing and the ability to adjust payment more closely to the sequential events is an important aspects of the ex ante ex post discussion. It is worthwhile emphasizing, therefore, that *even if the companies are more or less risk neutral, relative performance evaluations are useful* since it allows a more precise inference about the firms behavior and hereby the ability to provide more high

powered incentives without affecting the costs of risk. Consequently, more coordination is possible at given costs. Assume for example that the firm is risk neutral and that an attractive investment only shows up randomly via the observation of some variable with values H or L, depending on the firm's behavior as indicted in Table 4.3 below.

Table 4.3 Systematic multiple criteria evaluation.

	Observation		
Effort	L	H	Costs to firm
Low	½	½	0
High	½+ a	½'-a	1
Payment	P$_L$	P$_H$	

The firm in this case will supply maximal effort only is

$$(½+a)p_H + (½-a)p_L \ -1 \ \geq \ ½p_H + ½p_L - 0$$

i.e. only if

$$p_H - p_L \geq 1/a$$

Hence, the incentive power, p_H-p_L , is decreases when a increases. In other words, with a good information system, possibly because the common uncertainty has been eliminated via a relative performance evaluation, the incentive power can be smaller. This is attractive since the random variation in payment is costly to the consumers if not to the firms.   To summarize, if the firms are risk neutral and the consumers at least slightly risk averse, it is attractive to improve the behavioral inference via design of better information systems, by making relative performance evaluations etc. This is so since the payment variations needed to motivate a certain behavior that cannot directly be observed. Is increasing when the quality of the information system deteriorates. The payment variation is not attractive to the consumers.

Reduce the costs of in-period opportunism

4.52   Opportunistic distributors do not automatically take the actions called intended by the regulator, i.e. moral hazard problems occur. The regulation should motivate the companies to take the right actions, even if they are unobservable. The contracts must respect the incentive compatibility constraint, which states that the producers choose the actions that maximize the producers' own utility.

4.53   In order to provide incentives for unobservable actions, the compensation must be based on outcome. However, usually there is a stochastic relationship between the actions and the resulting output. This implies that output-based incentives will expose the companies to risk, because the payment depends on factors outside the producers' control, e.g. the weather. When the producers are risk averse, this risk carries a risk premium. Hence, there is a trade-off between providing incentives and minimizing the cost of risk, cf. above.

4.54   If the regulator can obtain better information about the companies' effort, he can expose them to less risk – and still induce them to take the same actions. According to the informativeness principle, any performance measure, which reduces the error in estimating the producer's actions, should be used in the contract, cf. Holmström(1979). This implies that the payment to a distribution company should depend on information about the performances of other companies, if this gives a more precise estimate of the effort provided by the company in question (e.g. due to common risk).

4.55   The important conclusion about risk allocation and in-period incentives that can be derived from the preceding paragraphs are, that we always need to make the best possible inference about the behavior of the companies using the available information. In the case of risk adverse firms, we need finer inference to reduce the risk they are exposed to. In case of risk neutral firms, we need it to reduce the risk that the consumers will be exposed to while providing incentives.

Reduce the costs of between-period opportunism

4.56   When a company has private information about its skills, cost structure etc. it may try to use this in the commitment and settlement negotiations before a new regulation period. In general, it will be able to obtain conditions that provide expected profit above the reservation value (i.e. it earns information rents) by taking advantage of the regulator's hesitance to have the regulation rejected and the firms quit. This is the problem of pre-contractual opportunism or adverse selection. See Akerlof (1970), Salanie (1997) or Milgrom and Roberts (1992) for detailed analysis of pre-contractual opportunism

4.57   The literature on contract theory points to at least four ways of reducing the adverse selection problem. Firstly, the regulator can collect information before designing the new conditions. In this way,

he can reduce the companies' informational advantage. Secondly, the companies can use signaling – or the selection from a menu of contracts, to reveal their true type through their behavior before a new regulation is determined. Thirdly, for some aspects like quality, the regulator can use rationing and offer a conditions that is only acceptable to some ("good") company types. This reduces companies' abilities to extract rents by mimicking worse types. Hence, rationing leads to fewer but better contracts in the sense that some adaptation of behavior, e.g. quality improvements, is forgone for some companies to save on the rents that other companies can charge. Last but not least, the regulator can undermine the private information of the companies and their ability to extract rents by relying less on the pre-regulation (a priori) information and more on information in period (ex post) information. We shall expand on this below.

Do not kill cooperation.

4.58   The parties can only achieve the full economic benefits from if they cooperate. The companies can help each other by sharing know-how, exchanging favors etc. Flexibility from both regulator and the companies may enable them to adjust to events not accounted for in the contract. Hence, it pays for the parties to work in a cooperative spirit where changes can be made without costly negotiations or conflict resolution.

4.59   Relative performance evaluation may have a negative impact on the cooperation between producers, cf. Lazear(1989). This is particular obvious when the negative impact on one company from the improved performance of other companies is immediately like in an ex-post regime with sequential updating. On the other hand, the immediate effects of changed behavior may also support coalition making among the companies (much like an oral auction makes coalitions easier by the possibility of more or less instant punishment for breaking a cartel, cf. also cooperation in repeated oligopoly market, cf. Laffont and Tirole (1993)

4.60   Using strong incentives may also complicate the cooperation. For instance, a company in a high-powered quality contract may protest when the regulator changes his conditions since this adversely affects the producer's payment. Often, the companies have better information about the conditions and behavior of other companies. Group incentives, where the total payment to a group depends on the performance of the entire group, may motivate the companies to

assist and monitor one another and perhaps impose some kind of social penalty (e.g. a bad reputation in the neighborhood), cf. Milgrom and Roberts(1992).

Motivate long-term concerns

4.61   The regulation should induce the parties to take the long-term effects of their actions into consideration. Electricity distribution requires large capital investments that are rather location specific and which has lower value in alternative uses. Such, so called specific investments, are particularly sensitive to the ability to make long-term commitments. A company that has invested in specific assets is very vulnerable to changes in the regulation. This leaves the company in a weak bargaining position in (re-)negotiations after the investment has been made. Of course, the companies foresee this and will therefore be more reluctant to make specific investments. This is the hold-up problem.

4.62   The hold-up problem can be reduced in different ways. Firstly, long-term regulation – and in particular the use of ex ante terms settled for a relative long regulation period, reduces the hold-up problem because the terms are settled before the companies make specific investments. In practice, however, it is impossible for the parties to make complete contracts that cover all possible events. This makes hold-up possible even in long-term regimes.

4.63   The role of reputation may also prevent the parties form holding-up the other party. A clever regulator with a good reputation may be reluctant to devalue this reputation by holding-up the companies, because it will ruin the regulator's chances to make good settlements in the future – with the present or even with new firms. It is well known from the theory of incentives that reputation has to be earned and takes considerable time to build up. It is however very fast to milk. Most likely, the planned use of sequential information in an ex post regime, may actually increase the ability to make long-term commitments. It is not likely that a fixed, long-term contracts, can survive when conditions changes dramatically and it may therefore be better to foresee this and plan possible renegotiations in an ex post regime. The minimal and maximal return on assets stipulate in the Norwegian model may serve precisely to increase the regulator's ability to make long term commitments, since dramatically high or low profits, that could put him under political or industrial pressure has already by coped with. (In the same spirit, old very long English tenant contracts were improved by including mediation institutions.)

4.64 Long-term a priori settlements can also alleviate ratchet effects, i.e. the tendency to under-perform in early periods to avoid tough conditions later on. This however requires a reasonable long regulation period and a somewhat uncertain review before the next period.

Balance pros and cons of renegotiation

4.65 Renegotiation enables the parties to adjust the regulation to changes in the environment. Hence, the parties can remove ex post inefficiencies through renegotiation. However, renegotiation also reduces commitment and may lead to strategic behavior. See for example Williamson (1996), Hart (1995), and Milgrom and Roberts (1992) for some analyses of the pros and cons of renegotiation.

4.66 If the parties know that the conditions will be renegotiated, they may not act according to the incentives in the initial regime but according to the incentives they expect to receive in the renegotiated regime. Hence, ex post renegotiations, and the associated problem of forgiveness, can lead to ex ante inefficiencies. Often powerful incentives rely on harsh penalties that are costly for both parties to implement, i.e. ex post both parties can be better off if the penalty is removed. If the parties foresee this as the result of renegotiation, the incentives will be weakened. The trade-off between risk sharing and incentives demonstrate this. If the parties renegotiate after the effort has been provided, the parties can improve the ex post efficiency by shifting the risk from risk averse to the risk neutral However, the incentives vanish if the producers expect this to happen.

Reduce the direct costs of regulation

4.67 The direct costs of regulation are the time and money spent on information collection, monitoring, bargaining, and conflict resolution – i.e. the costs of running NVE. It is important to reduce these costs because they do not directly generate a surplus – on the other hand, they are important activities as they provide the information required for well-coordinated decisions. Milgrom and Roberts (1992), Williamson (1996) and Hansmann (1996) analyze the direct cost of contracting.

4.68 From the point of view of the direct costs of regulation, it is clear that ex post regimes with sequential use of new information and possibly some (re-)negotiations along he way, is quite a bit more demanding.

Use transparent regulation

4.69   The regulation must take account for the parties' bounded rationality, see Hart (1995) for a discussion of bounded rationality and the implications for contract design. The parties act according to perceived incentives, which may differ from the actual incentives. Therefore it is important to use simple systems, so that the parties can easily relate their choice of action to the compensation scheme set out in the regulation. However, simple systems may also mean less complete contracts, where more questions are left unanswered in the contract.

4.70   In order to affect the behavior of the parties the incentives should be articulated ex ante. There is no motivational effect from an unexpected bonus. This may favor ex ante regulation. On the other hand, if the environment is uncertain such that the companies cannot foresee with good precision the impact and payments resulting from given actions, this does not contribute to incentive provision and an ex post regime with sequential updating may be superior

Institutional design and regulatory risk

4.71   One of the major challenges in implementing the ten rules for regulatory design is that it is interdependent with the institutional design, which in its turn was defined a given context. Below, we will develop a discussion on one critical aspect of institutional design related to the topic of the study: ex-post information.

4.72   Consider a schematic model of the information space of the regulated firm in Figure 4.1 below. As in , the firm is subject to multiple risks related to technology, climate and market factors, but it is also facing the regulatory uncertainty stemming from limited commitment to protect the specific assets (resources and information) that the owners and managers have invested in. The commitment element of the mechanism can compensate for the regulatory risk (although not for uncorrelated regulatory intervention, e.g., environmental regulation or fiscal policy), and the incentive power signals how much of the residual risk that the firm should carry. Information elicitation ex-ante can contribute to make the contract more complete in the interest of all parties.
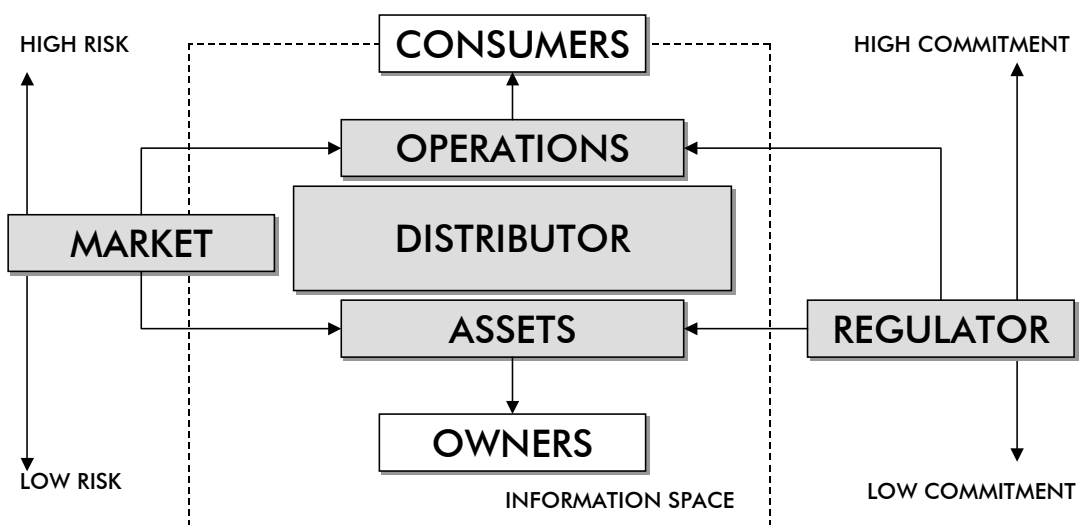

Figure 4.1 Risk and information in the regulation of electricity distribution.

4.73   However, a particular risk for post-contractual opportunism occurs when the regulator has a shorter tenure (horizon of interest) than the

firm and the mechanism is employing sophisticated ex-post information for settlement and commitment. Such regimes may indeed lower the information rents for the firms, but no regime can remove the underlying exogenous risks.

4.74   In a competitive market, firms reserve part of their rents for unforeseen risks that they carry on their equity with optimal risk hedging. In a regulated market, an opportunistic (or gambling) regulator may exploit the revealed outcome of uncertainty without allowing adequate rents for long-term capital recovery. In Figure 4.2 we illustrate the cost of these risks as a function of contractual commitment, here irrespective of motivation and transaction costs. As the commitment limits the regulatory risk, it also increases the risk premium to the full underlying exogenous risk. An ex-post settlement with ex-ante commitment not to extract rents should significantly decrease the risk premium, but the underlying market risk is now passed through to the clients at the settlement. Depending on the institutional design, the optimal timing of commitment and settlement may be between the extremes.
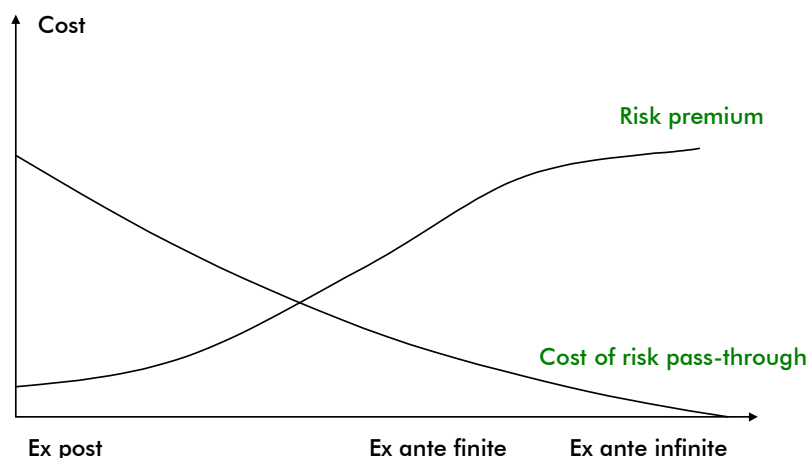
Figure 4.2 Risk premium and pass-through under ex-ante commitment.

4.75   We can illustrate the problem in schematically with respect to the contractual completeness that a regulator may achieve by an information elicitation effort and the commitment that is offered as a compensation for the information, cf. Figure 4.3 below. A situation where the firm signs a complete contract in full disclosure of information would open it to opportunistic action if, e.g., an entrant offer better conditions. Likewise, a regulator who engages in a long-

term contract with limited information about the technology and the costs risks to be captured by a low-performing and rent-extracting firm. Examples of these situations are presented in Chapter 5.
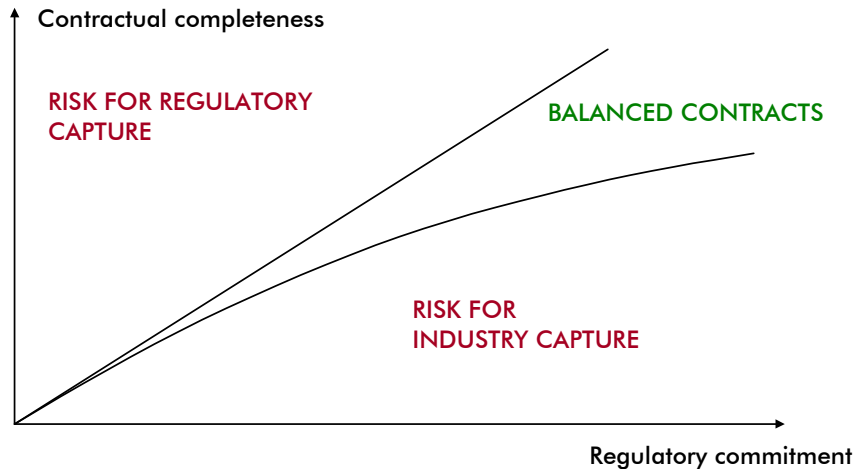
Figure 4.3 Regulatory balance in information and commitment.

4.76   The long-term equilibrium is achieved when the regulator and the firm define a *balanced contract* that hedges for the inevitable shorter tenure of the regulator compared to the firm. We have seen in and above how reputation, repeated contracting and other commitment devices may alleviate this hold-up problem. Institutional design, in particular formalized conflict resolution procedures and recourse are effective signals of commitment power. Although rarely used, binding arbitration instances can have disciplining effects of both parties that facilitate the conception of a balanced contract.

Menu of contracts

4.77   Menu of contracts play an important role in the theory of contracting. The role of a menu of contracts is usually to cope with ad verse selection problems, i.e. informational asymmetries before contracting. We have discussed this in the section on between-period opportunism above. The stress on the motivational uses of a menu of contracts is natural given the focus hereon in contract theory in general.

Coordination and menus

4.78   On the other hand, the coordination aspects of mechanism design should not play a less dominant role. In fact, coordination has been the primary focus of economist for years when discussing the advantages of markets etc, and although recent advances in contract theory have stressed the motivation problem and their possible interaction with coordination, we suggest that coordination should play a significant role in applied regulatory design.

4.79   From the point of view of coordination, the advantage of working with a menu of contracts is quite obvious. It is a way to adapt to differences in costs and benefits in different regions, time periods etc. To illustrate this, consider a case where we want to regulate some property e, as indicated in Figure 4.4 below. This property may be a quality parameter, a quantity measure, a timeliness property etc. The costs to the distribution company and the benefits to the consumers are indicated. In this case, the optimal level of the property gives the largest difference between benefits and costs. Under normal conditions, this is also a level, where marginal costs equal marginal benefits, i.e. where the slope of the two curves in Figure 4.4 are equal.
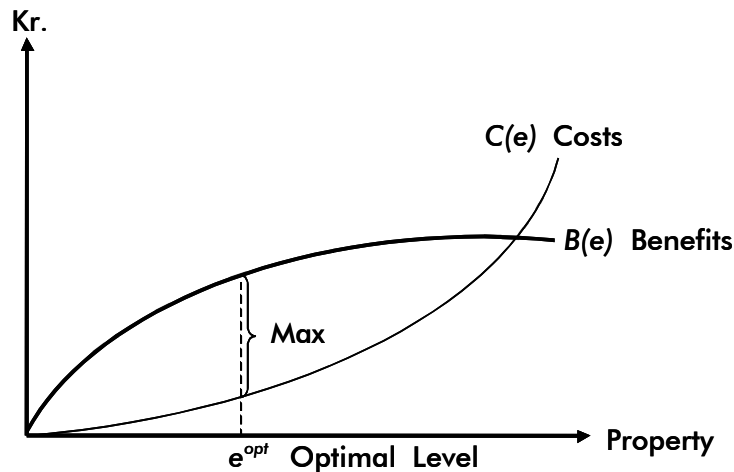
Figure 4.4 Regulation of one property

4.80   The optimal level of the property e can be ensured in many ways. We may for example use direct regulation, where we fix minimum *standards* at e^{opt}. Also, we may use *price* directed incentives where we fix a price equal to marginal benefits and let the firm respond to this. (A redistribution can then be ensured via a property independent fixed payment from the firm to the consumer). A third possibility, which we shall illustrate in the next figures is to use a *two-price* system, were the price is relatively high up to the optimal level and smaller thereafter.

4.81   Now, there is no reason to assume that the costs and benefit curves are the same in different regions, sub-regions, time-periods etc. On the benefit side, regional differences may result from different uses of electricity, different alternatives to electricity, different income distributions, different risk aversions etc. On the cost side, the differences may be due to different labor markets, different climates, different owner-ship structures, different equity and solidity of the firms etc. These differences calls for different levels of the property as indicated in Figure 4.5 in the case of cost differences and Figure 4.6 in the case of benefit differences.
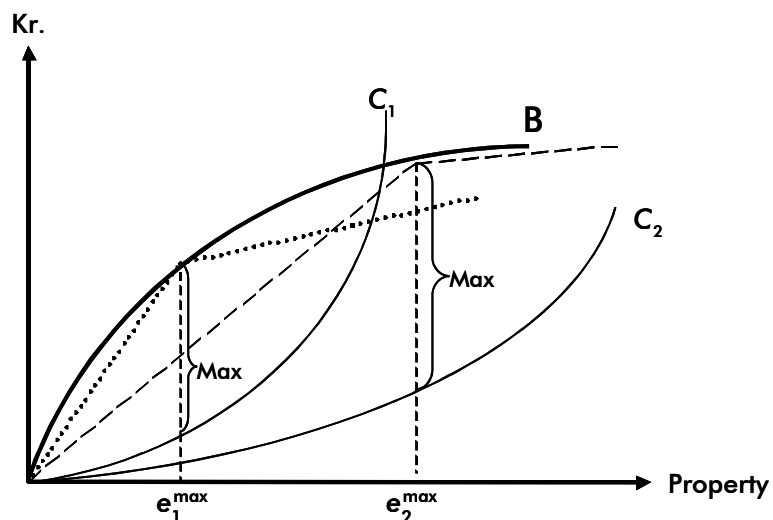
Figure 4.5 Adaptation to different costs.

Different costs

4.82   The differences in costs structure can be exploited by offering the firms two possible payment schemes corresponding to the two dotted curves in Figure 4.4. In the illustrated case, a firm with private information about its costs will choose the payment plan that is socially optimal and leads to the optimal adaptation of the property level to the underlying costs. (The illustration in Figure 4.4 is particularly simple as it allows first best adaptation of the property to the underlying costs functions even when the latter is private information to the firm. In other cases, as emphasizes by the ad verse selection literature, we would typically have to bias the property level to save on information rents. Usually, the low cost firm will have an incentive to imitate the high cost firm. This threat allows the low cost firms to extract rents, which in turn can be reduced by lowing the property level supplied, by the high cost firms. The logic and gains from adaptation of cost and benefits, however, remains the same.)
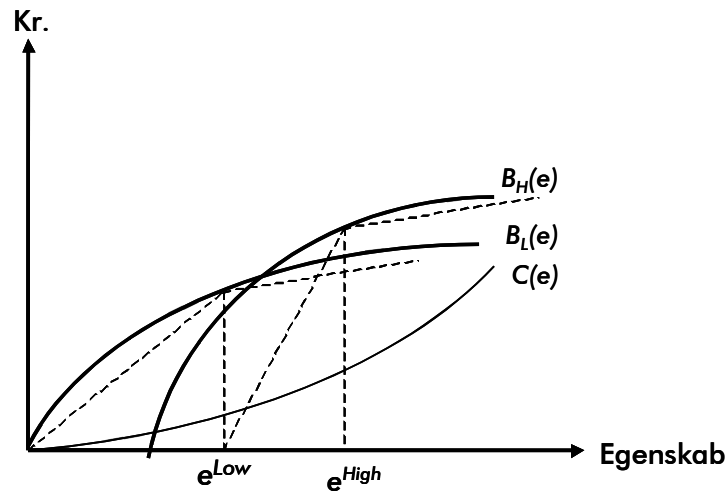
Figure 4.6 Adaptation to different benefits.

Different benefits

4.83   In case of differences in the benefit structures, an optimal adaptation could in a similar way be ensured by the consumers – or more appropriately in many cases the regulator - choosing from the different payment plans once again illustrated with dotted lines in Figure 4.6.

4.84   The so-called KILE system used in Norway to encourage quality adaptation is a specific example of such a system. In KILE, the regulator has ex ante chosen (mechanized) how the payment depends on different benefits structures. This is done by using marginal price schemes where the payment depends on the cost of lost load to different consumer groups.

Contract choice ex post

4.85   In the typical analysis, it is assumed that firms have private information ex ante or that the regulator /consumers have private information ex ante. There is no reason to restrain the adaptation to these cases, however. Private and public non-verifiable information can also be acquired during a regulation period, and by having designed a menu of contracts ex ante, the new information can be used in a controlled manner ex post. Indeed, the preplanning and restraining the possible used of information ex post, the negative effects on ex ante incentives may be eliminated.

5.   Empirical Differences

5.01   In this Chapter, we present a brief sample of practical experiences with regulation systems, with extra attention to the ex-ante and ex-post element and their integration and transition within the regulatory institutional context. Although the sample provides interesting findings with bearing to the topic of the report, note that non-exhaustive empirical evidence suffers from sampling error and, as for all empirical studies without counterfactual, lack of generality.

Electricity Distribution

5.02   The market conditions for the international energy industry have been completely overturned since 1990, not only in the USA and in Western Europe, but in the many developing and transition countries as well. The liberalization reform, accelerated by agencies such as IMF, World Bank and OECD, has primarily aimed at achieving market-orientation of the production and retail levels. Introduction of efficient power markets, vertical disintegration and harmonization of taxation have facilitated the process, increasing the allocative efficiency and reducing customer prices. However, the distribution and transmission levels have been less reformed. Regulation has been justified using reasons such as the natural monopoly character of the activity, the protection of invested capital, the comprehensive supply requirements, and the public interest of quality and accessibility.

5.03   Historically, the interests have been accommodated by public control, usually state or municipal monopolies, or by a cost-of-service regulation of private firms. The recent regulatory reform has proceeded in three steps to replace the existing structure, deemed expensive, inefficient and irresponsive to customer needs. First, governments have unbundled the industry, vertically separating generation, distribution, transmission and retail. In this stage, regulation has often been fairly loose and light-handed, giving prospects of future profitability. The next stage has implied a privatization of (at least) non-monopoly segments, generation and retail, with corresponding cash-out gain for the local governments. The third stage, when governments react to captive customers' complaints over the weak regulation, implies tougher regulation and tightened caps. Certainly, this deregulation-reregulation process is

far from economically optimal, although the recent surge for performance based regulation (PBR) or incentive regulation may alleviate some preceding flaws.

5.04   In a survey of 21 countries, Jamasb and Pollitt (2000) find supporting evidence for the regulatory use of benchmarking or yardstick regimes in regulation. The countries that have, or are about to employ, benchmarking are generally the most advanced in terms of market liberalization and reform. The methods vary, from DEA complemented with statistical approaches in UK, Norway, Finland, the Netherlands, New South Wales and Colombia, via total factor productivity in Ontario, to "ideal" or model firm approaches in Chile and Spain. International comparisons are pursued by the Netherlands, Norway, UK and Colombia for transmission regulation, where the national comparators are limited or unique, whereas most other regulators use ad hoc methods for regulation of the transmission level.

Littlechild's heritage

5.05   Figure 5.1 below lists some countries in which the authors have had cooperation, with notes to the regulatory approach and the evaluation mechanism chosen. Two tendencies are clear from the list. First, Littlechild's CPI-X revenue cap in UK has been a major source of inspiration for the European regulators. Second, when refining their regimes, most regulators have opted for some econometric estimation technique such as DEA to determine the efficiency potentials in the industry. However, the since the countries have different track records in the deregulated market, the list can also be interpreted as a snapshot of regulatory evolution at different stages. Here, the rather anecdotic evidence that three of the more advanced regulatory institutions (NVE, Dte in Holland, and ECG in Austria) seriously are considering ex-post regimes is an interesting indication. Also, the fact that the previously light-handed regime in Sweden from 2004 will operate with two complementary ex-post models for the grid operation (DEA) and the capital structure (Nätnyttomodellen, an ideal grid model), may also suggest some converging trends in the market.

Country	Reg.App.	Eval.Meth.	Development / In use
Australia	Ex ante	CPI-DEA/SFA/Stat	U
Austria	Ex post	DEA/SFA	D
Denmark	Ex ante	CPI-COLS	U – with renegotiation
England	Ex ante	CPI-DEA/COLS	U
Finland	Ex post	DEA	U
Netherlands	Ex ante	CPI-DEA	U
New Zealand	Ex ante	CPI-DEA	U
Norway	Ex ante	CPI-DEA	U
Spain	Ex ante	Ideal-Net	D
Sweden	Ex post	DEA/Ideal-net	U/D

Figure 5.1 Sample of Electricity Distribution Regulation Regimes.

There is no international agreement as to whether costs should be separated in CAPEX and OPEX, or treated as an aggregate. Although the possible trade-offs are acknowledged by countries advocating a split-up, various incentive issues and regulatory focus are considered more important. A common trait among the leading regulators is the systematized collection and disclosure of information.

Lessons from Sweden

5.06   Although no formal evaluation has been made of the Swedish light-handed ex-post approach, our close experience permits us to make some comments on the subject. Following the outline in Chapters 2 and 4, we give some short characteristics of the current regime.

5.07   The institutional design in Sweden after the deregulation 1996 is inspired by a regulation-by-rights philosophy that also governs other sectors, such as consumer and environmental protection in Sweden. The regulatory agency STEM enjoyed immediately an independent status, enforcement powers under the Electricity Act and an ambitious information dissemination program was launched. However, since the vagueness of the Electricity Act (1992) did not provide sufficient guidance for the market monitoring and the firms, organized in strong industry associations, vigorously opposed the first attempts to establish a regulatory discretionary practice using total factor productivity measures in 1996/97.

5.08   However, the legislators gradually realized the misalignment of instruments and reinforced the regulator with a revised Electricity Act (2000). The underlying idea is to substitute an output-based regime

with burden of proof on the regulated for the current heavy and ineffective light-handed input-based regime. The individuality condition, the ex post principle and the information disclosure practice are still respected in the suggested framework. However, rather than having to pinpoint observed instances of non-admissible costs, which requires an excessive effort on behalf of the regulator, the proposed system is supposed to be less discretionary and more time-efficient. Without specifying method or model for the performance assessment, the network utility approach is explicitly mentioned in the preamble.

5.09   After an intensive period of research and development 2000-2002, the regulator settled the instruments of the light-handed ex-post mechanism to be an ideal net model for revenues and an annual cost efficiency benchmarking using DEA. The actual policy can be explain from the regulator's vision statement, expressing three main tasks: *concession management, information dissemination* and *market monitoring* (Figure 5.2).

5.10   The *concession management* is an ex ante commitment element to protect the specific assets of the concessionaire in return for the universal service obligation and some limits in the intra-concession price discrimination. The concessions are granted for 5-25 years depending on behavioral information generated from the other two of the Agency's activities. Keeping the concession instrument centralized provides the regulator with a powerful structural mechanism that can be used to promote or demote market entry and exit, depending on the dynamics of the industry.

5.11   The *information dissemination* role is consistent with the light-handed approach as it delegates a maximum of decisions to the industry, including their own restructuring, motivation and learning. As a central and independent monitor, the agency is the least cost credible disseminator of market information to clients and firms alike. This includes fairly advanced econometric analyses and tariff comparisons that enable the market decision makers to make informed decisions even in the absence of true prices. Through public action, it is also intended to apply efficiency increasing pressure towards publicly owned firms that are less sensitive to high-powered regimes.
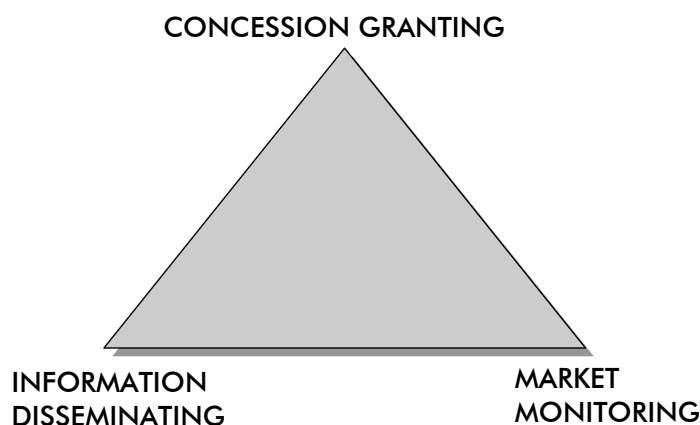
CONCESSION GRANTING

INFORMATION
DISSEMINATING

MARKET
MONITORING

Figure 5.2 Tasks of the Swedish Energy Agency.

5.12   The *market monitoring* role is partially based on an ex-post evaluation of the overall tariff level, where the asset base is evaluated using a GIS-based grid density calculation model and allowable tariffs are calculated using normative evaluations of operating cost, partially on review of the consumer and market protection provisions in the Electricity Act. Whereas the absolute level of enforcement is checked by optional recourse to administrative courts and internal consistency, the ex-post principle enables the regulator to allocate its resources strategically to incite and discipline firms without resorting to heavy-handedness.

5.13   In an cooperative institutional environment, the light-handed approach may have important benefits, cf. 3.64. In a mutually beneficial division of market coordination, both parties have long-term incentives to increase the total surplus to consumers and firms. The STEM mission statement in Figure 5.2 is indeed a clear commitment to information dissemination, industrial learning, and delegation. Industry associations have understood that the privilege of full decentralization can be revoked generally even for individual abuse (collective punishments give incentives to self-discipline). The recent unilateral monetary compensation for non-delivered power must be seen as a way to preempt ex-post intervention by the (less well-informed) regulator in an issue of public concern. Seen from a cooperative game theoretical angle, one may speculate whether the non-obligating ex-post approach has limited the conflict of interest between regulator and firm that is so present in some other jurisdictions.

5.14   In terms of social welfare, further studies of the light-handed approach of Sweden are necessary to determine the size and distribution of the coordination, motivation and transaction costs. In this context, it suffices to note that the approach (institutions, mechanisms and agents) form a consistent unit with a potential effectiveness if the intentions are carried through.

Lessons from Latin America

5.15   To study the impact of a misalignment between the regulatory instruments and institutions, and further to concretise the conceptual model in Figure 2.1 above, we take a look at four the fixed-line concession monopolies in four selected countries, Chile, Jamaica, the Philippines and Venezuela. Sources are World Bank reports under Galal and Nauriyal (1995), Alexander and Estache (2000). Although the countries are represent different levels of socio-economic development, the complexity of the technology and the demand characteristics make the comparison principally interesting. The industry structure of the countries is summarized in Table 5.1 below. As we can see, the regulators start from different conditions. Although the free entry theoretically should provide a contestable market, the absolute dominance by one firm in both Chile and the Philippines indicate that basic grid services indeed are moderately interesting for entry under regulation. To attract more bidders to the concession auction, Jamaica chose to throw in a 25-year monopoly on phone services (e.g., long-distance calls) into the deal.

Table 5.1 Telecom industry structure in Chile, Jamaica, Philippines and Venezuela.

Country	Grid operation	Services	Auction/ bidding	Grid share of dominant firm
Chile	Free entry	Competition	Yes	95%
Jamaica	Legal Monopoly	Legal Monopoly	No	100%
Philippines	Free entry	Competition	No	94%
Venezuela	Legal Monopoly	Competition	Yes	100%

5.16   The institutional design is also very different between the countries, as indicated by some dimensions in Table 5.2 below. We make some comments for each country.

5.17   Chile, with a long tradition for deregulation, opted for strong institutional backbone with an independent regulator with sizable budget and good information processing skills, counterbalanced with conflict resolution options through administrative courts and an independent arbitrator (three members, one from each party and one selected collectively). Thus, what might sound like a rather heavy-handed approach is in fact implemented with institutional checks, rather than bureaucracy, to balance the commitment problem.

5.18   Jamaica has installed an independent regulator with enforcement power limited by national and international arbitration courts. However, as the regulator operates with fairly limited means, the information asymmetry is considerable between in the incumbent and the regulator.

5.19   In the Philippines, the two regulatory agencies operate under a discretionary system with vaguely defined roles, leaving crucial decisions to the Supreme Court for occasional rulings. The conflict resolution is complicated by the lack of formalism and the political capture of the regulator.

5.20   Venezuela has a politically appointed regulator, heavily dependent upon the presidential office, ruling without recourse against the firms. The meager resources of the regulator are strained by the chosen mechanism, a quarterly price-cap, and the reviews are made with poor information.

Table 5.2 Institutional structure in Chile, Jamaica, Philippines and Venezuela.

Country	Regulator	Anti-trust	Courts	Arbitrator	Independence	Enforcement power	Skills
Chile	1	Y	Y	Y	High	Y	++
Jamaica	1	N	Y	Y	High	Y	0
Philippines	2	N	(Y)	N	Low	N	-
Venezuela	1	N	N	N	Low	Y	0

5.21   After reviewing the institutional design, we turn to the mechanism design decisions that regulate the relations between parties. Some limited characteristics are given in Table 5.3 below.

5.22   The Chilean regulator, employing sufficient resources for a mechanism that involves the determination of tariffs using a benchmarking procedure, mainly ex ante information but with some ex post correction for firms' rents using the capital asset pricing model (CAPM). The high-powered scheme is run for 5-year periods in a compromise between the information revealed in the period, the administrative costs and the commitment problem. Floors on the minimal industry return provide the firms with ex ante commitment against expropriation of assets and capital.

5.23   The Jamaican regime is a low-powered regime with very high levels of rent where the concessionaire unilaterally requests rate reviews. The mechanism is consistent with the institutional design, given the disequilibrium in favor of the firms. The use of information collected in the period is limited by the institutional design, thus a low powered system ex post is the only effective check against excessive profits.

5.24   The telecom grid operators in the Philippines are subject to a low-powered regime with weak ex-ante commitment and ex-post settlement. However, it is not the revealed information that decides the final reimbursement, but political pressure on the weak agencies. Not surprisingly, no foreign firms have been lured by the free entry to challenge the incumbent, who rationally responds to the mechanism by lobbying and political capture.

5.25 The Venezuelan price-cap is should perhaps offer high incentive power, but the frequent reviews due to political capture of the regulator turn the scenario into a perfect demonstration of the ratchet effect. However, since the agencies are fully occupied to assure that the concessionaire does not lower its cost by deteriorating quality or slowing down grid expansion, the rents are fairly stable.

Table 5.3 Mechanism design in Chile, Jamaica, Philippines and Venezuela.

| Country	Regime	Commitment	Information	Settlement	Review period	Incentive power	Return on assets
Chile	Yardstick	EA	+	EP	5 y	High	Min 12%
Jamaica	Rate of return	EA	-	EP	Req	Low	Min 17.5%
Philippines	Rate of return	EP	-	EP	Req	Low	Max 12%
Venezuela	Price cap	EA	0	EA	3 m	(High)	-

Impact on productivity

5.26 As could be induced from the mechanism design analysis in Chapter 4, the productivity increases have been the strongest in Chile, stagnating at a high level in Venezuela and deteriorating in the low-powered regimes. The patterns are illustrated in Figure 5.3 below and are indicative of the productive efficiency of the concessionaires even in other production factors that labour.
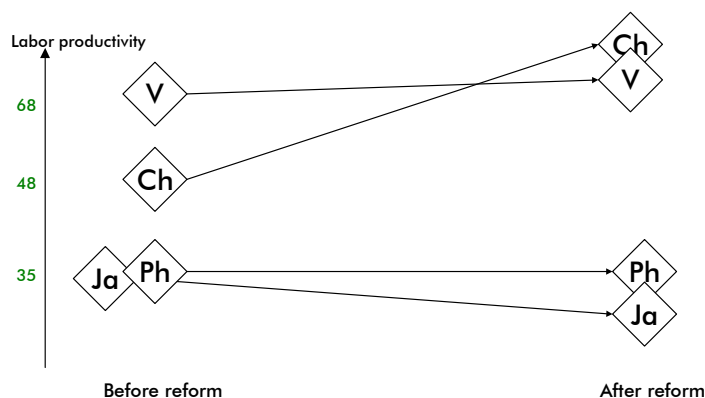
Figure 5.3 Impact on productivity.

Impact on quality

5.27   The service levels in terms of dependability (percentage of unsuccessful calls) and network expansion (% of pending demand) are given in Figure 5.4 below. Interestingly, the absolute quality is the highest in Chile under the yardstick system (1% failure rate) and lowest under the other high-powered regime in Venezuela (37% failure rate!), a striking demonstration of social losses in ex ante commitment with incomplete contracts. In terms of expansion rate, the Jamaican system shows high potential, but showed also the highest growth rate during the period after the reform. The Philippines shows equally high potential for expansion, but the growth rate actually decreased after the reform and is the lowest among the countries.
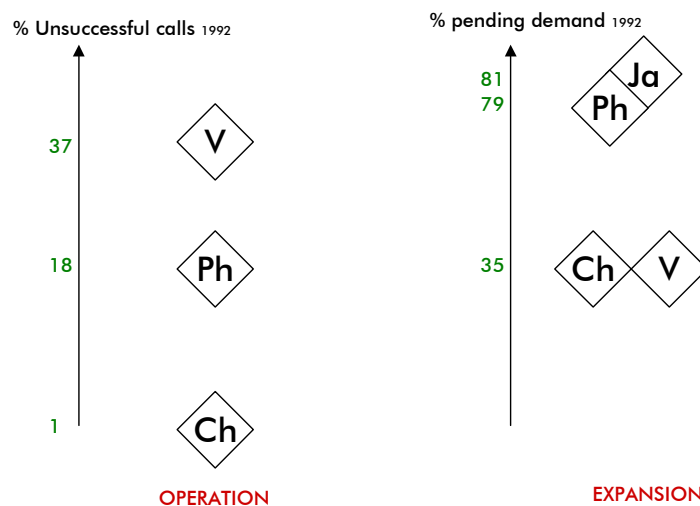
Figure 5.4 Quality indicators post reform.

5.28   We summarize the economic effect of the regulatory approaches (institutions and mechanisms) on firms on consumers in Table 5.4 below. In all countries the reforms increased the industry information rents, but only in Chile and Jamaica did the social welfare increase as well. The nominal low rates that discourage entrants in the Philippines (max 12%) are effectively circumvented by the incumbents information advantage, boosting the real returns to the highest among the four countries in spite of quality and productivity digress.

Likewise, the trigger-happy use of the information acquisition mechanism in Venezuela has had rather negative effects on consumer welfare as firms and agencies are in conflict. The positive effect in Jamaica is mainly attributed to the rapid network expansion that comes at a comparatively high price. Chile, finally, shows planned levels of industry rents under moderate increases in social welfare.

Table 5.4 Information rents (return on net worth, annual averages) and real changes in consumer surplus (changes in consumer surplus/sector average annual revenue) in Chile, Jamaica, Philippines and Venezuela.

Country	Return before reform	Return Post reform	Change in consumer surplus pre-reform	Change in consumer surplus post-reform
Chile	6.7%	13.8%	0.4%	0.5%
Jamaica	13.5%	20.5%	-13.4%	8.1%
Philippines	15.5%	25.7%	0.0%	-5.1%
Venezuela	-10.9%	21.7%	10.4%	-7.8%

Which are the Latin Lessons?

5.29   Regulatory reform is not only to find an optimal mechanism, nor can the absolute levels of social welfare be predicted in a vacuum. Low-powered regimes can give substantially higher rents to industry than high-powered ex-post regimes. To succeed in creating a viable regulatory approach, the choice of institutions, market definitions and instruments must be done simultaneously. Countries that have successful deregulations have established an institutional design that is characterized by independence and capacity to bridge to information asymmetry without resorting to consumer capture, while still leaving enough rents to the firms to ensure investments, quality service and market entry. When some of these conditions are absent, the equilibrium installs itself at a suboptimal level.

6.   Comprehensive Assessment

6.01   In this report on ex-post regulation, we have given a conceptual framework to analyze regulation (Chapter 2), by means of which we have contrasted three classical ex-post and ex-ante systems (Chapter 3) followed by theoretical (Chapter 4) and empirical (Chapter 5) demonstrations of our ideas about retrospective regulation. In summary, we have found ample support for the usefulness and potential welfare-increasing effect of the improved information solicitation in ex-post regulation. However, the subordinate and instrumental role of the ex-post timing has been underlined in several critical comments on regulatory approaches, mechanisms and instruments. Thus, the actual impact on the social welfare of the system actors is intimately connected to the effectiveness of the regulatory approach and how well the instrument is anchored in the chosen approach.

6.02   This Chapter is devoted to inspire an internal and introspective reflection on how the principles of the ex-post instrument can support some of NVE's organizational objectives. In our analysis that is loosely based on the conceptual model in Figure 2.1 above, we start with the principal decision maker's role, i.e. NVE.

### What is the future role of NVE in the electricity market?

6.03   From a more principal viewpoint, one may challenge the current and future position of the NVE in the regulatory approach. The choice of a predominantly forward-looking or retrospective mechanism can now be viewed as a signal of a regulation philosophy, where NVE assigns to itself a certain role. It is not in the scope of this project to evaluate these more principal issues, but it may nevertheless be of importance for the regulatory reform.

The Contractor in ex-ante regulation

6.04   In a regulatory approach that is dominated by ex-ante information, commitment and settlement, the regulator takes a proactive role as revenue-generator in the captive market. Acting as a contracting counterpart against the firms on behalf of the powerless captive clients, the regulator assumes an important role as market actor, negotiating delivery conditions, capacities, quality and allowable cost

with commitment powers for a regulatory period. Cf. Figure 6.1. The Contractor needs the ex-ante structure to balance its violated neutrality, exercising contracting powers requires a credible commitment guarantee to incite investments. Although internally consistent, the approach requires the Contractor always to be one step ahead of the industry in terms of output and input definitions, as well as in touch with the preferences of the clients. In industries under development or restructuring, this active role is a natural choice, since the preferences of the Contractor actually shapes the future market. In mature, decentralized, heterogeneous or technically complex markets, however, the Contractor carries a heavy and infeasible informational burden that likely gives substantial hikes in coordination and transaction cost.

EX ANTE

Revenue generator
Proxy contractor
Market engine
...

FIRMS ←→ Contractor   CLIENTS
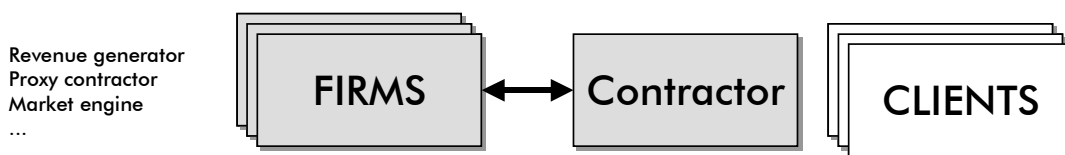
Figure 6.1. The Contractor role in an ex-ante regulation.

6.05   In between the rate reviews, the Contractor-regulator exercises its monitoring role not so much to review the accounts of the firms, but to avoid moral hazard in the execution of the service and to verify that investments are undertaken in the correct amount and timing.

The Clearer in ex-post regulation

6.06   In regulation approaches where the ex-post dimension dominates the mechanism, such as in competition regulation or in the Swedish electricity regulation, the explicit assumption is that firms contract freely with the clients under some fairly general (ex-ante) rules. All technological development, the service dimension and investment policy rest at the firms' responsibility. The regulator now acts retrospectively to enforce and settle reimbursements and conflicts ex-post. If we ignore the minimalist intervention role of the market "police" in competition law, the role is more that of a Clearer in a market space that lacks transparency and natural incentives for information dissemination. The Clearer reviews selected information concerning the aggregate "offer" of the firms and may intervene

when the individual contracts deviate too much from the "efficient" market conditions. In practice this translates, e.g., to the administration of yardstick regimes on pre-agreed terms. The output performance is not capped or guaranteed by the Clearer-regulator, which also leaves the opportunity (and incentive) for firms to develop complementary technologies to satisfy demand at various levels. The competence profile of the Clearer is not so much on the technical, as on the economic side. The choice of the retrospective mode is consistent if the Clearer maintains a strictly neutral and long-term view of the market developments, referring again to the institutional guarantees against ex-post opportunism. Thus, here commitment does not need to apply to the information revelation if the mechanism fulfils some elementary conditions (cf. Chapter 4). The analogy underscores this difference in the expected reactions from a market clearer (like an auctioneer) as opposed to a contractor (like a purchase manager) when a seller truthfully announces a high ex-post profit level. Whereas the auctioneer without much excitation may disseminate the information before the next auction to inform the buyers, the contractor rages at the effects of his failure to negotiate.
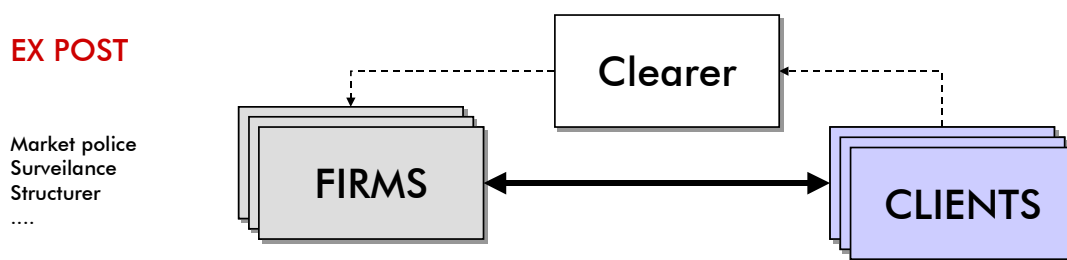
Figure 6.2 The Clearer role in an ex-post regulation.

6.07   The Clearer works in a continuous pace, but since its active intervention is not necessary for the market transactions, he may exercise a certain discretion with the extent and frequency of its monitoring. The Clearer-regulator does not spare any energy to render the market more efficient by disseminating information, prices and performance to clients and firms. Whenever necessary, and even ex-post, the Clearer must impose rules that improve the transparency of the market and leverage contractual inequalities. Thus, the role lends itself naturally more to supporting learning, competition and development. However, since the biggest threat to the Clearer is industry collusion, a clear and effective structural policy is imperative.

Strategic uncertainty and choice of role

6.08   As we have seen in Chapter 4, the benefits of delegation of decision rights in network industries under asymmetric information are great. Under high ex-ante commitment due to the institutional design, the regulator faces a high strategic uncertainty in terms of technological development and unmapped service dimensions. Not only are some central decision centralized, at a high informational cost, but there is also a risk that future operations are distorted by an obsolete or overly restrictive process model. In a parallel pre-project 5, we are investigating incentives for investments in non-grid technologies by regulated firms. Preliminary results from this forthcoming study indicate that effective multi-utility regulation under uncertainty may be more effective the less a priori structure that the regulator has imposed. In practice, a regulation approach with more ex-post instruments offers more flexible solutions to handle this output definition problem by using delegation and liability. Such approaches also offer advantages in the long run, should the market become more contestable. The Clearer-regulator operating in a more silent and long-run mode could then gradually reduce the interventions as the market itself fulfills the functions. To achieve the same effects with the Contractor, substantial hard-handed market intervention may be necessary, which might be inconsistent with established commitment principles.

Regulatory continuity and reform

6.09   Theory and empirics show unanimously that a credible reputation, a regulatory track record, is gold worth in terms of regulatory risk premium, irrespective of regime. Although the current regime has some structural traits that correspond to the Contractor role above, we have shown in a detailed analysis that the NVE scheme is rich and opens many possibilities for further use. Thus, rather than completely scrapping a well established system and risking lowered credibility for the replacing regime, we argue that the further studies in Chapter 7 should aim at a careful evolution of the existing regime in the indicated direction, rather than a more revolutionary change. Such gradual reform signals two important reputation effects: long-term commitment (by offering continuity) and independence (by implementing welfare-increasing reforms that refine the market).

Rents up for grabs

6.10   NVE, as most regulators, has been vested with the objective to maximize the social welfare on the electricity market. As discussed above, this objective implies simultaneously the inducement of efficiency and an allocation of surplus among producers and consumers. Economists usually stresses the first point, which may explain the early popularity of the price-cap schemes, whereas managers and clients stress the second, which determines the activity level and budget of the enterprises. We take a comprehensive view on the problem under the hypothesis that mere operating efficiency is not a sufficient condition for a long-term viable industrial structure in a regulated industry. Excessive or minimal rents, although irrelevant from an efficiency viewpoint, do impact the type, competence and strategy of the market actors. Excessive rents, awarded by a high-powered regime, may act as a "golden cage" for the firms, making them more willing to cooperate in market and product development, provided that the regulator is active. The exploding technological development in the telecom sector is a good example. Minimal or negative rents, if prolonged or proscribed, may create an adverse selection problem where only passive and disinterested owners (public?) accept the conditions, having impacts on the overall functioning of the sector. The European rail transport sector and the Philippine situation in Chapter 5 are examples of this problem.

An attempt to summary

6.11   In Table 6.1 below, we summarize some of the main differences between the two instruments along the previously introduced criteria in Chapter 3. As stressed already several times, the actual NVE scheme should not be equalized with the left column, which for clarity deals with a pure ex-ante system such as the Anglo-Saxon CPI-X system.

Table 6.1 Summary assessment of instrumental differences.

System cost/issue	Ex-ante instruments	Ex-post instruments
Coordination costs		
Investments	Correct incentives for cost-saving but discouraged late in period and for quality	Decentralized, level depends on incentive power, risk for overinvestment
OPEX	Strong incentives for cutting in pure ex-ante	Incentive power decides, important to construct benchmark and to control common risk
CAPEX	Has to be foreseen by regulator, dubious market intervention	Given by firms if no hit-and-run concessions are awarded
Innovation	Unless cost-cutting, delayed and distorted	Promoted to achieve differentiation from benchmark
Quality	Disincentives, firms may align at base level	Promoted as differentiation if benchmark allows
Motivation costs		
Industry rents	To avoid exit, normally generous. Caps reduce incentives and create multi-level distortions	Determined by yardstick and incentive power. Effectiveness presumes that high rents can stay
Distortions – regime	Less informed regulator defines service, value and operating risk premium	Coordination gains from integration blocked by information gathering regulator
Distortions –rents	Low level performers raise rents for efficient firms	High performers may drive out low performers
Transaction costs		
Regulator	High before reviews, heavy responsibility for production parameters and service regulations.	Lower, continuous work on information, benchmarking and structural design
Firms	Medium, higher if output regulation enforced (quality etc)	Medium, increases under annual reporting, but delegation facilitates planning
Clients	None	Some information gathering if contracting decentralized
Regulator's focus	Rent reduction at reviews, moral hazard during periods	Market information and anti-collusion measures, learning

Predicting the impact of regulatory reforms

6.12 Whatever the legal or economic wrapping, all regulation approaches create their own equilibrium. It carries with it an implicit incentive system, which eventually will have an impact on the sustainability of the regime. Incentives do not even need to be monetary; they can also be given or retained as contractual conditions, workloads, rewards and fringe benefits. Low-powered regimes, for example, give no incentives to cut costs, but to increase budgets to gain managerial prestige, flexibility and professional satisfaction.

6.13 To anticipate the final result of a proposed change to a regulatory mechanism, it is necessary to understand the objectives of the regulated suppliers and the role of the mechanism in the chosen approach. Two methods are to be avoided in this context: the historical and the patchwork.

6.14 When reviewing regulation, history may suggest that firms behave in a certain way. Unfortunately, this is of low predictive value. The past behavior and performance is contingent on past incentives. Issues as ownership, tenure, overall profitability and regulatory commitment all affect the incentive preferences of the firms, and even small changes in the regulation may change the market conditions and culture. Leaving a flawed legislation unaffected, under the reasoning that the socially responsible actors will not abuse it, is to set a price for "social responsibility". The idea of market liberalization is that the diversity of economic agents will lower prices and enhance quality, provided the incentives are right. Poorly designed mechanisms are an easy prey for the very same diversity that is the blessing of the solid and sound markets. Recent manipulations of auctions, concessions, cost reimbursement plans and other regulation confirm this and emphasize the need for proper incentive analysis.

6.15 The second danger lies in the idea that a reform can be introduced in a piecemeal and segmented manner. According to this line of thought, contracts, benchmarks and service regulations are used as fire extinguishers by the regulatory fire squad as soon as some hot issue is in full flame in the public eye. The result is often a patchwork of complicated rules, subsidies, caps, floors and bonuses for some random performance indicators, technical processes, fuel choices, staffing policies etc. The legislators' intention, however benevolent, is flawed by the message that there is no coherent regulatory strategy, no sound long-term incentives and no anticipation on behalf of the principal. The same shortsightedness that characterizes the

patchwork knitters will be promoted in the regulated industry, to the demise of social welfare. When choosing regulatory regime, soundness, coherence and clarity are essential principles for a viable mechanism.

The Way Ahead

6.16   The Norwegian electricity market and industry, including generation, transmission, regional and local distribution and retail, are among the most well functioning in the world. Firms as well as regulators have shown adherence and consistency in the early unbundling and market formation process, although perhaps the scope of the reform has yet to be fully understood by the final clients. In a transition from a cost-recovery tradition, the regulator launched an ambitious scheme with an ex-ante flavour to signal a behavioural change towards cost efficiency under stable conditions. Now the market maturity has caught up with the regulator and it may be time to refine the instruments in the lines of information decentralization and competitiveness. In this report, we have shown the features of such instruments and how they can be used to support a sound and viable division of roles in the market. It is now up to the market actors in the upcoming reform to converge upon a common vision of the future regulatory approach, in which these instruments then follow logically in their corresponding mechanisms. In the next chapter, we suggest some further studies that could facilitate this process by providing operational and strategic advice to inform the process. In any case, considering, ex-post, the state and readiness of the market, we have no hesitation, ex-ante, to doubt the lucidity of the future policies.

7. Further Work

7.01   In this Chapter, we sketch some further projects that may provide NVE and OED with necessary information to make the strategic decisions discussed. Overall, the suggested projects follow the conclusions in the previous chapter, i.e., regulatory continuity and rigorous instrumental and mechanism analysis.

A. Incremental improvement strategy on old system

7.02   A promising implementation strategy of ex-post instruments would be to thoroughly investigate how the elements of the existing model can be reinterpreted in an ex-post framework for commitment, information and settlement. Most evident is of course the efficiency improvement parameter X that could be estimated ex-post. The possible provisions on the underlying DEA models should be discussed, as well as the periodicity and incentive power of this element. The current ex-ante quantity adjustment IQ*IP may also be substituted for $C^{DEA}_{t+1}(y^{t+1})/C^{DEA}_t(y^t)$, i.e., the ratio of efficient costs at observed quantity both periods. The study could also investigate other mechanisms in the spectrum between the present Norwegian CPI-X scheme and the yardstick scheme, including schemes with less than full use of the new information, schemes with sliding scale / earnings sharing etc. These and other potential incremental changes should be investigated analytically and using past and simulated data to assess the impact and tune the parameters. The result of this study should be an ordered list of elements that could be changed, along with a qualitative and quantitative analysis of their impact upon the effectiveness of the reformed system.

B. Menu of grid-contracts

7.03   Along the lines of delegation and information revelation, it would interesting to investigate how coordination and motivation could improved using menus of contracts. Such approach may combine the strong economic theory support with the flexibility of a more decentralized regime. Some key issues to be answered in this study are which information that actually can be revealed by firms during a 1, 5 and 10 year horizon, what is the magnitude of the coordination and motivation gains, which should be the allocation of decision

rights and roles in the contracts, and how the approach interfaces with strategic issues related to industrial structure (ownership, multi-utility integration) and innovation (non-grid technologies), i.e., the specificity of the contracts vs. the value of the information acquired.

C. Yardstick design: asset valuation

7.04   To avoid distortions in yardstick regulation, it is important that the underlying model adequately reflects not only the objective exogenous operating conditions, but also the economic value of the resources allocated to the task. Many regulators have faced problems in the input definitions of grid assets under mixed ownerships, where the estimation errors may influence the entry and succession in the market. In the Netherlands, capital costs where re-estimated and normalized to avoid subnormal rents in yardsticks due to subsidized sunk investments. In Sweden and Spain, the asset base is valued completely exogenously using green-field planning tools, which separates operating efficiency from investment efficiency that could be cashed out in transfers. Other countries have used accounting conventions, with potential information problems when assets are acquired, transferred or refurbished. This project will critically investigate the long-term sensitivity of the yardstick regime to asset valuation and suggest some strategies to alleviate the problem.

D. Transition strategies for NVE

7.05   Depending on the outcome of an internal reconsolidation process at NVE, the reform may comprise non-trivial changes to the existing regime. A strategic and exploratory study should provide advice on the optimal transition sequence between mechanisms in order to assure organizational objectives of consistency, commitment and coherence, but also economic criteria such as market structure (governance, dominance, integration) in the medium time perspective. The regulators in the Netherlands and Sweden have undertaken similar studies to anchor their phased transitions towards more elaborate regimes. The relevance of the project is proportional to the evolutionary (A) or revolutionary (B) character of the reform.

E. Optimal regulatory approach in Norway

7.06   An inspiration to the interactive pre-reform decision and anchoring process may be provided by an exploratory study on optimal institutional design (approach, mechanisms, instruments) for the Norwegian energy market. The study is founded in the theory of industrial organization and regulation economics and draws on recent work on endogenous market design that has been implemented by e.g. the World Bank. Rather than presenting the results in the format of a traditional report, the study might be used for scenario playing with NVE and firms in an open discussion. Such exercise, if adequately prepared, may also serve the purpose of ensuring market endorsement for critical reform elements.

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