Bremer Energie Institut

Bremen Energy Working Papers

Paperseries No. 05

Gert Brunekreeft and Roland Meyer

Regulation and Regulatory Risk in the Face of Large Transmission Investment.

February 2011

In Cooperation with Jacobs University Bremen

JACOBS UNIVERSITY

Herausgeber/ Editor:

Bremer Energie Institut

College Ring 2 / Research V

28759 Bremen

Tel. +49 (0) 421 - 200-48 88

Fax +49 (0) 421 - 200-48 77

info@bremer-energie-institut-de

www.bremer-energie-institut.de

Ansprechpartner:

Katy Jahnke

Tel. +49 (0) 421 - 200-48 91

Fax +49 (0) 421 - 200-48 77

E-mail jahnke@bremer-energie-institut.de

Vorgeschlagene Zitierweise/ Suggested citing:
Autor, (Jahr), "Titel", Bremen Energy Working Papers No. #, Bremer Energie Institut.

Regulation and Regulatory Risk

in the Face of Large Transmission Investment

Gert Brunekreeft* and Roland Meyer[1]

***Corresponding author**

Jacobs University Bremen / Bremer Energie Institut

College Ring 2; D-28759 Bremen; Germany

Tel.: (0049)-(0)421-200 3497, Mail: g.brunekreeft@jacobs-university.de

27 January 2011

Abstract

Most transmission systems in Europe are currently in need of large network expansions, in particular to cope with increasing shares of load remote renewable energy sources. Given that the scope for further cost reductions is largely exhausted, we observe a paradigm shift into the direction of implementing more cost-pass-through elements into price-based regulation to strengthen the necessary investment incentives. Regulatory emphasis is shifting from cost-reductions to promoting investment. Obstacles to investments arise in particular from regulatory risk and efficiency risk. Addressing these topics, we recommend a move towards more cost-based approaches, with ex-ante investment approval and less reliance on ex-post benchmarking.

Keywords: regulation, regulatory risk, network investments

[1] The authors gratefully acknowledge support and useful discussions for this research project from Amprion GmbH.

1 Introduction

The European transmission networks currently face large investment needs. On the one hand the aging of networks requires replacement investments, while on the other hand expansion investments are needed to meet environmental targets. The background of the latter is the large-scale integration of renewable energy sources. Beyond direct network connections this leads to a systematic change in network flow patterns. Notably, the increasing share of load-remote wind energy that is mainly concentrated at the more windy coastal areas leads to a fluctuating feed-in of electricity which needs more transmission capacity in the direction of load areas. This is particularly the case for the integration of the increasing capacities of large offshore wind farms. The German Energy Agency ("Deutsche Energie-Agentur") recently forecasted a grid expansion need of 3,600 km new overhead line routes for Germany by 2020 (which equals approximately 6,600 km circuit length). Together with the grid expansion projects identified until 2015 (3,000 km circuit length) this means an increase of 25 percent of transmission lines within 9 years compared to an overall network length of existing high voltage lines of approximately 36,000 km. The European Network of Transmission System Operators for Electricity (ENTSOE), an association representing 42 European Transmission System Operators (TSO), recently published its Ten-Year Network Development Plan (TYNDP). According to the TYNDP, Europe may be facing transmission expansion of 42,000 km by 2020, of which 35,000 km are new lines and 7,000 km are network upgrades. We find comparable investment needs in the US energy sector.

In the face of these developments, investment incentives for network operators have moved into the focus of discussion regarding necessary adjustments to the regulatory framework. The paradigm shift from former cost-based to price-based or incentive regulation raised the question whether the issue of investment incentives is adequately addressed, given that the focus of price-based regulation is mainly on efficiency incentives. At the moment there seems to be another paradigm shift in regulatory focus into the direction of implementing more cost-pass-through elements for capital expenditures.

This contribution studies some aspects in the regulatory debate on the incentives and disincentives for investments in transmission network expansions. Investigating the typical features of network regulation, we conclude that major concerns about investment incentives are related to the regulatory lag, regulatory risks and efficiency risks. Steps forward are to approve investment budgets ex-ante, to rely less on benchmarking, to strengthen investment incentives by an OPEX-CAPEX-split, and to provide rate-of-return-adders.

In section 2 we describe the main issues of regulation and investments in energy networks. Section 3 analyses the regulatory investment risks in more detail. In section 4, we discuss the problems of efficiency risks caused by TOTEX benchmarking. Section 5 steps into investment budgets and sliding scales. Section 6 concludes.

2 Regulation and investments

Thinking about monopoly regulation, we should distinguish two extremes (cf. Joskow, 2006). One polar case is cost-based regulation and the other polar case is price-based regulation. Under cost-based regulation any changes in the costs of the firm are fully passed through to consumers. Traditional forms are the typical rate-of-return regulation or cost-plus regulation. Price-based regulation intentionally cuts the link between allowed revenues or prices and the costs of the firm. Thereby it mimics competition: the typical cornershop cannot increase prices just as its individual costs go up. It will have to go with the market. Examples are price-caps, revenue-caps, RPI-X regulation and yardstick regulation. The idea of the price-based regulation is to set incentives for cost reductions. If allowed revenues and underlying costs are not related, then the firm has strong incentives to reduce costs as this translates into higher profits. With full cost-pass-through, cost reductions must be passed through to consumers in the form of lower prices and therefore effort to reduce costs is fruitless. In between the extremes, we find “sliding scales”, which create partial cost-pass-through mechanisms, also called “revenue sharing”.

Another way of looking at the two extremes is who bears the risk. With full cost-pass-through all risk is shifted to consumers; with price-based approaches, the investors bear the risk. Therefore, we might say that the cost-pass-through factor in a sliding scale is also a risk-sharing factor (cf. esp. Grout and Zalewska, 2003). An advanced development is the “menu of sliding scales” where the regulated firms themselves determine the cost-pass-through factor and therefore reveal their willingness to accept or avoid risk. The menu to choose from consists of a set of risk-return options, such that a higher level of risk acceptance is compensated with higher regulatory returns and reverse.

Price-based regulation was intentionally designed for a world with “inefficient” monopolies, as the general perception was that companies had built up significant inefficiencies before the wave of liberalization. Therefore, any regulatory framework for liberalized firms should set incentives to improve efficiency and pass through (part of) the cost savings to end-users. This works if costs go down. If in contrast costs go up, the effects may go into the opposite direction. Currently, it seems that many TSOs around the globe have had ample time to squeeze out the ineffciency, so that the scope for further cost reductions is rather limited. At the same time, as indicated above, many TSOs worldwide face very substantial investment requirements which increase costs to a significant extent. This applies in particular to Europe and Germany where the installed renewable production capacity increases at fast pace. Thus, the underlying cost driver is currently changing: the question is no longer how to improve efficiency but rather how to promote invesment at reasonable costs. As a result, it appears that a change in the regulatory approach is taking place: a move away from strict price-based models to more cost-pass-through approaches. The challenge is to combine price-based models with cost-pass-through components to create efficient investment incentives. The regulatory framework needs to set incentives for investment that is necessary, avoid unnecessary investment, and secure that investment comes at least costs.

Literature on the relation between regulation and investment starts to develop. One of the more prominent examples is the survey by Guthrie (2006). We note that the body of Guthrie’s (2006) analysis is driven by the (implicit) assumption that investments are cost-reducing and thereby conforms precisely to the main intention of price-based regulation. Our line of argument, however, focuses on expansion investment which normally increases costs. Therefore, all the typical effects seem to be reversed. The literature seems to head into a direction that price-based regulation may promote short-run efficiency (cost reduction), but may impede (cost-increasing) long-run investment. Below we discuss four arguments supporting this claim.

Cost of Capital: Risk-adjusted Rate of Return

The 'buffering hypothesis' put forth by Peltzman (1976) explains the effect of market risk on the regulated firm: “Regulation should reduce conventional measures of owner risk. By buffering the firm against demand and cost changes, the variability of profits and stock prices should be lower than otherwise. To the extent that the cost and demand changes are economy-wide, regulation should reduce systematic as well as diversifiable risk.” The crucial factor is how much of the shocks can be passed through to customers. Profit-maximizing prices of a firm with market power pass through only some of the demand and cost shocks, absorbing the remainder; consequently, profits vary with demand and cost shocks. The investment in the rate-of-return-regulated firm gives moderate, but safe, returns.

It is a different story for firms regulated with price-based regulation (say, a price cap). Restricting attention to systematic, nondiversifiable risks, Wright et al. (2003) examine the case of price caps in detail. They conclude that the cost of capital is higher under price-cap regulation than for an unregulated firm, and therefore (following the buffering hypothesis) as compared to a rate-of-return regulated firm, if there is cost uncertainty. This is intuitive because, if costs change while prices stay the same, the variability in profits will be strong.

To conclude, price-based regulation increases risk of uncertainty for the regulated firm as compared to cost-based regulation. The consequence of this is that different types of regulation should apply different risk-adjusted rate of return on capital to reflect the appropriate cost of capital of the investment (Grout & Zalewska, 2003).

Quality of Service and the Reduction of Gold-plating

There is justified concern that price-cap regulation impedes investment in quality of supply (QoS), which is an important indicator of network adequacy (and reliability). The incentives for a monopoly to invest in quality under different regulatory regimes have been studied extensively by Spence (1975) and Sheshinski (1976). First, it should be noted that an unregulated monopolist need not but can have incentives to set optimal quality; the details depend on the effect of quality changes on the demand function. To be precise, the change in quality should not alter the slope of the demand function. Secondly, note that quality can be too high. As the classic form of rate-of-return regulation is said to induce excessive quality, one might expect quality to go down in many cases as a result of implementing price-cap regulation. This does not imply that quality would be too low. Thirdly, note that quality changes can be triggered by investment, which is capital expenditure (CAPEX), or alternatively by improving and maintaining existing assets, which would be operating expenditure (OPEX). In regulatory practice, capital and operating expenditure can be treated entirely differently, and hence the incentive on quality may differ.

What does the literature suggest? With fixed prices, quality will be lower than optimal (Spence, 1975). In economic terms, a quality improvement shifts the demand function outward. With a price increase, part of this additional willingness to pay can be captured in additional profits. A price cap does not allow this price increase, and as a result the quality improvement does not take place to its full extent. In the short run, price caps set a rather straightforward incentive to cut costs at the expense of quality as prices need not be adjusted downward under price-based regualtion.

Ter-Martirosyan (2003) and Kwoka & Ter-Martirosyan (2008) find interesting effects in an econometrical analysis for the US. First, they find detrimental effects of price-based regulation on SAIDI (the duration of supply outages), but not on SAIFI (the frequency of outages). Moreover, they find that quality regulation offsets the detrimental effect on SAIDI, but not on SAIFI. SAIDI (duration) is among other things determined by the speed of repair of disturbances and is typically OPEX driven. This is typically a short-run effect and easy to manage. SAIFI (frequency) is almost exclusively determined by network investment (CAPEX) and is a long-term effect.

Timing of Investment

Much of the analysis on investment covers the capacity and quality questions, whereas the issue on the timing of investment is short of attention. Brunekreeft & Borrmann (2010) develop a formal approach to study the effects of different types of regulation on the *timing* of monopoly investment. The main comparison in the analysis is price-based versus cost-based regulation. Price-based regulation means that the investment does not affect regulated prices. Under cost-based regulation, a cost-increasing investment would trigger higher allowed prices (i.e. cost-pass-through).

Investment only makes sense if something changes. Brunekreeft & Borrmann (2010) work with two types of dynamics. First, “wear and tear” causes variable production costs to increase over time. An investment lowers the variable production costs at the expense of higher cost of capital. Second, demand growth implies that at some point in time it may be profitable to expand capacity. Note that without such assumptions, there will be no reason to invest in the first place. Using these two types of dynamics, two types of investment can be examined. First, 'replacement investment', which follows from wear and tear, and second, 'expansion investment', which follows from demand growth. The effects of regulation on the timing of investment are different for replacement and expansion investment. The main finding in Brunekreeft & Borrmann (2010) is that cost-based regulation accelerates the investment moment. Thus, if the regulator's priority is to speed up investment, it should seriously consider using rate-of- return-adders for investments.

It should be noted, however, that speed of investment is not the same as efficiency; investment can also be too early. As worked out in Brunekreeft & Borrmann (2010), if efficiency has main priority a more differentiated picture appears.

A promising approach to accelerate investments is to treat "old" assets differently from new assets (investment). Conceptionally, rate-of-return adders do exactly what cost-based regulation does: they trigger an increase in revenues as a result of an underlying cost change.

In the US such adders were initiated by the Federal Energy Regulatory Commission in its Order 679 (see FERC, 2006). Since most utilities fall under regulation of the states' Public Utility Commissions (PUCs), the regulatory framework offers only little incentives for network investments aiming to integrate the states' electricity markets. With Order 679, FERC introduced "incentive-based rate treatments", consisting of a couple of mechanisms to strengthen investments incentives to improve market integration. As elements of these treatments, rate-of-return adders should be granted for grid investments meeting at least one of the following two criteria. First, the investment removes network congestion and would therefore reduce price differences between markets (economic investments). Second, the investment contributes to supply security and system reliability (reliability investments). Although only few practical examples for granted adders can be found, they appear to vary in the range of 1 to 3 percentage points on the overall invested capital (equity plus debt).

A similar arrangement has been introduced in Italy, where adders of 2 or 3 percentage points are granted on the total invested capital for a period of twelve years. Investments that increase transmission capacity or increase network reliability according to the network security plan receive an adder of 2 percentage points. An adder of 3 percentage points is granted for investments that reduce congestion within or between market areas, including cross-border capacities (see AEEG, 2007).

Another example for return-top-ups is given by France for the case of gas transmission investments. The France energy regulator CRE gives a regular adder of 1.25 percentage points for all investments. This top-up can increase by up to 3 percentage points in case of investments which are regarded important for market development.

Time inconsistency and regulatory uncertainty

Time inconsistency may appear in cases of conflicting short-run and long-run goals. The best economic example is monetary policy. In the short run, politicians will be tempted to reduce unemployment at the expense of (short-run) higher inflation. In the long run, this achieves nothing but higher inflation. In the long run, a low inflation target basically ignoring effects on national output and employment is best. Hence, the time inconsistency is that the long-run policy of a low inflation target is overrun by the short-run, low-unemployment, high-inflation trade-off.

For the context of regulation, it is claimed that time-inconsistency is higher under price-based regulation than under cost-based regulation. Basically, the argument is that cost-based regulation follows a reasonable rate of return, whereas price-based regulation has no such reference. Therefore, the regulatory commitment to long-run, sunk investments is lower and regulatory risk is higher, and thus we would expect a detrimental effect on investment activity.

The precise line of argument relies on one-sided upward capping and is best illustrated by Gans & King (2003). We illustrate this with an example. Assume an investment project with sunk costs and high demand uncertainty; the project can be a success or a failure. Assume that these events have the same probability (0.5). Assume further that unregulated rate of return in case of success would be 12% and in case of failure, 8%. The expected rate of return will thus be 10%. Now assume that the project will be price cap regulated, aiming at 10%; in the case of good demand, the cap binds and the rate of return will be 10%, while in the case of poor demand the cap does not bind and rate of return will be 8%. The expected rate of return under the price cap regulation is thus 9%. If investors require 10%, then the investment will not take place. The problem is one-sided upward capping and downward market risk. Principally, the problem could be solved by allowing a 12% rate of return in good times. But here is the regulatory commitment problem. The 12% rate of return only bears any relation to ex ante risk expectations (which may be quite far in the past); it does not relate to actual underlying costs and as a 'real' cost benchmark is lacking, the regulator will have difficulty justifying this. Alternatively, if the sunk investment has been made irreversibly, an opportunistic regulator may be tempted to simply ignore the past expected value and go down on real costs in times of good demand. It is difficult to achieve a credible regulatory commitment.

In the US, the so-called Hope supreme court decision of 1944 established that regulated investors are at least entitled to a "fair and reasonable" rate of return on invested assets. This ruling decreased regulatory uncertainty which in turn triggered a wave of investment in the gas pipelines (see Makholm, 2006, p. 16/17). To avoid automatic cost-pass-through, possibly leading to inefficient investments, regulators started to apply the "used and useful rule"; in some cases, where investments were considered to be superfluous, CAPEX were not allowed to be fully passed through leading to substantial write-offs on asset values (see Lyon & Mayo, 2005). Yet, as argued by Gilbert & Newbery (1994), used-and-useful rate-of-return regulation (UUROR) may strike a good balance between short-run and long-run goals and may thus be a good policy to achieve efficient investment incentives. In a slightly different context, Vogelsang (2009) argues along the same lines.

3 Regulatory risk

The regulatory risk of a network investment relates to the question whether and to which extent an investment is included in the regulatory asset base and is refinanced over the asset life time.

As explained above, the current regulatory debate is driven by very substantial investment requirements. We observe two major developments in regulatory practice. First, a move from ex-post control of the usefulness of an invesment to an explicit ex-ante approval procedure. This reduces regulatory uncertainty. If ex-post uncertainty is high, obviously investment incentives are low. It was not uncommon to apply a used-and-useful test after the investment (ex post); this would happen for instance if there is no explicit investment approval procedure, but an efficiency check with ex-post benchmarking. This is acceptable, if investment needs are low. If investment needs are high, this procedure becomes risky. We observe a move towards ex-ante approval procedures to deal with regulatory uncertainty. The second development, which follows from the first development, is a reduction of the value of benchmarking. If the investment has already been approved ex ante, it would be a regulatory mistake to make an additional test ex post, which is what an ex-post benchmark does. We observe that a movement towards a two-tier approach: ex-ante approval as a used-and–useful test, and an ex-post benchmarking to test for least costs of the investment.

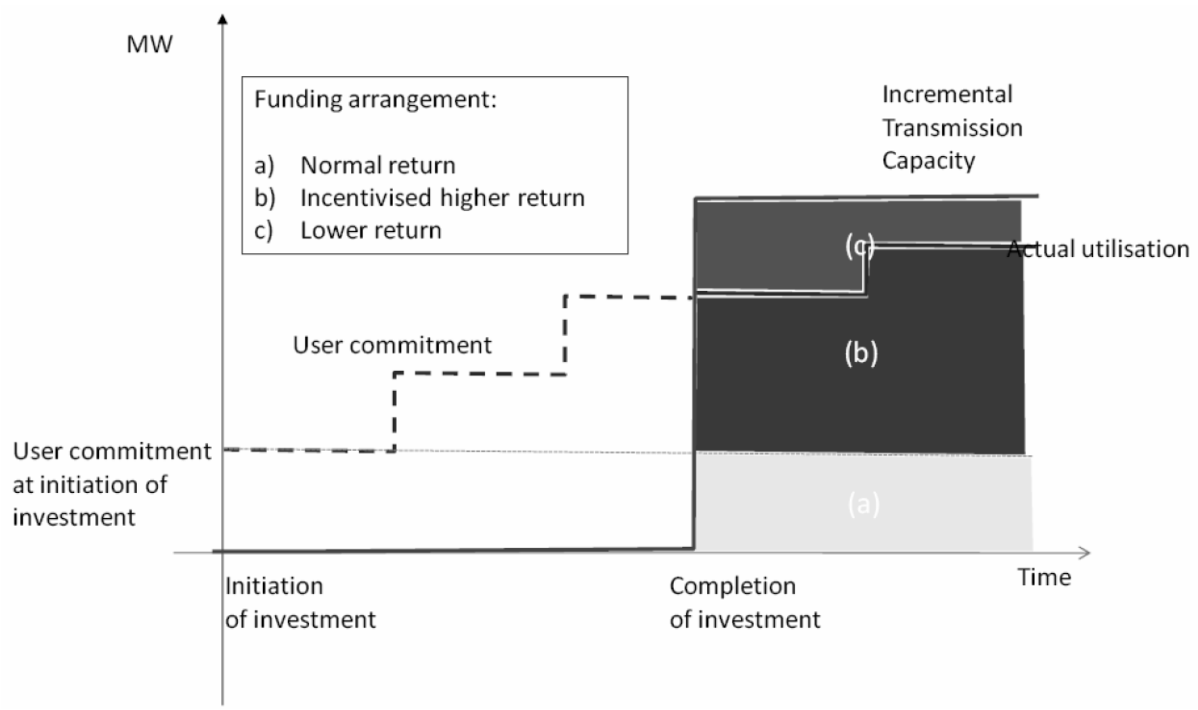
If there is an ex-ante approval procedure, the ex-post benchmarking should if at all only test for *efficiency* and not for *necessity* of the investment. This can be done and depends on details of the benchmarking. This basically relates to the question which output is used in the model. The two alternatives to capture the main output of a network are to use either the *size of the grid* (e.g. physical network length) or the *network flows* (e.g. MW of power transmitted). If the size of the grid is chosen as output, the network itself is taken as given and only the cost efficiency of the existing grid is tested. The reason is that this specification acknowledges a larger network as a valuable output of the TSO instead of questioning whether the network might be too large for given power flows. If instead actual network flows are benchmarked, the network may be deemed inefficient if the line is not fully used; therefore, despite ex-ante allowance by the regulator, the investor would still face a used-and-useful penalty resulting from the benchmark. Therefore, ex ante approval and ex-post benchmakring can easily be inconsistent. This tendency of benchmarking exercises to induce risks can be generalized. In the light of the uncertainties surrounding the methodologies applied, the parameters used and the benchmarking partners chosen investments which are benchmarked ex post are less reliable from an investor's perspective.

An example for the regulatory use of benchmarking to derive efficiency targets for transmission system operators and where this problem has been considered is given by the ECOM+ project developed by Agrell & Bogetoft (2006). The project was commissioned by the regulators of Austria, Denmark, the Netherlands, Norway and Portugal. The model was further developed to the e^3 GRID PROJECT (Agrell & Bogetoft, 2009), in which 19 European Regulators and 22 transmission system operators participated. The approach is a Data Envelopment Analysis (DEA) which uses TOTEX as the only *input*. Capital costs are calculated on the basis of standardised asset lifetimes. The *outputs* (cost drivers) are represented by a normalized size of grid, connection density and the capacity of renewable energy that is connected to the grid. Methodologically, this benchmarking specification does not test for network utilisation, since network lengths (instead of network flows) are chosen as outputs. This type of benchmarking addresses the regulatory risk, but still the efficiency risk remains, which is further discussed in the following section 4.

An interesting variation of how to deal with the uncertainty of the market and therefore the uncertainty of used-and-useful regulation is a scheme which was suggested by the UK energy regulator Ofgem. Ofgem has acknowledged the risk of those *anticipatory investments* in face of uncertain future capacity needs. Previously, the British TSOs were required to have a legal *commitment* by generators before investing in network expansions to connect new generation assets. In absence of such a commitment, they were exposed to the risk that network assets did not (fully) enter the regulatory asset base to be refunded by network charges. Realising that such an arrangement would either lead to a delay of network connections, might induce inefficiently small investment (piecewise investments), or may be too risky for the TSOs to provide incentives for timely investments, Ofgem started to rethink their regulatory framework. In its review of future network regulation named “RPI-X@20”, Ofgem recognises that a strengthening of investment incentives will be necessary to ensure that the ‘right’ amount of investments takes place in time.

Initially, Ofgem suggested an incentive mechanism to deal with the asset utilisation risk of anticipatory investments (see Ofgem, 2008). This mechanism considered three different rates of return for investments. The part of the invested capacity for which there was a user commitment at initiation of the investment, should earn the *normal rate of return*. For capacities above legal commitments, the rate of return should depend on the actual utilisation. The part of additional capacity that was actually utilised should earn an incentivised *higher return*. For the non-utilised capacity, a lower *rate of return* would apply. Figure 1 visualises this incentive mechanism.

Figure 1: Potential incentive mechanism to reflect asset utilisation risk



Source: CEPA (2010) based on Ofgem

The economic attractiveness of this incentive mechanism is that by adjusting the different rates of return, the risk sharing between TSOs and consumers can be balanced in favour of an efficient trade-off between investment and efficiency incentives. It turned out, however, that the Scottish TSOs did not support this incentive mechanism so that Ofgem opted for a simple and pragmatic approach (see CEPA, 2010). Accordingly, Ofgem will give stronger guarantees for a full pass-through of investment costs for TSOs to reduce regulatory risk.

4 Efficiency risk

Although often interrelated, we distinguish here between regulatory risk – as described in the previous section – and efficiency risk. As the main source of *regulatory risk* we identified the utilisation risk in cases where the regulated return on investment depends on a used-and-useful assessment by the regulator. However, even in cases where the usefulness of an investment is beyond doubt, regulatory incentives to ensure that investments are carried out at reasonable costs may result in what we denote as *efficiency risk*.

Under price-based regulation, efficiency incentives result from the X-factor that determines to what degree the TSO's revenues are reduced over the regulatory period. A common approach in regulation to determine X-factors is the use of benchmarking. Given a sample of comparable network companies, each company's inefficiency is estimated or calculated using either parametric or non-parametric benchmarking techniques. The idea of this procedure is to mimic competition between companies that actually operate as monopolies in distinct markets.[2]

These efficiency targets are relevant for investment incentives as soon as they apply not only to operating costs (OPEX) but also to capital costs (CAPEX) – in other words in case of a *TOTEX benchmarking*. This causes an *efficiency risk* for network investments due to the long lifetime of network assets of 40 years and more. Accordingly, the costs of an investment have to be recovered over a timeframe which is far beyond a regulatory period. Since the efficiency targets of future regulatory periods are not known at the time an

[2] The most consequent application of this mechanism is known as *yardstick regulation*. Under this form of regulation the price or revenue caps are fully determined by the benchmarking process so that the network operators' revenues are completely decoupled from their actual costs (see Jamasb & Pollitt, 2004).

investment is initiated, the return on investment is exposed to the risk of inadequate cost recovery. This may be a severe obstacle to network investments.

A main *methodological problem* of benchmarking is that its results are often sensitive and therefore – from the company's point of view – hardly predictable. The broad range of literature on the use of benchmarking for regulatory purposes shows that there is no consensus on how to measure inputs and outputs and how to control for structural differences between the sample networks to take account of the exogenous environmental influences on a network operator's performance.[3] Efficiency comparisons of transmission systems require an international benchmarking with relatively few observations on the one hand and large structural differences on the other. For this reason, the reliability of international benchmarking results is typically weak and thus increases efficiency risk. Apart from methodological problems there is a *general criticism* on TOTEX benchmarking. Network investments are irreversible and therefore lead to *sunk capital costs*. Including these CAPEX into the benchmarking approach means to apply an *ex-post* efficiency test for investments already made. The impact of this efficiency risk on *ex-ante* investment incentives has already been discussed above. There is a countereffect. Even if CAPEX cannot be adjusted ex post, an ex-post TOTEX benchmark will have a disciplining effect ex ante (i.e. before the investment). The question is whether this advantage of efficiency pressure outweighs the disadvantage of higher efficiency risk.

An effective approach to address the efficiency risk of ex-post benchmarking is to exclude CAPEX from benchmarking and apply OPEX benchmarking instead. This means that the X-factor only applies to operating costs, while capital costs are treated separately. In practice this may take the form of a cost-pass-through arrangement for CAPEX. The advantage of such an *OPEX-CAPEX-split* is that the investment risk caused by the benchmarking procedure is significantly reduced. Although this does not eliminate the reliability problems of international benchmarking, the cost pressure of efficiency targets at least focuses on those costs that are basically in control of the network operator instead of being irreversibly fixed as a result of investment decisions made in the past. Although it is intuitive that an OPEX-CAPEX-split is effective in strengthening investment incentives, there are at least two aspects that deserve a critical reflection. The first issue of a separate

[3] See Jamasb & Pollitt (2001 and 2003) for an overview of commonly applied benchmarking approaches.

treatment of OPEX and CAPEX is that it may distort the TSO's investment and operating decisions. There is no definite and unambiguous OPEX versus CAPEX allocation. It is partly the network operator's choice of favouring one or the other. A TSO may for instance decide to make a replacement investment for old transmission lines, which will increase its capital costs. Alternatively, however, the TSO could in the same situation put more efforts in the maintenance and repair of these lines with the result of increasing operating costs. In case of an OPEX-CAPEX-split the TSO's decision is most probably distorted in favour of investments, since capital costs are subject to a cost pass-through, whereas operating costs underlie the cost pressure of incentive regulation. This distortion is similar to what is known as the Averch-Johnson-effect under rate-of-return regulation (see Averch & Johnson, 1962). Given the importance of adequate investment incentives, one might be willing to accept this effect.

A second aspect that should be considered under an OPEX-CAPEX-split is that the *ex-ante* efficiency incentives that a TOTEX benchmarking might provide for investments are given up by letting capital costs to be passed through to consumers. In other words, one sacrifices the disciplining effect of an ex-post efficiency testing and might therefore lower the TSO's cost awareness at the time the investment is made. Accordingly, one has to find a different way of incentivising cost effective investments. As the discussion above revealed, efficiency incentives are most effective when provided *ex-ante* rather than *ex-post*. A pragmatic approach is therefore to implement these incentives into the investment budget or, more precisely, into the *target-performance comparison* of investment expenditures. There are several ways of treating capital over- and underspend with different implications for the trade-off between efficiency and investment incentives.

5. Ex-ante approval and investment allowances

Cost-increasing investment may run into problems under price-based regulation. The increase of allowed revenues to finance the investment would only come at the start of the next regulatory period, setting clear incentives to postpone these investments towards the end of the regulatory period. In practice, regulators address this problem with investment allowances. The TSOs can request a revenue increasing investment allowance *during* the regulatory period. As a rule, at the end of the regulatory period, the investment allowance runs out and the investment is transferred into the normal price-based regulation.

This uneasy procedure, which basically combines cost-based and price-based approaches in a somewhat artificial way, raises questions. The first issue was a recent debate in Germany. The German system works with investment budgets for the TSOs on enlarging or restructuring the transmission grid. Typically, the regulator wants to control the approved investment budget, which necessarily leads to ex-ante approval of the investment. The problem that came up is how to combine the ex-ante approach with the ex-post incentive-based regulation, which relies on benchmarking. It is beyond the scope of this paper to go into too much detail; it suffices to say that combining ex-ante approved investment budget and incentive-based regulation relying on ex-post TOTEX benchmarking is not an obvious thing to do and might provide a good argument for an OPEX-CAPEX split.

Furthermore, the question comes up what to do with deviations between planned investment expenditure (which is what an investment allowance is) and actual investment expenditure. In other words, how to deal with capital over- and underspend? On one extreme, a regulator may decide that the *planned* investment expenditures, as forecasted at the time the investment plans are approved, will enter into the regulatory asset base independent of how much the *actual* expenditures will turn out to be after the investment is made. Therefore, there would be no cost-pass-through. Obviously, the firm's efficiency incentives are high powered under this arrangement. On the other hand, the firm bears all risks of any deviations. On the other extreme, *actual* investment expenditures enter the asset base, i.e. there is a full cost-pass-through. In this case there is no external cost risk, but neither are there any incentives for cost effective investments. Both capital overspend and underspend are borne by the customers via the regulated network charges. An optimal solution would choose a way in between these extreme cases, which is known as sliding scale.

Sliding scales are used by e.g. the British regulator Ofgem. The British regulatory system applies a version of the OPEX-CAPEX-split described above, known as the *building-blocks-approach*.[4] While operating costs are subject to the efficiency targets set by the X-factor, capital costs of investments are passed through and refunded by consumers over the

[4] Actually, the UK regulator Ofgem currently revises the regulatory framework rather dramatically. The main aim for the revisions, known as RIIO, are to come to "sustainable network regulation".

asset's life time after entering the regulated asset base. The investment allowance is determined at the beginning of the five year regulatory period based on forecast investment expenditures, the so-called *baseline allowance*. According to the sliding scales, the TSOs have to bear 25 percent of the cost in case of a CAPEX overspend, while they may keep 25 percent of the benefit arising from a CAPEX underspend (see Ofgem, 2006). Although this incentive mechanism is theoretically attractive, it is not as "easy-going" in practice as it may look like. Which degree of cost- and benefit-sharing optimally solves the trade-off between efficiency and investment incentives? It is not obvious why 25 percent should be the "magic number". It seems that the most critical issue of this mechanism is the forecast of future network expenditures up to 5 years ahead of time. By construction of the sliding scales, the TSOs will have strong incentives to convince Ofgem of higher capital costs compared to those calculated by Ofgem to raise its profits. Although practical experience may provide learning effects with respect to this issue, a regulator has limited possibilities for an ex-post intervention in cases of too large deviations of forecast and actual expenditures. It is the strong necessity for a price-based regulation to provide a stable and reliable regulatory environment. Any attempt to punish a network operator by a stricter regulation for the next period may severely harm the regulator's reputation and lead to the problem of commitment mentioned in section 2 above. Uncertainty tends to weaken both efficiency and investment incentives and is therefore the last thing a regulator could want.

Apart from the high investment needs, a complicating factor for effective regulation is that the investment expenditure is uncertain. Therefore, the variation in capital over- and underspend can be large. An elegant way to address this uncertainty is to leave the choice to accept or avoid risk to the network owners themselves. This approach can be implemented with the "menu of sliding scales". As explained above, a sliding scale balances between price-based and cost-based approaches and can thus be a risk-sharing device. The "menu" allows the regulated network operators to choose the sliding-scale factor themselves individually. The regulator determines the set of sliding-scales factors and the associated revenue-cap level, which together is the menu, from which the companies then choose.

A well-designed menu sets incentives for the companies to reveal their true expectations of their investment needs (a so-called "truth-telling mechanism"). The main steps are as follows. The companies inform the regulator about their expected investment needs; the regulator makes his own calculations and informs the company of this; the company can then adjust its initial estimates. These numbers reflect the expectations of the firm versus the expectations of the regulator. The idea is that if the firm expects higher investment needs than the regulator, the firm will not want to accept risk and will opt for a high cost-pass-through factor (i.e. will want cost-based regulation). If the firm expects lower investment needs than the regulator, it will want to retain a large share of expected capital underspend and will therefore accept high risk and will opt for a low cost-pass-through factor (i.e. price-based regulation). The key factor of this scheme is self selection: the mechanism is designed such that firms will select the type of regulation themselves according to their individually preferred risk.

A menu of sliding scales has been implemented in the UK in 2005 (cf. Crouch, 2006). The experiences as reviewed by Ofgem (2010) in preparation of the new regulatory period are promising. This approach may be a promising way forward to deal with uncertain deviations between planned and actual investment expenditures. We note, however, that this mechanism belongs to a world with investment budgets and ex-ante approval procedures. As explained above, this creates an uneasy tension with ex –post benchmarking.

6 Conclusions

Most transmission systems in Europe are currently in need of large network expansions, in particular to cope with increasing shares of fluctuating renewable energy sources. The speed of market developments has led to a higher uncertainty of network investments and has an increasing effect on network costs. Accordingly, there is a need to rethink and adjust the regulatory framework to ensure adequate investment incentives for TSOs. Although *price-based regulation* has been successful in setting efficiency incentives, it seems that the scope for cost reductions has been largely exhausted. In case of cost increasing investments, a pure price-based regulation seems to impede necessary investment incentives. Accordingly, we observe a kind of paradigm shift in international regulation to address the investment issue. To strengthen incentives for cost increasing and uncertain network investment, more *cost-based elements* are included in the regulatory price- or revenue-cap formulae.

First, an effective way to promote timely and adequate investments is the use of *rate-of-return adders*, as have been implemented by the U.S. regulator FERC as part of its “incentive-based rate treatments”. In Europe we find examples in Italy and France. A promising approach to trigger new investments would be to treat "old" assets differently from new assets and reward expansion investment as compared to existing assets.

Second, the regulatory framework should be adjusted to take account of increasing *investment uncertainties*. In particular, the TSO should not bear the risks of early network investments that are needed for a timely connection of quickly developing generation assets. In case of such early investments, anticipating uncertain future capacity needs, the regulatory risk caused by *ex-post used-and-useful tests* may be a severe obstacle to investments. Instead, regulators should provide an *ex-ante approval* of investments or give stronger guarantees for a complete cost-pass-through of investments.

Third, a regulatory adjustment should consider a reduction of *efficiency risk*, in particular caused by an application of an ex-post TOTEX benchmarking. One point of criticism is the unreliability of international benchmarking which is needed for an efficiency test of TSOs. A second aspect is that ex-post efficiency incentives are questionable for capital costs which are mainly sunk after an investment is made. In addition, it is methodological difficult to ensure that a TOTEX benchmarking only tests for efficiency (i.e. least costs of investments) instead of necessity (i.e. utilisation of capital assets).

Fourth, and building upon the previous findings, a different treatment of operating costs and capital costs (OPEX-CAPEX-split) seems to be a promising way to optimise on the trade-off between efficiency and investment incentives. While the efficiency incentives of price-based regulation continue to apply for operating costs, capital costs – and thus investments – are subject to a cost-pass-through.

In all we conclude that the drivers for regulation are currently changing: away from a focus on cost reduction, towards a focus on facilitating cost-increasing efficient investment. This changes the regulatory model. With investment, risk sharing is becoming the focus of the regulatory approach. Given investment needs, a pure price-based approach relying on ex-post benchmarking seems to reach its limits. Summing the conclusions above, we recommend a move towards more cost-based approaches, with ex-ante investment approval and less reliance on benchmarking.

References

Agrell, P & Bogetoft, P., 2006, "ECOM+ Results 2005, Final Report". Sumicsid, Brüssel, June 2006.

Agrell, P & Bogetoft, P., 2009, "International Benchmarking of Electricity Transmission System Operators, e3GRID Project – Final Report". Sumicsid, Brüssel, March 2009.

Averch, H. & Johnson, L.L., 1962, "Behavior of the Firm Under Regulatory Constraint". American Economic Review, 52, 1053-1069.

Brunekreeft, G. & Borrmann, J. 2010, "The Effect of Monopoly Regulation on the Timing of Investment". Bremen Energy Working Papers, No. 1, Feb 2010, Jacobs University Bremen/Bremer Energie Institut.

CEPA, 2010, "Ofgem RPI-X@20: Providing Financeability in a Future Regulatory Framework" , Cambridge Economic Policy Associates Ltd (CEPA), Mai 2010.

Crouch, M., 2006, "Investment under RPI-X: Practical Experience with an incentive compatible approach in the GB electricity distribution sector", Utilities Policy, 14, 240-244.

DENA, 2010, "DENA-Netzstudie II – Integration erneuerbarer Energien in die deutsche Stromversorgung im Zeitraum 2015 – 2020 mit Ausblick 2025 – Zusammenfassung der wesentlichen Ergebnisse durch die Projektsteuerungsgruppe".

ENTSOE, 2010, "Ten-Year Network Development Plan", Final. ENTSOE, Brussels.

FERC, 2006, "Promoting Transmission Investment Through Pricing Reform", Order 679, Federal Energy Regulatory Commission (FERC), Juli 2006.

Gans, J. S. & King, S. P. , 2003, "Access Holidays for Network Infrastructure Investment", Agenda, 10, 163-178.

Gilbert, R.J., und Newbery, D., 1994, „The Dynamic Efficiency of Regulatory Constitutions", RAND Journal of Economics, 25 (4), 538-554.

Grout, P. A. & Zalewska, A., 2003, "Do Regulatory Changes Affect Market Risk?". Unpublished LIFE Working Paper 03-022, Maastricht University, Maastricht.

Guthrie, G., 2006, "Regulating Infrastructure: The Impact on Risk and Investment", Journal of Economic Literature,Vol. 44: 925–972.

Jamasb, T. & Pollitt, M., 2001, "Benchmarking and Regulation: International Electricity Experience". Utilities Policy, 9, 107–130.

Jamasb, T. & Pollitt, M., 2003, "International Benchmarking and Regulation: An Application to European Electricity Distribution Utilities". Energy Policy, 31, 1609–1622.

Jamasb, T. & Pollitt, M., 2004, "International Benchmarking and Yardstick Regulation: An Application to European Electricity Utilities". DAE Working Paper, No. 0115, Department of Applied Economics, University of Cambridge.

Joskow, P. L., 2006, "Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks". Cambridge: MIT Center for Energy and Environmental Policy Research.

Kwoka & Ter-Martirosyan, 2008, “Does Incentive Regulation Compromise Service Quality: The Case of U.S. Electricity Distribution” Northeastern Univeristy working paper, 2008.

Lyon, T.P., & Mayo, J.W., 2005, “Regulatory Opportunism and Investment Behavior: Evidence from the U.S. Electric Utility Industry”, RAND Journal of Economics, 36 (3), 628-644.

Makholm, J., 2006 (April), “The Theory of Relationship-Specific Investments, Long-Term Contracts and Gas Pipeline Development in the United States’, Nera Working Paper.

Ofgem, 2006, “Transmission Price Control Review, Final Propsals”. Ref: 206/06. Office of Gas and Electricity Markets (Ofgem), Dec. 2006.

Ofgem, 2008, “Transmission Access Review – Initial Consultation on Enhanced Transmission Investment Incentives”. Ref: 175/08. Office of Gas and Electricity Markets (Ofgem), Dec. 2008.

Ofgem, 2010, “Regulating Energy Networks for the Future: RPI-X@20 Recommendations”. Consultation. Office of Gas and Electricity Markets (Ofgem), Feb. 2009.

Peltzman, S. 1976, “Toward a More General Theory of Regulation”. Journal of Law and Economics, 19, 211-240.

Sheshinski, E., 1976, “Price, Quality and Quantity Regulation in Monopoly Situations”, Economica 3, 127–137.

Spence, A. M., 1975, “Monopoly, Quality and Regulation”, Bell Journal of Economics, 6: 417-429.

Ter-Martirosyan, A., 2003, “The Effects of Incentive Regulation on Quality of Service in Electricity Markets”, Working paper, Dpt. Of Economics, George Washington University, March 2003.

Vogelsang, I., 2009, “Incentive Regulation, Investments and Technological Change”, mimeo, Boston University

Wright, S., Mason, R., & Miles, D., 2003, “A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the U.K.”. London: Smithers & Co.