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Regulatory agencies and regulatory risk

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Regulatory Agencies and Regulatory Risk*

by Günter Knieps and Hans-Jörg Weiß

Discussion Paper
Institut für Verkehrswissenschaft und Regionalpolitik
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Abstract:

The aim of this paper is to show that regulatory risk is due to the discretionary behaviour of regulatory agencies, caused by a too extensive regulatory mandate provided by the legislator. The normative point of reference and a behavioural model of regulatory agencies based on the positive theory of regulation are presented. Regulatory risk with regard to the future behaviour of regulatory agencies is modelled as the consequence of the ex ante uncertainty about the relative influence of interest groups in the regulatory process. The problem of regulatory risk is analysed separately in competitive network areas and in non-competitive network areas. For both cases a specific measure of regulatory risk is proposed. But measurement and compensation are different issues. The impossibility of compensating for regulatory risk is demonstrated. Finally, the disaggregated regulatory mandate is presented as an institutional reform approach.

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1. Introduction

In the current debate on regulatory reforms the issue of regulatory risk gains increasing importance. Several definitions of regulatory risk are known from the economic literature, e.g.: "[R]egulatory risk arises whenever regulation affects the cost of capital of the regulated firm" (Wright, Mason, Miles, 2003, p. 118). "Regulatory risk arises when the interaction of uncertainty and regulation changes the cost of financing the operations of a firm" (Ergas et al., 2001, p. 5.). In general, these definitions of regulatory risk do not differentiate systematically between, on the one hand, the impacts of a specific regulatory intervention on the risk of the regulated firms, or – more generally – on the social welfare (regulatory impact) and, on the other hand, uncertainties arising from the discretionary behavior of regulatory agencies.

Effective regulation changes the systematic risk of the regulated activities, thereby (ceteris paribus) leading to increasing or decreasing opportunity costs of the invested capital (cf. Gaggero, 2007). The impact of regulation on the entrepreneurial risk and therefore the cost of equity capital are neither a normative justification for regulatory interventions in competitive markets, nor are they an argument against necessary regulatory interventions to discipline market power. Instead they ought to be treated as positive or negative side effects of regulation. In competitive markets regulation should obviously never be introduced in order to mitigate the risk of the firms involved. In those parts of network industries where network-specific market power is still present, the risk of the business under regulated conditions has to be taken into account. Neither the risk of the unregulated monopolist nor the risk of the business under hypothetical conditions of competition should therefore be considered as relevant reference points (see Myers, 1972, pp. 79-81; Buckland, Fraser, 2001, p. 879).

It is important to differentiate between regulatory impact and regulatory risk due to discretionary agency behaviour. From the perspective of the public interest theory of regulation, regulatory agencies are considered to behave in a welfare-maximising manner (cf. Posner, 1974, pp. 336 ff.). Ahn, Thompson (1989), for example, analysed the regulatory risk surrounding the triggering of a rate case

(triggering risk) and uncertainties surrounding the setting of the allowed rate of return (setting risk) in the context of the implementation of rate-of-return regulation. In Ahn, Thompson the "error terms" surrounding the implementation of the regulatory instrument are distributed symmetrically, so there is no systematic bias in one direction. Thus regulatory risk is treated in the context of a welfare-maximising agency, implementing a given regulatory instrument in a given regulatory framework.

It is well-known from the positive theory of regulation that regulatory agencies cannot commit to welfare-maximising behaviour. "A common concern among those involved in regulation is that the regulator can itself introduce risk, through unpredictable or unjustifiable regulatory intervention, so raising the regulated firm's cost of capital, and leading to inefficient investment" (Wright, Mason, Miles, 2003, p. 119). Regulatory agencies make use of their discretionary power in response to the relative influence of the interest groups involved (cf. e.g. Stigler, 1971; Peltzman, 1976; Becker, 1983).

The discretionary behaviour of regulatory agencies has been in particular discussed in connection with missing investment incentives in regulated industries due to regulatory opportunism (e.g. Newbery, 2000; Gans, King, 2003). The focus of this literature is on the missing commitment ability of regulatory agencies vis-à-vis the regulated firms. In particular, regulatory agencies cannot commit themselves to allow full cost recovery of the invested capital. As a consequence, incentives for underinvestment arise. These are typically termed hold-up problem, commitment problem or problem of regulatory opportunism. The policy focus is on the design of possible compensation mechanisms, especially so-called access holidays. However, as will be shown in the present paper, compensation mechanisms cannot solve the problem of regulatory opportunism. Policy recommendations (e.g. access holidays) which neglect or try to bypass the influence of interest groups are not credible and therefore cannot compensate for regulatory risk. Instead it is necessary to tackle the problem at its roots and to constrain the scope of the discretionary behaviour of regulatory agencies.

The paper is structured as follows: In section 2 the normative point of reference (2.1) and a behavioural model of regulatory agencies based on the positive theory of regulation are presented (2.2). Regulatory risk with regard to the future behaviour of regulatory agencies is modelled as the consequence of the ex ante uncertainty about the relative influence of interest groups in the regulatory process. In section 3 the problem of regulatory risk in competitive network areas is analysed. Section 4 deals with regulatory risk in non-competitive network areas. For both cases a specific measure of regulatory risk is proposed. But measurement and compensation are different issues. In section 5 the necessity for institutional reform due to the impossibility of compensating for regulatory risk is elaborated. The disaggregated regulatory mandate is presented as an institutional reform approach.

2 Regulatory risk caused by an extensive regulatory mandate

2.1 The normative dimension: Regulatory needs due to monopolistic bottlenecks

From the normative point of view it is important to differentiate between those parts of a network industry which are competitive and those parts which are characterised by network-specific market power. Liberalisation of network industries does not mean that all sector-specific regulation becomes superfluous. In most network industries there remain some non-competitive network areas. The theory of monopolistic bottlenecks enables a localisation of the remaining network-specific market power in order to determine the minimal regulatory basis (cf. Knieps, 1997, pp. 327 f.; Knieps, 2006, pp. 53 ff.). Its objective is to derive, based on the principles of network economics, a regulatory basis consistent for all network sectors which justifies sector-specific regulatory inventions. The conditions for a monopolistic bottleneck are fulfilled:

(1) if a facility is necessary for reaching customers, i.e. if no second or third such facility exists, in other words if there is no active substitute. This is the case if there is a natural monopoly and a single provider is able to make the facility available more cheaply than several providers.

(2) if at the same time the facility cannot reasonably be duplicated as a way of disciplining the active provider, in other words, if there is no potential substitute. This is the case if the costs of the facility are irreversible.

The owner of such a monopolistic bottleneck has stable market power, even if all players have perfect information and a complete willingness to switch so that even small changes in prices result in a migration of demand. Irreversible costs are no longer decision-relevant for the established firm – in contrast to the potential competitor, who is faced with the decision whether to invest in a given market or not. Thus the incumbent has lower decision-relevant costs than the potential competitors. This leads to scope for strategic behaviour, so that inefficient production or surplus profits no longer necessarily result in newcomers entering the market.

Within a given network the entire value chain has to be examined in a disaggregated manner, that is, it has to be differentiated into those network areas that do have bottleneck characteristics and the other areas that are characterised by effective competition. The latter is by no means confined to potential competition. Both active and potential competition with and without technological differentiation as well as product differentiation and innovation (of both products and processes) constitute potential parameters of effective competition. Due to the absence of irreversible costs service networks are competitive, no matter if they possess the characteristics of a natural monopoly or not. Competitive network areas are subject to general competition law, whereas sector-specific regulation is superfluous (or even detrimental).

In non-competitive network areas the application of general competition law is not sufficient. Sector-specific regulation is required. The special focus of regulatory activities to discipline market power should be on the design of a symmetrical regulation of the access to monopolistic bottlenecks, combined with a price level regulation of access charges.[1] The implementation of sector-specific regu-

[1] Regulatory agencies should not force firms to apply specific pricing structures, such as Ramsey prices or two-part tariffs, as this would impede their search for innovative pricing systems.

latory laws is typically delegated to specialised agencies. The necessity of a division of labour between legislative bodies and executive agencies has already been pointed out by Posner (1974). Regulatory agencies have more or less scope for discretionary activities, depending on the character and the extent of the competencies delegated by the legislator to the regulatory agency as specified in the regulatory mandate (cf. Spulber, Besanko, 1992). If regulatory agencies are successful in guaranteeing non-discriminatory access and avoiding monopolistic access prices, welfare improvements occur (cf. Knieps, 2006, pp. 64-69; Blankart, Knieps, Zenhäusern, 2007, p. 423).

2.2 The positive dimension: Regulatory agencies influenced by interest groups

In the meantime it is well known that regulators do not necessarily act in the public interest. The basic hypothesis of the positive theory of regulation is that the influence of interest groups is the central explanatory variable in the behaviour of a regulatory agency. Trying to influence the decisions of the regulatory agency in a favourable direction is in the interest of the participants in the regulatory process. Thus, a behavioural model is needed to explain how regulatory agencies make use of their discretionary power in response to the relative influence of the interest groups involved (cf. e.g. Stigler, 1971; Peltzman, 1976; Becker, 1983).

Already in a simple model context with a homogeneous group of consumer interests and a homogeneous group of producer interests, we can define a function M representing the influences on regulatory agencies. For reasons of simplification the following Cobb-Douglas function is assumed to represent the concurring influences of the interest groups (cf. Spulber, 1989, pp. 94 ff.; Besanko, Spulber, 1992, p. 156):

$$M = M(\Omega, \pi) = \Omega^{1-\alpha} \cdot \pi^{\alpha} \tag{1}$$

The variables Ω and π denote consumer surplus and producer surplus (profit), respectively. α is a parameter representing the relative weights of the two interest groups. α can have values in between zero and one. In case of the corner solution α = 0 the regulatory agency acts solely in the interest of consumers (consumer protection hypothesis). In the other extreme, i.e. α = 1, the regulatory agency acts solely in the interest of producers (capture hypothesis). In case of $0 < \alpha < 1$ the regulatory agency prefers a weighted average. Given α, the relative influence of producers versus the relative influence of consumers can be expressed by the marginal rate of substitution (*MRS*).

$$MRS = -\frac{\partial M / \partial \pi}{\partial M / \partial \Omega} = -\frac{\alpha}{1-\alpha} \cdot \frac{\Omega}{\pi} \tag{2}$$

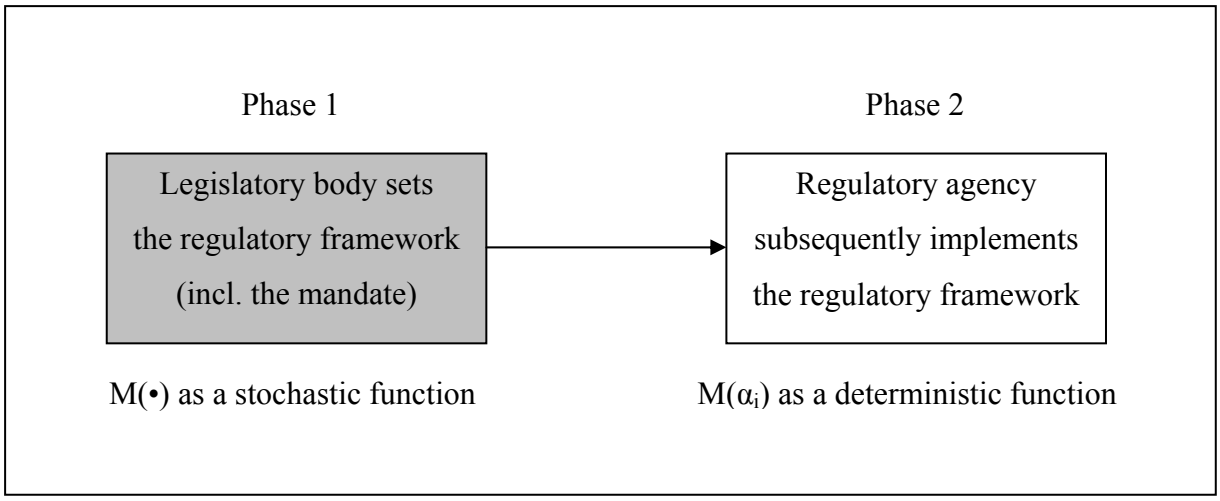
In the positive theory of regulation it is usually assumed that the relative influence of interest groups is exogenously given. Regarding the presumed Cobb-Douglas function this corresponds to the assumption that α is a given parameter. Peltzman considers the extreme case of unlimited discretion on the part of the regulator which is not bound by a regulatory mandate. It is assumed that the regulator can observe the relative strength of the interest groups and implements price and entry regulation accordingly (cf. Peltzman, 1976, pp. 222 ff.).[2]

The basic contribution of the Stigler-Peltzman Model is the analysis of the role of interest groups in the process of regulation. However, the necessary differentiation between legislator and regulatory agency is lacking (cf. Weingast, Moran, 1983, p. 768). It is important to differentiate between the time phase when a regulatory law (including a regulatory mandate) is debated and ultimately passed by the legislator (phase 1) and the subsequent implementation by a regulatory agency (phase 2). For a given regulatory mandate the legislator can foresee that interest groups will be a major determinant of the behaviour of the regulatory agency and the resulting regulatory outcome in phase 2. But it would be illusionary to assume that the legislator is also able to predict the relative strength of the interest groups, i.e. the value of parameter α, with certainty. From

[2] Spulber (1989), Besanko, Spulber (1992) and Newbery (2000, Chap. 2) also assume that the relative strength of the interest groups is observable and exogenously given.

the perspective of the legislator in phase 1 it is therefore necessary to treat parameter α and the implied influence function M(α) as uncertain. At best the legislator can form rational expectations about a probability distribution θ of the possible realisations of the uncertain parameter α in phase 2 (see Fig. 1).

Figure 1: The two-phases approach to analysing regulatory risk



The stochastic influence function does not only substantiate regulatory risk, but can also serve as a definite starting point for its measurement. In the following, a discrete characterisation of regulatory risk is chosen. $M(\alpha_i)$ denotes the influence function when parameter α_i is realised as indicator of relative interest group influences. Then we have

$$M(\alpha_i) = M(\Omega, \pi; \alpha_i) = \Omega^{1-\alpha_i} \cdot \pi^{\alpha_i} \tag{3}$$

If for future influence parameters $\alpha = (\alpha_{1, \ldots,} \alpha_n)$ an associated probability distribution $\theta = (\theta_1, \ldots, \theta_n)$ is known, a measure of regulatory risk can be developed which is not restricted unilaterally to producer effects (cost of capital).[3] Only one-sided risk measures are of interest, because from the point of view of normative theory the influence of interest groups on the regulatory process always leads to welfare losses. Based on Stone (1973) and his general characterisation of risk measures, in the following a one-sided risk measure in the sense of an

[3] Models in the tradition of the Capital Asset Pricing Model (CAPM), which are usually used to analyse the impact of regulation on the cost of capital of firms, are not able to represent the impact on consumer interests (cf. Myers, 1972, pp. 65 ff.).

expected deviation from a target value is used (cf. Ebert, 2005, pp. 20 ff.). Concerning the problem of the measurement of regulatory risk, it follows that any $M(\alpha_i)$ gives rise to a welfare level $W(\alpha_i)$, the sum of consumer surplus $\Omega(\alpha_i)$ and producer surplus $\pi(\alpha_i)$. The welfare level $W(\alpha_i)$ may deviate from the welfare optimum W^{Opt} indicating the attainable outcome from the normative point of view. In this paper we propose to measure regulatory risk by the following one-sided risk measure:[4]

$$\rho = W^{Opt} - \sum_i \theta_i \cdot W(\alpha_i) \tag{4}$$

For every probability distribution $\theta = (\theta_1, ..., \theta_n)$ of the influence parameter $\alpha = (\alpha_1, ..., \alpha_n)$ regulatory risk is measured as expected welfare loss.

The possible welfare losses due to misregulation are quite different in competitive and non-competitive network areas. Therefore a deeper analysis of regulatory risk requires a disaggregated approach as its normative foundation. Based on the normative framework explained in section 2.1, in the following two sections the regulatory risk in competitive network areas (section 3) and the regulatory risk in non-competitive network areas (section 4) will be analysed separately.

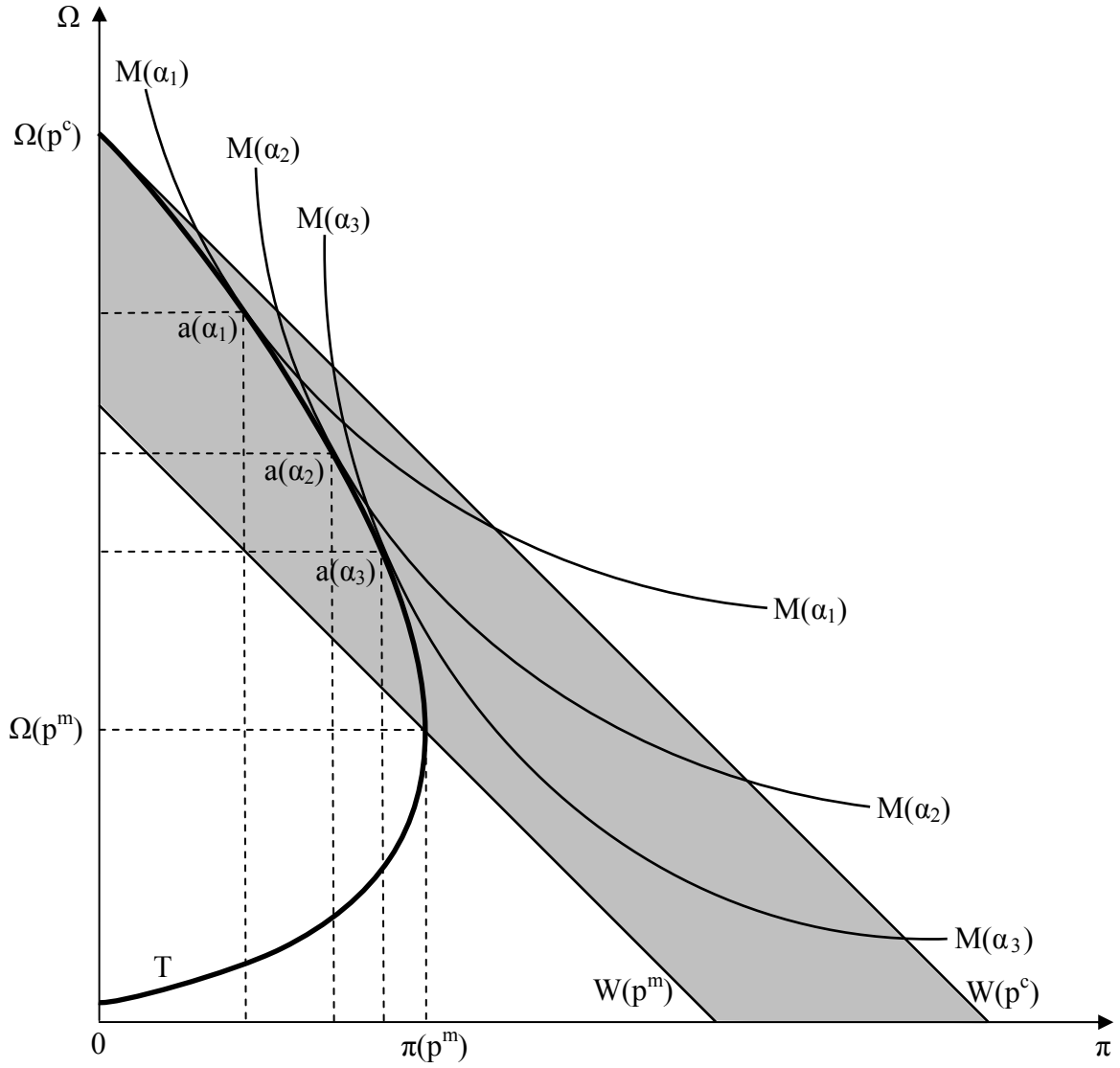
3 Regulatory risk in competitive network areas

As long as network industries were treated as special sectors exempted from general competition law and network providers were protected against market entry by legal entry barriers, the choice of the regulatory basis was not regarded as problematic in the process of implementing regulatory instruments. In the U.S., for example, rate-of-return regulation was applied globally to the regulated firm. But also after the liberalisation of network industries, overregulation may occur due to discriminatory behaviour of regulatory agencies. Examples are the

[4] In the present context it is sufficient to take the expected value of the welfare loss as risk measure. It belongs to a popular class of downside risk measures called lower partial moments (cf. Ebert, 2005, pp. 22 f.).

regulation of telecommunications service markets (e.g. Knieps, 2005), the regulation of local transportation services (e.g. Weiss, 2006) or long distance bus services (e.g. Maertens, 2005).

Figure 2: Regulatory risk in competitive network areas



In the following the risk of a regulatory intervention in competitive network areas due to the discretionary behaviour of regulatory agencies will be analysed. Because any regulatory intervention in competitive markets leads to welfare losses, we can derive a regulatory production possibility set whose efficient surface can be characterised by means of a transformation function T with

$T(\pi(p), \Omega(p)) = 0$ as shown in figure 2 (cf. Spulber, 1989, p. 95, fig. 2.3.1). $\Omega(p)$ and $\pi(p)$ denote consumer surplus and profit, both depending on the price. Consumer surplus is maximised with competitive price p^c and zero profit. In this case welfare level $W(p^c)$ is reached. Profit is maximised with monopoly price p^m. Due to the dead-weight loss of monopolistic price setting, in this case only the lower welfare level $W(p^m)$ is reached.

To clarify the argument, in the following the case of a regulatory agency with unlimited competencies (delegated by the legislator) is analysed. Depending on the relative influence of interest groups (parameter α_i) the agency will choose a point $a(\alpha_i)$ on T between $W(p^c)$ and $W(p^m)$, realising it by appropriate price setting.[5] The maximum welfare level $W(p^c)$ follows from the maximisation of the influence function M subject to the constraint of the transformation function in the special case of $\alpha = 0$. The (lowest) welfare level $W(p^m)$ is the result in the special case $\alpha = 1$. For any parameter $\alpha_i \in (0,1)$ the maximisation of influence function $M(\alpha_i)$ with respect to T leads to a welfare-inferior outcome $W(\alpha_i)$ with $W(p^m) < W(\alpha_i) < W(p^c)$.

Any point in the relevant range of the transformation function is a possible point of tangency and possesses a positive probability, since in phase 1 the relative influence of interest groups is unknown.[6] A welfare loss due to over-regulation can be expected almost with certainty (consumer interest maximisation is only a special case), the magnitude of the welfare loss depending on the relative strength of the interest groups. Based on the risk measure introduced in section 2.2, regulatory risk in competitive network areas can be measured as follows:

$$\rho_c = W(p^c) - \sum_i \theta_i \cdot W(\alpha_i) \tag{5}$$

[5] Regulatory agencies usually have a broad set of regulatory instruments available to pursue their goals. A differentiated analysis of these instruments would not lead to further insights in the present context. To simplify the exposition it is assumed that the agency can reach any desired point on the transformation function by adjusting the price.

[6] In figure 1 three M-isoquants are displayed as examples, each representing a different value of α_i.

The telecommunications sector in Europe is an illustrative example. The regulatory mandate specified in the Framework Directive and the Access Directive provides unspecific regulatory obligations with a subsequent large scope for discretion by the different regulatory agencies in Europe (cf. Blankart, Knieps, Zenhäusern, 2007, pp. 416 f.). In markets that are competitive, irrespective of country-specific characteristics, contradictory conclusions have been drawn by different national regulatory agencies and these were accepted by the European Commission. The Swedish and Finnish regulatory agencies concluded that their international call markets are effectively competitive, whereas in Hungary, Portugal, and Ireland these markets were considered to be in need of being regulated. A large number of cases regarding ex ante regulation have been assessed by the European Commission, but a consistent treatment from a normative point of view is still lacking (cf. Knieps, 2005, pp. 79-80).

4 Regulatory risk in non-competitive network areas

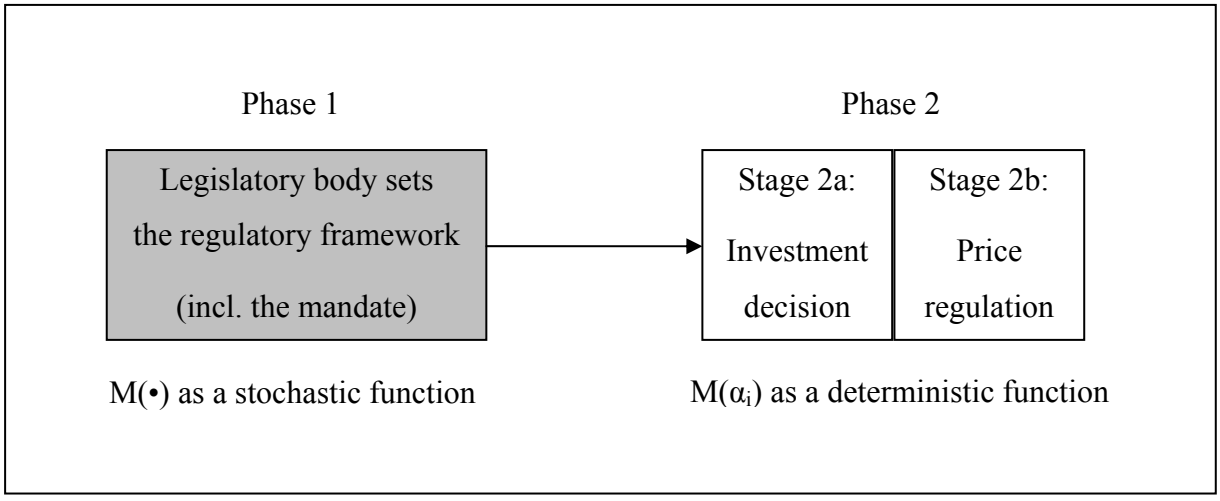
The discretionary behaviour of regulatory agencies has been especially discussed in connection with missing investment incentives in regulated industries due to regulatory opportunism (e.g. Newbery, 2000; Gans, King, 2003). The problem of regulatory agencies not adhering to original agreements (e.g. compensation rules) was already noticed by Kolbe, Tye, Myers (1993). They call it "problem of moral hazard" (p. 53) and find it to be unsolvable. They illustrate it with the gunfighter example:

> "The problem of moral hazard may be illustrated by a somewhat whimsical example. Suppose a world famous gunfighter invites a tenderfoot to a poker game, but reserves the right to pull out his gun and change the rules at any time. What up-front risk premium does the tenderfoot require if he is to join the game? [...] If the risk premium itself is also subject to seizure during the game (i.e., if the amount of the potential loss is also under the control of the gunfighter), there is no risk premium great enough to induce the tenderfoot to play because the tenderfoot can never hope to do anything but lose all assets brought to the table. The game never takes place" (Kolbe, Tye, Myers, 1993, pp. 53 f., footnote omitted).

What Kolbe, Tye, Myers refer to as "moral hazard" is usually termed "opportunism", leading to the problem of underinvestment.[7] The gunfighter is in a sense the perfect opportunist.

Whereas the literature on regulatory opportunism only focuses on phase 2, the explicit introduction of phase 1 of the two-phases approach is required (as outlined in section 2.2) in order to derive the regulatory risk due to the problem that the regulatory agency cannot be committed to welfare-maximising behaviour (see Fig. 3). Because of the sequential nature of the irreversible investment decision by the regulated firms (stage 2a) and the access regulation to the monopolistic bottleneck implemented by the regulatory agency (stage 2b) a regulation induced hold-up problem arises, depending on the relative influence of interest groups. It is important to note that investment takes place in phase 2, i.e. after realisation of $M(\alpha_i)$ is known. It will be shown that this leads to an underinvestment problem which cannot be overcome by the regulatory agency itself.

Figure 3: The two-phases approach in non-competitive network areas



To elaborate the concept of regulatory risk in non-competitive network areas, in the following (as before in section 3) the case of a regulatory agency with unlimited discretionary powers to regulate firms in non-competitive network areas

[7] The term "moral hazard" is misleading, because – as will be shown – this is not a problem of asymmetric information.

will be analysed. The starting point is the modelling framework developed in Besanko, Spulber (1992), considering the most simple case of a regulated firm facing an inelastic demand. Besanko, Spulber concentrate only on phase 2. Their framework will be generalised by means of a transition from a deterministic influence function $M(\alpha_i)$ to a stochastic influence function $M(\bullet)$. Thus the legislative phase 1 of determining the regulatory mandate will be considered explicitly.

The production technology in the regulated market is characterised by irreversible investments. The more capital is irreversibly invested ex ante, the lower the operating cost ex post. In Phase 2 two stages have to be distinguished. At both stages one central decision has to be made. At stage 2a investment takes place, and at stage 2b production and consumption. To simplify the exposition the output quantity is assumed to be independent of the price (inelastic demand) and exogenously given.[8]

At the beginning of stage 2a the regulated firm decides upon the magnitude of its capital investment K, which cannot be altered at stage 2b. The cost per unit of capital investment is r and has to be covered at stage 2b.[9] The magnitude of K is determined by the regulated firm. In the present simplified context it is assumed that the regulatory agency determines the regulated price p at the beginning of stage 2b. When setting the price the agency is influenced by interest groups, represented by the Cobb-Douglas influence function

$$M(\alpha_i) = M(\Omega, \pi_{gross}; \alpha_i) = \Omega^{1-\alpha_i} \cdot \pi_{gross}^{\alpha_i} \qquad (6)$$

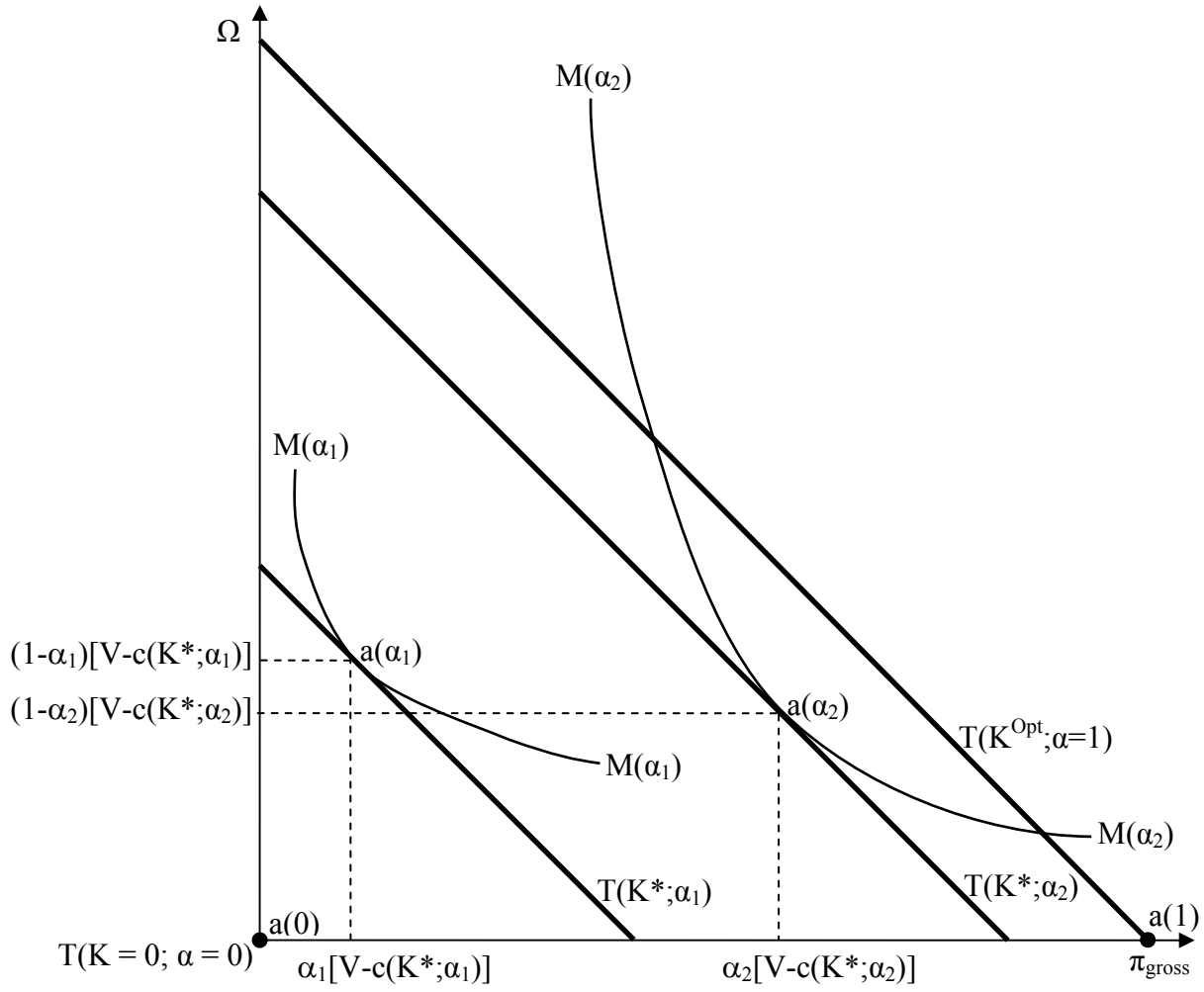
In this case the producer surplus π_{gross} does not represent the net profit (π_{net}), but the gross profit of the firm (contribution margin), i.e. before subtracting the opportunity cost of the capital investment. This difference is central to the argument. The reason for ignoring all capital cost in the price setting process is its irrelevance for all interest groups (and therefore also the regulatory agency), because at stage 2b their magnitude ($r \cdot K$) can no longer be altered.

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[8] Therefore all investments, prices, profits etc. can be normalised on one unit of output.

[9] The problem of discounting can thus be neglected. It is assumed that r represents all relevant opportunity cost (depreciation and interest) of the capital investment.

Figure 4: Regulatory risk in non-competitive network areas



At stage 2b it is only redistribution that matters. What is available for redistribution is the difference V – c(K) between the willingness to pay of consumers per unit of output (V) and the operating costs per unit of output (c). V as well as c is identical for every unit of output. V is a parameter and c is a function c(K) with the following properties: $c' < 0$ and $c'' > 0$. For every unit of output $\Omega = V - p$ denotes the consumer surplus and $\pi_{gross} = p - c(K)$ denotes the gross profit of the regulated firm. The magnitude of K, as decided at stage 2a, determines the amount available for redistribution at stage 2b. The more capital is invested at stage 2a, the lower the operating cost and the larger the amount available for redistribution. The transformation function introduced in section 3 (see T in figure 2) simplifies to a straight line with a negative slope of 45°. The central differ-

ence is that the position of T is not given exogenously any more, but depends on the capital investment K, which in itself depends (in equilibrium) on the regulated price and is therefore influenced by the interest groups. If more capital is invested this leads to a shift of the transformation function in the direction of the upper right corner (see figure 4).[10]

In the modelling framework of Besanko, Spulber all stochastic elements are absent. Without any stochastic element the prerequisite of any risk consideration is missing. Not only ordinary market risk is ignored, but there is also no basis for the analysis of regulatory risk. To incorporate the possibility of regulatory risk along the lines of the approach introduced in section 3, a generalisation of Besanko, Spulber (1992) seems to be straightforward. Since now phase 1 becomes relevant, α becomes a stochastic parameter. For every $\alpha_i \in (0,1)$ the regulated price, determined by the regulator at stage 2b influenced by interest groups, can be derived by maximisation of $M(\alpha_i)$ subject to constraint T(K):

$$L = \Omega^{1-\alpha_i} \cdot \pi_{gross}^{\alpha_i} + \lambda(V - c - \Omega - \pi_{gross}) \tag{7}$$

$$\frac{\partial L}{\partial \Omega} = (1-\alpha_i) \cdot \frac{\pi_{gross}^{\alpha_i}}{\Omega^{\alpha_i}} - \lambda = 0 \tag{8}$$

$$\frac{\partial L}{\partial \pi_{gross}} = \alpha_i \cdot \frac{\Omega \cdot \pi_{gross}^{\alpha_i}}{\Omega^{\alpha_i} \cdot \pi_{gross}} - \lambda = 0 \tag{9}$$

$$\frac{\partial L}{\partial \lambda} = V - c - \Omega - \pi_{gross} = 0 \tag{10}$$

Solving these equations simultaneously leads for every α_i to the values

$$\Omega = (1-\alpha_i) \cdot (V - c) \tag{11}$$

$$\pi_{gross} = \alpha_i \cdot (V - c) \tag{12}$$

[10] This is a modified version of Besanko, Spulber (1992, p. 157, fig. 1), generalised for a stochastic influence function M(•).

Recognising that c depends on the magnitude of K as chosen at stage 2a, we can characterise the regulated price p at stage 2b as

$$p(K,\alpha_i) = \alpha_i \cdot V + (1-\alpha_i) \cdot c(K) \tag{13}$$

If the regulator maximises consumer surplus (special case α = 0), he only allows the recovering of the operating costs c(K). If, on the contrary, the regulator maximises gross profit (special case α = 1), the price is as high as the consumers' willingness to pay and extracts all consumer surplus.

The costs of the capital investment are irrelevant when the regulatory agency sets the price at stage 2b; however, they are highly relevant for the regulated firm when determining the investment level K at stage 2a. The firm will anticipate the effect of K on p when maximising its objective function (net profit):

$$\pi_{net}(K,\alpha_i) = p(K,\alpha_i) - c(K) - r \cdot K = \alpha_i \cdot V - \alpha_i \cdot c(K) - r \cdot K \tag{14}$$

The optimal investment level K* of the firm, maximising net profit subject to the regulatory constraint, is characterised by the following condition:

$$-\frac{dc}{dK} \equiv -c' = \frac{r}{\alpha_i} \tag{15}$$

The relative influence of the interest groups is of central importance. The more the regulator is influenced by consumer interests, the less will be invested. More interesting is the comparison with the welfare optimum. Due to the assumption of an inelastic demand the only relevant criteria for welfare optimisation is cost minimisation by setting K adequately. The total cost per unit of output consists of the operating cost c(K) and the cost of the capital investment rK. The cost-minimal capital investment K^{Opt} is reached, when

$$-\frac{dc}{dK} \equiv -c' = r \tag{16}$$

In the special case $\alpha = 0$ there is no investment at all, because any investment would lead to a negative net profit.[11] For all parameter values $\alpha_i \in (0,1)$ there is some investment, but the chosen level K* is lower than the cost-minimising (and welfare-optimal) level K^{Opt}. Only in the special case $\alpha = 1$ does the net-profit-maximising investment level K* equal the cost minimising level K^{Opt}.

From a social welfare point of view the reference point is the total cost minimum $c(K^{Opt}) + rK^{Opt}$, which can be used to calibrate risk measures – in analogy to the ones introduced in section 3.[12] Depending on α_i the lower investment level $K^*(\alpha_i) < K^{Opt}$ results in a welfare loss whose magnitude is measured by the waste of costs

$$c(K^*(\alpha_i)) + r \cdot K^*(\alpha_i) - c(K^{Opt}) - r \cdot K^{Opt} \tag{17}$$

Therefore a measure of regulatory risk in non-competitive network areas can be stated as follows:

$$\rho_{nc} = \sum_i \theta_i \cdot [c(K^*(\alpha_i)) + r \cdot K^*(\alpha_i)] - c(K^{Opt}) - r \cdot K^{Opt} \tag{18}$$

5 The necessity of institutional reform

5.1 The impossibility of compensating for regulatory risk

As a means of compensating for regulatory risk in non-competitive network areas the concept of access holidays has recently gained interest in the current debate on regulation. Access holidays means an obligation on the part of the regulatory agency to not regulate a new infrastructure facility during an ex ante pre-determined time period in order to avoid underinvestment incentives. It is assumed that the regulatory agency is able to credibly commit to access holi-

[11] This case corresponds to the case analysed in Newbery (2000, pp. 35 f.) using a deterministic, linear influence function.

[12] In the present modelling framework the determination of minimal total cost is not problematic, because of the assumed absence of any market risk that could lead to estimation errors à la Ahn/Thompson (1989).

days, despite the fact that it is not able to credibly commit to ex post access prices. The idea is that access holidays should create incentives to invest the optimal amount of capital from a social welfare point of view (cf. Gans, King, 2003, pp. 168 f.).

In the simple modelling framework of Besanko, Spulber (1992) the calculation of the necessary revenues for covering total cost is straightforward. This also holds in more complex settings with asymmetric market risks, where the compensation can be calculated in analogy to the risk of "junk bonds" (cf. Kolbe, Tye, Myers, 1993, p. 25, fig. 2-2).[13] Depending on the specifics of the relevant investment project, different revenues for covering the expected cost are necessary. But the original source of the problem does not disappear after calculating the necessary cost recovery, because the real problem is the missing ability of the regulatory agency to make ex ante credible commitments regarding the regulated prices ex post (cf. Gans, King, 2003, pp. 168 ff.).

The question arises, however, whether the problem of regulatory opportunism can really be solved within phase 2 by shifting the regulatory intervention from the ex post (stage 2b) to the ex ante situation (stage 2a) and simplifying the regulatory parameter (price regulation versus length of regulation). For every future realisation of $M(\alpha_i)$ the regulatory agency has different incentives to break the promised agreement about the length of the access holidays (depending on the relative future strength of influence of the interest groups). The problem of regulatory opportunism cannot be solved by means of a simplification of the regulatory parameter. The root of the problem is to be found in the inability of the regulatory agency to commit itself to welfare-maximising solutions due to a stochastic M-function (arising in phase 1). The regulatory risk carries forward into missing compensation and missing commitment to access holidays.

[13] The underinvestment problem can also be modelled in a setting with market risks, incorporating the possibility of a project being a "flop" (cf. Newbery, 2000, chap. 2; Gans, King, 2003). But this was done with a deterministic M-function, i.e. there is some market risk but no regulatory risk. In the present case of a stochastic M-function the extent of underinvestment is stochastic, depending on the influence of interest groups.

5.2 The disaggregated regulatory mandate

Due to the regulatory agency's lack of commitment capability in relation to the regulated sector, regulatory risk cannot be compensated for. Instead, the institutional solution to this problem can be found in a reform of the regulatory mandate by the legislator. Only by imposing an appropriate constraint of the regulatory agency's discretionary freedom of action can the regulatory agency achieve commitment capability to implement welfare-maximising behaviour and thus reduce regulatory risk.

In the regulatory mandate the competencies of the regulatory agency for implementing regulation are prescribed. The regulatory mandate has to be embedded within the legal framework of regulation. Reform efforts must start with the redesign of the regulatory mandate by statutory constraints to limit the discretionary behaviour of the regulatory agency and subsequently the influence of interest groups. As regards the remaining field of activity, however, the expertise of the relevant regulatory agency should be trusted. In the following, the basic elements of a disaggregated regulatory mandate based on disaggregated regulatory economics will be presented (cf. Knieps, 2005, pp. 87 f.).

The regulatory risk in competitive network areas, as characterised in section 3, can be avoided if the following constraints to regulatory agencies are implemented by law:

(1) Prohibition of regulatory interventions leading to market closure. Market entry and exit must be possible in all network areas.

(2) Prohibition of market power regulation outside of network areas – functionally defined by the legislator – where monopolistic bottlenecks may still exist. All other network areas are competitive and only subject to general competition law.

(3) Adherence to a differentiated localisation and regulation of monopolistic bottlenecks; the necessity of this regulation is to be reviewed periodically (due to the phasing-out potentials of monopolistic bottlenecks).

Regulatory risk in non-competitive network areas, as characterised in section 4, can be reduced if the following obligations to regulatory agencies are implemented:

(1) To apply price-cap regulation for disciplining the market power of monopolistic bottlenecks in combination with accounting separation.

(2) Not to disturb the financial viability of the regulated firm by inadequate application of price-cap regulation. When determining the lower limit of the price level (cost recovery constraint), the point of reference should be decision-relevant cost, including opportunity cost of capital investment.

The disaggregated regulatory mandate constitutes a binding constraint of the regulatory agency's freedom of action and thus reduces the regulatory risk of an excessive regulatory base as well as the regulatory risk of underinvestment.

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