Corporate Self-Regulation vs. Ex-Ante Regulation - The Case of the German Gas Sector*

Georg Meran and Christian von Hirschhausen
DIW Berlin and Berlin University of Technology

September 2003

1 Introduction

The issue of "optimal" regulation of network industries is a recurring one in the literature on regulation, but it has regained attention in the course of the debate on the pros and cons of industrial "self-regulation"(e.g. Starkie, 2000, Engel, 2002, Brunekreeft, 2002). Various forms of *external* regulation by an independent, but generally badly-informed regulator can thus be compared to *internal* regulation by industry itself. The empirical evidence on that matter is scarce, thus stylized facts are generally taken as indications for efficient and less efficient outcomes of the regulatory process. New evidence of that type is provided by the process of liberalization of the European energy markets. In particular, the traditional structural and ex-ante regulation "UK-style" has been complemented by an approach to self-regulation through *association agreements*, as practiced in the German electricity and gas industries. These agreements are cartel-type, private contracts negotiated between the main players in the industry, accompanied by weak ex-post control exercised by an anti-monopoly agency (e.g. German Cartel Office). Until recently, the 'German way' was judged by its own proponents, the German energy industry and large parts of the political establishment, as a success story of liberalization (at least in electricity), whereas outsiders considered the self-regulated regime rather suspiciously. [1]

In this paper, we compare different regulation policies in the (German) gas industry, ranging from self-regulated association agreements and no competition policy, to ex-ante regulation combined with a pro-active competition policy. The gas industry is chosen because - contrary to electricity - it has not yet been subject to an extensive analysis of regulatory regimes. Our hypothesis is that ex-ante regulation of network access tariffs,

*We thank Karsten Neuhoff and Reimund Schwarze for comments. The usual disclaimer applies.
DRAFT PAPER! PLEASE DO NOT CITE! COMMENTS WELCOMED!

[1]Within the European Union, Germany is the only country to have opted for an unregulated negotiated third party access (NTPA) to the network, whereas most other countries have chosen regulated TPA with a strong role for regulatory agencies.

even when combined with competition policy measures, though being superior in terms of social welfare, does not necessarily improve the situation of all of the parties concerned; different sets of policies may benefit different interest groups (i.e. incumbent gas producers and transmitter, potential market entrants, industrial consumers, household consumers). Self-regulation, as opposed to external (ex-ante) regulation, has been treated in the literature in the context of "regulatory threat"; this approach also fits the German electricity and gas sectors. The literature analyzes cases of self-regulation where the government threatens to implement a formal regulation procedure should it consider the results of self-regulation unsatisfactory, i.e. beyond a critical threat-point. [2] Regulatory threat is increasingly analyzed as an alternative to heavy-handed ex-ante regulation. Thus, Starkie (2000) argues that the British Airport Authority (BAA) has self-restrained itself to a voluntary price cap for two of its airports (Glasgow and Edinburgh) following a threat of severe ex-ante regulation. Brunekreeft (2002) is the first to analyze the association agreements in the German *electricity* sector, showing that the absolute and relative levels of access charges can be explained by changing regulatory threats of the German Federal Cartel Office (FCO, *Bundeskartellamt*). By looking separately at access prices and non-price discrimination as potential threat-points, the FCO has given the vertically integrated utilities incentives to shift their margins from easily observable network prices to not-so easily observable non-price discrimination. Last but not least, Engel (2002) argues that self-regulation may have advantages in terms of lower transaction costs, and a better use of technical knowledge; however, there is no prior for this institutional solution.

In this paper, we apply an IO-approach to comparing different regulatory regimes in the (German) gas industry. The next section presents stylized facts and recalls the recent policy debate. Section three presents the players and the setting of the model, and derives the solutions of two extreme market forms: *bilateral monopoly* between the vertically integrated gas producer and the monopsonistic industrial gas consumer, and a *pure competitive market.* Subsequently, we analyze the overall outcome of the self-regulation association agreement. Section four compares the results from different sets of policy-mix between regulation and competition policy, Section five concludes.

2 Institutional Setting

Since the EU-Directives 96/92 and 98/30 on electricity and gas liberalization in the European Union, energy sector reform has been high on the policy agenda. However, results were modest thus far. Problems of implementing the Directive have abounded. In particular, vertical unbundling and the introduction of competition in gas production, has staggered on only gradually. The slow reform progress is criticized regularly by the European Commission (2002) in its yearly benchmarking reports. The German solution of self-regulation has been particularly targeted, and the absence of ex-ante regulation been interpreted as an explanation for the high gas price level in the country.

[2]"Regulatory threat can be defined as the change of the probability of an intervention upon an agent's behavior by some outside authority as a response to the agent's prior behavior." (Brunekreeft, 2002, 2).

The institutional framework of self-regulation was as follows: There was *vertical integration* of gas transmission and the dominant wholesale trader, accompanied by the absence of regulation of network access and expansion. Instead, network access was self-regulated between the incumbent monopolist and representatives of industry and large industrial users. The *Association Agreement* ('Verbändevereinbarung') on network access and other key issues was negotiated between the Association of Germany Industry (BDI), the Association of Industrial Energy and Power Users (VIK), the Association of the German Gas and Water Industry (BGW), and the Association of Communal Utilities (VKU). Foreign producers, traders, and non-industrial customers were deliberately excluded from the negotiations. There was only a passive, ex-post control of the abuse of a dominant position, carried out by the German Cartel Office.
Whereas opinions are divided whether the assocation agreements have worked in electricity, the judgement of the agreements in the gas industry is very negative, both on the side of large consumers (VIK), household consumers, and the Federal Government. Prices have remained high, third party access was negligable, and competition has emerged for a few large customers only (BMWA, 2003).
The topic has significantly picked up speed with the implementation of the new EU-Gas Directive (2003/55/EC, the so-called "Acceleration Directive") that rules out the German *Sonderweg* of self-regulation. The Directive provides that each Member State has to designate one or more competent bodies with the function of regulatory energy authority. Under increasing pressure from the European policy process and mounting criticism from the German policy and from research (Monopolkommission, 2000, 2002), the German government has just recently subordinated the gas industry regulation to the inter-sectoral regulatory of network industries in Germany (RegTP). Independently of the competences of the new regulatory agency, the debate over pros and cons of self-regulation will continue, and talks about a new association agreement in Germany ("VV Gas III") to prevent the implementation of the regulator may also reappear. It is therefore important to understand the possible implications of the move from self-regulation to ex-ante regulation, to which we now turn.

3 The model

3.1 Players and setting

We begin with defining the players and its behaviour in the gas market. The gas market consists of two groups of suppliers, the cartelized German gas industry and small foreign/domestic suppliers called third party. The demand side is dominated by large industry users the interests of which are organized in the Association of Industrial Energy and Power User (VIK). Domestic households and small industries form the residual market demand.
Let us first describe the behaviour of the competitive fringe consisting of the third party and domestic households.

Profits of the third party (TP) are[3]

$$\pi_{TP} = (p - a)q_{TP} - C_{TP}(q_{TP}) \tag{1}$$

where $C_{TP}(q_{TP})$ is a convex cost function, p is the gas market price and a the access fee set by the association. Profits π_{TP} are maximized by choosing q_{TP} so as to meet the first order condition:

$$(p - a) = C'_{TP}(q_{TP}) \Rightarrow \hat{q}_{TP}(p - a), \, \hat{q}'_{TP}(p - a) > 0 \tag{2}$$

$\hat{q}_{TP}(p-a)$ is the profit maximizing supply of the third party and, hence, its monotonically increasing supply function.
Similar, household's demand can be derived[4]. Households maximize net utility[5]

$$U(q_{HH}) - pq_{HH} \tag{3}$$

which yields the first order condition

$$U'(q_{HH}) - p = 0 \Rightarrow \hat{q}_{HH}(p), \, \hat{q}'_{HH}(p) < 0 \tag{4}$$

where $\hat{q}_{HH}(p^G)$ is the monotonically decreasing demand function.
To keep the model tractable, we assume in the following:

assumption 1 *The houshold's aggregated demand function $\hat{q}_{HH}(p)$ and the third party‘s supply function $\hat{q}_{TP}(p - a)$ are linear, i.e. the second derivatives are zero.*

3.2 Bilateral monopoly

Additional to the third party and households, the gas market participants consists of the monopolistic gas supplier offering q_{BGW} and the monopsonistic association of the German Gas and Water Industry demanding q_{VIK}. Hence, market equilibrium is characterized by[6] the following equation

$$q_{VIK} + \hat{q}_{HH}(p) = \hat{q}_{TP}(p - a) + q_{BGW} \tag{5}$$

Notice that the equilibrium is achieved by the gas price p. Hence, p is a function of q_{VIK}, q_{BGW} and a. To be more precise

$$p = p(\Delta, a), \, \Delta \equiv q_{VIK} - q_{BGW} \tag{6}$$

[3]Without loss of generality we assume that the third party consists of one supplier. The main feature of competitiveness consists in that TP takes the market price as exogenously given.

[4]As for the small supplier, we assume that only one household demands gas.

[5]Without loss of generality we assume that gas is an income neutral good.

[6]If one neglect leakage within the gas distribution system the market equilibrium condition is equivalent to the mass balance identity.

where Δ is the net demand of the association (VIK and BGW) in the gas market. This demand must be met by the net supply $\hat{q}_{TP}(p-a) - \hat{q}_{HH}(p)$ which is supplied by the competitive fringe (see (5)).
A simple comparative static analysis leads to

$$p_\Delta = \frac{-1}{\hat{q}'_{HH}(p) - \hat{q}'_{TP}(p-a)} > 0 \tag{7}$$

$$p_a = \frac{-\hat{q}'_{TP}(p-a)}{\hat{q}'_{HH}(p) - \hat{q}'_{TP}(p-a)} = \hat{q}'_{TP}(p-a)p^G_\Delta > 0 \tag{8}$$

(7) and (8) show how the equilibrium price depends on the gas quantities of the members of the association agreement (net demand) and on the access fee. The signs conform with the intuition. Rising net demand increases the gas price and higher access fees lead to same result as well.
Both big players, the monopsony and the monopoly, are setting their quantities in a non-cooperative manner. In fact, they are playing a Nash-Cournot game exploiting the competitive fringe which is defined by it's non-strategic supply and demand functions. The Nash-Cournot-game can be defined as follows:

$$\max_{q_{BGW}} [p(\Delta, a)q_{BGW} + a\hat{q}_{TP} - C_{BGW}(q_{BGW}) - C_N(q_{BGW} + \hat{q}_{TP}) \tag{9}$$

$$\max_{q_{VIK}} [\pi_{VIK}(q_{VIK}) - p(\Delta, a)q_{VIK}] \tag{10}$$

where C_{BGW} is the convex cost function of BGW's gas production and C_N are capacity costs of production. In the following we make use of he following assumptions:

assumption 2 *The capacity costs of gas transportation are in the long run (almost) linear, i.e. $C''_N = 0$. Third party's marginal costs of gas production are lower then the marginal production costs of BGW, i.e. $\forall q : C'_{TP}(q) < C'_{BGW}(q)$.*

From the first order conditions one can derive the N-C-equilibrium $\{q^{bi}_{BGW}, q^{bi}_{VIK}\}$:

$$p^{bi} - q_{BGW}p^{bi}_\Delta - ap^{bi}_\Delta\hat{q}'_{TP} - C'_{BGW} - C'_N[1 - \hat{q}'_{TP}p^{bi}_\Delta] = 0 \tag{11}$$

$$\pi'_{VIK} - p^{bi} - q_{VIK}p^{bi}_\Delta = 0 \tag{12}$$

where $p^{bi} = p(\Delta^{bi}, a), \Delta^{bi} = q^{bi}_{VIK} - q^{bi}_{BGW}$.
To summarize, together with eqs (2), (4), and (5) the first order conditions (11) and (12) form the gas market equilibrium if the two big players act strategically. Graphically, this equilibrium is depicted in picture 1 with the help of reaction curves[7] derived from the two fist order conditions. From (11) we can derive the optimal response of q_{BGW} for given q_{VIK} which is denoted by $q_{BGW}(q_{VIK})$. Similar, VIK's reaction curve $q_{VIK}(q_{BGW})$ can be derived from (12). Finally, the associations net demand $\Delta^{bi} = q^{bi}_{VIK} - q^{bi}_{BGW}$ can measured along the vertical axis by a 45°-line through the equilibrium point BI which allows to read off the price $p(\Delta, a)$ in the left half of the picture.

[7]The chararacteristics of these curves are summarized in the appendix.

3.3 A pure competitive market

It is instructive to compare the allocation of the cartelized market with a pure competitive market where all participant take the price as given. This case is relevant if competition policy (ex post regulation) is effective and can successfully assure an ideal market. In this case, the supply of the gas supply association BGW must be derived from the maximization program

$$pq_{BGW} + aq_{TP} - C_{BGW}(q_{BGW}) - C_N(q_{BGW} + q_{TP}) \tag{13}$$

Notice, that BGW takes the supply of the third party as given. The respective first order condition yields

$$p - C'_{BGW} - C'_N = 0 \Rightarrow \hat{q}_{BGW}(p),\, \hat{q}'_{BGW}(p) > 0 \tag{14}$$

Similar, the demand of VIK can be derived from maximizing its total profits

$$\pi_{VIK}(q_{VIK}) - pq_{VIK} \tag{15}$$

for given gas price p. The demand can be derived from the first order condition

$$\pi'_{VIK}(q_{VIK}) - p = 0 \Rightarrow \hat{q}_{VIK}(p),\, \hat{q}'_{VIK}(p) < 0 \tag{16}$$

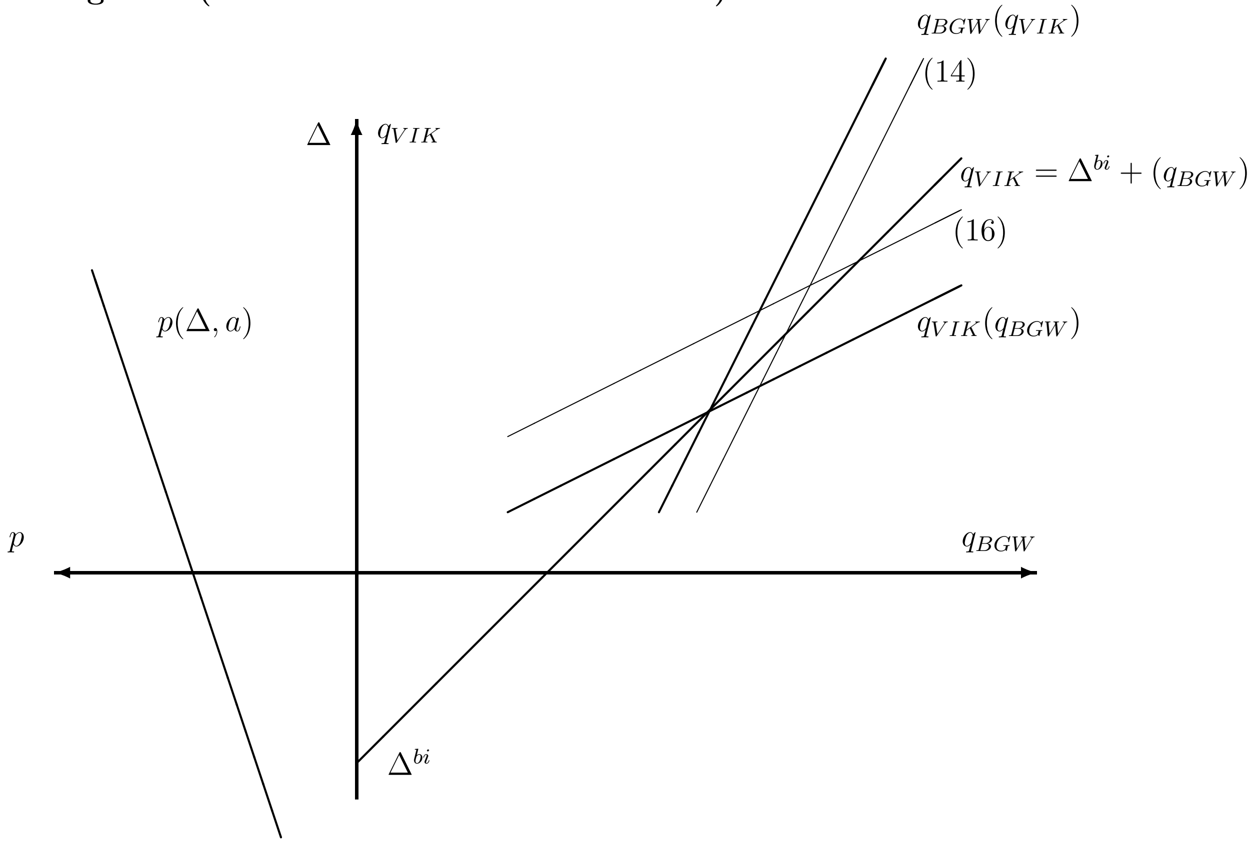
proposition 1 (More competition does not imply a lower gas price) *Assume that $a \geq C'_N$, i.e. total access fees cover at least the network costs. Then the transition from a cartelized market to a full competitive market may lead to a higher or lower market price. Total supply may rise or fall. Of course, welfare increases with more competition.*
Proof: In this preliminary version we confine ourselves to a graphical proof. For this purpose we have to take the optimality conditions (11), (12) and (14) and (16) under close inspection. It can easily be shown, that (11)and (12) imply that

$$p - C'_{BGW} - C'_N > 0 \tag{17}$$

$$\pi'_{VIK}(q_{VIK}) - p > 0 \tag{18}$$

Due to the assumed properties of the relevant functions (14) must lie to the right of BGW's reaction function. Similar, (16) is somewhere above VIK's reaction curve. An example is drawn into the picture (thin lines). Thus, in a competitive equilibrium both q_{BGW} and q_{VIK} increase leaving the effect on net demand Δ undetermined. In our example Δ is rising.

Figure 1 (Market structure and allocation)



To summarize: It is undoubted that more competition increase total welfare. Nevertheless, the figure shows that more competition has it's losers and it's winners. If net demand Δ increases (decreases) in the course towards more competition the third party (households) is (are) the winner(s). On all accounts, the former big players BGW and VIK will loose during the transition towards more competition.

3.4 Association Agreement

The German association agreement can be modeled within a two-stage time-structure. First, the agreement is settled comprising long term contracts on gas deliveries between the monopolistic supplier (BGW) and the monopsonistic buyer (VIK) and a stipulated access fee which applies to all supplier (non-discriminatory access)

In the second stage the gas market will unfold as described in subsection 2.2. The market is characterized by two major players the monopolistic supplier and the monopsonistic buyer. They choose supply and demand strategically taking into account their reaction (Nash strategies) and the reaction of a competitive fringe consisting of a third party supplying and households demanding gas.

The agreement is modeled as a two stage game to assure self-enforcement. Long term contracts are legal and hence feasible. Similar, the German legislation provides for self-regulation which allows to stipulate an enforceable access fee a. Conversely, future supply and demand decisions in the gas market can not be stipulated ex ante (cartel instability). Hence, these options can only be anticipated. In our deterministic model this is done by the precise forecast of the second period's Nash equilibrium.
The self-regulation can be modeled by a cooperative Nash bargaining approach[8]. BGW and VIK maximize

$$(\pi_{VIK}(q^{bi}_{VIK}) - p^{bi}q^{bi}_{VIK} - T - \bar{\Pi}_{VIK}) \quad \text{x} \tag{19}$$
$$(p^{bi}q^{bi}_{BGW} + a\hat{q}_{TP} - C_{BGW}(q^{bi}_{BGW}) - C_N(q^{bi}_{BGW} + \hat{q}_{TP}) + T - \bar{\Pi}_{BGW})$$

by choosing the access fee a and a long term contract $T = p_0 q^0_{VIK}$ where p_0 is the price fixed ex ante and q^0_{VIK} the volume of gas ordered ex ante[9].
Before proceeding the threat points $\bar{\Pi}_{VIK}$ and $\bar{\Pi}_{BGW}$ need some explanation. The German system of self regulation is a bargaining process under the threat of the public legislator to introduce an ex ante regulation scheme if the private player do not reach an agreement. In this case the access fee a will be set by a regulatory body. As a result, the respective profits can be anticipated by calculating the non-cooperative Nash-equilibrium given the access fee a^{reg} set by a future regulatory authority. Probably, this fee will be close to marginal transportation costs, i.e. $a^{reg} = C'_N$. Moreover, substituting self-regulation by a public regulatory framework may foster further competition in the gas market be it by an accompanying competition policy (ex post regulation) or by the signaling effects encouraging potential gas producer to enter the market. Also, the intrinsic cartel instability of the big buyers might intensify competition on the demand side. If this scenario applies, then the threat points refer to profits under full competition (see egs (13) and (15).
In the following we assume that the threat points are determined by an cartelized market under access fee regulation. From the first order condition of (19) one can derive the following rule to fix the access fee a^{vv}:

$$-p^{bi}_a \Delta^{bi} + \hat{q}_{TP} + (a - C'_N)\hat{q}'_{TP}(p^{bi}_a - 1) = 0 \tag{20}$$

proposition 2 (association agreement (Verbändevereinbarung)) *The association agreement sets $a^{vv} > C'_N$ which implies the exploitation of households since the gas market price p^{bi} increases with a vis á vis the reference case of a first best access fee $a = C'_N$. How the net price $p^{bi} - a$ reacts on a depends on the curvatures of the profit function π_{VIK}*

[8]In our paper we do not go in to details on how the axiomatic bargaining approach models the final outcome of a sequential non-cooperative bargaining process in a proper way.

[9]To keep the amount of symbols tractable we have introduced the variable T. Strictly speaking, this substitution is only admissible if households and the third party exhibit linear demand and supply functions respectively. Moreover, in the framework of a deterministic two-period model many problems of long term contracts are assumed away (contract length, options, take-or-pay provisions etc.) See Crocker and Masten (1988).

and the cost function C_{BGW}. As a result, the third party may gain from an association agreement compared to the case of a state-run regulation of the cartelized market.
Proof: See appendix.

4 Policy mix

The recent discussion on deregulation of power networks differentiates between ex ante and ex post regulation. While the first refers to classical price regulation the latter involves active competition policy. In our model we were taking into account both policy measures. Ex ante regulation is modeled as introducing a price cap which in fact leads to a lower access fee a whereas competition policy results in a more competitive market structure. Here, we assume the textbook case of a competitive market comprising of participants taking the gas price as given.
The following table combines the two policy measures and their joint impact on the gas price.

Figure 2 (Policy mix)

		ex ante regulation	
		yes	no
competition policy	yes	?	p^{bi} may rise or fall
	no	p^{bi} decreases as a is lowered net price $p^{bi} - a$ may rise or fall	association agreements (vv)

Beginning from bottom right one can read off the effects of both policy types. Competition policy without ex ante regulation leads to an ambiguous price movement (cf. figure 1). Of course, the welfare impacts are clear cut as more competition increases total welfare defined as sum of all profits and consumer surplus. Nevertheless, there are winners and losers depending on the price movement in the course towards more competition. Recall, that the starting point is the status quo, i.e. the self-regulating cartel of BGW and VIK. Also, ex ante regulation has its own ambiguities. If the access fee a is lowered by, say, introducing a price cap, then the gas price drops which, in turn, leads to an increase of consumer surplus. Whether the third party gains from this price reduction depends on the speed of decrease. If p drops faster than a then TP will loose and vice versa.

5 Conclusions

In this paper, we have compared different regulatory settings for a network industry, based on a stylized representation of the regulatory process in the German gas industry. The point of inception was self-regulation of access prices by the incumbent gas production and transmission monopolist (BGW) and the large industrial users (VIK), a bilateral monopoly. This approach to self-regulation has been widely criticized for discriminating

against third party gas producers and household consumers. We compare the point of inception with ex-ante regulation, in the absence of or in combination with a proactive competition policy.
We find that the move from a bilateral monopoly to a fully competitive market does not necessarily lead to lower market prices, and that total supply may rise or fall; what we can state, evidently, is that more competition increased welfare. When analyzing the self-regulated association agreement, we find that it leads to an exploitation of households; however, the effect on the third party gas producer is unclear; the latter may in fact gain from the self-regulated access. We conclude that abandoning the association agreements and moving to ex-ante regulation increases welfare, but does not necessarily improve the situation of the third party producers.
We have left some issues open that merit further analysis. The idealtype model yields a deterministic solution, and does not take into account information asymmetry. Both assumptions might be dropped to render the model more realistic. The topic of regulatory threat, at the outset of this paper, can also be enhanced; in reality, one can think of more possible constellations between the industry player, the Cartel Office, the potential regulator, and the government. An intermediate result of deregulation, i.e. a close cartel on the supply side and a larger cartel on the demand side, might also be a more realistic representation of the current situation. Last but not least, we have neglected the contract structure between upstream and downstream market participants, leaving the opportunity to develop a dynamic version of this model.

6 Appendix

6.1 Reaction functions

To determine the shape of the reaction curves in figure 1 one has to differentiate the first order conditions (11) and (12). Thereby, the price function $p(\Delta, a)$ implicitly defined by (5) and assumption 1 must be taken into account.
To determine the characteristics of $q_{VIK}(q_{BGW})$ we take q_{BGW} as exogenous variable and differentiate (12). This yields after some rearrangements

$$0 < \frac{dq_{VIK}(q_{BGW})}{dq_{BGW}} = \frac{-p_{\Delta}^{bi}}{\pi''_{VIK} - 2p_{\Delta}^{bi}} < 1 \tag{21}$$

Similar, the slope of the reaction function $q_{BGW}(q_{VIK})$:

$$0 < \frac{dq_{BGW}(q_{VIK})}{dq_{VIK}} = \frac{-p_{\Delta}^{bi}}{-(C''_{BGW} + 2p_{\Delta}^{bi})} < 1 \tag{22}$$

Notice, that the reciprocal value of $\frac{dq_{BGW}(q_{BGW})}{dq_{VIK}}$ is greater than 1.

6.2 Proposition 2

To prove the first part insert (2) into (11). This yields

$$(C'_{TP} - C'_{BGW}) + (a^{vv} - C'_{N})(1 - \hat{q}'_{TP}p_{\Delta}) - q_{BGW}p_{\Delta} = 0 \tag{23}$$

Notice that all relevant functions are evaluated at the Nash-equilibrium $\{q^{bi}_{BGW}, q^{bi}_{VIK}\}$. Assume per contradiction that $a^{vv} \leq C'_N$. From (23) and (8) it follows that $C'_{TP} - C'_{BGW} > 0$ and, by assumption 2, $\hat{q}_{TP} > q^{bi}_{BGW}$. From (11) we can infer that

$$-p^{bi}_a \Delta^{bi} + \hat{q}_{TP} < 0 \rightarrow -\Delta^{bi} + \hat{q}_{TP} = -q^{bi}_{VIK} + q^{bi}_{BGW} + \hat{q}_{TP} < 0 \tag{24}$$

Inserting (5) into (24) leads to $-\hat{q}_{HH} < 0$ which is not true. Hence, $a^{vv} > C'_N$.
To prove a decrease of the gas price as the access fee is lowered one has to carry out a comparative static analysis of eqs (11) and (12). Differentiating with respect to a and recalling assumption 1 we arrive at

$$\begin{bmatrix} (\pi''_{VIK} - 2p^{bi}_{\Delta}) & p^{bi}_{\Delta} \\ p^{bi}_{\Delta} & -(C''_{BGW} + 2p^{bi}_{\Delta}) \end{bmatrix} \begin{bmatrix} \frac{dq^{bi}_{VIK}}{da} \\ \frac{dq^{bi}_{BGW}}{da} \end{bmatrix} = \begin{bmatrix} \hat{q}'_{TP} p^{bi}_{\Delta} \\ \hat{q}'_{TP} p^{bi}_{\Delta} \end{bmatrix} \tag{25}$$

Solving this equation system yields

$$\frac{dq^{bi}_{VIK}}{da} = \frac{-\hat{q}'_{TP} p^{bi}_{\Delta}(C''_{BGW} + 3p^{bi}_{\Delta})}{\Sigma} \tag{26}$$

$$\frac{dq^{bi}_{BGW}}{da} = \frac{\hat{q}'_{TP} p^{bi}_{\Delta}(\pi''_{VIK} - 3p^{bi}_{\Delta})}{\Sigma} \tag{27}$$

where Σ is the determinant of the system matrix. It can easily be shown that Σ is unambigously positive. Hence, gas demand and gas supply of the big player is decreasing with respect a.
To proof the stated relation between p^{bi} and a one has to differentiate p^{bi} totally with respect to a. After some calculation one arrives at:

$$\frac{dp^{bi}(\Delta, a)}{da} = p^{bi}_{\Delta} \frac{\Delta^{bi}}{da} + p^{bi}_a = \frac{-3p^{bi}_{\Delta}\pi''_{VIK} + p^{bi}_{\Delta} C''_{BGW} - \pi''_{VIK} C''_{BGW} + 3(p^{bi}_{\Delta})^2}{\Sigma} > 0 \tag{28}$$

The reaction of the net price $p - a$ can be find by differentiating totally and inserting (28). After some calculation one gets

$$\frac{dp^{bi}(\Delta, a)}{da} - 1 = \frac{-p^{bi}_{\Delta}(\pi''_{VIK} + C''_{BGW})}{\Sigma} \tag{29}$$

which exhibits an ambiguous sign.

7 References

BMWA (German Ministry of Economics and Labour) (2003): Bericht des Bundesministeriums für Wirtschaft und Arbeit an den Deutschen Bundestag. Berlin, September.

Brunekreeft, Gert (2002): Regulatory Threat in Vertically Related Markets - The Case of German Electricity. University of Cambridge, CMI Working Paper 10, and DEA Working Paper WP 0228.

Crocker, K. J. and S. Masten (1988): Mitigating contractual hazards: unilateral options and contract length. Rand Journal of Economics, 19, 327-343.

Engel, Christoph (2002): Verhandelter Netzzugang. Bonn, Pre-prints aus der Max-Planck-Projektgruppe Recht der Gemeinschaftsgüter, 2002/4.

European Commission (2002): Second Benchmarking Report on the Implementation of the Internal Electricity and Gas Market. Brussels, Commission Staff Working Paper, SEC (2002) 1028 (October 1.
Meran, Georg, and Schwarze, Reimund (forthcoming): Pitfalls in Electricity Restructuring. German Economic Review.
Monopolkommission (2000): Wettbewerbspolitik in Netzstrukturen. 13. Hauptgutachten. Baden-Baden, Nomos.
Monopolkommission (2002): Netzwettbewerb durch Regulierung. 14. Hauptgutachten. Baden-Baden, Nomos.
Starkie, David (2000): A New Deal for Airports. London, IEA Regulation Lectures.