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The Difficulty to Behave as a (regulated) Natural Monopolist – The Dynamics of Electricity Network Access Charges in Germany 2002 to 2005

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Abstract

Reviewing the development of network access charges in the German electricity market since 2002 reveals significant variation. While some firms continually increased or decreased their access charges, a variety of firms exhibited discontinuous behavior with price changes in both directions. From an economic viewpoint this price setting turbulence is astonishing because grid operators are non-contestable natural monopolists, which in this time period were regulated by Negotiated Third Party Access (NTPA). Depending on the effectiveness or ineffectiveness of NTPA, expected behavior would be either regulated average cost prices or monopoly prices, but not the observed turbulence. Although in 2005 NTPA scheme was replaced by a Regulated Third Party Access (RTPA) scheme with a regulator, an analysis of the factors influencing the price setting behavior within this period offers valuable information for the new regulator and the still discussed new incentive regulation, which is expected to start in 2009. Using multivariate estimations based on firm data covering the years 2000-2005, we test the hypotheses that asymmetric influence of regulatory threat, different cost and price calculation knowledge, strategic use of structural features and the obligation to publish specific access charges have influenced the electricity network access charges in Germany.

Keywords: deregulation, natural monopoly, power industry

JEL-Classification: D42, L43, L94

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1 The Problem

The German electricity market can be divided into various sections dealing with generation, transmission networks, distribution networks and retail (Growitsch and Wein 2004)). The national grid or transmission networks - in Germany an amalgamation of four combined sub-networks (regional closed loop controls, Regelzonen) - is defined as the network of extra-high-voltage level (220/380 kV). It is used to transmit electricity from the generation plants to the interconnection sites which link the national grid to the regional distribution networks. Regional and local distribution is based on high-, medium- and low-voltage level networks (110, 20, and 0.4 kV). Transmission and distribution networks are good examples of stages with subadditive cost functions: Density and stochastic scale advantages necessitate only one network supplier (natural monopoly). Because of the existence of enormous sunk costs, potential competition cannot work; non-contestable natural monopolies are a given (Brunekreeft 2002, Growitsch and Wein 2004). In contrast to that, if non-discriminatory access to both networks stages is provided, the generation and retail sections will be stages in which competition is possible.

Until the beginning of deregulation in 1998 the German electricity utilities had had no reason to calculate network access charges. Competition had not occurred, and retail prices for private households and small businesses had been regulated. By implementing the EU electricity directive (96/92/EC) in 1998 the German legislator opened the German electricity market to all customers irrespective of size or commercial status and chose to give access to electricity grids by Negotiated Third Party Access (NTPA). The negotiations concerning the economic rules for access, and especially the prevention of monopoly access prices, were the crucial points of NTPA. The network owners and users, which were represented by several associations, bargained for more than two and one-half years to develop a contractual framework for the network access (association agreement). At the end of 2001, the final association agreement, the so-called VV II+, was adopted. It created an obligation to calculate network access charges systematically based on a catalog of calculation principles for the first time for all nine hundred network operators in Germany. Although, in 2005 NTPA, and therewith the VV II+, was replaced by a RTPA regime with a regulator, an analysis of the factors influencing the price setting behavior within this period offers valuable information for the new regulator and the still developing incentive regulation, which is expected to be implemented in 2009.

Table 1 represents the comparison of access charges from October 2002 to April 2005. Surprisingly, against the presumption that the VV II+ agreement and its calculation principles will cause an overall descent of the access charges, it shows a lot of variation in the price setting behavior. Whereas more than one-third of all low- and medium-voltage network owners have not changed their access charges, the other two-thirds have raised or have lowered their prices. Referring to the high-voltage sector, nearly sixty percent of the firms levy charges which are higher in April 2005 than they were in October 2002;

less than thirty percent work with the same prices.

Table 1: Development of network access charges – 10/2002 to 04/2005

	Low-voltage	Medium-voltage	High-voltage
		%	
Increasing	23.4	27.9	57.8
Constant	39.9	37.8	28.9
Decreasing	36.8	34.3	13.3
No. of observations	680	641	45

Source: Deregulated German electricity market data set 2006; see chapter 4.

Referring to the development between October 2002 and April 2005, the results are even more astonishing since it is shown that several operators changed their prices "in all directions". For example, there are numerous operators that started with a relative high price, then lowered their price, and at the end raised their price again. Therefore, in order to capture all price changes during October 2002 and April 2005 we calculate the so-called "disquietness" within the access charges development. The variable "disquietness" represents the average quadratic divergence of the access charges over time:

$$disquietness = \frac{(value_t - value_{t+1})^2 + (value_{t+1} - value_{t+2})^2 + ...}{number\ of\ quadratic\ differences}. \quad (1)$$

Table 2 shows hypothetical, but characteristic, access prices of two low-voltage operators from October 2002 to May 2005. Whereas both firms would be registered as price increasing firms in Table 1, Table 2 shows that Firm 2 changed its prices more often than Firm 1. Hence, the value of the variable "disquietness" for Firm 2 is much higher than value of "disquietness" of Firm 1.

Table 2: Disquietness – two hypothetical firms

	10/2002	03/2003	10/2003	04/2004	10/2004	04/2005	Disquietness
Firm 1	5.91	5.91	5.91	5.91	5.91	6.01	0.002
Firm 2	5.91	5.81	5.81	5.85	5.91	6.01	0.00504

Source: Hypothetical firms, own calculations.

Calculating disquietness for all voltage levels and excluding all firms with the same access charges at starting and ending time, we generated Table 3. The descriptive values show that firms with decreasing prices changed their prices more often than firms with increasing prices and that price changes are relatively high on the low-voltage level, less on the medium-voltage and nearly unimportant on the high-voltage level. This result is given by the average and median values but is not in all cases supported by the standard deviation.

Table 3: Descriptive values of "Disquietness"

	Low-voltage	Medium-voltage	High-voltage
Increasing			
Mean	0.047	0.029	0.004
Median	0.012	0.005	0.003
Standard deviation	0.129	0.144	0.004
No. of observations	159	179	26
	Low-voltage	Medium-voltage	High-voltage
Decreasing			
Mean	0.060	0.034	0.023
Median	0.024	0.007	0.014
Standard deviation	0.147	0.097	0.028
No. of observations	250	220	6

Source: Deregulated German electricity market data set 2006; see chapter 4.

Disquietness, or turbulence, in price setting behavior seems astonishing because, from the economic viewpoint, grid operators are non-contestable natural monopolists which during the observed period have been regulated by NTPA. Hence, depending on the effectiveness or ineffectiveness of NTPA, the expected observations would be either regulated average cost prices or monopoly prices, but not the observed turbulence. Furthermore, because most cost elements of networks are long-run costs, there are very few arguments to increase prices beyond the starting point of regulation. Nevertheless, the results displayed in Tables 1 and 3 indicate that in the German electricity market such a stable equilibrium has not been reached. The question is whether this is just a failure of NTPA that may be corrected by the new regulatory regime with an incentive-based RTPA scheme or are there other factors not directly connected to NTPA that may have influenced the price setting behavior?

This paper compiles the arguments advanced as to why in many cases the German network operators did not find the optimal price in 2002. The paper is organized as follows: Section 2 gives a short overview on the German history of NTPA and associations' agreements. The theoretical explanations for price changing behavior based on industrial organization theory are provided in Section 3. Data, empirical hypotheses and methodology are presented in Section 4. Section 5 contains further descriptive analyzes.

Multivariate estimations results on the significance and relevance of the reasons for price changing behavior are discussed in Section 6. Finally, we summarize our results in Section 7.

2 A Short History of NTPA and Associations‘ Agreements

Until April 1998 the German electricity market was characterized by regional operating monopolies: customers were forced to buy power from one local monopolist; the energy firms agreed that no firm would try to enter the market of another firm (Deregulierungskommission 1991). Satisfying European obligations, the German legislator opened the electricity market for all customers in April 1998. This market opening was accomplished by choosing the option of negotiated third party access (NTPA), which implies a strong priority for private negotiations between network owners and users. From 1998 until the end of 2001, the associations of both parties negotiated several agreements. The first agreement, VV I, came into effect in May 1998, followed by the second agreement, VV II, in January 2000. The first validity period of the final agreement, VV II+, in effect from January 2002, ended in December 2003. In May 2003 it was accepted by law ($1^(st$) amendment to EnWG) as the general code of practice. The second period of VV II+ ended in July 2005. In addition to NTPA and its associations´ agreement the German cartel offices (Bundeskartellamt and Landeskartellamt) had had the possibility to control network access ex post, especially to secure non-discriminatory access. Consequently, Meran and von Hirschhausen (2004, 1) have described the German way of energy regulation as "cartel type, private contracts negotiated between the main domestic players in the industry, accompanied by weak ex-post control exercised by anti-monopoly agency". In June 2003, the EU acceleration directive demanded the installation of regulation authorities in all member states by July 2004. One year later, in July 2005, the German legislator implemented the directive by the second amendment to EnWG. NTPA was replaced by RTPA, and the federal network agency (Bundesnetzagentur) was appointed as the new federal regulatory authority. Table 4 represents the regulatory framework and chronological sequence in detail.

Table 4: NTPA in Germany

Date	Description	Content	Actors
04/1998	Reform of energy law	Legal opening of electricity and gas markets for all customers; negotiated third party access (law on electricity and gas supply; EnWG)	Federal legislator
05/1998	Association agreement I (Verbändevereinbarung I;VV I)	Access charges, calculated on the principle of contractual path - distance based rates	Network users: German Business Association (BDI), association of large industrial electricity consumers (VIK) Network owners: association of electricity economy (VdEW)
05/1998 – 12/1999 Validity period of VV I			
12/1999	Association agreement II (Verbändevereinbarung II; VV II)	Access charges based on connection points; two geographical zones	Network users: see above Network owners: see above
01/2000 – 12/2001 Validity period of VV II			
12/2001	Association agreement II+ (Verbändevereinbarung II plus; VV II+)	General terms of contracts, principles of the calculation of access charges market comparison scheme	Network users: see above, Network owners: see above + association of grid operators (VDN), association of regional distribution utilities (ARE), association of municipal distribution utilities (VkU), task force of Federal Ministry of Economics
01/2002 – 12/2003 First validity period of VV II+			
05/2003	VV II+ = general code of pratice	1. amendment to EnWG: VV II+ accepted by law as the general code of practice without constraining the regulatory power of cartel offices	Federal legislator
06/2003	Cancelation of NTPA	European Union: Duty to introduce regulation authority in all member states,“German way of regulation” has to be finished until 07/2004	European legislator
01/2004 – 07/2005 Second validity period of VV II+			
07/2005	RTPA (regulated third party access)	2. amendment to EnWG: Introduction of regulation authorities (federal network agency and federal states regulation agencies); introduction of legal rules; preparing of incentive regulation	Federal legislator
07/2005 VV II+ as important background for decisions of federal network agency			

Source: Glachant, Dubois and Perez (2004), Monitoring-Report (2003), Federal Ministry of Economic Affairs (2006a, 2006b), Federal network agency (2006).

3 Theoretical Background

The main aspects of electricity market regulation are the securing of non-discriminatory network access and the prevention of monopoly network access charges. Considering the very complex market structure, including various cost relevant interconnections between the non-contestable and potential competitive production stages, the determination of an adequate pricing rule for network access charges is a rather sophisticated task. Whereas economic theory offers a variety of different pricing rules (e.g., (long run) average incremental cost prices, efficient component price rules or Ramsey-prices (Baumol and Sidak 1994, Sidak and Spulber 1997, pp. 403-426), it cannot give a definite answer. NTPA, as one possible solution to this problem, seems to be inappropriate. The observed price turbulence and differences in the price setting behavior show that a stable equilibrium with prices equalling long-run average costs was not achieved. Various reasons are responsible for that failure.

First of all, it can be assumed that the so-called regulatory threat, which refers to the power of the cartel offices to control the access charges (Brunekreeft 2001, 2002), had an influence on the price setting differences. The behavior of large vertically integrated network operators - active in the low-, medium- and high-voltage section - is assumed to be under more public scrutiny and hence under a more intense control of the cartel offices than the behavior of the much smaller - not vertically integrated - utilities. Therefore, the integrated operators could have decreased their access charges more than the non-integrated utilities. On the other hand, the regulatory threat could have become ineffective towards the end of NTPA. The end of NTPA was already foreseeable during 2003. Hence, the incentive to decrease prices became weaker after the first quarter of 2003. It might be even possible that operators raised their prices expecting the inoperativeness of NTPA.

A second reason for price setting turbulence could be that in the pre-deregulation period access charge calculation had not been necessary. It is conceivable that the calculation knowledge had been unevenly distributed. Large integrated firms active in several markets and sections had better knowledge than small firms operating only in one local market. In other words, integrated firms had more experience with optimal price calculation and therefore would change their prices less frequently. When combined with the above-mentioned more intense control, either constant or decreasing prices are assumed for these firms.

Another possible explanation could be the strategic use of structural characteristics. At the end of 2001 a market comparison scheme has been introduced as a part of the final association agreement, VV II+. It developed three so-called structural features (Strukturmerkmale) that were intended to account for differences in the networks. Network suppliers which

- are located in East Germany,

- can be characterized by low possibilities to secure economies of scale (low population or consumption density), or
- are obligated to bear additional social costs (high cable rates because of ecological or aesthetical reasons)

obtained the "right" to levy higher access charges by the institutional rules of the market comparison scheme. If firms that fulfilled these features recognized that they were charging lower access charges than they were allowed to, they were invited to mark up their fees (Wein 2005).

Finally, the obligation to publish specific access charges and structural features - also introduced with the comparison scheme - might have had an influence on the price setting behavior as well. Firms that had charged relatively low access charges were informed that they were able to increase prices without fear of regulation (Growitsch and Wein 2005). On the other hand, relatively expensive firms were informed that they should fear regulation. The effect should be a price reduction of expensive operators and a price increase of cheap operators.

Recapitulating, several theoretical arguments can be enumerated why price changes could have occurred in both directions:

- Asymmetric influence of regulatory threat depending on firm size and the expected ending of NTPA .
- Differences in price calculation knowledge between vertically integrated and non-integrated operators.
- Strategic use of structural features inviting operators with high cost structural features to increase their charges.
- Publishing obligation of access charges offering information on access charges of all operators.

4 Data, Hypothesis, and Methodology

The market comparison scheme, which was constituted by the last association agreement at the end of 2001, required network operators to publish network access charges. The German association of electricity network operators collected and published the data of all its member firms that were active in low-, medium- or high-voltage (VDN 2006). Altogether, the access charges are available for:

- October 2002,
- March 2003,
- October 2003,
- April 2004,
- October 2004,

- April 2005.

Access charges to the low-voltage networks are registered for customers with power metering as well as customers without power metering, and at the medium- and high-voltage networks for customers with power metering only. In each network section, the charges are differentiated in terms of characteristic consumption classes; for example, for low-voltage without power metering between 1.700, 3.500 and 30.000 kWh/a, and for medium-voltage between 1.600, 2.500 and 5.000 utilization h/a (Katzefey et al. 2002). Furthermore, the firm-specific arithmetic mean values of the charges are published, separated for the low-, medium- and high-voltage networks.

In accordance to the market comparison scheme, the data of VDN also include firm-specific information on the following structural features:

- Structural feature number 1 measures the regional intensity of demand. Regarding the low-voltage network, the population density (inhabitants per sqkm) is used. Low population density (D) means below 2.500 inh./sqkm, medium is below 3.500 inh./sqkm and high is above 3.500 inh./sqkm. To avoid contortions, areas without low-voltage supply (forests, lakes, etc.) are not included. The consumption density (MWh/sqkm) takes into account the current flows in medium- and high-voltage networks in relation to the entire area of the network. This feature is applied to the whole area because unpopulated territories in these networks cannot be excluded technically (Katzefey et al. 2002). Consumption density (D) in medium-voltage (high voltage) is classified as low if MWh/sqkm are below 500 (5.500), medium is below 1.700 (15.000) MWh/sqkm, and high is above 1.700 (15.000) MWh/sqkm.
- The second structural feature, "cable rate" (CR), measures the cable length in comparison to the whole length of the respective network's conductions. This structural feature is supposed to represent the fact that network operators are frequently obliged (for aesthetical and environmental reasons) to use underground lines. The associations agreed on three classes of CR $\leq$ 50 percent), medium (50 percent $<$ CR $\leq$ 75 percent), and high (CR $>$ 75 percent).
- The third structural feature includes the fragmentation of network suppliers due to their service areas: East Germany and West Germany. It represents the consideration that oversized networks have been established in East Germany after 1989. The over-sizing effects are the result of not forecasting the diminishing peak load quantity (around 70 percent) after the reunification (stranded costs).

Table 5 reports the percentage distribution of the firms within each structural feature based on the data of April 2005. At that time, almost all network operators had reported their structural variables, and for almost all firms the classification has not changed since October 2002 (VDN 2006).

Additionally, in order to analyze the influence of different firm sizes and firm structures on the development of access charges, we differentiate the firms by their degree of vertical

Table 5: Firm distribution within structural features (in percent)

	Low-voltage			Medium-voltage			High-voltage		
1^{st} structural feature	population density			consumption density					
	low	med.	high	low	med.	high	low	med.	high
	29.6	30.2	40.2	14.8	30.7	54.5	56.7	30.0	13.3
2^{nd} structural feature	cable rate								
	low	med.	high	low	med.	high	low	med.	high
	4.4	18.1	77.5	7.6	15.0	77.4	59.4	11.6	29.0
3^{rd} structural feature	East-/West-Germany								
	West Germany: 81.4 (579 firms)								
	East Germany: 18.6 (132 firms)								

integration. If a firm has not reported an access charge for the high-voltage section, we assume this firm is not active in the high-voltage section. Hence, no vertical integration is given. Accordingly, firms active in the high-voltage section are identified as being vertically integrated. Table 6 shows the number and percentage of firms considered as vertically integrated and not vertically integrated.

Table 6: Vertical integration

	No	Yes	All
Active in high voltage section?	659 (92.7 percent)	52 (7.3 percent)	711 (100.0 percent)

Finally, considering the influence of publishing obligations, we classify firms as expensive if their average access charges fall in the upper thirty percent of the voltage section. This frontier is chosen in relation to the market comparison scheme. The difference between the frontier defined by the market comparison scheme and our frontier is that we do not use a specific thirty percent frontier for every structural class within each voltage section. These classes were developed by the market comparison scheme to differentiate the firms by their structural features. By combining the three different categories (low, medium, and high) of the first two structural features with the two categories (east and west) of the third feature eighteen structural classes for each voltage section were generated. Every firm belonged to one class, and the upper thirty percent frontier of the average access charges was used to identify firms under suspicion of being expensive. Hence, these firms had to fear an arbitration board proceeding, with the board examining the firms‘ cost calculations under the criterion of reasonableness. Since some classes only include one or two firms we do not use this class-specific frontier but define an overall frontier for the whole voltage section. In the same manner, we classify a firm as cheap if the firm‘s average access charges belong to the lower thirty percent of the voltage section.

To measure the development of access charges depending on the described variables we calculate the growth rate of access charges:

$$\frac{access\ charge_t - access\ charge_{t-1}}{access\ charge_{t-1}} \cdot 100. \tag{2}$$

Furthermore, as shown in Table 7, we analyze the influence of time by considering different time periods. For example, choosing October 2002 as the base point, we calculate the growth rate of half a year until May 2003, one year until October 2003, and so on. Based on the starting point, the very short perspective of one-half a year can be analyzed five times and the very long perspective of two and a half years only once.

Table 7: Influence of time

		Ending point in time					
years		10/02	03/03	10/03	04/04	10/04	04/05
	10/02	–	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$
	03/03		–	$\frac{1}{2}$	1	$1\frac{1}{2}$	2
Starting point in time	10/03			–	$\frac{1}{2}$	1	$1\frac{1}{2}$
	04/04				–	$\frac{1}{2}$	1
	10/04					–	$\frac{1}{2}$
	04/05						–

According to the theoretical background the following hypotheses can be derived:

- For large vertically integrated firms we would expect negative growth rates. These firms set lower access charges because they are probably more affected by regulatory threat. Furthermore they could have better calculation knowledge than relatively small non-integrated firms, leading to lower growth rates.
- In Spring of 2003 the foreseeable end of NTPA lowered the incentive to decrease prices. Hence, positively influenced growth rates in 2004/05 could be expected.
- Since the market comparison scheme allows firms located in East Germany, characterized by low population/consumption density, and/or firms with a high cable rate to levy higher access charges, this could work as an invitation to increase prices. Therefore, the growth rates should be positively influenced.

- In September 2002 the publishing obligation of access charges revealed information on other operators´ prices. Since then expensive firms - access charges in the upper 30 percent of the voltage section - must fear regulation. An incentive to cut prices was raised, and we would expect negative growth rates. According to this, cheap firms - access charges in the lower 30 percent of the voltage section – had an incentive to increase their prices. Hence, positive growth rates would be expected.

Table 8 summarizes the relevant variables and the hypotheses.

Table 8: Explaining variables and hypotheses

	Growth rate
Integrated (active in high-voltage, yes=1, other=0)	–
Short "life" time for NTPA expected	+
East Germany (East=1, West=0)	+
Lower density (D; Inh. per sqkm/MWh per sqkm)	+
Higher cable rate (CR; $0 \leq CR \leq 1$)	+
Expensive in t-1 (yes=1, other=0)	–
Cheap in t-1 (yes=1, other=0)	+

5 Descriptive Analysis

Descriptive information on the average access charges for the low-, medium- and high-voltage levels are represented in Table 9. First, it is shown that the access charges decrease from the low-voltage to the high-voltage level. The mean values in low- and medium-voltage are lower in March 2003 than in October 2002, and after March 2003 they remain relatively stable. The mean values for the high-voltage level have systematically increased since October 2002. In all voltage levels, the standard deviation value is lower in March 2003 than in October 2002, indicating that the variance has decreased. After March 2003, the standard deviation remains relatively stable in all voltage levels. Referring to the minimum and maximum values, the observed changes should be carefully interpreted, since in the first period not all German operators disclosed their access charges. In contrast to a rather slight change of the access charges from October 2002 to March 2003 within the 'cheap'-mark (30%-mark), the values within the 'expensive'-mark (70%-mark) show a dramatic change for the same period. Altogether, the descriptive analysis indicates that the period from October 2002 to March 2003 is of most interest, especially for the low- and medium-voltage level.

Table 9: Descriptive information on average access charges (ct/kWh[1])

	Mean	Median	Standard deviation	Min.	Max.	30%-mark	70%-mark	no. of obs.
				Low-voltage				
10/02	5.55	5.49	0.64	2.87	8.15	5.17	5.85	484
03/03	5.49	5.40	0.58	4.11	7.67	5.15	5.76	507
10/03	5.47	5.39	0.58	3.11	7.77	5.15	5.71	659
04/04	5.47	5.38	0.57	3.11	7.77	5.15	5.71	664
10/04	5.47	5.40	0.58	3.11	7.77	5.16	5.70	671
04/05	5.46	5.39	0.58	3.11	7.77	5.15	5.71	667
				Medium-voltage				
10/02	2.80	2.73	0.46	1.54	5.11	2.53	3.00	468
03/03	2.76	2.70	0.38	1.93	4.28	2.52	2.96	484
10/03	2.74	2.68	0.37	1.93	4.28	2.52	2.92	622
04/04	2.74	2.68	0.37	1.93	4.28	2.52	2.92	625
10/04	2.75	2.69	0.35	1.93	4.28	2.52	2.92	627
04/05	2.76	2.70	0.38	1.93	5.54	2.53	2.94	631
				High-voltage				
10/02	1.23	1.18	0.18	0.88	1.70	1.11	1.32	44
03/03	1.22	1.19	0.16	0.88	1.59	1.10	1.26	41
10/03	1.23	1.20	0.15	0.98	1.59	1.13	1.30	40
04/04	1.25	1.24	0.14	0.98	1.59	1.16	1.34	36
10/04	1.25	1.25	0.14	0.98	1.59	1.17	1.33	37
04/05	1.29	1.27	0.15	0.98	1.66	1.19	1.35	36

[1] charges without metering, chp (combined heat and power cycle) shares, mark up for synthetic load profile, and concession fees.

Table 10 displays the percentages of firms with negative and positive growth rates of access charges depending on the time perspective and voltage level. Considering the very long run (2.5 years) we are able to evaluate the total effect. Almost one-half of the low- (48.3 percent) and medium-voltage firms (45.2 percent) decreased their access charges, while nearly three-quarters (71.4 percent) of the high-voltage firms increased their access charges. This trend is observable within the other time perspectives with a baseline of

October 2002 as well. Additionally, referring to the very short perspective it is seen that the main price changes occurred either in the first period from October 2002 to March 2003 or in the last two periods from April 2004 to October 2004 and October 2004 to April 2005. Between these periods a relatively small percentage of firms changed prices.

Table 10: Percentages of firms with negative and positive growth rates of access charges

	Low-voltage			Medium-voltage			High-voltage		
	−	+	n*	−	+	n*	−	+	n*
Very long run (2.5 years)									
10/02 – 04/05	48.3	30.9	447	45.2	35.7	434	14.3	71.4	28
Long run (2.0 years)									
10/02 – 10/04	48.2	33.8	452	45.6	32.1	430	20.7	62.1	29
03/03 – 04/05	20.1	18.3	497	18.9	26.9	472	6.1	51.5	33
Medium run (1.5 years)									
10/02 – 04/04	46.1	29.1	447	42.1	30.9	430	25.0	57.1	28
03/03 – 10/04	22.5	27.6	497	16.5	17.4	472	9.1	27.3	33
10/03 – 04/05	14.9	15.0	653	15.6	22.8	615	5.7	48.6	35
Short run (1.0 year)									
10/02 – 10/03	45.9	26.8	447	39.9	29.2	431	24.2	45.5	33
03/03 – 04/04	9.1	7.6	497	7.8	7.6	473	9.1	21.2	33
10/03 – 10/04	18.1	23.1	653	12.4	14.5	615	8.6	22.9	35
04/04 – 04/05	11.0	10.6	661	12.9	19.3	622	0.0	33.3	36
Very short run (0.5 year)									
10/02 – 03/03	41.5	27.4	383	38.9	26.5	370	25.0	38.9	36
03/03 – 10/03	3.8	2.8	501	2.5	2.5	477	0.0	2.6	38
10/03 – 04/04	4.4	4.7	654	4.4	4.4	617	8.6	17.1	35
04/04 – 10/04	14.8	20.1	662	8.2	10.1	621	0.0	5.6	36
10/04 – 04/05	12.0	6.6	665	6.6	12.0	625	0.0	30.6	36

* number of observations.

6 Multivariate Analysis

Table 11 represents an overview on the estimated models. Since the growth rates which are used as left hand variables can range form -∞ to +∞, the Ordinary-Least-Square-(OLS)-method is applied (see for example Gujarati 1995, Hill, Griffiths and Judge 1997).

We carry out normality tests after Jarque-Bera and homoscedasticity-tests after White to check for important assumptions of the OLS-method (Greene 1997, Gujarati 1995, Kawakatsu 1998). Since the number of firms active in the high-voltage sector is too low, multivariate estimations have to be constrained to the low- and medium-voltage sectors (see Table 9). Furthermore, models with a starting point later than October 2002 exhibit a very low explanation power (low or negative R^2) and/or have to be excluded because of too few observations. This limits our multivariate analysis to the econometric feasible models with the starting point of October 2002. Since the results vary only slightly with the time perspective it is sufficient to present the models $1+2$ (very long run) and $29+30$ (very short run). All other models can be found in the appendix.

Table 11: Estimated models

		Ending point in time					
		10/02	03/03	10/03	04/04	10/04	04/05
Starting point in time	10/02	–	Models 29+30	Models 19+20	Models 11+12	Models 5+6	Models 1+2
	03/03		–	Models 27+28	Models 17+18	Models 9+10	Models 3+4
	10/03			–	Models 25+26	Models 15+16	Models 7+8
	04/04				–	Models 23+24	Models 13+14
	10/04					–	Models 21+22
	04/05						–

The estimation results for the very short run perspective from October 2002 until March 2003 are reproduced in Table 12. For the low-voltage sector (model 29) it is shown that firms located in East Germany when compared to firms located in West Germany have significantly (one percent level) increased their access charges by more than three percent. Therefore, the hypothesis of invitation seems to be correct: The fact of working in East Germany and hence having the allowance to charge higher prices - which was given by the market comparison scheme - created incentives to charge higher network prices. The consumption density variables point in the same direction. Firms assigned a low (medium) population density increased their access charges by 1.7 (1.3) percent. The coefficients are significant on the five percent level and 10 percent level respectively. In contrast, the variables for the structural feature "cable rate" do not show the expected sign: high cable rates are accepted as a reason to charge higher prices by the market comparison scheme, but low and medium cable rate operators significantly increased their prices between October 2002 and March 2003. However, given a relatively high error probability (significant on the ten percent level) the effect remains critical.

The variable for vertically integrated firms (active in high-voltage) is not significant. These firms did not decrease their charges as expected.

Operators that had been expensive in October 2002 significantly (one percent level) lowered their prices by nearly four percent. Hence, the hypothesis of a strong influence of regulatory threat cannot be rejected. In relation to this, operators with relatively cheap access charges in October 2002 significantly (one percent level) increased their prices by nearly four percent. Therefore the hypothesis that the publishing obligation of access charges invited these firms to increase their prices seems to be correct as well. Overall, all low-voltage network operators decreased their access charges by more than three percent between October 2002 and March 2003 (significant on the one percent level). Hence, a "correct" influence of regulatory threat can be assumed.

The model is able to explain 17.8 percent of the variance. Further, it is highly significant, and the test of homoscedasticity indicates no problems. The assumption of normally distributed residuals has to be rejected, but normal distribution can be assumed because 377 firms are included.

Model 30 describes the estimation made for the medium-voltage section. As in the previous model, a strong influence of East Germany as the firm´s location is given: East German medium-voltage operators increased their prices by more than five percent compared to operators located in West Germany (significant on the one percent level). Consumption density had no influence. Operators characterized by a medium cable rate significantly increased their prices by more than three percent (five percent level) which does not fit to our hypothesis. Vertical integration had no influence. As in the low-voltage section, expensive firms in October 2002 seemed to have been affected by regulatory threat and therefore cut prices by more than five percent (significant on the one percent level). Cheap firms significantly increased their prices by almost five percent (one percent level). Altogether, all operators cut their prices approximately three percent (significant on the one percent level). As for the low-voltage section, the influence of regulatory threat seems to be correct. The goodness of fit of this model does not vary from the previous one.

Table 13 presents the estimations for the very long run perspective with the starting point of October 2002, and because most variables and goodness of fit criteria show the same results as the two previous models it is not necessary to discuss all results. Compared to the very short run perspective, the variables of low population density and cable rate in the low-voltage section show a higher significance. Low population density and low cable rate are significant on the one percent level, and medium cable rate is significant on the five percent level. However, as discussed before, the direction of the cable rate variables was unexpected. Furthermore, all low-voltage operators significantly decreased their prices by more than 3.5 percent until May 2005 (one percent level). This value is higher than the value for the very short run perspective, indicating an ongoing decrease of access charges in the very long run. This contradicts the hypothesis of regulatory threat becoming ineffective towards the end of NTPA.

The estimation results of the medium-voltage section in the very long run perspective (model 2) are identical to the very short run perspective. The only difference is that the constant variable is not significant. Hence, the overall development of access charges remains unsure.

Table 12: Growth rates of average access charges – very short run perspective

		Model 29 Low-voltage 03/03 - 10/02	Model 30 Medium-voltage 03/03 - 10/02
East Germany? (Yes=1)		3.441*** (4.084)	5.463*** (4.217)
Population/ Consumption density (Inhabitants per sqkm/ MWh per sqkm)?	low ($D < 2500 = 1$)	1.695** (2.276)	–
	low ($MWh < 500 = 1$)	–	0.824 (0.520)
	medium ($2500 \leq D < 3500 = 1$)	1.320* (1.953)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	0.447 (0.383)
Cable Rate (CR)?	low ($CR < 50 = 1$)	2.291* (1.690)	2.985 (1.538)
	medium ($50 \leq CR < 75 = 1$)	1.255* (1.681)	3.588** (2.528)
Active in high voltage? (Yes=1)		-0.330 (-0.343)	-2.466 (-1.613)
Expensive 10/02? (Yes=1)		-3.933*** (-4.900)	-5.251*** (-4.282)
Cheap 10/02? (Yes=1)		3.977*** (5.736)	4.924*** (4.394)
Constant		-3.277*** (-5.515)	-2.965*** (-3.500)
R^2 (adjusted)		0.178	0.144
F-Test (p-value)		11.147*** (0.000)	8.694*** (0.000)
N		377	367
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{na} (0.597)	H_0^{na} (0.608)
Estimation method		OLS	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.
Source: Data set “Deregulated German electricity market 2006”; estimated with “EViews 5.1”.

Table 13: Growth rates of average network access charges – very long run perspective

		Model 1 Low voltage 04/05 - 10/02	Model 2 Medium-voltage 04/05 - 10/02
East Germany? (Yes=1)		4.812*** (5.534)	5.902*** (4.287)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	1.908*** (2.606)	–
	low ($MWh < 500 = 1$)	–	0.971 (0.581)
	medium ($2500 \leq D < 3500 = 1$)	1.325* (1.913)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	0.066 (0.054)
Cable Rate (CR)?	low ($CR < 50 = 1$)	2.887*** (3.190)	2.672 (1.245)
	medium ($50 \leq CR < 75 = 1$)	1.603** (2.107)	2.955* (1.951)
Active in high voltage? (Yes=1)		-0.994 (-1.160)	-1.612 (-0.894)
Expensive 10/02? (Yes=1)		-5.068*** (-5.723)	-7.475*** (-5.730)
Cheap 10/02? (Yes=1)		4.969*** (7.455)	5.334*** (4.526)
Constant		-3.716*** (-7.011)	-1.478 (-1.647)
R^2 (adjusted)		0.248	0.154
F-Test (p-value)		19.141*** (0.000)	10.748*** (0.000)
N		441	428
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{a**} (0.030)	H_0^{na} (0.788)
Estimation method		OLS[3]	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set "Deregulated German electricity market 2006"; estimated with "EViews 5.1".

7 Conclusions

At the end of 2001, the final association agreement was established in which a market comparison scheme was a rigorous part. The aim of the market comparison scheme was to regulate the bottleneck of the electricity sector: that is, the access charges to electricity grids. Analyzing the dynamics of access charges from 2002 to 2005 reveals that many network operators changed their prices in this period. Some of them cut prices, some of them raised prices and a variety of firms changed their prices in both directions. From an economic point of view this behavior is quite unusual. The expectation would be either regulated average cost prices or monopoly prices, depending on the effectiveness or ineffectiveness of NTPA. Furthermore, prices should remain stable from the beginning of NTPA since there are little arguments for cost changes or demand variations afterwards. Nevertheless, several other factors, apart from the basic regulatory scheme, could be responsible for the observed price setting turbulence: asymmetric influence of regulatory threat depending on firm size and time, different cost and price calculation knowledge, strategic use of structural features and the obligation to publish specific access charges. Using multivariate estimations, we tested these hypotheses and derived the following results:

- The hypotheses of asymmetric influence of regulatory threat and differences in the price calculation knowledge cannot be confirmed. Large vertically integrated firms did not show a significant divergence in their price setting behavior compared to small non-integrated firms. Furthermore, the overall decrease of access charges being higher in the very long run perspective than in the very short run perspective contradicts the hypothesis of regulatory threat becoming ineffective towards the end of NTPA.
- The hypothesis of strategic use of structural features is confirmed for two of the three structural features. Operators located in East Germany, as well as operators with a low or medium population/consumption density, increased their access charges in the short and the long run. Therefore, the assumption that these features worked as an invitation to increase prices seems to be correct. However, we are not able to confirm this for the third structural feature of cable rate.
- The hypothesis that the publishing obligation of access charges influenced the price setting behavior seems to be correct as well. Expensive firms decreased their prices. Hence, they were presumably affected by regulatory threat. Additionally, cheap firms increased their prices, indicating that the information of the other operators´ prices set incentives to adopt that price level.

In addition to these estimation results, the descriptive statistics reveal that it was from October 2002 to March 2003 that most price changes occurred. The majority of low and medium network operators decreased their prices in the short as well as in the long run. Supported by our estimations, this implicates that regulatory threat played an important role in the low- and medium-voltage section.

A few shortcomings of our work should be mentioned. First, a lot of variance (more than two-thirds) could not be explained with the multivariate estimations. Additionally we also found some unintended reactions that increased access charges. More data in terms of firm-specific data and data on the institutional environment of the market are needed to examine these reactions in more detail. Finally, due to only a few observations of high-voltage operators, we were not able to examine the price setting behavior in this sector. Since the descriptive statistics reveal that a majority of the operators increased their prices in the short as well as in the long run, it would be of great interest to know which factors are responsible for this.

Finally, from the viewpoint of economic policy it seems that the final association agreement of NTPA partly worked in the sense of regulating the access prices of electricity grids. On the other hand, the results show that other factors - more or less connected to the regulatory design - influence the price setting behavior, too. Therefore, our results deliver important hints as to which additional factors should be considered for the new incentive regulation.

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Appendix

Table A - 1: Growth rates of average network access charges – long run perspective

		04/05 - 03/03		10/04 - 10/02	
		Model 3 Low- voltage	Model 4 Medium- voltage	Model 5 Low- voltage	Model 6 Medium- voltage
East Germany? (Yes=1)		1.875** (2.258)	2.970*** (2.732)	5.397*** (6.140)	5.761*** (4.839)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	0.682 (1.405)	–	2.077*** (2.749)	–
	low ($MWh < 500 = 1$)	–	1.750 (1.505)	–	0.695 (0.480)
	medium ($2500 \leq D < 3500 = 1$)	0.253 (0.600)	–	1.585** (2.271)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	1.488 (1.642)	–	-0.380 (-0.357)
Cable Rate (CR)?	low ($CR < 50 = 1$)	3.209* (1.710)	-1.117 (-0.751)	2.244** (2.334)	3.257* (1.756)
	medium ($50 \leq CR < 75 = 1$)	0.546 (1.236)	-0.867 (-0.775)	1.425* (1.759)	3.989*** (3.035)
Active in high voltage? (Yes=1)		-0.790 (-1.379)	-0.423 (-0.316)	-0.403 (-0.468)	-2.529 (-1.605)
Expensive	03/03? (Yes=1)	-2.095*** (-2.864)	-3.579*** (-3.584)	–	–
	10/02? (Yes=1)	–	–	-5.681*** (-6.350)	-7.772*** (-6.893)
Cheap	03/03? (Yes=1)	0.844* (1.835)	1.527* (1.730)	–	–
	10/02? (Yes=1)	–	–	5.080*** (7.308)	5.596*** (5.491)
Constant		-0.583* (-1.709)	0.396 (0.584)	-3.590*** (-6.532)	-2.121*** (-2.734)
R^2 (adjusted)		0.051	0.029	0.257	0.227
F-Test (p-value)		4.220*** (0.000)	2.720*** (0.006)	20.216*** (0.000)	16.591*** (0.000)
N		484	458	445	425
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{a***} (0.000)	H_0^{na} (0.999)	H_0^{a**} (0.021)	H_0^{na} (0.391)
Estimation method		OLS[3]	OLS	OLS[3]	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set "Deregulated German electricity market 2006"; estimated with "EViews 5.1".

Table A - 2: Growth rates of average network access charges – medium run perspective

		04/05 - 10/03		10/04 - 03/03	
		Model 7 Low-voltage	Model 8 Medium-voltage	Model 9 Low-voltage	Model 10 Medium-voltage
East Germany? (Yes=1)		0.636 (1.473)	2.576*** (2.890)	2.585*** (3.418)	1.544*** (2.617)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	0.284 (1.000)	–	0.933* (1.690)	–
	low ($MWh < 500 = 1$)	–	1.427 (1.517)	–	0.917 (1.453)
	medium ($2500 \leq D < 3500 = 1$)	0.379 (1.253)	–	0.581 (1.220)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	0.421 (0.613)	–	0.417 (0.848)
Cable Rate (CR)?	low ($CR < 50 = 1$)	1.778*** (2.986)	-0.907 (-0.754)	3.033 (1.581)	-0.115 (-0.142)
	medium ($50 \leq CR < 75 = 1$)	0.704* (1.823)	0.170 (0.193)	0.383 (0.723)	0.466 (0.767)
Active in high voltage? (Yes=1)		-0.581 (-1.169)	-0.192 (-0.166)	-0.353 (-0.532)	-0.936 (-1.288)
Expensive	10/03? (Yes=1)	-0.808** (-2.205)	-2.971*** (-3.661)	–	–
	03/03? (Yes=1)	–	–	-2.460*** (-3.326)	-2.315*** (-4.271)
Cheap	10/03? (Yes=1)	0.711** (2.275)	0.760 (1.121)	–	–
	03/03? (Yes=1)	–	–	1.242** (2.474)	1.323*** (2.762)
Constant		-0.503** (-2.233)	0.674 (1.271)	-0.712* (-1.788)	-0.220 (-0.597)
R^2 (adjusted)		0.031	0.019	0.059	0.063
F-Test (p-value)		3.588*** (0.000)	2.406** (0.015)	4.805*** (0.000)	4.818*** (0.000)
N		632	592	484	458
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{a**} (0.024)	H_0^{na} (0.999)	H_0^{a***} (0.004)	H_0^{na} (0.951)
Estimation method		OLS[3]	OLS	OLS[3]	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set “Deregulated German electricity market 2006”; estimated with “EViews 5.1”.

Table A - 3: Growth rates of average access charges – medium run perspective

		Model 11 Low-voltage 04/04 - 10/02	Model 12 Medium-voltage 04/04 - 10/02
East Germany? (Yes=1)		4.716*** (5.466)	5.497*** (4.720)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	1.851*** (2.643)	–
	low ($MWh < 500 = 1$)	–	0.980 (0.694)
	medium ($2500 \leq D < 3500 = 1$)	1.193* (1.778)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	-0.507 (-0.487)
Cable Rate (CR)?	low ($CR < 50 = 1$)	1.091 (0.961)	3.122* (1.723)
	medium ($50 \leq CR < 75 = 1$)	0.927 (1.263)	4.203*** (3.282)
Active in high voltage? (Yes=1)		-0.688 (-0.837)	-2.133 (-1.402)
Expensive 10/02? (Yes=1)		-4.974*** (-5.507)	-7.015*** (-6.361)
Cheap 10/02? (Yes=1)		4.681*** (7.340)	5.409*** (5.425)
Constant		-3.410*** (-6.718)	-2.510*** (-3.296)
R^2 (adjusted)		0.237	0.214
F-Test (p-value)		18.088*** (0.000)	15.404*** (0.000)
N		441	425
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{a**} (0.048)	H_0^{na} (0.308)
Estimation method		OLS[3]	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set "Deregulated German electricity market 2006"; estimated with "EViews 5.1".

Table A - 4: Growth rates of average network access charges – short run perspective

		04/05 - 04/04		10/04 - 10/03	
		Model 13 Low-voltage	Model 14 Medium-voltage	Model 15 Low-voltage	Model 16 Medium-voltage
East Germany? (Yes=1)		0.409 (1.024)	2.286*** (2.625)	1.602*** (3.399)	1.256** (2.537)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	0.324 (1.274)	–	0.663* (1.814)	–
	low ($MWh < 500 = 1$)	–	1.086 (1.195)	–	0.800 (1.531)
	medium ($2500 \leq D < 3500 = 1$)	0.353 (1.288)	–	0.761** (2.157)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	0.927 (1.403)	–	-0.127 (-0.333)
Cable Rate (CR)?	low ($CR < 50 = 1$)	1.567*** (2.653)	-0.840 (-0.728)	1.677** (2.357)	-0.183 (-0.274)
	medium ($50 \leq CR < 75 = 1$)	0.661* (1.960)	-0.299 (-0.354)	0.512 (1.316)	1.016** (2.086)
Active in high voltage? (Yes=1)		-0.056 (-0.166)	0.380 (0.343)	-0.166 (-0.267)	-0.836 (-1.302)
Expensive	04/04? (Yes=1)	-0.709** (-2.165)	-2.552*** (-3.215)	–	–
	10/03? (Yes=1)	–	–	-1.446*** (-3.382)	-1.763*** (-3.910)
Cheap	04/04? (Yes=1)	0.291 (1.040)	0.436 (0.668)	–	–
	10/03? (Yes=1)	–	–	1.205*** (3.425)	0.802** (2.132)
Constant		-0.362* (-1.785)	0.582 (1.159)	-0.690** (-2.289)	0.086 (0.290)
R^2 (adjusted)		0.022	0.010	0.051	0.044
F-Test (p-value)		2.822*** (0.004)	1.790* (0.076)	5.218*** (0.000)	4.416*** (0.000)
N		639	598	632	592
Test of normality after Jarque/Bera[2]		H_0^{a}*** (0.000)	H_0^{a}*** (0.000)	H_0^{a}*** (0.000)	H_0^{a}*** (0.000)
Test of homoscedasticity after White[2]		H_0^{a}* (0.066)	H_0^{na} (0.999)	H_0^{na} (0.119)	H_0^{na} (0.466)
Estimation method		OLS[3]	OLS	OLS	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set "Deregulated German electricity market 2006"; estimated with "EViews 5.1".

Table A - 5: Growth rates of average network access charges – short run perspective

		04/04 - 03/03		10/03 - 10/02	
		Model 17 Low-voltage	Model 18 Medium-voltage	Model 19 Low-voltage	Model 20 Medium-voltage
East Germany? (Yes=1)		1.745** (2.367)	0.526 (0.909)	4.399*** (5.161)	5.235*** (4.470)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	0.297 (0.774)	–	1.744** (2.519)	–
	low ($MWh < 500 = 1$)	–	0.817 (1.421)	–	0.426 (0.296)
	medium ($2500 \leq D < 3500 = 1$)	-0.004 (-0.014)	–	1.110 (1.567)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	-0.115 (-0.241)	–	0.183 (0.176)
Cable Rate (CR)?	low ($CR < 50 = 1$)	1.899 (0.950)	-0.288 (-0.435)	1.025 (0.920)	3.071* (1.686)
	medium ($50 \leq CR < 75 = 1$)	0.199 (0.620)	0.266 (0.326)	0.952 (1.347)	3.717*** (2.890)
Active in high voltage? (Yes=1)		-0.823* (-1.759)	-0.776 (-1.282)	-0.482 (-0.625)	-1.726 (-1.147)
Expensive	03/03? (Yes=1)	-1.678** (-2.485)	-0.823 (-1.290)	–	–
	10/02? (Yes=1)	–	–	-4.516*** (-5.057)	-6.192*** (-5.590)
Cheap	03/03? (Yes=1)	0.626* (1.817)	0.768** (2.089)	–	–
	10/02? (Yes=1)	–	–	4.605*** (6.954)	5.628*** (5.651)
Constant		-0.274 (-1.063)	-0.102 (-0.405)	-3.475*** (-6.575)	-2.928*** (-3.829)
R^2 (adjusted)		0.040	0.013	0.215	0.191
F-Test (p-value)		3.539*** (0.001)	1.771* (0.081)	15.998*** (0.000)	13.532*** (0.000)
N		484	459	440	426
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{a***} (0.000)	H_0^{a***} (0.001)	H_0^{a*} (0.079)	H_0^{na} (0.475)
Estimation method		OLS[3]	OLS[3]	OLS[3]	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set "Deregulated German electricity market 2006"; estimated with "EViews 5.1".

Table A - 6: Growth rates of average network access charges – very short run perspective

		04/05 - 10/04		10/04 - 04/04	
		Model 21 Low-voltage	Model 22 Medium-voltage	Model 23 Low-voltage	Model 24 Medium-voltage
East Germany? (Yes=1)		-0.133 (-0.445)	1.337* (1.793)	1.289*** (2.902)	0.927* (1.712)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	-0.073 (-0.326)	–	0.675** (2.001)	–
	low ($MWh < 500 = 1$)	–	0.596 (0.770)	–	0.451 (0.910)
	medium ($2500 \leq D < 3500 = 1$)	-0.257 (-1.192)	–	0.726** (2.226)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	0.525 (0.928)	–	0.401 (1.245)
Cable Rate (CR)?	low ($CR < 50 = 1$)	0.288 (0.656)	-0.708 (-0.715)	1.453** (2.192)	-0.095 (-0.287)
	medium ($50 \leq CR < 75 = 1$)	0.269 (1.139)	-0.823 (-1.131)	0.457 (1.276)	0.496 (0.818)
Active in high voltage? (Yes=1)		-0.644* (-1.691)	0.647 (0.669)	0.318 (0.556)	-0.309 (-1.133)
Expensive	10/04? (Yes=1)	-0.001 (-0.005)	-1.193* (-1.757)	–	–
	04/04? (Yes=1)	–	–	-1.192*** (-2.958)	-1.278** (-2.318)
Cheap	10/04? (Yes=1)	0.595*** (2.782)	0.011 (0.020)	–	–
	04/04? (Yes=1)	–	–	0.828** (2.548)	0.537* (1.657)
Constant		-0.197 (-1.068)	0.556 (1.294)	-0.583** (-2.087)	-0.023 (-0.116)
R^2 (adjusted)		0.013	-0.003	0.036	0.018
F-Test (p-value)		2.048** (0.039)	0.802 (0.601)	3.947*** (0.000)	2.380** (0.016)
N		643	601	640	597
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{na} (0.838)	H_0^{na} (0.999)	H_0^{na} (0.249)	H_0^{a**} (0.013)
Estimation method		OLS	OLS	OLS	OLS[3]

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***; t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set "Deregulated German electricity market 2006"; estimated with "EViews 5.1".

Table A - 7: Growth rates of average network access charges – very short run perspective

		04/04 - 10/03		10/03 - 03/03	
		Model 25 Low- voltage	Model 26 Medium- voltage	Model 27 Low- voltage	Model 28 Medium- voltage
East Germany? (Yes=1)		0.294 (1.597)	0.270 (0.593)	1.438** (2.022)	0.616** (2.018)
Population/ Consumption density (Inhabitants per sqkm/ MWH per sqkm)?	low ($D < 2500 = 1$)	-0.039 (-0.275)	–	0.251 (0.732)	–
	low ($MWh < 500 = 1$)	–	0.440 (1.117)	–	0.367 (1.123)
	medium ($2500 \leq D < 3500 = 1$)	0.018 (0.129)	–	-0.184 (-0.694)	–
	medium ($500 \leq MWh < 1700 = 1$)	–	-0.599** (-2.360)	–	0.579** (2.284)
Cable Rate (CR)?	low ($CR < 50 = 1$)	0.225 (0.808)	-0.149 (-0.266)	1.607 (0.805)	-0.146 (-0.354)
	medium ($50 \leq CR < 75 = 1$)	0.024 (0.159)	0.656 (1.347)	0.198 (0.833)	-0.451 (-1.443)
Active in high voltage? (Yes=1)		-0.530** (-2.204)	-0.554 (-1.068)	-0.315 (-1.293)	-0.145 (-0.394)
Expensive	10/03? (Yes=1)	-0.175 (-1.047)	-0.411 (-0.822)	–	–
	03/03? (Yes=1)	–	–	-1.523** (-2.381)	-0.693** (-2.478)
Cheap	10/03? (Yes=1)	0.399*** (2.896)	0.260 (1.276)	–	–
	03/03? (Yes=1)	–	–	0.129 (0.444)	0.422* (1.709)
Constant		-0.123 (-1.039)	0.114 (0.864)	0.006 (0.027)	-0.269 (-1.414)
R^2 (adjusted)		0.014	0.017	0.029	0.016
F-Test (p-value)		2.146** (0.030)	2.318** (0.019)	2.788*** (0.005)	1.956* (0.050)
N		633	594	487	463
Test of normality after Jarque/Bera[2]		H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)
Test of homoscedasticity after White[2]		H_0^{na} (0.153)	H_0^{a**} (0.024)	H_0^{a***} (0.000)	H_0^{na} (0.282)
Estimation method		OLS	OLS[3]	OLS[3]	OLS

Significant on 10 %-, 5 %-, and 1 %-level: *, **, and ***;
t-values in parentheses. [2] H_0^a: null hypothesis could be rejected; H_0^{na}: null hypothesis could not be rejected; p-values in parentheses.[3] Heteroscedastie-consistent-OLS-Estimation after White.
Source: Data set "Deregulated German electricity market 2006"; estimated with "EViews 5.1".

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