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The Contestable Markets Theory - Efficient Advice for Economic Policy

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Abstract

During the nineties of the last century, several formerly monopolistic markets (telecommunication, electricity, gas, and railway) have been deregulated in Germany based on European directives and theoretically inspired by the theory of contestable markets. The original contestable market theory implied three assumptions necessary to be satisfied to establish potential competition: Free market entry, market exit possible without any costs, and the price adjustment lag exceeding the entry lag. Our analysis shows that if the incumbent reduces its prices slowly (high adjustment lag) and the market entry can be performed quickly (low entry lag), a new competitor will be able to earn back sunk costs. Therefore it is not necessary that all three conditions are complied with for potential competition to exist. Applying this „revised" contestable market theory to the deregulated sectors in Germany sections, natural monopolies can be identified in telecommunication local loops and local/regional connection networks, in the national electricity grid and the regional/local electricity distribution networks, in the national and regional/local gas transmission/distribution sections, and in the railroad network only. These sections are not contestable due to sunk costs, high entry lags expected and a probable short price adjustment lag. They are identified as bottlenecks which should be regulated. The function of system operators in energy and railroad are closely related to the non contestable monopolistic networks.

JEL-Classification: D42, H54, L43

I Introduction

During the nineties of the last century, several formerly monopolistic markets have been deregulated in Germany based on European directives. While physical network utilities like telecommunication, electricity, gas and railways had been supposed to be natural monopolies in total earlier, competition in networks has been considered to be possible since that time. Access to the essential facilities is but a necessary prerequisite for competition, as either new suppliers are not able to build up own networks or parallel infrastructure is undesirable due to possible cost duplication. Divers regulatory regimes have been established in the analysed sectors (cp. *Berndt/Kunz* (2000), *Boss et al.* (1996), *Brunekreeft/Keller* (2000), *Deregulierungskommission* (1991), *Fritsch/Wein/Ewers* (2001), *Neu* (1999), and *Stoetzer/Wein* (1997).

- In the telecommunication sector a regulatory authority was established and a national telecommunication law, the TKG, enacted. The former monopolist and current market leader 'Deutsche Telekom AG' is active on all sections of value added and holds the preponderate part of the physical infrastructure, the local network – last mile – in particular. Private competitors have been authorized for interconnection and use of Deutsche Telekom´s network.
- German power authorities (electricity and gas) had been comfortably protected against any competition. But electric and gas utilities lost their regional monopolies in the course of deregulation. New competitors are able to use the networks henceforth, at least as long as free capacities are available, the aims of the national power industry law are not touched or gas providers are not bound to long term supply contracts (take-or-pay-clauses).
- The national railroad company 'Deutsche Bundesbahn' has been privatised since the railroad reform. She has to grant third party access to her railway system by law.

New competitors achieved access against payment to networks and infrastructural facilities by the amendment of the national competition law GWB in § 19 IV, Nr. 4 GWB. Prerequisite is the impossibility of supply on upstream or downstream markets without network access.

In the course of this article we will demonstrate, that the criticism at this theory do not regard certain important aspects. If, for instance, a potential competitor enters the market with small supply, the incumbent firm will have no incentive to decrease its price rapidly and noticeable, since the losses associated with a shrinking contribution margin would exceed losses due to decreasing sales. As it is therefore possible for the new entrant to amortise the irreversible investment, sunk costs lose

importance. For that purpose we will introduce the theory and the primary premises shortly and face the criticism subsequently. In the following the theory will be applied to the German telecommunication market. Finally, we will draw the results and give some basic regulatory advice for the German telecommunication market.

II The Theory of Contestable Markets and Critics towards

The theory of contestable markets has been established by W. Baumol, J.C. Panzar, and R. Willig in their 1982 book *Contestable Markets and the Theory of Industry Structure*. Within the theory, a market would be perfectly contestable, if the following three conditions were satisfied (cp. Baumol et al. 1982, pp 5-7; Borrmann/Finsinger 1999, pp 278-280; Viscusi et al. 2000, pp 160-161):

1. *Market entry is totally free* in the sense of Stigler. This condition means that new firms face no disadvantages compared to the incumbent firms. They have access to the same production technology, input markets, input prices, products, and serve the same demand. There is no asymmetric information about customers´ preferences, and legal market barriers do not exist. The potential customers are indifferent about the supplier, they react totally rational and immediately.
2. *Market exit is costless*, sunk costs are zero. Accordingly, all costs concerning market entry are fully recoverable. Any market firm could sell its production facilities either on a secondary market for their present value or use them in different markets alternatively without any losses.
3. *The entry lag* (which means the time between noticeable market entry of the new firm and its ability to sell its products) *is less than the price adjustment lag* (the time between market entry and the price reaction of the incumbent firms). The market will only be contestable if the incumbent firms do not reduce its price significantly during this period.

If these three conditions are complied with, incumbent firms will face *potential competition* by the threat of *hit-and-run-entry*. Even in case of a monopoly, the incumbent firm is therefore disciplined and sets the equilibrium price as if under perfect competition. Otherwise, a new firm would costlessly enter the market (free market entry), undercut the monopolist´s price, gain super normal returns, and leave the market (market exit is costless) at the time the incumbent firm responds by adjusting its price (entry lag less than price adjustment lag). The central result is then an equilibrium leading to a social efficient outcome.

The most common arguments against the theory of contestable markets criticise the premises as to be unrealistic and not robust (cp. Borrmann/Finsinger 1999, pp 301-304; Knieps (2000), pp 33-34; Viscusi et al 2000, p 161). In the following we will analyse to what extent these criticisms are qualified.

Discussing the premises of the theory, certain aspects which contradict the situation on several markets become obvious.

- *Market entry is totally free (1).* This assumption tends to be not satisfied in reality. There is hardly symmetric information about customers preferences. Customers are not perfectly informed and do not act totally rational in monetary dimensions. Legal market barriers are quite common. And, if production technology is complex, free access is unlikely.
- *Market exit is costless (2).* As defined above the level of irreversibility of an investment depends on either the possibility to sell a specific asset on secondary markets or on a probable alternative usage. But even in sectors were one or both of these possibilities are given a certain level of sunk costs will occur: e.g. expenditures for marketing, brand building, legal permits or market research. Such sunk costs arise as well, if production facilities are hireable; the costs for renting are sunk costs likewise. Markets with sunk costs (close to) zero do not exist accordingly.
- *Entry lag is less than price adjustment lag (3).* The level of closeness to reality of this condition depends on the dimension of market entry. Assuming a market entry the incumbent firm faces an optimisation problem: It rationally calculates the losses due to a price reduction (sales * -? price) and compares them with the opportunity costs (loss of profit: profit per unit * -? sales). It will reduce its price, if opportunity costs are higher than losses due to price reduction. Such a situation will be given if the market entry is expected to lead to a great loss of market shares (meaning high -? sales). In other words: The incumbent firm reacts the more immediate, the more aggressive the market entry is. If the incumbent firm expects to lose little market share, she would probably not decrease her price; the market entry would be left without response. The reaction of the incumbent firm is also deterred by the customers´ ability and the speed of switching to the new supplier. Long-term contracts and market intransparancy escalate the entry lag, whereas at least the latter – in form of informational deficits of the incumbent concerning the new entrant - could also increase the price adjustment lag. A last incrementing

factor of the price adjustment lag can be found in regulatory conditions, which delay a price reduction by the incumbent firm through a long lasting permission process.

As we see, all the three assumptions are not that realistic. Contrariwise, it would be scientifically arguable to judge a theory just on the realism of its assumptions.

The important question is about how *robust* is the theory instead. In this perspective, the assumptions two and three could be considered differently. They show a monodirectional substitutive relation: If the price adjustment lag is for various reasons larger than the entry lag, sunk costs will lose importance. A potential competitor would enter the market, if the sunk costs are less than the positive (above normal) surplus resulting from market entry. That profit depends on the price adjustment lag: The longer the price adjustment lag the higher surplus. It becomes obvious, that at a certain duration of price adjustment lag, market entry could be reasonable although sunk costs exists. The market is therefore contestable. Although the static market outcome is no competitive equilibrium (incumbent firm has not reduced its price), experiences on real markets show a convergence towards competitive prices on the long run. This might be explained theoretically by the growth and therefore a gain in market shares of the new firm; for rational reasons (s.a.) the incumbent will reduce its price.

Nevertheless, the theory of contestable markets is just applicable to a certain extend. Several markets tend to lack contestability and are therefore not disciplined by potential competition, regulation could be necessary. Before adopting a regulatory regime to a specific market it is necessary to analyse whether evidence for a *natural monopoly* exists. A natural monopoly is described as a market, which shows subadditivity. If such a market lacks contestability additionally, it is called a *bottleneck* or *essential facility* (cp. Knieps 2001). Those conditions are frequently fulfilled in sectors with grid-bound or pipeline-bound infrastructure (e.g. telecommunication, energy markets). Such a market is efficiently supplied by just one supplier. More than one supplier in the market would lead to cost duplication. As the market is not contestable (and the monopolist therefore not disciplined by potential entrants) and current competition is not intended, it is necessary to regulate this market (segment): *bottleneck regulation should be implemented*. If despite of economic rationality new competitors have entered the market and built up own infrastructure the regulatory suggestions would change. Assuming cartel agreements are prohibited, the oligopolistic competition prevents monopoly prices. Regulation would therefore lose its necessity.

In accordance with the considerations above, we suggest to divide a natural monopolistic sector into its sections of value added by using the assumptions of the contestable market theory. Regulation should be restricted on the essential facility. The aim of this kind of regulation is assuring access and inhibiting excessive prices. In consequence, the revised theory of contestable markets can be used to create an analytical framework for regulatory policy suggestions.

III Contestability in the Telecommunication Market

In this chapter we will describe in which area the telecommunication sector can be split up. The following analysis is based upon the current German telecommunication market assuming that no regulation has been introduced in this market yet: The viewpoint "no regulation" allows to identify necessary regulations. The restriction to the current German market is important because the conditions for natural monopolies have to be applied to given demand conditions and given technical circumstances. As we focus the argumentation on regulatory concerns in connection with subadditivity and essential facilities on natural monopoly markets, we will leave out testing the applicability of assumption one.

The telecommunication sector can be divided in *local loop*, *connection network*, *services*, and *terminals* (see *Gabelmann/Gross* 2000, and *Fritsch/Wein/Ewers* 2001, pp 253-255).

- *Local loop* means the physical infrastructure between customers and local switchboards. Every client usually has one exclusive connection to the switchboard. The local loop can be seen as a section with subadditive cost function because a monopolistic provider is able to realize density advantages: The connection of several subscribers to the switchboard provided by one firm is normally cheaper (in other words: more efficient) than the same provision by several firms. Current competition in local loops is therefore not desirable. Contrariwise it is very important to examine whether potential competition can be expected in the local telecommunication markets. Turning away from present circumstances the subadditivity condition might be removed by the use of alternative technologies in the future (micro waves -, powerline -, telecommunication broadband cable - or mobile phone networks) or by increasing telecommunication demand. Considering the applicability of the second assumption (absence of sunk costs) in our opinion a

new entrant has neither an opportunity to sell the local equipment on a secondary market nor a possibility of alternative usage (investments are irreversible): Expenses for creating local loops can not be returned in case of ceasing the local provision. Hence, it is impossible to leave this market without intensive losses. The existence of considerable sunk costs questions the contestability of this market section. Regarding condition three it is clear that market entrants require a longer period of time to build up a new network. Hence the entry lag in this section is important. Additionally, creating new own networks will only be reasonable if a large market entry is intended. In such a case the incumbent will suffer a big decrease of revenue if he does not adjust his price. Therefore we expect a short price adjustment lag in the networks. The existence of a short price adjustment lag and of a high entry lag in the networks violates assumption three.

- *Connection networks* include all technical equipment which are necessary to interconnect the local loops. A special hierarchical network structure has been developed in Germany, separating between local, regional, and national connection networks (cp. Monopoly Commission 2001, §§ 73-80). Local connection networks are provided by "Deutsche Telekom" predominantly. In contrast to local loops, (local) connections are used by several subscribers, stochastic economies of scale persist: As the volume of the cables is not exhausted; parallel local infrastructure are not necessary. Since new firms have rarely established own local connections yet, subadditive cost functions are probably given on local networks. On the regional network level the former monopolist "Deutsche Telecom" has built up 273 regional connection networks, while its largest competitor, "Mannesmann Arcor", has been able to establish one third thereof. Other competitors are hardly to be found. From the economic viewpoint, this development can be interpreted in two ways: On the one hand, subbadditivity could have been vanished in one third of regional networks because parallel infrastructures due to technical progress or increased demand. On the other hand, Mannesmann Arcor possibly uses connections which had been established before deregulation. These capacities might have been built up to circumvent the former legal monopoly restriction. We are not able to appraise the relevance of subadditivity in regional connection networks. Analysing national connections it appears that German market leader provides 23 points which are interconnected. Several competitors have built up own national networks, and local telecommunication suppliers have merged with other connection networks. As the competitors´ networks have been designed for own purposes only and therefore not been connected to the former monopolist´s network, third competitors are not able

to use this infrastructure today. Connections to abroad and to mobile networks are not touched by this problem. Contrary to the opinion of the Monopoly Commission we assume that new owners of fixed networks and potential users of these networks will – in case of effective competition - find solutions to overcome existing switching costs. As the technological development in telecommunication – and therefore a more efficient use of nation-wide connections - can be expected additionally, competition will increase further on (cp. FAZ 2002). Thus, we assume that current competition by several suppliers in the national connection exists and therefore regulation is no longer requisite. As in regional connection networks we can not assess whether the condition of subadditive cost function is not fulfilled or alternative national networks are the result of former regulation. Independent from that we assume *potential* competition in the German national connection networks to be dispensable. Admittedly, the effectiveness of potential competition should be considered in local and regional networks sections. Analysing condition two, it seems as if sunk costs are not that relevant: If the firms are using micro waves or satellite transmission capacities they will have the ability to change to other regional markets to some extent. Therefore, loss-free market exit is partly possible in this area. Analogous to the considerations in the local loop, market entrants require a longer period of time to build up a new connection network. Hence the entry lag in this section is important. As mentioned above if the incumbent adjusts his price he will face less decreasing revenues compared to a situation without a price reduction. We expect a short price adjustment lag in the networks therefore. A short price adjustment lag combined with a high entry lag in the networks leads to a violation of assumption three.

- *Services* can be defined as the use of networks to provide telecommunication services. It seems obvious that economies of scales are limited in this field and therefore a subadditive cost function seems to be unlikely. Services can be supplied by several firms without any additional costs compared to the provision by one supplier. Current competition is possible and desirable, whereby potential competition becomes less important.
- *Terminals* are all equipment which can be used by customers to use telecommunication networks and services, for example telephones and fax machines. The economic interpretation of this section is consistent to the section services: The cost function is not subadditive because several firms supply terminals without any indication for additional unnecessary costs; current competition is effective, and potential competition not required therefore.

Examining all conditions led us to the following conclusions:

- The local loop section has to be characterised as a natural monopoly; at least the technological and demand conditions are given. The non-existent possibility to sell production facilities on secondary markets and the absence of alternatives for the local loop creates large market exit costs. This section is not contestable, as market entry lag is high, price adjustment lag is low and sunk costs exist. For the German telecommunications market all indicators show that the local loops should be considered as non contestable natural monopolies (bottleneck, essential facilities; cp. Knieps 2001). Hence regulation is necessary, especially to ensure the non discriminatory access.
- Connection networks can be recognized as natural monopolies, mainly on the local level. Regional and in particular national networks are supplied by divers firms. We are not able to decide whether these market structures are caused by regulation or provoked through changing demand or technical conditions. Nevertheless, no current competition take place in local and regional connection networks. To prevent entry cost disadvantages it is necessary to secure access to local loops as well as to local and regional connection networks. Multi routing, micro wave and satellite communication are technical possibilities which lead to loss-free market exits in this section. In any other case sunk costs are given. The high entry and the low price adjustment lag are decisive: Potential competition can not be expected in all connection networks. But we have current competition on national level. Thus, regulation should be restricted to local and regional connection networks.
- Concerning the services and the market for terminals we are of the opinion that the sections do not show subadditive cost functions and current competition works. The power of potential competition is not decisive and can be neglected.

IV Regulation Requirements in the German Electricity Industry

In the electricity sector we can differentiate between the sections of value added "generation, national grid, system operation/ system service, regional and local distribution, trading/sales and measurement/accounting" (cp. Brunekreeft 2000, Kumkar 2000, and Monopolkommission 2002, §§ 837-841). These sections will be described below and analysed for possible evidence of subadditive cost functions thereby. If subadditivity is not identifiable, current competition will

possible and any further questions concerning contestability will become unnecessary. If subadditivity is detected whereas, the existence and amount of irreversible costs will be examined (assumption two) and it will be analysed, if the price adjustment lag exceeds the entry lag (assumption three).

The *generation* section contains the production of electricity in power plants essentially. Germany (as many other countries) shows a multitude of differently sized power plants, based on divers primary energy carriers (gas, oil, coal, lignite, water, nuclear power, biomass and partly solar). As the power plants are connected to the national or European power grid, the electricity producers will be able to supply outside their production region, if third party access to the regional and local distribution network is granted. Both the multitude of power plants and the non-discriminatory access to essential facilities indicate that subadditive cost functions do not occur in German generation market. It seems to be rather senseless and technically impossible to provide entire Germany with just one power plant. There are – in other words – no evidences for economies of scale. Current competition is economically desirable therefore and occurs in Germany; significant overcapacities in Europe increase competition further on. Potential competition is not necessarily discussed hence.

The *national grid* – in Germany an amalgamation of four combined sub-networks (regional closed loop controls, Regelzonen) - is defined as the network of high and 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 regional distribution networks. The national carriers assume two function of operations: the transmission of electricity from the power plants to regional distribution networks or directly to the national grid connected large-scale consumers occurs in the function of a *transmission operator*. The basic task of the *system operator* function is balancing network input and withdrawal (consumption) within the regional closed loop controls. We will describe its function later on explicitly.

In the national grid section significant bundling advantages are detectable, as costs of transmission does not increase with additional supply (marginal costs close to zero). Parallel conductions would lead to cost duplication therefore, as long as capacity constrains are irrelevant. The national grid shows a subadditive cost function hence. Current competition is neither desirable nor existent, as

parallel networks are not available. The question about potential competition is important accordingly.

As of high and extra high voltage level networks are not usable on secondary markets, costless market does not exist. Indeed there is a chance of using alternative communications due to the intermeshed European network, at least if a sufficient amount of inter national interconnection sites exist.

Another aspect concerning the question of contestability is if condition three of the contestable markets theory is complied with. If the price adjustment lag exceeds the entry lag sufficiently, the market entrant obtains the possibility to amortize its sunk costs. The construction of a national grid (or even just parts of it) is more than likely time consuming and therefore connected with a high entry lag. Apart from that, it can be assumed that the incumbent reacts with a rapid price reduction, as he expects a large market entry and worries about decreasing sales. A low price adjustment lag is in all likelihood therefore. Merging high entry and low price adjustment lag, condition three of the contestable markets theory is not complied with.

As mentioned above, the basic task of the *system operator* function is balancing network input and withdrawal (consumption) within the regional closed loop controls. The regional dispatcher plans, manages and controls input and withdrawal as well as reserve capacities in case of temporary shortages. This function is generally assumed by the national grid network operators, as he should be able to assure supply guarantee at the at least possible costs by holding out reserve capacities. The division of the function would inhibit the realisation of stochastical economies of scale. We assume the existence of a subadditive cost function therefore. There might be economies of scope with the national grid additionally, as controlling electricity input and withdrawal should be feasible with at least additional costs. Moreover the demand of reserve capacities could be announced competitively to establish competition *for* instead of potential competition *in* the field. Such a call for bids should be economically reasonable, as a frequent change of the system operator seem to generate technical problems and high transaction costs. We consider the system operation function to be a natural monopoly, interconnected to the national grid section

Two different economic consequences can be drawn for the national grid. Firstly, sunk costs

incurring by market entry cannot be redeemed, as temporary above normal profits are unlikely due to expected price reductions by the incumbent. Contestability is not given secondly, as the price adjustment lag does not exceed the entry lag. Even the possibility of using new infrastructure in different manner than originally intended would not facilitate potential competition, as condition three dominates condition two (one way substitutive relation). Recapitulating our results it is shown that potential competition is not existent and therefore not able to discipline the incumbent in the section national grid. Combined with a subadditive cost function, this section of value added can be identified as an essential facility, a bottleneck.

Regional and local distribution is based on high, medium and low voltage level networks (100 – 0.4 kV). In a few cases, small power plants induct electricity not into the national grid but into the medium level voltage network. A delimitation of and differentiation between the network sections are complex therefore.

Within distribution networks, large economies of scope lead to a subadditive cost function beyond dispute; thus a single supplier is desirable. There is actually no evidence for parallel networks, except from the rare direct connection of large-scale consumers to the national grid. Current competition does not occur, so potential competition gains importance.

Potential competition is limited however, as it is not possible to sell distribution networks either on a secondary market or use them in different markets alternatively without any losses. Sunk costs are expected to be above zero therefrom, they would inhibit contestability, if the incumbent decreased its price rapidly.

Analogous to the considerations on the national grid in the electricity market it will probably take the entrant a long time to be able offer its services to final customers, as establishing own infrastructure is rather time-consuming. This again would provide an incentive of price reduction to the incumbent firm, by what a low price adjustment lag is likely. Thus, condition three of the contestable markets theory is not complied with in this section.

Essential sunk cost, a rapid price reduction of the incumbent in reaction of the new market entry and long lasting construction of new infrastructure avert potential competition. Combined with a

subadditive cost function this section can be identified as an incontestable essential facility.

Both the sections of value added *trading/sales* and *measurement/accounting* do not show any indications for subadditive cost functions. Economies of scale are so limited, that several suppliers could provide such services to at least the costs of a single supplier. Only on-site services as fitting and disassembly of electric meters could show economies of scale, although cooperations with local distributors, other competitors or firms from different lines of business could lead to comparable results. Current competition is hence desirable and observable in both sections. The question concerning potential competition is dispensable therefore.

Analysing the several sections of added value by the revised theory of constestable markets, it can be shown, that generation, trading/sales and measurement/accounting are not natural monopolies and should not be regulated hence. In these sections, current competition is effective. The national grid and the regional and local distribution networks are natural monopolies whereas, as both areas show a high entry and a low price adjustment lag and contestability is impossible therefore. Considerable sunk costs support this finding additionally. The open issue of a possible alternative use of the national grid for communication/wheeling purposes within an intermeshed European network can be left unanswered therefore. On the electricity market, the national grid and the distribution networks are to be regulated bottlenecks.

V Regulation Requirements in the Gas Market

The gas market can be divided into the sections exploitation/import, national transmission, system clearing, regional and local distribution and provision (cp. Schulz et al. 2001, Ströbele 2001 and Monopolkommission 2002, §§ 837, 842 et seq.). As in the telecommunication and the electricity sector we will analyse, which sections of value added show indications for a natural monopoly and an essential facility, if cost of market exit in form of sunk costs exist and if rapid price reductions by the incumbent or delayed market entry prevent the contestability of any section.

Although the section *exploitation/import* shows a high dependence on gas import (about 80%) in Germany, the multitude of suppliers indicates an absence of a natural monopoly. The market power of a few suppliers in Germany are not founded in subadditive cost structures but can be ascribed to different reasons. Potential competition to restrict a natural monopoly is not important therefore.

In the *national transmission* section the different German regions are interconnected by just one conduction, as capacity restraints are usually not tapped; there are just few parallel pipelines. National transmission conductions in Germany are not intermeshed systems, individual transports can be tracked consequently. As a rising gas demand is estimated, further national transmission conductions could be established, what creates an option to switch between two network carriers. The German monopoly commission states indeed, that this option will be an exception. An enduring subadditive cost function can be expected inasmuch.

The construction of national transmission conductions faces significant market exit costs assuredly, as there is no secondary market for gas pipelines and an alternative usage seems rather unlikely. The second assumption for contestability is not complied with, which leads to the question if the price adjustment lag exceeds the entry lag.

Market entries in this section should feature a high entry lag due to an elaborate planning process and a long construction of the network. National transmission networks are probably built with a high capacity, as additional material costs increase just with factor of two-thirds compared to volume of conduction. A big market entry is to be expected therefore. This again stimulates the incumbent, who reckons with a noticeable loss in market share, to reduce its price expeditiously. The price adjustment lag would be low therefore. A high entry and a low price adjustment lag inhibit the contestability of the national transmission gas market.

The national transmission section in the gas sector is under current conditions to be assessed as a natural monopoly, which is supposably not constestable due to significant sunk costs, a high entry lag and probably rapid price reaction of the incumbent. Independent from condition one, the national transmission section can be identified as a non contestable natural monopoly.

Regional and local distribution and provision is organised as an intermeshed network, i.e. Gas is

inducted at specific sites and discharged at another spot. Physical flow is not important, as long as the gas pressure is sufficient. As it economically not reasonable to establish parallel networks in this section due to density advantages, a natural monopoly can be identified. Branch lines, i.e. direct connections from the transmission network to final customers, are exceptions. Market exit is considerably expensive in all likelihood, as secondary markets for regional and local distribution networks do not exist and an alternative use is not conceivable. As in the transmission network, a high entry and a low price adjustment lag can be expected; condition one is not necessarily surveyed. Regional and local provision can be identified as essential facilities.

The natural monopolists power is limited by substitutive competition admittedly, since fuel oil, electricity and coal can be used for heating alternatively. As conversion costs are significantly high, substitutive competition can just take effect on the long run.

The section system *clearing* includes, transport optimisation, gas management in case of divers qualities of inducted gas, and the gas dispatch, which is the actual clearing function. Similar to the system operator in the electricity sector, transport optimisation is the efficient transport of gas on the shortest possible way, independent from contractual agreements. In an extreme example, if two contracts of delivery from A to B and B to A exist, gas will not be transported at all (network advantage). Such a coordinative function implies a realisation of stochastical economies of scale again, which is efficiently taken over by just one supplier. Further on, the operation of the transmission network and the system clearing are technically closely related, economies of scope exist. Economies of scale and scope suggest to assign the transport optimisation to the natural monopoly transmission network provision. When securing a non discriminatory third-party-access to the bottleneck national transmission/ transport optimisation, it is important that all gas carriers participate in the cost savings due to stochastical economies of scale, as the collectivity of all carriers contribute the network advantages. Gas dispatch and pressure equalisation should be a task of the network monopolist as well: as transportation costs are significant in the gas sector and import quantities are rather constant, an even utilisation is important, since seasonal fluctuations in demand have to be intercepted by the use of gasholders. Gasholders in Germany are primarily the pipelines themselves, empty salt caverns and former gas- and oilfields. In conclusion, all system services are closely related to the non contestable monopolistic networks; independent from inherent tendencies to show a subadditive cost function, they are essential facilities as well.

The *provision* includes every services occurring at the final customer, except the physical supply of gas. Analogous to the electricity sector, subaddivity is not plausible.

On the German gas market, the sections exploitation/import and provision can not be considered to be monopolistic areas, current competition is possible and more or less active. On the national transmission section, strong evidence for a subadditive cost function is noticeable, current competition as a matter of discipline is not available. Since in both sections significant sunk costs exist, whose relevance is not abolished by a high price adjustment and a low entry lag, they can be identified as essential facilities. System services are closely related to the network provision and have to be associated with the non contestable area as well. Intermodale or substitutive competition limits monopolistic power in the gas sector on the long run.

VI Regulation Requirements in the Railway Sector

The sections of value added network, train control system and service can be identified for the railway (cp. Knieps 1996 and Monopolkommission 2002, §§ 814-821). It is necessary to verify if these sections are natural monopolies, which role the sunk costs play and to what extend there are entry- and price adjustment lags.

The rail infrastructure as well as the railway stations belong to the *network section*. There is no doubt about economies of scale in this area, resulting from fixed costs of the network. As long as the full capacity is not tapped, average costs sink with rising utilisation. Therefore economies of scale lead to a natural monopoly, as well approved by empirical analysis. The railway-infrastructure is neither disposable on secondary markets nor can it be used alternatively. Thus market exit will cause high costs. To examine the relevance of these sunk costs, it will be necessary to survey if the established reacts slowly on the market entry. In this case the competitor would be able to earn the sunk costs back. But as market entry takes a long time and the incumbent has to anticipate great losses in sales due to alternative network infrastructure, it is likely to expect a high entry lag and a low price adjustment lag. The costs of market exit will not be neutralized. The railway-infrastructure represents a bottleneck therefore. However the railway has to compete with various carriers on the

road, in the air and on the water. The options of price setting for service providers and network owners are limited hence. The reason for the substantial losses of the Deutsche Bundesbahn is to find in numerous regulatory interferences presumably, e.g. in the compulsory perpetuation of unprofitable connections.

The *service* section comprehends transportation services primarily: access to the network and the possibility to use the train control system are an essential prerequisite. There are no economies of scale which suggest the existence of a natural monopoly: Several suppliers can offer transportation services without additional costs compared to provision by just one company. Competition is desirable. An analysis of contestability and possible sunk costs can be left out therefore.

The *train control system* is – comparable to the system operator in the electricity market - in charge of an ex-ante-coordination for the network slots, the control of the course of network usage as well as the issue of the schedule. There is a scientific discussion, if the slot commercialisation, the associated slot pricing, and the emergency aid in case of broken down trains - independent from the actual ownership - should become a task of the control system. According to the energy market stochastical economies of scale will presumably show the advantages of a monopolistic supply. It is controversial whereas, if there are economies of scope between the infrastructure and the control system, which would demand a conjoint provision of both. On the one the hand it is noticeable that Deutsche Bahn organisationally combines the infrastructure and the control system in regions with little traffic only (cp. Knieps 1996, p 41). Contrariwise the question occurs, which rights and duties would be left in the network section, if the functions mentioned above were transferred to the control system completely. Essential parts of the entrepreneurial decision (capacity control and price setting) would be taken out of the responsibility of the network carrier in particular. The entire discussion will lose relevance assumedly, if non discriminatory third party access is ensured, by a complete vertical compartmentation of network and service for instance. Analogous to recommendations in the electricity and gas sector, the control system should be collated to the uncontestable monopoly network infrastructure insofar.

In the railway sector the section service should be organised competitive. The track infrastructure can be appraised as a natural monopoly featuring high costs of market exit as well as a high entry and a low price adjustment lag. Potential competition is not possible, the railway system can be assessed

as a bottleneck. Substitutive (intermodal) competition could take disciplining effects admittedly, it stays open, if the railway system should be regulated. The transport control system should be provided by a single supplier, the network owner.

VII Conclusion

Initially we surveyed which premises in the theory of contestable markets are mentioned as necessary for potential competition to be effective. Based on these premises we developed a revised theory which is focused on the question of robustness of specific premises. By means of application on the railway, natural gas, electricity and telecommunications markets we were able to elaborate, that on basis of the revised theory it is possible to show more clearly than before in which section of added-value there is a requirement for regulation.

The original contestable market theory implied three assumptions to be satisfied to establish potential competition. Premise one demands a costless market entry: A market entrant faces the same conditions as the incumbent firm. Assumption two stipulates that market exits have to be possible without any costs. If the price adjustment lag takes longer than the entry lag the third condition will be fulfilled. Our analysis shows that if assumption three is not satisfied this non-compliance can work as substitute for assumption two: If the incumbent lowers his prices slowly (high adjustment lag) and the market entry can be performed quickly (low entry lag), a new competitor will be able to earn back sunk costs. The second assumption will be the lesser important the longer the pay back period is. Therefore it is not necessary that all three assumptions are fulfilled to have potential competition. Thus, the original contestable market theory underestimated the force of potential competition.

We have applied the „revised“ contestable market theory to the German telecommunication market and have been able to clearly identify the sections in which regulation is required. As to local loops natural monopolies have to be accepted today. If new technologies are developed and adopted or demand curves shift to the left the condition of subadditivity is no longer given and current competition will be possible. Under the present conditions local loops are not contestable due to sunk costs, high entry lags should be expected and the price adjustment lag will probably be short. The current local loops are identified as bottlenecks which should be regulated. Regulation should

ensure non discriminatory access and prevent monopoly prices. The analyses of connection networks has led to contradictory results. Local and regional connection networks should be regulated because a high entry lag and a low price adjustment lag must be expected (absence of potential competition) as well as current competition does not exist today. The national connection network shows current competition between several network providers, hence regulation can be abolished in this field. Moreover, services can be supplied by several firms, current competition works.

On the electricity market the national grid and the regional/local distribution networks definitely are natural monopolies. In both networks a high entry lag and a low price adjustment lag can be expected and sunk costs are not relevant. The contestability of these network areas is not given. Electricity transmission and distribution networks are the bottlenecks to be regulated for which the nondiscriminatory access has to be established. The sections of added value 'generation, trade/sale and measurement/payoff' appear to be the areas in which no natural monopoly exists and in which, thus, current competition is desired. Potential concurrence is not necessarily required. Competition partially already exists in these sectors. This competition would probably be intensified if the nondiscriminatory access to transmission and distribution networks was better ensured as it is now.

In the areas of national and regional/local gas transmission/distribution subadditive cost functions persist - current competiton as means of regimentation is not effective. High market exit costs, low entry- and high price adjustment-lags make national and regional/local transmission/distribution non contestable monopolistic bottlenecks. The system-services are closely connected to the network operation and thus also have to be imputed to the non contestable areas. The substituting competition on the warmth market limits bottlenecks in the gas market on the long run. On the levels 'production/import and supply' several suppliers are possible from an economical point of view . The reason for the lack of current competition in the gas market is probably the still existing discrimination when it comes to the access of bottleneck facilities.

The railroad infrastructure can be considered a natural monopoly. It has high market exit costs, a high entry- and a low price adjustment-lag. Therefore current competition is impossible. The railroad network thus has to be considered a bottleneck which could be disciplined by substituting competition, intermodal competition precise. As to that it is unclear if the railroad network is to be

regulated. The train control system should be provided by one supplier only because considerable economies of scope between network and control system probably exist if the nondiscriminatory access can be ensured. On the operating area no signs of subadditivity are recognizable. Therefore current competition is possible and will be reinforced if the nondiscriminatory access to network and train control system can be ensured.

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