ENTRY INTO DEREGULATED NETWORK INDUSTRIES AN ANALYSIS OF DUTCH TELECOMMUNICATIONS

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ABSTRACT

Deregulation has become common practice in many utility sectors. But, access to networks featuring economies of scale remains required. Technological progress could stir competition between infra-structural networks. But, incumbents could deter the introduction of new networks such as in television by integrating infrastructures and services.

Entry into mobile telephony is limited due to scarcity of spectrum frequencies. The way entry was staged influenced GSM market structures. Auctions could transfer scarcity rents to governments. An analysis of UMTS auctions shows that auction outcomes are largely determined by GSM market structures and by roaming rights.

Key words: economies of scale, entry, limit price, vertical integration, UMTS auctions

Entry into Deregulated Network Industries:

An Analysis of Dutch Tele-communications

1. INTRODUCTION

Welfare economics generally concludes that market performance is optimal, if perfect competition prevails. However, most industries are characterized by cost structures that feature some economies of scale. This applies particularly to network industries. Utilities such as gas, water, electricity, railways and telecommunications posses vast economies of scale. These physical network industries were considered natural monopolies for this reason. State-ownership and/or regulation were devices used to prevent private exploitation of monopoly power. Government intervention was also prompted to stimulate universal access to utilities, such as telephone or railway transport services. Government ownership of utilities was more common in Europe than in the US. Regulation of a natural monopoly can be economically sound. Welfare is improved, if regulation lowers prices and expands output. However, regulation also causes costs that may exceed the welfare gains of regulation. Regulatory bodies are inclined to expand their personnel. However, personnel in the US regulatory agencies increased from 70.000 in 1970 to 128.000 in 1999 in spite of deregulation (Carlton & Perloff, 650). Moreover, regulation can create other market failures, such as overcapitalization. Another drawback of regulation involves the lack of incentives to increase efficiency and stimulate innovation. The alleged inefficiencies of regulation inspired a wave of deregulation in the 1980s in both the EU and the US. Deregulation was prompted by new theoretical insights and by technological developments. Contestable market theory emphasized free entry instead of regulation as a device to improve industry performance. Technological developments brought less capital-intensive techniques such as mobile telephony to the fore. Several network industries such as telecommunications, airlines, railroads and electricity were opened up for entry. Former monopolists could now be challenged by entrants, but were also free to pursue strategies of internationalization and vertical integration that were prohibited under regulation.

This paper focuses on issues of deregulation and entry in telecommunications and the cable sector. The paper addresses the question whether deregulation will entail the building of new networks. Moreover, will market forces establish competitive prices and outputs? The paper analyzes how established network companies can block the emergence of new networks by pursuing limit price strategies or by vertical integration. Competition can be stirred up, if service providers are allowed to enter existing networks The paper then focuses on entry in European mobile telephony markets. Economies of scale were less important in mobile markets. EU regulation forbade monopolies in mobile markets. It is argued that timing of entry had an impact on GSM market structures, which affected the results of UMTS auctions in the UK, the Netherlands, Germany, Italy and Austria.

2. HOW TO REGULATE A NATURAL MONOPOLY?

A natural monopoly is usually defined as an industry, in which one firm can produce a market quantity of output at lower costs than two or more firms can. Monopoly spurs efficiency in those industries, but also causes welfare losses due to market power, because monopolies can set price above competitive levels. An industry only classifies as a natural monopoly, if optimal capacity size exceeds monopoly output. This paper concentrates on physical or supply side and not on virtual or demand side network effects (Shapiro & Varian). Many utility industries have invested in vast infrastructures. Electric power companies have invested in wiring grids and telecommunication companies in copper and fiber optic cables that can reach every home and business. It would be wasteful to duplicate those investments as long as capacity is sufficiently large to satisfy consumer demand at prices that are considered socially optimal. Regulation of a natural monopoly can take several forms as will be illustrated by a simple model. The following linear cost and demand functions are assumed:

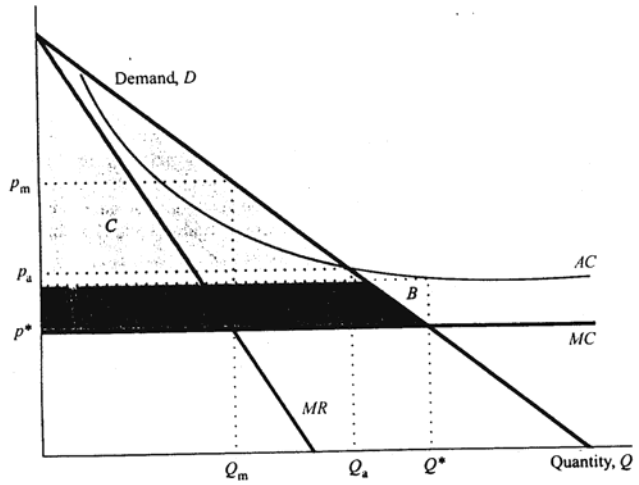
$C(Q) = F + cQ;\ P = a - Q$

A private monopolist would charge the monopoly price (P_m) and supply monopoly output (Q_m). Monopoly output $Qm = (a-c)/2$ and monopoly price $Pm = c + (a-c)/2$

A perfectly competitive firm- in contrast- would supply Qc = a-c and charge a price P*, that equals marginal cost c. A monopolist will thus supply exactly half the amount of a

perfectly competitive supplier under conditions of constant marginal costs[1]. However, a supplier would lose an amount equal to annual fixed cost F, if price were set at the level of marginal cost. Governments that want to mimic a perfectly competitive market can achieve this goal by subsidizing the regulated industry by an amount equal to F. One approach to regulation therefore, consists of subsidizing utilities, which usually coincides with government ownership. State-owned railroad companies that are subsidized are cases in point. Average cost pricing constitutes another approach to regulation. No subsidies are required under such a regulatory regime. Average costs include both variable and fixed (sunk) cost. Average costs will equal price, if the following identities apply: $ac = c + F/q$.

Figure 1. Price Regulation of a Natural Monopoly



Monopoly price will exceed average costs, if fixed (sunk) costs are smaller than monopoly profits [$F < (a-c)^2/4$]. Or, to put it differently; excess profits will be earned, if $P > c + \sqrt{F}$. This identity can be derived applying the rules for profit maximization[2]. Arguably, a natural monopoly only needs to be regulated, if monopoly profits exceed fixed costs. Such a natural monopoly can be represented graphically by an average cost curve, which is continuously declining up to the capacity limit (figure 1). Fixed costs are less than monopoly profits in figure 1, so that long run competitive price (Pa) is located below monopoly price (Pm). A regulator could set price at the level of average costs Pa. The monopolist would then sell Q_a units. This is a second best solution,

[1] If the equation for the inverse demand function is $P = a - Q$, marginal revenue for a monopolist is $a - 2Qm$. Marginal revenue is set equal to marginal cost, which is c. $Qm = (a-c)/2$, which is exactly half of perfectly competitive output: $Qc = a-c$. Qc is often called S.

because price should equal P* to achieve efficient allocation. The perfectly competitive output Q_c or S would then be supplied. However, subsidization can also incur inefficiencies so that average cost pricing may be preferred. A combination of marginal and average cost pricing exists, if utilities charge a two-part tariff, consisting of a fixed fee to cover capital costs and a usage charge to cover variable costs.
Regulation could also take the form of rate of return (ROR) regulation. Many regulatory boards in the US have put limits on the rate of return on capital of natural monopolies, such as electric and gas companies instead of controlling prices directly. However, it might be difficult to determine the appropriate rate of return on capital. Moreover, rate of return regulation does not induce firms to behave efficiently. Regulated monopolies are often considered overcapitalized, because they lack incentives to curb capital costs under a rate of return scheme of price fixing, the so-called Averch-Johnson effect.
Another way to regulate an industry involves the use of price caps. The price changes of the regulated industry are linked to price changes of goods in comparable industries under a price cap scheme. Hence, price caps set benchmarks to avoid questions of optimal capital intensity and return rates.

3. STRATEGIES IN DEREGULATED MARKETS; LIMIT PRICE

Privatization and deregulation have become common practice in the EU and the US during the last decades. Deregulation was triggered by new technologies that competed with existing networks. Privatization was also spurred by the alleged drawbacks of government ownership, such as poor service and immunity to technological progress. However, liberalization could create private monopolies and price increases. But, entry was supposed to curb private monopoly power. However, entry can be deterred by large investments in networks. Moreover, actual entry -instead of spurring competition- could entail excess capacities and high prices as will be demonstrated below.
A monopoly is called sustainable, if no firm can enter profitably. A monopoly is always sustainable, if price equals average costs (Martin, 1993, 298). Regulation is superfluous in that case, as was demonstrated above. But, entry can also be deterred, if established firms pursue a limit price policy. A limit price is defined as the price that leaves an

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[2] No excess profits are earned, if $\Pi m = F$; $\Pi m = (Pm - c)\, Qm = Qm^2$; $Qm = \sqrt{F}$.

entrant with profits that just equal its fixed costs $(P_{lim} - c)q_e = F$. No (identical) firm can profitably enter an industry if price is set slightly below the limit price. Limit price theory usually assumes that a potential entrant expects the incumbent firm to maintain its output after it has entered. Limit price equals monopoly price, if fixed cost amount to one fourth of monopoly profits. An entrant with the same cost function as an incumbent monopolist will then produce half of monopoly output [$q_e = ½ (S - Q_m)$] [3]. Price-cost margins will be cut in half as a consequence of such entry and the entrant will incur profits of one quarter of incumbent profits before entry occurred. Entry would cut incumbent's profits in half. The formula for the limit price is: $P_{lim} = c + 2\sqrt{F}$. We can conclude that a hitherto regulated monopolist can deter entry at monopoly price, if fixed costs ≥ ¼ Π_m. Limit price exceeds average costs and excess profits of three-quarters of monopoly profits are reaped, if F = ¼ Π_m. Hence, limit price exceeds average costs by a large margin. Our conclusions contrast with some analyses of natural monopoly, in which it is assumed that an equilibrium is only sustainable, if price equals average costs (Brauetigam, 1297). Our analysis –in contrast- indicates that markets can be sustainable at prices that exceed average costs by a wide margin. This conclusion applies if fixed costs are sunk. Contestable market theory contends that price will equal average costs, if markets can be freely entered and exited. A market is called non-contestable, if investment is specific and has zero or low second hand value[4]. Investments in physical networks fit this picture to a large extent[5].

It was mentioned above that an entrant has to make conjectures about possible incumbent responses. A possible conjecture involves that an incumbent monopolist maintains output as was assumed above. But an incumbent monopolist might also be expected to restrict output and accommodate entry. Accommodation would produce a Cournot duopoly equilibrium, in which both firms share the market equally and incur

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Pm = c + (a-c)/2; Pm = c + Qm: Pm = c + $\sqrt{F}$.

[3] MRe = a- Qm – $2q_e$ = c : → q_e = ½ (a-c) – Qm, → q_e = ½ Qm.
Πe = ½ Qm . ½ (Pm - c) = ¼ Πm;

[4] Another definition of contestability involves that firms can exit from markets without incurring losses.

[5] Network companies would be worthless on acquisition markets, if excess capacity abounds. Entry would create excess capacity and hence would contribute to the sunkennness of such investments.

each 4/9th of monopoly profits[6]. But, a prospective entrant will consider accommodation unlikely, because post-entry limit price profits exceed Cournot duopoly equilibrium profits ($1/2\ \Pi_m > 4/9\ \Pi_m$). An incumbent can thus credibly deter entry by maintaining monopoly output, if $F \geq ¼\ \Pi_m$. An incumbent can also pursue a limit price policy, if $F < ¼\ \Pi_m$. Accommodation would provide profits of $1/9\ S^2$ to both incumbent and entrant. However, an incumbent could also deter entry by expanding output above monopoly output, if $F < ¼\ \Pi_m$. An incumbent pursuing a limit price strategy will earn profits of $(S-2q_e)\ (P_{lim} - c) = (S-2\sqrt{F})\ 2\sqrt{F}$. An incumbent will prefer to pursue a limit price policy instead of accommodation, if limit price profits exceed accommodation profits ($2S\sqrt{F} - 4F > 1/9S^2$). Solving this equation by extracting the square root renders the insight that an incumbent monopolist will prefer to pursue a limit price strategy, if fixed cost exceed $1/256\ S^2$ or 1/64th of monopoly profits $F > 1/64\ \Pi_m$. Limit output will vary between $7/8\ S > Q_{lim} > ½\ S$. Capacity needs to be sufficiently large to supply all customers at the limit price.

A potential entrant could also expect an incumbent to collude after it has entered. Price equals monopoly price if firms collude and output remains at the monopoly level. The entrant and the incumbent would share the market equally and receive half of monopoly profits each ($1/8\ S^2$). Hence, the incumbent monopolist's profits in the collusive case equal that of the case in which he maintains output after entry (Stackelberg leadership). An incumbent will prefer to pursue a limit price policy over collusion and/or the Stackelberg outcome, if $F > 1/49\ \Pi_m$. Entry is more likely, if collusion is expected, but collusion may create large excess capacities. Only one fourth of capacity will be used, in collusion, if both firms have capacities of Q* (perfectly competitive output). Regulation, therefore, often includes a ban on entry, which is seen as socially wasteful under these conditions. We can conclude that collusion produces the worst outcome from a welfare point of view. Price remains at the monopoly level and excess capacity is rampant under collusion. Accommodating behaviour (Cournot duopoly equilibrium) would give slightly better results. Both firms will each supply one third of perfectly competitive output. Entry will also increase excess capacity in this case. Excess capacity will now amount to 2/3th of total capacity. A limit price strategy would produce the best welfare results in a deregulated industry. Price-cost margins will be reduced to $2\sqrt{F}$

[6] $q_{cour} = (a-c)/(n+1)$; $\Pi_{cour} = (a-c)^2/(n+1)^2$

and excess capacity will also be reduced to 2 $\sqrt{F}$. Limit price will be located below monopoly price, if F < ¼ Πm; below duopoly price, if F < 1/9 Π_m and below Stackelberg price, if F < 1/16 Π_m. But, limit price is located above average costs and an incumbent monopolist pursuing such a strategy would incur excess profits of Π_{excess} = 2S $\sqrt{F}$ - 4F- F. It was mentioned above that excess profits equal 3 times the amount of fixed costs in the case where limit price equals monopoly price. This ratio will increase, if F declines. Hence, excess profits under limit pricing will amount to 11F, if F = 1/16Π_m and to 27 F, if F = 1/64Π_m.

Our analysis induces us to argue that incumbent monopolists will often feel compelled to pursue a limit price policy, if their industries are opened up for entry. This supports the general finding that successful entry requires innovation. This could be either a cost reducing process innovation or a consumer utility enhancing product innovation. One way to control a natural monopoly is to divest the infrastructure and put it under governmental control and/or ownership. Service providers could then use the network at regulated prices. The re-purchase of Tennet the company that operates the high voltage electricity network in the Netherlands by the Dutch state is a case in point. Natural monopolies could also be (re)regulated as has happened with the access to the local loop in fixed telephony.

4. REGULATING ENTRY IN DUTCH TELEPHONE MARKETS

It was demonstrated above that economies of scale could deter entry to network industries. But, entry could occur, if newcomers are allowed to use the existing network. Carrier select entry into US telecommunications first occurred in 1976, when the FCC (Federal Communications Commission) granted MCI interconnection privileges after a long legal battle. The natural monopoly characteristics of fixed telephony entailed that entry required access to the existing network. US long distance rates declined dramatically after MCI and other firms such as Sprint had entered the long distance market. Under regulation, ATT had kept long distance rates above average costs to subsidize local service. But, cross-subsidization became unsustainable, after the market was opened up. A new regulatory authority was installed in order to supervise US interconnection rates after the 1982 ATT consent decree.

The European Union initiated deregulation of telecommunications in the late 1980s. The first document on telecommunication deregulation; the Green Book was published in 1987. The EU published many documents on the liberalization of telecommunication markets, in which she advocated to end monopolies and to establish EU wide standards. GSM was set as the second European standard for mobile telephony and was followed by GPRS and UMTS standards. Mobile operators required the use of the fixed network to end many calls. The European Union advocated the implementation of cost-based interconnection tariffs to provide these services at competitive rates. The EU wanted national regulatory bodies to supervise interconnection tariffs. Liberalization of EU telecommunications were scheduled to be completed in 1998.

Deregulation meant a radical break with history for the state-owned national PTT's, that were now gradually privatized. British Telecom was the first European PTT that became a stock quoted company. The Dutch State sold 30 percent of its shares in the Dutch PTT in 1994 and more shares later. It still owned 43 percent of KPN in 2001. KPN as most former PTT's went through an episode of intense restructuring after privatization. It divested its postal services in 1998 and was forced to sell its cable company Casema in 1995 to allow competition between networks. KPN remained the owner of the fixed network. But, interconnection tariffs required approval from OPTA; a newly established Dutch regulatory authority. Cost-based rate of return (ROR) regulation was used to determine the level of Dutch interconnection tariffs. This regulatory mode led to various disputes. OPTA decided in september 1998 that KPN's rates of return on investment in local telephone services were too high and demanded a tariff reduction of 25%. But, this decision was severely challenged by several economists, the cable companies and KPN. They objected to the proposed tariff reduction by arguing that huge investments were required to accommodate rapidly increasing demand in infrastructures. KPN wanted among other things to install new fiber optic lines to connect Dutch cities in a new ISDN network. OPTA attenuated the tariff reduction somewhat. It is questionable, whether KPN's financial needs should influence interconnection tariffs. KPN was rapidly turning into a multi-national and could address international capital markets to finance its investments. KPN pursued a capital consuming acquisition policy in the late 90s, which does not indicate that it was capital constrained at the time. It concluded a joint venture with US-based Qwest. The new company was divested from its mother and was launched at the Dutch stock exchange in 1999. It acquired telecommunication companies in Belgium, Germany (E-

Plus), Ireland, Czechia, Rumania, Hungary, the Ukraine, China and Indonesia. The Japanese telecom company NTT Donomo acquired a minority share of 15 percent in KPN Mobile in spring 2000 after an earlier attempt of KPN at merger with Spanish Telefonica had failed. KPN now counts 3 large shareholder, the Dutch State, Donomo and Bell South. OPTA introduced some price cap elements into regulation in 2000[7]. Price cap regulation links price changes of telecommunication services to a basket of goods. Price cap regulation was introduced in US long distance telephone markets in 1989. The cap was adjusted each year for the rate of inflation minus 3 percent. The FCC evaluated price cap regulation positively in its 1992 review. It had led to considerable price decreases (Church & Ware, 830).

Competition in Dutch fixed telephony was boosted when new firms got access to the existing network in the mid 1990s. The market for international telephony was the first to experience fierce competition from new suppliers. Carrier-select companies used existing networks and offered their services at lower rates. Competition induced by carrier select companies was met by KPN that cut international telephone rates drastically. Dutch carrier select companies only obtained small market shares, which could be explained by KPN's price policy and by capacity shortages. KPN indicated that it lacked the capacity to satisfy all requests of carrier select companies. One could argue that KPN would have had more (excess) capacity, if it had pursued an accommodating strategy. Telephone services to businesses became another area of intense competition. Entrants such as Versatel and MCI have built new infra-structures (back bones and city rings) to connect business centers. But their combined market shares did not exceed the 5 percent mark in 2000 [8]. We could, therefore, conclude that KPN precluded substantial entry into fixed telephony by lowering price and giving priority to its own customers.

Technological progress enabled other types of networks to supply telephone services. The cable network was originally built to transmit television signals, but can also be used for telephone and internet services. The municipalities owned the cable networks until the early 1990s, when they were privatized. Concentration increased after privatization due to acquisitions. A few large players such as UPC, that had a market share of about 35 percent in 2000 have come to dominate the Dutch cable network

[7] `*Publieke Belangen en Marktordening; Liberalisering en Privatisering in Netwerksectoren'*, Nota Ministerie van Economische Zaken, maart 2000.
[8] NRC-Handelsblad, 21-10-2000.

market. Diffusion of cable technology is almost complete among Dutch households, but most business lack cable connections. Cable telephone and internet services did not gain much ground in the Netherlands and were only offered in a few localities in 2000. It was mentioned above that the cable companies objected to the interconnection tariff reduction proposed by OPTA in 1998. This seems an obvious reaction, because they have to follow these price cuts, if they want to build up market shares in fixed telephone and internet services.

The mobile telephone network constitutes a second alternate telephony network. Mobile telephony has become very popular in just a few years. Mobile tariffs exceeded fixed tariffs but this did not hamper mobile's rapid take-off. This indicates that many consumers value mobile telephony more highly than fixed telephony. Mobile and fixed telephone networks are thus not perfect substitutes, but are to a large extent complementary. KPN operates both fixed and mobile networks and receives interconnection fees from mobile networks. Technological progress proceeds at a rapid pace and will continue to change the landscape of telecommunications. Recent developments include the installation of broadband networks by cable and fixed telephone companies (ADSL) and GPRS and UMTS technologies by mobile phone companies. New technologies will increase network capacities and improve their performances. ADSL will increase capacity of a fixed telephone connection by more than a tenfold of that of ISDN. UMTS technologies will increase mobile telephone capacities by a factor ranging between 6 and 24[9].

5. STRATEGIC MOVES; VERTICAL INTEGRATION

Network companies could either open their networks for stand-alone service providers or provide these services themselves. Many telecom companies have pursued a policy of integrating physical networks and services in order to boost demand and deter entry. The acquisition of internet service providers by telephone and cable companies are cases in point. KPN acquired xs4all. Zonnet was acquired by Versatel and Wanado by Casema. Some cable companies founded their own internet service providers. UPC founded Chello and Essent started Excite & At Home. The question arises, if

[9] A consumer who is connected to an UMTS network has a capacity which is 24 times as large as GSM 900 and 6 times as large as GSM plus GPRS; *`Netwerken in Cijfers', Trendrapportage over ICT Infra-structuren 2000'.*

competition between telephone and cable networks suffices to provide lively competition in internet services or whether access should be (re)regulated. KPN is required to allow internet service providers on its fixed network at regulated prices. Cable companies are not yet required to give access to independent internet service providers. However, OPTA and NMA (Dutch Competition Authority) announced in march 2001 that cable companies could be designated as firms possessing considerable market power in broadband internet services. Such a decision would entail that cable companies should allow access to independent internet service providers at reasonable prices. UPC's stock price plummeted when this news broke.

Vertical integration of physical networks and content companies seems a lucrative strategy. The acquisitions of Time/Warner and Netscape by America on Line (AOL) and of Endemol by Telefonica in spring 2000 are examples of such a strategy. But, vertical linkages may entail foreclosure due to monopolization of content. Music producers have filed a complaint with the EC Commission. They demanded access to AOL/Time Warner's music library under competitive conditions. Another example of a strategy that combines content and physical networks is the acquisition of television channels by cable companies. The attempt by Dutch Cable Company UPC to acquire tv programmer SBS is a case in point. The deal collapsed when UPC's stock price plummeted in spring 2000, but UPC still owns 25 percent of SBS stock. The attempted acquisition attracted the attention of Dutch policy makers. The Dutch government expressed the opinion that new regulation might be warranted to prevent abuse of monopoly power by the cable companies [10]. NMA and OPTA expressed the view that cable companies should transmit all programmers at regulated tariffs[11]. Cable companies such as UPC will possess (local) monopoly power in Dutch television broadcasting for some time to come, because new technologies such as digital air-transmitted television are not expected to appear in the near future. This situation differs from EC countries such as France and Spain where digital and analogue pay-tv on both the cable and the satellite platform has advanced rapidly since 1998. Competition between these two platforms has contributed to the diffusion of pay television in those countries. Digital television could also be transmitted by a terrestrial platform, so those 3 networks may be engaged in oligopolistic competition in the near future. The EU Commission will not allow existing platforms to consolidate into a single platform,

[10] Kabelnota 2000 `*Kabel en Consument, Marktwerking en Digitalisering'*.

because this could prevent access of pay TV companies such as Canal +[12]. Some analysts argue that subscription television could overtake advertising as the main source of revenues in 2002 [13]. Dutch pay television, however, has not taken off yet. Canal+ has accused UPC of denying them sufficient digital capacity to transmit their programs without restrictions. They filed a complaint with OPTA, but OPTA did not rule in Canal+'s favour [14].

Vertical integration is an interesting strategy to increase both profits and consumer welfare in the case of two successive monopolies. But, industrial organization theory teaches that integration could foreclose entry and reduce social welfare, if monopoly is involved in only one market (Sonnenschein).

We will first discuss the case of two separate monopolies in programming and infrastructures. It is assumed that the cable company possesses a monopoly and obtains revenues by selling subscriptions. The subscription price includes a package of television stations plus the use of the physical network. Programmers are represented by a single company, which sells their services as a package. The programmer charges the cable company a fee of a magnitude d per subscriber. All other costs are assumed fixed costs. The cable company will maximize its profits $\Pi_{cable} = (P_{cab} - d)Q$. Hence, it will sell $Q = (a-d)/2$ subscriptions[15]. The programming company will maximize $\Pi_{tv} = dQ = d(a-d)/2$ and set its price d at ½ a [16]. The number of subscribers will then amount to ½ (a – ½ a) = ¼ a. Hence, the cable company will charge subscription prices of:

P = a – Q = a - ¼ a = ¾ a.

Profits for the cable and the broadcasting companies amount to:

$\Pi_{cable} = (P-d)Q = (\frac{3}{4}a - \frac{1}{2}a)\frac{1}{4}a = a^2/16$

$\Pi_{tv} = dQ = \frac{1}{2}a.\frac{1}{4}a = a^2/8.$

Total profits thus amount to $\frac{3a^2}{16}$

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[11] 24 mei 2000. *`Visie NMA en OPTA op Kabelnota'*

[12] EU Commission, november 1999*; `The Development of the Market for Digital Television in the European Union'*, p. 9

[13] EU Commission, november 1999, 9.

[14] OPTA, 21 december 2000. *`Besluit inzake Geschil tussen Canal+ en UPC Nederland NV'*

[15] Marginal revenues = a – 2Q – d = 0; → Q = (a-d)/2

[16] Marginal revenues minus marginal costs = (a-2d)/2 = 0: → d = a/2

An integrated monopolist, however, would only demand a price of ½ a and would accordingly sell twice as many subscriptions. Integration would boost profits that would now amount to $a^2/4$. Consumers would also benefit, because monopoly price of ½ a lies below the non-integrated price of ¾ a.

Our analysis shows that the upstream producer (who does not sell to the final consumer) incurs highest profits, if there is no vertical integration. We assumed that cable companies sold to final consumers. However, the opposite may also occur. Programmers such as Canal + sell subscriptions to final consumers and pay a fee to infra-structural companies. Pay tv will not take off, if companies like Canal+ have to pay monopoly fees to the cable companies.

Vertical integration would benefit the downstream firm most in our model. His revenues would double, if we assume that integrated monopoly profits are equally split between upstream and downstream firms. The upstream firm would not benefit from vertical integration in this scheme. It would receive half of $a^2/4$, which equals its revenues before vertical integration. The Dutch situation differs somewhat from the picture sketched above, because Dutch cable companies are required to transmit a certain package of public and private tv stations. The Dutch situation can be explained by regulatory measures that set Dutch cable subscription prices at a relatively low level. The Dutch situation is a remnant of the past when households paid an obligatory fee for cable use and a package of tv stations. Stations that were not included in the package such as CNN had to pay a transmission fee to the cable companies, which CNN has refused.

Vertical integration could benefit both companies and consumers as was demonstrated above. But, vertical integration could impair welfare and variety, if entry of independent tv stations and new technologies is deterred. Regulation could become superfluous, if competition between networks would emerge. The introduction of digital satellite television could create such a situation. Vertical linkages between (cable) networks and programmers could, however, prevent the emergence of competition between networks as will be demonstrated below. The digital newcomer could be kept from entering, if cable companies refuse the satellite network to transmit their (popular) programs. The satellite entrant could establish its own tv stations, but this would increase investment costs. Anti-trust suits filed by US satellite companies have led to legally enforced transmission of integrated television channels in some cases. However, this would not help new networks much, if cable companies could charge them monopoly prices.

We 'll first analyze the effects of digital entry in a situation where vertical integration is absent. It is assumed that television programmers supply their products to both cable and satellite companies. These infra-structural companies charge equal subscription prices and therefore share the market equally. It is further assumed that television programmers receive a collective fee from cable/satellite companies per subscription. All other costs are considered fixed. TV stations would then maximize their profits by charging the cable and satellite companies a price c_{tv} per subscription of ½ a :

$\Pi_{tv} = c_{tv} Q = c_{tv} (a - c_{tv})2/3$

$\frac{\partial \Pi}{\partial c} = a - 2c_{tv} = 0; \rightarrow c_{tv} = ½ a$

$q_{cab} = q_{sat} = (a-c_{tv})/ 3 = (a – ½ a)/3 = 1/6 a$

$P = a – Q = a – 2. 1/6 a = 2/3 a.$

The introduction of digital satellite television would thus reduce bundled subscription prices from ¾ a to 2/3 a. Cable and satellite networks would both incur profits of (2/3 a – ½ a) 1/6 a = 1/36 a^2. Together they would make profits of 1/18 a^2. TV programmers would make profits of ½ a. 1/3 a = 1/6 a^2. Hence, combined profits would amount to 2/9 a^2. Vertical integration by both cable and satellite companies does not constitute an attractive strategy under these conditions, because profits would remain at the 2/9 a^2 level in a duopoly and each duopolist would receive 1/9 a^2 .

However, digital entry could be easily deterred, if cable companies and programmers are vertically integrated. The entering satellite network can only obtain programs from independent stations at a fee. Applying a Cournot duopoly quantity setting model may indicate the effects of vertical integration. Market shares of firms in a Cournot duopoly equal (Shy, 178):

$q_i = \frac{a - 2c_i + c_j}{3}$.

Independent tv programmers will maximize their profits:

$\Pi_{tv} = c_{tv} q_{sat} = c_{tv}(a-2c_{sat} + c_{cab})/3$

The satellite network company would pay a fee to tv programmers ($c_{tv} = c_{sat}$). But, the integrated cable company would pay a price of zero and thus incurs zero marginal costs. Setting marginal revenues minus marginal costs equal to zero:

$a- 4 c_{sat}= 0; \rightarrow c_{sat} = ¼ a$.

$q_{cab} = (a - 2c_{cab} + c_{sat})/3 = 5/12 a$

$q_{sat} = (a - 2c_{sat} + c_{cab})/3 = 1/6\ a$

$P = a\text{-}Q = a - 7/12\ a = 5/12\ a$

Our analysis shows that the integrated cable company will have 2,5 times as many subscribers as the non-integrated satellite company. We could conclude that (incomplete) vertical integration benefits consumers, because price would decline from 2/3 a to 5/12 a. The integrated cable company would make profits of 5/12 a.5/12 a = 25/144 a^2 and the satellite company of 1/6a (5/12 –3/12)a = 1/36 a^2. Independent programmers would incur profits of 1/4a.1/6 a = 1/24 a^2. The competing technology could thus be foreclosed, if its fixed cost exceed profits of $a^2/36$. Price would rise to ½ a, if satellite television is successfully deterred.

Our analysis indicates that vertical integration between content and infra-structural companies could deter entry of alternate physical networks and of independent television stations. OPTA and NMA want to regulate access of independent programmers to the cable. They also conveyed the view that disputes on tariffs could be settled easier, if cable companies keep separate bookkeeping accounts for infrastructural and programming divisions (OPTA en NMA, 2000). But, such separation could be easier achieved, if infra-structures and programs were supplied by separate companies. Digital and cable companies would then have equal chances to obtain subscribers. Governments could also repossess infrastructures and sell capacities on a cost basis. Diversity would be stimulated, if bundled supply of tv programmers would also be precluded. A completely unbundled situation, in which each tv station can set its own subscription price seems preferable. Consumers could then choose few or many stations depending on their preferences and do not need to buy a whole package.

6. ENTRY STRATEGIES IN MOBILE TELEPHONY

Mobile telephone networks are less capital intensive than landlines. The physical investment costs per UMTS connection amount to 240 $, whereas an ADSL connection costs 1176 and an ISDN-BA connection 1375 $[17]. We can conclude from these figures that fixed investments in mobile telephony amount to less than one fifth of ISDN and

[17] `*Netwerken in Cijfers 2000'*, Trendrapportage van het Ministerie van Verkeer en Waterstaat. The Hague.

less than one fourth of ADSL connections. We might, therefore, conclude that mobile telephone prices should be lower than fixed telephony. But, mobile operators need to pay interconnection tariffs to fixed telephone networks, which raises their costs and prices. They also need to buy spectrum licenses from governments. But consumers do not consider mobile and fixed telephony homogenous products and mobile prices can, therefore, be set above fixed prices.

The EU guided the liberalization of the European mobile telecom sector. EU directives forbade monopolies in mobile telephony and the EU took action against certain member states that had maintained monopoly provision of the second-generation GSM mobile system[18]. Countries were required to issue at least two GSM 900 licenses. Later EU directives established that entry should only be limited by considerations of efficient use of radio frequencies. However, this technical limit did not determine the number of competitors unequivocally. EU countries issued between 3 and 5 GSM licenses.

It is obvious that the number of licenses affects market structures and therewith competition. This applies with the greatest strength, if entry is completely precluded after licenses have been distributed. But, unlicensed firms can still enter a national market. They can either acquire a licensed company or obtain access to the mobile network through roaming. EU competition authorities have usually allowed acquisitions of licensed operators by a foreign party. Arguments of international network efficiency played a large role in these rulings. The Vodafone-Mannesmann acquisition is a case in point. EU policies with respect to roaming and interconnection include that firms with considerable market power (market share > 25%) should treat all reasonable requests for access in an indiscriminate manner. Interconnection tariffs should be determined on a cost basis (EU Directive 1997, 21). However, it was not clear whether the mobile market should be considered a separate relevant market.

EU mobile licensees were required to roll out a GSM network that provided complete coverage in due time. This was to prevent fortune seekers from bidding for licenses. It was, however, left unclear whether complete coverage could also be achieved through interconnection. Coverage for UMTS netwworks was set at a lower level (about 80 %). Firms could only bid for one license. Mergers between mobile licensees in a national market were not allowed, because this could restrain network build-up.

[18] `*Status Report on European Union Telecommunications Policy'* april 1997, p. 6

We will first address the question how the number and the sequence of licensed entrants might affect competition. KPN obtained the first Dutch license for mobile telephony in 1989. The first GSM licenses were issued to both KPN and Libertel (Vodafone) in march 1995. The Dutch authorities selected Libertel as a second provider in a `beauty contest', which left several international consortia empty-handed. The Dutch government decided to allocate future licenses through auctions. An auction for a third GSM license scheduled for 1997 was cancelled. A new auction was organized in february 1998 in which several entrants bid for 2 full licenses. Three new entrants started operations in early 1999: Telfort, Dutchtone and Ben. The third entrant (Ben) could enter, because it obtained a number of smaller frequencies from two different parties [19]. The price of a complete license amounted to 600 million guilders. The staged licensing process in the Netherlands had several consequences. The auction price of the new licenses brought the new competitors in a disadvantageous position vis a vis KPN and Libertel, which had obtained their former licenses free of charge. These newcomers were also handicapped due to the time that had passed (3 years) between the first and second round of issuing. The Netherlands has counted 5 suppliers of mobile telephony from 1998 until this date (2001). Other European countries only counted 3 or 4 GSM suppliers. All 4 entrants to the Dutch mobile market are subsidiaries of multi-national telecom companies. Big profits were expected to lie ahead due to the rapid diffusion of mobile telephony. The number of mobile callers exceeds that of fixed telephony in many countries. This is because mobile telephony is person-related, whereas fixed telephony is household-related. It was mentioned above that governments were required to issue at least two GSM licenses. The high demand for licenses, however, prompted governments to issue more than two licenses. The combination of first mover advantages and scarce licenses seemed to make entry a now or never decision at the time. The EU ban on monopoly posed a problem for incumbent monopolists. They had to decide how to behave towards entrants. They could either accommodate or fight entry. It will be demonstrated below that the choice between an accommodating or leadership strategy is affected by the number and timing of entrants into mobile markets. KPN remained dominant in the Dutch mobile telephone market. It had a market share of about 50 percent of connections at the end of 1999. Libertel (Vodafone) ranked second with about 30 percent and the 3 midgets Ben, Dutchtone and

[19] Kamerstuk 24095, nr 55. *`Frequentiebeleid',* Brief van de staatssecretaris en de

Telfort all had market shares below 10 percent [20]. These market shares have remained remarkably stable. Dutch market structures in mobile telephony could be interpreted as the result of a two-staged Stackelberg leader-follower model. It was indicated above that an incumbent monopolist would be inclined to behave as a Stackelberg leader, if it was confronted with only one follower. However, it would be indifferent between leadership and accommodation, if a second follower would appear at a later date. The best response function of the second follower would be:

$2q = (1 - 1/2 - 1/4)\ S\ ; \rightarrow q = 1/8S.$

Total output would amount to $(½ + ¼ + 1/8)S = 7/8S$ and price would decline to 1/8 S, if the former monopolist maintains its output. The former monopolist would incur profits of $1/8S\ .1/2\ S = 1/16\ S^2$, which equals firm profits in a three firm Cournot equilibrium. But, the situation changes, if firms appear bunch-wise. A Stackelberg leader would maintain its monopoly output, if it were followed by two entrants that appeared simultaneously. The best response function of each follower is: $2q_f = S - q_1 - q_f$:; $\rightarrow 3q_f = S - q_1$: $\rightarrow$

$q_f = 1/3\ (S - q_1)$. Firm 1's residual demand function:

$P = a - q_1 - 2q_f$; $P = a - bq_1 - 2/3\ (S - q_1)$:

The incumbent monopolist maximizes its profits

$(P-c)q_1 = (1/3S - 1/3q_1)q_1$;

$MR - MC = 1/3\ S - 2/3\ q_1 = 0; \rightarrow q_1 = ½\ S = Qm$

Each follower would supply $1/3\ .\ ½\ S = 1/6\ S$.

$P = a - Q \rightarrow P = a - 5/6a = 1/6\ a$

The former monopolist would thus maintain its output and reap profits of $1/12\ S^2$, which exceeds Cournot profits in a three firm oligopoly ($=1/16\ S^2$). It can be proven that a Stackelberg leader will always supply monopoly output irrespective of the number of followers, if they arrive simultaneously[21]. A combination of simultaneous and sequential entry will give case-specific results. The Dutch situation where first one and then 3 entrants appeared favours Stackelberg behaviour. Hence, Libertel would enter at half of KPN's size. The three followers that arrived simultaneously at a later date would each enter at one eighth of KPN's size in a Stackelberg model.

$P = a - Q,\ c(q) = F$,

Minister van Verkeer en Waterstaat, d.d. 4 september 2000

[20] Ministerie van Verkeer en Waterstaat, *`Verkenningen'* p. 35.

Market share KPN = (a-c)/2; Market share Libertel = (a-c)/4

Best response function for each of 3 newcomers;

$2q = (1 – ½ - ¼)S - 2q;$

$\rightarrow 4q = ¼ S \rightarrow q = (a-c)/16 = 1/16 S.$

$P = a – Q \rightarrow P = a – (1/2 + ¼ + 3/16) a = 1/16 a$

A leadership strategy is more profitable than an accommodating strategy under these conditions. Each firm would incur profits equal to $S^2/36$ in a Cournot oligopoly counting 5 firms. But, KPN's profits in the Stackelberg equilibrium amount to ½ S . 1/16 S $= S^2/32$. KPN 's strategic choice to remain dominant seems therefore a rational response in the Dutch situation. KPN's leadership strategy could explain why KPN matched the price cuts of its rivals. The new entrants started a price war in 1999, but KPN responded rapidly and the market shares of the three newcomers remained small. Telfort started a new price war in the spring of 2000. It had 500.000 subscribers in march 2000 and wanted to expand this number to 1 million within the year 2000. However, KPN again reacted quickly and lowered its tariffs. It could be argued that neither KPN nor Libertel were inclined to accommodate the three late arrivals.

Dutch GSM market structure differed from UK and German market structures. British Telecom and Vodafone had both shares of about 30 percent of the UK market in april 2000; the time of the UK UMTS auction. Orange (Vodafone) and One2One had rapidly increased their market shares up to about 20 percent at that time. The German GSM market was also more equally distributed than the Dutch. The German market leaders Mannesmann (Vodafone) and Deutsche Telekom both had market shares of about one third of the market. E-Plus (KPN) had a market share of somewhat above 20 percent, whereas VIAG's market share was below 10 percent.

Italian and Austrian mobile markets resembled Dutch market structure Telecom Italia (the former monopolist) had a market share of over 50 percent at the close of 1999, whereas his runner-up Omnitel (Vodafone) had a market share of about 30 percent. Wind and BLU (BT/Benetton) only occupied small market shares. The Austrian former PTT Mobilkom also had a market share of over 50 percent, whereas the second supplier Deutsche Telekom possessed more than 25 percent before the UMTS auction began in november 2000. Two other firms owned by Deutsche Telekom and Teledanmark held small market shares. Hence. some former monopolists such as Brithish Telekom and

[21] $\Pi_{stack} = S^2 / 4n > \Pi_{cour} = S^2/(n+1)^2$

Deutsche Telekom had lost dominance whereas KPN, Telecom Italia (Tim) and Mobilkom had not. The differences in GSM market structures in those markets that all featured four suppliers could be explained by the way entry was staged. A leadership policy is only more attractive than an accommodating policy in a four firm configuration, if at least two of the three entrants arrived simultaneously. Accommodation would have been the best incumbent response, if all three entrants arrived sequentially

Leadership strategies could also explain why Dutch and Italian mobile telephony tariffs were about half as large as UK and German tariffs. Tariffs for private use were much lower than for business use in all Western European countries[22].

7. EUROPEAN MOBILE MARKETS AND SPECTRUM AUCTIONS

It will now be argued that GSM market structures set the stage for UMTS auctions. Western European governments all issued 4 to 6 UMTS licenses through auctions or beauty contests. These numbers are induced by technical considerations, that only allows auctioning of 145 mHz in total. Dutch, German and Austrian governments set 25 mHz apart and put 120 mHz on auction. This 120 mHz can be split up in three different ways. It can be split in 6 lots of 20 mHz; 4 lots of 30 mHz or in 5 lots; 2 of 30 and 3 of 20 mHz. Dutch spectrum frequencies were divided in two lots of 30 (plus 5) and three lots of 20 (+5) mHz. The german UMTS auction endogenized the number of licenses that were issued. Twelve spectrum blocks of 10 mHz were auctioned in Germany in august 2000. Firms could bid for either 2 or 3 blocks, so that either four or 6 equal sized firms or 5 firms of two different sizes could emerge. The Austrians followed the same procedure in their november 2000 auction. The UK government partitioned the available space in 5 lots: one lot of 35 mHz was reserved for a newcomer. The remaining 4 lots were partitioned in one lot of 30 and three lots of 25 mHz. The Italian government auctioned 5 licenses of 25 mHz each in october 2000. The UK, Germany, Italy and Austria all counted 4 GSM incumbents. All auctions were organized as ascending auctions and each firm (consortium) could only obtain one license. Hence, in all auctions except the Dutch the number of licenses exceeded the number of incumbent suppliers. We could wonder if the Dutch government could have done better?

To answer this question we will first address the issue of the effects of market structures on profits by applying a Cournot oligopoly model. This can give us some insight under what conditions five firms could survive in a mobile market. We assume a demand curve for fixed telephony that fits P = a - Q and marginal costs for fixed telephony that equal zero. Consumers' preferences for mobile telephony are assumed to exceed those of fixed telephony but mobile telephone companies need to pay an interconnection tariff to owners of fixed infrastructures equal to c. It is assumed that higher reservation prices for mobile telephony are just sufficient to cover this marginal cost. Hence, the demand function for mobile telephony is P = (a + c) - Q

Each (equal-sized) supplier of mobile telephony will make profits of $a^2/(n+1)^2$ It is assumed that fixed (sunk) capital costs of a mobile network are assumed to amount to one fourth of the fixed landline network. Fixed telephony constitutes a natural monopoly and the price of fixed telephony under average costs regulation would equal: $P_{fix} = ac$. A long run equilibrium in mobile telephony will be established, if the price of mobile telephony equals average costs. We include only fixed capital costs and omit marketing and license costs.

$P_{mob} = ac_{mob} = c + F_{fix}/ 4q$

$F_{mob} = \Pi_{mob} = q^2$; $q = \sqrt{F_{mob}} = ½ \sqrt{F_{fix}}$

The number of equal sized firms in a (Cournot) long run equilibrium in the mobile market can be calculated in the following way:

$(N +1)q = S.$

$N_{mob} = a : ½ \sqrt{F_{fix}} - 1 = 5$

$\rightarrow 2a : \sqrt{F_{fix}} = 6 ; \rightarrow F_{fix} = 4a^2/36 = 1/9\ a^2$.

Hence, five mobile phone companies could only be sustained in long run equilibrium, if fixed (sunk) cost of fixed telephony $F \leq 1/9\ a^2$. This means that each mobile operator supplies output $q \geq ½ \sqrt{a^2/9} \geq a/6$. Total supply thus amounts to $\geq 5/6a$ and price $\leq 1/6$ a. Each mobile operator will now incur profits $\geq a^2/36$.

Profits might exceed average costs, if firms collude. It was mentioned above that the government determines the number of licenses that are sold at periodic auctions. Entry could thus be prohibited in between auctions. The absence of an entry threat could induce firms to behave collusively. Profits of mobile phone companies increase by

[22] Kamerstuk 24095, nr 55 tabel 1. Measurement date is march 2000.

eighty percent, if companies collude instead of compete ($a^2/36$ versus $a^2/20$). Nine firms could survive under collusion ($a^2/4 : 9 = a^2/36$).

It was mentioned above that mobile operators could be required to give access to their networks. International roaming between licensees is needed, but roaming could also allow entry of unlicensed operators. Roaming can only occur, if mobile capacities are not completely used. Excess capacities could emerge due to the EU obligations of license holders to roll out networks. OPTA argued in may 1999 that competition might entail excess mobile capacities [23]. This raises the question whether one network would constitute a more efficient solution than building several duplicative networks. We assume that five networks are completely duplicative. Fixed cost per firm in the collective shared network will then amount to $F_{fix}/4N = a^2/36N$. Each mobile operator will then supply $q = \sqrt{a^2}/36N$. The number of mobile operators will then amount to $N = a/\sqrt{a^2/36}\,N - 1$. Hence, $N^2_{mob} = 36\,N - 1$.

The industry could thus support almost 36 firms, if they share a common network that possesses sufficient capacity to meet demand at competitive prices. But, mobile telecom would constitute a natural monopoly under these conditions. Only one network should be built and roaming should be regulated. It is not clear whether large excess capacities exist in mobile networks. Large radio spectrums allow larger market shares, if each mobile firm is required to build its own network. Large spectrum licenses are worth more than small ones under these conditions. We shall assume that (future) market shares are proportionate with lot sizes. Profits of mobile telephone companies will depend largely on the number of competitors in a Cournot model. Profits are almost halved, if the number of equal sized competitors increases from 4 to 6.

$$\Pi_{\text{i cour}} = \frac{(a-c)^2}{(n+1)^2}$$

$$n = 4; \rightarrow \Pi_{\text{icour}} = \frac{(a-c)^2}{25},$$

$$n = 6; \rightarrow \Pi i_{\text{cour}} = \frac{(a-c)^2}{49}$$

We could, therefore, assume that firms incur profits that are almost twice as large in the case of a four instead of a six firm Cournot equilibrium. Profits in a 5 firm configuration with unequal market shares would differ for large and small firms. The

[23] OPTA, 7 mei 1999. `*Beleidsadvies UMTS Vergunningen*'

ratio of profits would vary with q^2, because each firm would earn $(P-c_i)q_i = q_i^2$ in a Cournot setting where market shares reflect cost differences. Profits for each lot would then amount to:

q = 35 Megahertz: Profits : 1225
q = 30 Megahertz: Profits : 900
q = 25 Megahertz: Profits : 625
q = 20 Megahertz: Profits 400

This exercise allows us to predict that a 20 mHz lot would only be worth one third of a 35 mHz lot, if lots of unequal sizes are put on auction. We compared our hypothetical results with the actual results obtained on 5 UMTS auctions that took place in 2000. The results of the 5 auctions were as follows:

Table 1
UMTS AUCTION REVENUES 2000

Country	**UK**	**Netherlands**	**Germany**	**Italy**	**Austria**
Lot size					
35	7,4	1,6 + 1,6			
30	10				
25	6,7,+ 6,8 + 6,9	1,0+ 0,9+0,9		12 / 5	
20			6 times 8,5		0,7/6
Total	37,8	6	51	12	0,7

All prices are in billions of Euro.

It can be noted that prices of equal-sized lots did not differ much within countries. This supports our argument that valuations of licenses are related to lot sizes. The price ratio's of lot sizes corresponded with our theoretical ratio's. KPN and Libertel paid 1,75 times as much for their large licenses as Telfort, Ben and Dutchtone did for their small ones. The theoretical ratio is 1,96 in this case. The British 35 lot was sold at a relatively low price to TIW (the entrant), whereas Vodafone paid almost 1,5 times as much for its 30 mHz license. Vodafone's 30 MhZ lot would be worth 1,44 times a much as the 25 lots, but they paid a little bit more (1,49). The awkward relationship between the prices paid for the 30 and 35 lots in the UK indicates that incumbents valued a large lot more than entrants, which was to be expected. We can thus conclude that price differences within countries can be largely explained by size differentials of spectrum frequencies.

The large differences in per capita UMTS revenues between countries are harder to explain.

Table 2
UMTS 2000 AUCTION REVENUES PER CAPITA (Euro's)

	Price	Date
United Kingdom	635	march-april 2000
The Netherlands	170	july 2000
Germany	615	august 2000
Italy	210	october 2000
Austria	144	november 2000

The UK and German auctions obtained much higher revenues per capita than the Dutch, Italian and Austrian auctions. One explanation involves differences in profits per capita between countries. Frequencies of countries with relatively low mobile rates such as Italy and the Netherlands could be less valuable for this reason. Another reason involves different license lengths (UK and Germany 20 years; the other EU countries 15 years). Differences in auction design involve another explanation. Government revenues will only be maximized, if firms feel compelled to bid up to their expected discounted profits. Auctions will, therefore, only produce good results (from a government point of view), if the number of contestants does not equal the number of licenses. Some experts say that the number of licenses should exceed the number of incumbents at least by one in order to attract entry (Klemperer). Entrants will otherwise eschew entry, because incumbents are expected to value a license more than an entrant. An incumbent could lose its former investment, if it does not succeed in obtaining a license. It could, therefore, also be argued that auctions would provide even better results, if fewer licenses are issued than there are incumbents. Such a situation would force at least one incumbent to withdraw, whereupon his (sunk) assets would become obsolete. But, no government wanted to stage an auction where the number of incumbents exceeded the number of licenses issued. A number of licenses that exceeds the number of incumbents has the additional advantage of widening market structures, which could boost competition. Paul Klemperer explains the success of the UK auction by the fact that five licenses were put on auction, while there were only four incumbents. He ascribed the even better result of the German auction to luck rather than design (Klemperer, 2000, 10). I disagree with the latter statement, as will be elaborated below. This principle of incumbents plus one (N+1) licenses was violated by the Dutch auctioneers who put 5

licenses (=N) on auction in july 2000. The number of potential entrants had already declined to one (Versatel) shortly before the auction started. Versatel withdrew after it was accused by Telfort of driving up prices with the intent to harass incumbents.
The good results of the UK auction could be explained by the large number of contestants (13) that bid for five licenses The German auction where 7 contestants bid for a maximum of 6 licenses seems to contradict this contention. However, the German auction demonstrates that auction outcomes do not only depend on the divergence between numbers of contestants and licenses but also on the relationship between lot sizes and GSM market shares. UK and German GSM firms had more equal market shares, which expanded the number of contestants for the large licenses. It was shown above that large (35 mHz) frequencies could be worth 3 times as much as small ones (20 mHz). Hence, firms will bid up for large licenses, if the number of large firms exceeds the number of large licenses. . The importance of this competition for dominance is testified by the result of the German auction where 6 firms continued to bid up, after Debitel had left. German revenues were increased by 18 billion Euro, (more than one third of total auction revenues) by this bidding for dominance in a five firm outcome. Hence, neither Mannesmann (Vodafone), nor Deutsche Telekom or E-plus (KPN) was prepared to give up their ambitions of dominance. This was to no avail, since 6 licenses were issued at the close of the German auction. Hence, firms only acknowledged defeat after they had spent 18 billion Euro in an attempt to beat their rivals. That dominance is worth a high price is also testified by the UK auction where British Telecom and Vodafone drove up the price for the 30 mHz spectrum. The intensity of competition might be explained by the small difference in market share between Vodafone and BT. Competition for dominance was absent in the Netherlands. There were two large licenses for two large incumbents. The price that is paid for each lot in an auction equals the valuation (plus ε) of the bidder that withdraws last. Large lots will, therefore, only obtain high prices, if the number of bidders for each lot size exceeds the number of licenses.
It is obvious that more than one entrant needs to enter the auction, if licenses number N + 1. The Italian auction, was therefore a risky affair with only 6 participants (4 incumbents and 2 entrants) bidding for five licenses. The incumbent BLU withdrew early from the Italian auction leaving room for two new consortia (IPSE and Andala). This seems to contradict the wisdom that incumbents value licenses more than entrants. But BLU had only obtained a market share of less than 3 percent. Moreover, entry

might have been made too attractive due to the extra frequencies that were reserved for newcomers in Italy. The disappointing result of the Italian auction could thus be attributed to the small number of contestants and the equal lot sizes. There were no big prices to win and the price of each lot was thus established at the level of Benetton's valuation, which was relatively low due to its small market share. The small number of participants could also explain the disappointing result of the Austrian auction. There were only 6 bidders for a maximum of 6 licenses. Six licenses of 20 mHz were sold on the second day of the auction only 15 percent above minimum price. It would have been plausible, if market leaders Mobilkom and Deutsche Telekom had bid up to obtain three instead of two lots. However, both firms did not seriously try to maintain dominance on the Austrian market.

Auctions that were scheduled for late fall 2000 and 2001 obtained even worse results for French and Belgian governments that could not find buyers for all licenses they wanted to sell. Revenues did not rise above floor prices as a consequence. The collapse of UMTS auctions revenues in the fall of 2000 could be explained by increased pessimism about mobile profits. This can be attributed to a change of sentiment, but changed expectations about roaming rights might have played a key role in these outcomes. The EU had indicated in several documents that firms with market power should grant access to their networks. However, it was not completely clear whether mobile telephony should be considered a separate market. Mobile roaming rights were not regulated but determined through negotiations. OPTA expressed the opinion that clarity about roaming rights regulation could have encouraged the three Dutch midgets to bid for the large licenses[24]. The 3 late Dutch arrivers had built smaller GSM networks and could only roll out a large UMTS network by (temporarily) using KPN's or Libertel's GSM network. It was not totally clear, however, at the time of the UMTS auction, whether roaming should be granted and at which prices. OPTA had designated both KPN and Libertel as suppliers with considerable market power in october 1999. Libertel, however, objected to the decision. But, OPTA found her objections invalid in their november 2000 decision on the case. Hence, two Dutch suppliers are required to grant access to their network as a consequence of this ruling. This decision implies that licensed and unlicensed firms can file a complaint, if they are denied access to the network, or if prices are deemed to be too high. This regulation might tip the balance in

[24] NRC-Handelsblad, september 2000

favour of small players and carrier select companies and send roaming tariffs spiraling downwards. Hence, a large market share could be much less attractive than it originally appeared. Entry of carrier select companies could be denied, if excess capacity is lacking. However, there are some indications that UMTS networks will possess ample excess capacities. The intention of German license holders to cooperate in UMTS investments supports this view. E- Plus and Telefonica even announced in march 2001 that they considered a merger of their German activities. Heavily indebted telephone companies became hesitant to roll out their UMTS networks. Vodafone alluded in march 2001 that it wanted to postpone the building of its UMTS network by 5 to 6 years. Less capital intensive GPRS technology could do the job in the meantime. European ADSL investments are also lagging behind. We might conclude that investment in UMTS capacities has lost much of its splendour.

8. CONCLUSIONS

Telecommunications has changed from a regulated monopoly into a liberalized industry in both the EU and the US within a decade. But, competition relies largely on how access to existing networks is regulated. Incumbent monopolists could deter entry of new networks by pursuing a limit price strategy or through vertical integration

Market structures in mobile telephony are largely determined by licensing practices. The paper demonstrates that UMTS auction outcomes in 2000 largely depended on the number of large incumbents in relation to the number of large licenses Large firms wanted large licenses to protect their market shares. But, dominance might have lost much of its attraction due to roaming regulation.

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