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The Need for a New Approach to Regulating Fixed Networks

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Abstract

The increasingly observable excess capacity in the fixed networks calls into question the established long-standing pricing standards for wholesale services based on forward-looking long-run incremental costs (FL-LRAIC). The FL-LRAIC standard has worked quite well in expanding markets, although even there price-squeeze problems have appeared. In contracting markets the price-squeeze issue, however, becomes paramount and lower prices both at the wholesale and retail levels would be efficient. This would favor a retail-minus approach (RM) under long-term contraction. Because both expansion and contraction could be relevant in the future, we propose an optional approach based on the wholesale price formula $p = \min\{FL-LRAIC, RM\}$. This will generally protect alternative competitors against price-squeeze while at the same time allowing the fixed-network incumbent full downward price flexibility. It also protects alternative competitors and end users against excessively high prices. Hence, implementing this option successfully at wholesale level would eliminate the need to regulate retail markets. The combination of RM and FL-LRAIC seems to be most realistic, because it is relatively simple and internationally partly tested already. We show that this option is superior to FL-LRAIC or RM alone and to other approaches, such as short-run marginal costs. We also consider a possible combination with capacity-based charging, which may have particular merits for converged services in next generation networks (NGNs).

1 Introduction

In 1997/98 the European Union (EU) liberalized its markets for fixed-network voice telephony by granting alternative operators non-discriminatory access to regulated inputs from the incumbent operator (the formerly state-owned monopoly provider and the only operator with a nation-wide network). The concrete design of access regulation has been a cornerstone of ex ante regulation and has provoked intense discussions since then.

The topic of fixed-network regulation gained additional importance in 2007 when the European Commission replaced the 2003 "Recommendation on Relevant Telecommunications Markets",¹ with a new one stipulating that regulation of retail fixed-network calls is unlikely to be necessary any longer (see Appendix for details of the EU regulatory framework). The main argument for this was that wholesale regulation and general competition law should be sufficient to address any competition problems which may arise in these markets. The Commission substantiates the "non-relevance" of voice telephony markets in its new recommendation in explicit terms only with reference to the increasing importance of broadband connections and associated technological innovations (most notably, IP-based telephony) on the one hand, and (in part only recently) imposed regulatory instruments on the wholesale level on the other. However, for most countries these "intra-modal" developments will only partly justify changes of the recommendation list on empirical grounds.² Intra-modal competition is based almost exclusively on local loop unbundling, cable, carrier pre-selection and call-by-call, and here there have been only gradual improvements in competition. In some countries – such as Austria – the market shares of the incumbent have recently stabilized or in some cases even increased significantly. By contrast, in many member states the mobile sector has begun to exert increasingly competitive pressures ("inter-modal") on fixed voice telephony markets ("Fixed-to-Mobile Substitution" = FMS). Indeed, with regard to the mobile sector (2G and 3G) we observe persistent growth at European penetration levels to 119% in 2008³ whereas fixed-line penetration has been decreasing steadily for several years.⁴

Subsequently, fixed networks have been subject to excess capacities with access prices still regulated at average costs in most EU member states. In this situation, however, the welfare-optimal retail call prices of the incumbent often appear to be below the regulated (cost-oriented) access price, because wholesale regulation is based on the average, and not on the marginal, costs of access. With access prices fixed at a long-run average cost level, which is significantly above short-run marginal costs in communications, regulated fixed-

¹ European Commission (2007).

² See European Commission (2008a), Volume 2, figure 40, which shows only minor competitive improvements for relevant fixed-line segments with respect to the evaluation period of the new market recommendation.

³ European Commission (2009), Volume 1, p. 10.

⁴ See OECD (2009), figures 1.1, 3.2 and 3.6, or Schäfer/Schöbel (2006), pp. 6-87, for international case studies.

network operators also lack pricing flexibility for inter-modal competition at the retail level. This holds for alternative competitors because they have to depend on inputs for which they pay a too high price and for incumbents because they have to avoid price-squeeze accusations and therefore are de facto subject to minimum-price regulation at the retail level. This might then further reinforce FMS patterns. As a result, current regulation provides wrong signals, since, in a competitive market, prices would be lowered towards the short-run instead of to a hypothetical long-run pricing benchmark. The latter was deemed to be a desired regulatory target, when access prices were calculated against the backdrop of expanding markets in the first stages of liberalisation. Those observations hold irrespective of the actual recommendation list and the relevant markets specified therein. Hence the future design of access regulation will again take centre stage in view of the upcoming market analyses conducted under the EU framework.

Accordingly, some scholars and practitioners recently advocated regulatory changes in access pricing.⁵ Although there is a large literature on access pricing in network industries,⁶ there has been no systematic attempt at evaluating regulated (communications) markets which exhibit non-temporary over-capacities. The main research questions therefore are: i) Should national regulatory authorities (NRAs) maintain a concept of access pricing based on long-run average costs in markets where non-temporary over-capacities exist and, if not, ii) what is the best alternative form of access regulation based on a set of pre-defined criteria. Finally, one also has to consider iii) the impact on retail competition, since wholesale and retail markets are inherently interrelated via regulations and underlying competition problems. In investigating these questions we take the EU framework as our point of departure, but our analysis extends more generally to any future regulation of telecommunications markets where FMS is intense. The latter in turn not only raises the question of future access regulation in fixed networks, but also brings together regulation of wireline and wireless markets at the wholesale level. Our paper aims at deriving clear policy implications taking account of practical feasibility.

The rest of this paper is structured as follows: Section 2 first describes the standard case of cost-based access regulation and then outlines regulatory alternatives. Section 3 focuses on the group of practically relevant approaches and provides an evaluation of alternatives of access regulation. Given the policy focus of our paper, “optimality” is therein defined with regard to efficiency *and* implementation considerations. Our analysis clearly indicates sub-

⁵ See Kruse (2007), pp. 110-115, or IRG (2005). Briglauer et al. (2008a,b) show that the current cost-based access regime will lead to a margin-squeeze for fixed-network operators if inter-modal competition is intense.

⁶ For an extensive view see the surveys of Armstrong et al. (1996), Laffont/Tirole (2000) and Armstrong (2002), who use a theoretical framework, and Vogelsang (2003), who points out the policy implications of these results. More recent work focused on various alternatives to cost-based access pricing, such as Calzada (2007) and Kennet/Ralph (2007) discussing capacity-based versus time-based interconnection charges or Goncalves (2007) discussing the adequacy of retail-minus as an alternative to cost orientation in determining bitstream access charges.

optimality of the current standard of access regulation, which demands a shift towards a more flexible access pricing regime. Section 4 concludes.

2 Alternative Approaches to Access Regulation

The provision that the interconnection services are to be offered at a cost-oriented basis has been implemented under the so-called FL-LRAIC (Forward-Looking Long-Run Average Incremental Costs) standard within European Member States.⁷ FL-LRAIC as a long-run measure aims at the costs of efficient production of units where those variable and fixed costs are included which are essential for a group of services.⁸ Consequently, outdated technologies and inefficiently incurred costs like redundant manpower are not reflected. In the forward-looking approach only the actual (forecasted) operating costs are considered, hence the equipment is assessed at the replacement value and over-capacities are not taken into account.⁹ The costs also include a reasonable profit depending on the risk of the investment. In order to calculate the *average* incremental costs per minute, the sum of the costs considered are divided by the (actual or forecasted) traffic minutes. From an economic perspective, FL-LRAIC results in interconnection charges above short-run marginal cost (which are near zero within capacity constraints), since adequate fixed and common costs are also included. FL-LRAIC likely sends the right signal for a make-or-buy decision of operators active in the market and for potential market entry.¹⁰ If they were able to produce the service at lower costs (i.e. more efficiently), they would do it themselves, otherwise they would buy it. But those desirable properties hinge on the assumption that regulated markets are expanding.

2.1 The Benchmark Case with Excess Capacities

Since the systematic and non-temporary volume decline in fixed networks has been going on for years, the current over-capacities are not due to cyclical or seasonal patterns, nor can they be rededicated to other service provisions (such as broadband) sufficiently. Furthermore, we assert that resulting net over-capacities are not due to strategic behaviour (“pre-emption”) or miscalculations on part of the regulated firm.

Although there is a remarkable average volume decline in fixed-line telephony in many countries, one has to keep in mind that substitution patterns have to be distinguished among

⁷ See Cullen International (2007); the methodologies mandated by European regulators differ gradually with respect to cost bases and cost standards. The US variant is known as the “TELRIC” standard, where the cost basis is not the service but rather the telecommunications network elements used.

⁸ See IRG (2000).

⁹ See Evans/Guthrie (2005) for the inclusion of optimally planned excess capacity under the heading of “optimized deprival value”.

¹⁰ See, however, Sappington (2006), who shows that the make-or-buy decision can be quite independent of the level of access charges.

market segments. In general, FMS is strongest with regard to national calls. In contrast, the reduction for fixed-narrowband subscriber access has been significantly smaller than for calls.¹¹ This is due to the fact that substitution of access is related to a discrete decision (access or no access at all), whereas – for those subscribing to both networks – calls can be substituted continuously, on a minute-by-minute basis.

Given that FL-LRAIC are based on average costs and that economies of scale prevail, FMS would conceptually lead to an increase in wholesale access charges when the regulator takes into account this average volume decline. Such access charge increases based on declining volumes have already occurred in Germany and Austria.¹² The resulting feed-back mechanism would foster even further future volume decline, not least because the freedom for competitive price decreases on the retail level is typically also limited on the part of the regulated (incumbent) firm. In order to protect intra-modal competition, NRAs usually impose some kind of price-squeeze tests, according to which prices (P) must satisfy $P_{Retail} \geq P_{FL-LRAIC} + \text{retail costs and other wholesale costs}$.

Figure 1 shows the extent of allocative inefficiencies (area ABCD) when cost-based access charges ($P_{FL-LRAIC}$) are to be maintained with excess capacities ($K_0 > X_{FL-LRAIC}$). As Figure 1 indicates, there might be a positive rationing price $P_r < P_{FL-LRAIC}$ where existing capacity (K_0) is fully employed. But in fixed-networks one might also end up in a situation with capacity exceeding demand at any positive rationing price ($K_1 > Demand(P_r = 0)$). Allocative inefficiencies thus increase with the amount of excess capacity. Fierce inter-modal competition would eventually bring corresponding retail prices down to short-run marginal costs ($SRMC$), which is, as mentioned above, usually prevented by some form of ex ante regulation / margin-squeeze tests. This downward pressure on retail prices gets reinforced in view of the typically high share of sunk investments in network industries such as communications. Given the long-run market demand decline, these costs have become irrelevant on the part of fixed-network operators and in view of efficiency considerations.

In light of FMS, relying on the FL-LRAIC standard alone would induce unnecessary over-capacities and allocative inefficiencies. Furthermore, distortions towards inter-modal competition would be reinforced. To avoid such a “vicious circle” one has to look for more favorable forms of access regulation which simultaneously allow for a lowering of wholesale charges and increased pricing flexibility at the retail level.

¹¹ For an overview of empirical studies see Stumpf (2007), pp. 14-15.

¹² Final decision of the German regulator is available at: http://www.bundesnetzagentur.de/enid/BK3c-8-ss37/BK3c-8-ss37_E_56f.html. For the recent decision of the Austrian regulator see: http://www.rtr.at/de/tk/Z_9_07_100.

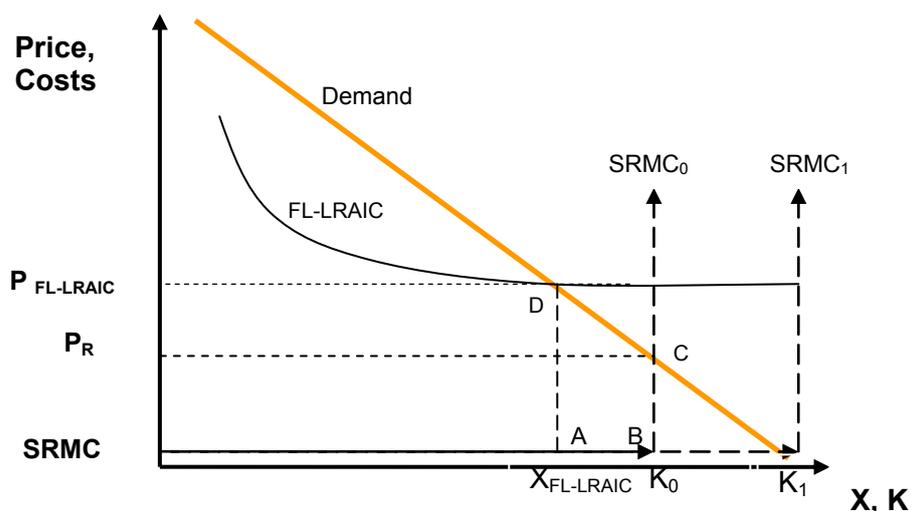


Figure 1: Welfare loss under excess capacity when access is regulated at FL-LRAIC

2.2 Practical Alternatives

Three major methodologies have been adopted for access price regulation since the liberalisation of communications markets started: Simplified versions of the Efficient Component Pricing Rule (the so-called “Retail-Minus” or “Margin-Rule”), diverse Price-Cap formulas and cost-based access charges (such as FL-LRAIC).¹³ We will start with searching within the group of available cost-based alternatives in sections 2.2.1 - 2.2.2.

2.2.1 Access charges based on short run costs

First best pricing implies that access prices are set equal to marginal access costs, which most of the time approach zero for volume-dependent communications services. Indeed, according to Figure 1 SRMC (or any positive rationing prices) would be the efficient cost standard in light of the existing excess capacities. However, such prices would hardly allow for sufficient gross margins in order to cover the incumbent’s fixed, and to a large extent, sunk outlays. This would lead to considerable losses (“stranded costs”) on the part of the regulated enterprise which might be deemed unfair, since contraction of the market was unforeseen and not due to misbehaviour of the incumbent (but rather due to the success of mobile telephony). Furthermore, long-run marginal cost standards might have been calculated (by NRAs) based on amortization periods which turned out to exceed the actual expansion period considerably. In order to minimize these losses, some mark-ups depending on demand elasticities appear to be justified, eventually leading to some SRMC+ standard. Empirically, determining the “+” according to the Ramsey principle is a practically impossible task for NRAs (see section 2.2.3). Deviation from first best pricing should rather be

¹³ See Cullen International (2008) for regulations imposed in European member states.

dependent on entrepreneurial evaluations giving flexibility in inter-modal competition and discretion to the regulated firm in recovering fixed costs.

2.2.2 Capacity-based access charges

For alternative operators, input prices constitute a substantial¹⁴ per minute cost share as they have to pay pre-determined access charges on a per-minute basis, which is also subjected to elementary peak-load pricing in most EU member states. By contrast, for the incumbent operator marginal costs are in effect negligible within capacity constraints. Capacity-based charges (CBC) present an alternative to the usual method of charging for interconnection on a per minute basis. CBC sets the price equal to the incremental cost of the capacity, which is expressed as a monthly fee for a specific amount of bandwidth.

Several arguments favour CBC. It gives the SMP-operator more flexibility in designing wholesale price structures. Taking into account the increasingly popular flat-fees on the retail level, a capacity-based price scheme on the wholesale level also gives more freedom to alternative competitors to offer customers similar price structures. A further argument in favour of CBC is that this price scheme is closer to the structure of costs of a telecommunications network. The costs do not primarily depend on the additional call minutes, but the main blocks are units of transmission and switching capacity, which are usually fixed costs. So under CBC the NRA could impose the same cost structure on the interconnection partners and thus reduce the above-mentioned cost asymmetry. In addition, CBC may be favoured in the advent of all-IP “Next Generation Networks” (NGN), where minutes of use are no longer an appropriate measure of network utilization.¹⁵

Under CBC alternative operators will have strong incentives to fully employ capacities booked in advance, which helps decelerating the overall market contraction. In the current market situation CBC would thus ensure better utilization of existing over-capacities.

Critics argue that CBC could disadvantage small operators with low volumes, since they pay for the whole capacity without filling it up. This anticompetitive effect could depend on alternative operators’ flexibility in ordering capacity. Only if there is some lumpiness i) in capacity increments and/or ii) in time commitment they would be systematically disadvantaged. Also, if wholesale reselling of capacity is allowed, potential disadvantages become negligible because operators could resell unused capacities to the small operators. Limited acceptance of CBC among NRAs is mostly due to a range of tricky implementation issues and due to the fact that CBC models are informationally demanding for the NRA. Only a few countries, like Spain and Portugal in Europe, have successfully introduced voice

¹⁴ According to regulatory experience, wholesale outlays constitute (roughly speaking) more than 50% of total costs.

¹⁵ As opposed to the traditional “Public Switched Telephone Network” (PSTN), next generation networks are based on the internet protocol (IP) and are thus packet-switched and capacity-based and will operate next to the internet.

interconnection fees on a CBC basis. In these countries capacity-based usage charging is an optional alternative to per minute pricing.

Finally, it should be mentioned that CBC is conceptually close to two-part wholesale tariffs. Just like CBC, two-part tariffs allow for more efficient capacity utilization and retail pricing flexibility than linear FL-LRAIC pricing. Facing general market decline, the variable component would mirror short-run usage costs in a better way and the fixed component would be subject to price reductions to the extent of underlying sunk costs. However, the fixed component also brings along higher average costs for smaller sized operators. Clearly, this anticompetitive effect gets intensified with decreasing market volumes. In this respect two-part wholesale tariffs are strictly dominated by CBC and are thus excluded from our further analysis.¹⁶

2.2.3 Price caps and Ramsey pricing

Under price-cap regulation, price ceilings are imposed for each product or applied to a basket of pre-defined goods. The regulated firm can retain all generated profits, provided prices are set at or below the cap. The value of the price-cap is adjusted on a periodic and short-run basis using a specific formula reflecting inflation, productivity development and various exogenous factors. Most characteristic, the traditional close matching between revenues and costs under cost-based regulation is mitigated under price-cap regulation.

Price-caps will provide some desirable characteristics in a static framework. However, dynamic convergence towards efficient Ramsey prices is much more uncertain. The idea of Ramsey access pricing is to allow the regulated firm to recover fixed and common costs in such a way that overall welfare is maximized. In doing this, NRAs would have to determine simultaneously optimal mark-ups for access and retail prices. In their construction, Ramsey prices refer to both cost and demand characteristics by which informational requirements become very high; NRAs not only have to be informed about cost conditions but they are also supposed to estimate interrelated demand (super-) elasticities. Since NRAs generally fail to calculate Ramsey prices directly, price-cap mechanisms – which delegate the pricing decision to the typically much better informed firm – have been initially developed to solve the Ramsey pricing problem.¹⁷

However, if price caps are targeted only towards specific wholesale access products, the regulated firm loses pricing flexibility in order to rebalance prices according to demand elasticities. This is, in part, why Laffont and Tirole suggest that a single (“global”) price-cap should be applied to both wholesale and retail products,¹⁸ arguing that an incumbent

¹⁶ Discriminatory two-part tariffs with the fixed fee based on capacity utilization could be both efficient and competitively neutral, but they would simply represent a variant of CBC.

¹⁷ See Vogelsang/Finsinger (1979), Brennan (1989) or Vogelsang (1989).

¹⁸ Laffont/Tirole (1996).

maximizes profits with respect to all products. Global price caps would induce Ramsey prices if weights attached in the basket construction (ex ante) were exactly proportional to realized quantities of the services involved. Here realized quantities refer to the ex post profit-maximizing prices under the price-cap constraint. But deriving optimal weights of the global price-cap basket would become tantamount to solving the Ramsey problem. Furthermore, global price caps would combine markets with highly different competition intensities (e.g. access and calls markets) which might give rise to anticompetitive strategies on the part of the regulated firm as well as inefficient entry. Therefore Laffont and Tirole recommended imposing a precautionary “imputation rule” (the ECPR, see section 2.2.4) in addition to the cap. To the extent that this rule would be binding its application will be immediately related to some form of cost floor control, which again ties prices to cost and reduces retail pricing flexibility. On top of that global price-caps would be incompatible with the European approach of market-by-market deregulation. Rather, all markets would either remain regulated or would be deregulated together (in line with the suggestion in Hellwig (2008)).

Nevertheless, we will argue below that some aspects of price-caps have desirable properties. They are the use of baskets as a tool for aggregating price options for services and the flexibility provided by the possibility to stay below the cap. The latter has been criticized for retail price-caps because it could lead to price-squeezes. That is generally not a problem, however, for wholesale price-caps (as long as they are linear and non-discriminatory).

2.2.4 Retail-minus and efficient component pricing

Whereas other pricing rules aim at choosing optimal access and retail pricing, the retail-minus (RM) rule is a partial pricing rule that takes retail pricing as given and deducts relevant retail costs.¹⁹ In particular, it is assumed that retail prices have been set by the NRA or “regulated” by competitive market conditions in the past. If downstream prices are “regulated” in either of the two ways then RM can be used to establish consistent wholesale prices. If wholesale prices are regulated on their own (cost-based) then RM can help finding consistent retail prices. On the other hand, inflated RM wholesale prices can be expected if end-user prices are excessive to begin with. Thus, RM does not solve the problem of market power at either level; all that it does is provide a tool to check for regulatory consistency and freedom from price-squeeze for the case of downstream deregulation. The assumption of efficient retail prices as the starting point of RM will be necessary for achieving allocative efficiency. In the late market and liberalisation phase this property seems increasingly valid because of the competitive pressure FMS exerts on fixed-network markets and because of established (mainly cost-based) access regulations.

¹⁹ In view of the systematic market decline „relevant“ will be again determined by the share of (retail) sunk costs.

Conceptually, RM is a simplified version of the "Efficient Component Pricing Rule" (ECPR), which in its basic form states that the access price should be equal to cost of providing access plus the incumbent's opportunity cost of access. This opportunity cost is the incumbent's lost profit (or quasi-rents) in retail markets caused by providing access.²⁰ Two attractive features are attributed to ECPR. Firstly, entrants receive correct signals downstream as they only enter if they are at least as efficient at the retail level as the incumbent firm. Secondly, since the incumbent is compensated for lost retail profits he should have no incentives to practice any discriminatory strategies. Formally, ECPR might be expressed as²¹

$$1) \quad A = b + \sigma * [P_I - (c_I + b)]$$

where the access price (A) depends on the incumbent's marginal costs of providing access (b), P_I denotes the incumbent's retail price, c_I the incumbent's marginal costs on the retail level and σ the so-called displacement ratio. σ captures multiplicatively effects of i) technological substitution, ii) retail product differentiation and iii) bypass by entrants.

The RM (or margin) rule only applies if $\sigma=1$ in formula 1), i.e., $A = P_I - c_I$. This will be the case if i) access and final outputs are related in fixed proportions, i.e. one unit of access enables entrants to offer one unit of retail service, ii) the incumbent's and entrants' retail products are homogenous and iii) entrants are price takers before and after market entry.²² Assumption i) might hold in communications given a suitable choice of units.²³ But, assumptions ii) and iii) are related to the retail level and will be fulfilled in communications (such as fixed voice telephony) only in approximate terms, if at all. Application of RM in regulatory practice will therefore be conceptually straightforward but generally imperfect.

As a partial rule, ECPR does also not coincide with optimal Ramsey prices, whenever the above conditions are not met. In that case optimal access prices might still be expressed in terms of the ECPR rule where formula 1) is amended by a Ramsey term reflecting information about demand and supply side elasticities.²⁴ In addition to this, $\sigma \neq 1$ implies that ECPR remains a version of cost-based access pricing where informational demands and analytical complexity would be augmented compared to "direct" cost-based access pricing. Naturally, this also holds for any more "sophisticated" versions of ECPR which are as hard to follow as the Ramsey pricing rule.

²⁰ See Armstrong (2002), pp. 311-312.

²¹ See Armstrong et al. (1996).

²² See Vogelsang (2003), p. 834.

²³ Technology for voice telephony might be described in such a way that producing one minute of retail telephony requires one minute of bundled wholesale services; otherwise it would be just as right to say that producing one final unit requires (typically or at least) two wholesale inputs: one minute of (local) origination and one minute of (local) termination; obviously σ – as well as associated access prices – varies according to the definition of the wholesale unit.

²⁴ See Armstrong (2002), p. 337.

Although implementation of RM access prices raises some in-built regulatory challenges, it has taken on greater significance and practical relevance in recent years.²⁵ This is in particular due to the fact that RM appealingly addresses excess capacities in that the fixed-network incumbent can lower retail (and wholesale) prices as competitive pressure from other infrastructures (most notably from mobiles) increases.

3 Evaluation of Alternatives

Based on economic decision criteria outlined in section 3.1 the subsequent analysis in sections 3.2 - 3.6 evaluates feasible alternatives²⁶ for access price regulation. In each case market expansion is contrasted with the current situation of market contraction.²⁷

3.1 Evaluation criteria

The following economic evaluation criteria are considered relevant for the pricing of intermediate inputs in case of long-term quantity reductions:

- i) Investment incentives: access prices should provide correct investment signals and, in particular, planning security for the individual market participants. The relevant investments include bottleneck investments by incumbent, bottleneck bypass or substitutes by alternative competitors and downstream investments by incumbent and alternative competitors. Long-term excess capacities call into question a general desirability of additional investment activities. The long-term decline in volume changes the rating criteria regarding investments, leading to a preference for better utilization of existing capacity and upgrading to new, expanding areas rather than to create new capacity for the old services.
- ii) Impact of pricing on intra- and inter-modal competition: With shrinking sales volumes in the fixed network the objective of promoting market entry and – in connection with FMS – the goal of promoting entry-based competition via regulation are called into question. As regards competition within the market, regulated access prices must ensure that intra-modal competitors are not subjected to market foreclosure. Therefore, wholesale regulations have to be checked for their ability to prevent margin-squeeze. This is deemed desirable as long as infrastructure-based (most notably inter-modal) competition does not guarantee

²⁵ See the ongoing discussion within the Independent Regulators Group (IRG), which published principles of implementation and best practice regarding the use of retail-minus pricing (IRG (2005)). Since then retail-minus has been applied by NRAs for diverse narrowband ("Wholesale Line Rental") and broadband ("bitstream", "naked-DSL") access products.

²⁶ In this paper deregulation is not considered as an option, since in the medium term there will be hardly a deregulation of all wholesale markets. Thus, for the regulation of single wholesale markets the question of the best alternative will remain relevant. However, regarding any future regulatory decisions one is moving more and more towards an environment in which the potential errors of regulation increase, while the potential benefits of regulation decrease. The regulatory complications associated with long-term volume reductions make – when in doubt – deregulation look more appropriate when the alternative is untried and new regulation is expensive.

²⁷ This analysis draws partly on Vogelsang (2009), pp. 125-142, which also provides additional comments and detail.

sustainable competition for all relevant markets.²⁸ Finally, NRAs have to take utmost account of making ex ante obligations technologically neutral such that they never impose nor discriminate in favour of a certain technological platform (Directive 2002/21/EC, recital 18). In light of our discussion this requirement refers to all kinds of wireline and wireless technologies which are enabling voice communications services.

iii) Promoting the interests of end users through low prices and innovation: Consumer benefits in terms of allocative efficiency of end-user prices focus on the compatibility of the competitive wholesale regulation with competitive retail markets. Were the competition problems "predatory pricing" and "price squeeze" considered under criterion ii), it is now the opposite problem of "excessive pricing" that is to be evaluated in terms of consumer benefits. According to the EU regulatory framework (Universal Service Directive, Art. 17 § 1 lit. b) wholesale regulation should be considered first in addressing retail and wholesale competition problems. Only in case wholesale regulation is shown to be insufficient to cure competition problems at the retail level remedial measures are justified on retail markets. Concerning this matter regulation has to be appropriate and least burdensome with regard to the respective competition problem and the remedy imposed.

iv) Practical implementability: This criterion takes account of information requirements, transaction costs incurred and legal requirements. All the relevant forms of regulation we consider here, in principle, meet the requirement of practical implementability. The relevance of criterion iv) therefore refers to the forward-looking differences in implementation costs (compared to FL-LRAIC) and to the legal clarity.

3.2 SRMC and SRMC+

i) Whereas FL-LRAIC send reliable investment signals under expansion, SRMC do not. SRMC tend to fluctuate between zero and infinity (or the price that rations demand) due to demand fluctuations and lumpy capacity expansion. SRMC are therefore not a very reliable investment signal, something that is well-known from electricity generation. In contrast, under long-term contraction wholesale prices based on SRMC become an adequate signal for alternative competitors not to invest in bypass or substitutes (cable, unbundling activities and mobile networks) inefficiently. On the retail level, however, SRMC can lead to down-stream investments that are not necessarily appropriate. Because of the then available retail mark-

²⁸ If FMS is sufficiently established with respect to all relevant retail segments, then any kind of remaining ex ante regulation is ultimately called into question (apart from termination issues). It may, however, be that the customer shift from fixed to mobile is not associated with a higher demand elasticity observed in the fixed market, but only in a leftward shift in the demand for fixed-line subscription, and a corresponding right shift of the demand for mobile. This would for instance occur if the fixed-network customers were moving because they prefer mobility so much that marginal price changes have no influence. In this case, the fixed-line incumbent could pursue a limit-pricing strategy (or cash cow strategy) and may even want to increase its prices if, for example, he is left only with customers unwilling to switch. Therefore, alongside the discussion of optimal access regulation market-specific inferences about FMS and the actual state of inter-modal competition appear to be cornerstones on which future regulatory judgements should be based.

ups provided by low-price wholesale purchases under SRMC, inefficient operators could also remain in the market.

ii) SRMC will likely give rise to non-price discrimination strategies ("raising rivals' costs," "sabotage") and thereby to an indirect margin-squeeze irrespective of the overall market trend. This would particularly hold at a price of SRMC without markup.²⁹ As regards inter-modal competition, SRMC will increase the asymmetry between fixed-mobile interconnection (termination) rates in both directions even further, which – ceteris paribus – gives rise to an increase in FMS.

iii) Wholesale prices based on SRMC (and a glide path leading to them) are at least as compatible with end-user pricing as wholesale charges on the basis of FL-LRAIC. Also, SRMC generally leads to static efficiency and to compatibility with the retail level. Again, these characteristics basically hold true under expansion and under contraction.

iv) While the SRMC approach will, under expansion, lead to prices that on average are likely to be not too different from FL-LRAIC, SRMC under excess capacity is likely to be close to zero. In view of the temporal conversion to a new scheme and in view of the reputation and credibility of the regulator or its past decisions an implementation via an optional approach or a glide path is to be considered. In addition, markups on SRMC are likely to be necessary (leading to SRMC+) to make the incumbent whole. However, legal ambiguities in the actual implementation would especially result under a glide path (as regards arbitrariness in scheduling) as well as for the determination of mark-ups involved in SRMC+.

In conclusion, whereas SRMC might induce inefficient downstream investments they would allow for efficient wholesale investment signals under contraction but are generally deemed unfair since the incumbent operator could not cover any of its fixed and sunk outlays. Furthermore, SRMC (or any positive rationing prices) would also be highly detrimental in view of future investment activities related to the envisaged roll-out of all-IP based networks. The shortcomings of SRMC could in principle be cured by an adequate markup (SRMC+). However, as the mark-up is likely to be significant, there is also a high potential of regulatory misjudgment and arbitrariness under incomplete information.

3.3 FL-LRAIC

i) Since economies of scale are captured in the averaging of the FL-LRAIC approach and since in the practical application common cost markups are added, the investment incentives of the incumbent are duly taken into account under expansion. This does not usually include risks of real options, though.³⁰ However, regarding predictability FL-LRAIC offers the greatest

²⁹ Mandy (2000) works this point out nicely.

³⁰ FL-LRAIC typically do not consider incumbent's risks associated with bypass or demand reductions.

certainty. The other competitors will in expanding markets under correct measurement of FL-LRAIC not only invest efficiently in the downstream market, but especially in bypass. This has long been evident in core networks, while in access networks bottlenecks still exist and new ones are added for Next Generation Access (NGA).³¹ Also, the high level of investment in mobile networks has been encouraged through the use of the FL-LRAIC for fixed networks and especially as a basis for termination fees in both directions.

Apart from necessary maintenance investments, investment incentives are not an issue under long-term contraction. As regards the future prospect of migration to all-IP-based networks, FL-LRAIC would send wrong pricing signals with respect to PSTN elements which could be rededicated in the course of network migration.

ii) Purchasing access at FL-LRAIC the other competitors should be able to compete in the downstream markets, especially after price squeezes have been eliminated by regulatory intervention. Regarding the effect of the use of FL-LRAIC for wholesale access on the inter-modal competition is likely that the resulting lack of price flexibility has especially disadvantaged the fixed networks compared to the (at the retail level) unregulated cellular network. This lack of flexibility manifests itself particularly in the regulation of minimum retail prices of the incumbent. Problems of competitive distortions show up for flat-rates or option prices downstream, whenever FL-LRAIC is applied on a per minute basis.

Under contraction FL-LRAIC (without an accompanying combination with end-user or other wholesale regulation) will even more likely lead to a price squeeze. Such cases signal the desire of the incumbent to lower end-user prices. Thus, FL-LRAIC would only be competitively neutral in relation to the retail level if a price squeeze could be prevented by regulation. However, the competitors' access purchases help alleviating the problem of overcapacity in a similar way as the incumbent does by lowering prices for end-users. The wholesale charges should therefore be lowered along with the retail price.

The European Commission suggests basing termination charges on a narrow view of increments leading to what they call "pure LRIC" in order to determine interconnection charges that as the end result would be significantly lower than FL-LRAIC and come to lie near SRMC.³² The Commission justified this specific application for termination services, arguing that i) termination involves call externalities and that ii) because of the mutuality of termination each network can be asked to pay its own overhead and other common costs.

³¹ Whereas the term NGN is typically related to core networks, NGA relates to next generation infrastructure in the access network. Given this distinction, the term "all-IP based networks" then encompasses both variants.

³² European Commission (2008b).

Obviously this argument does not apply to origination services so that "pure LRIC" would appear problematic outside the termination context.³³

iii) FL-LRAIC are reasonable average prices, but usually over-estimate marginal costs relevant for static efficiency in the origination and termination markets. Most of the time, this difference is quite significant, while at peak times and in sparsely populated areas, an underestimation can usually be expected. Obviously, over-estimation and corresponding allocative inefficiencies get much more pronounced under contraction (Figure 1).

iv) Calculation of FL-LRAIC is relatively costly and time consuming. The almost inevitably resulting simplifications lead to distortion and measurement errors, which themselves are difficult to estimate. However, such information and valuation problems under FL-LRAIC, can be considered largely as sunk after about a decade of proven regulatory practice. Also, FL-LRAIC due to their conceptual simplicity and their obvious fairness, are relatively easy to implement politically. This is particularly true because it is a clear and methodologically unified approach that in most jurisdictions has already been sanctioned by the courts. This is a great advantage in individual cases, which can point to the acceptance provided by precedents. A change in the interconnection regime can therefore only be justified by systematic superior benefits compared to the existing FL-LRAIC benchmark.

To conclude, FL-LRAIC have by and large been a successful and well-established basis of price regulation under expansion. This applies particularly to wholesale markets, while FL-LRAIC in expanding end-user markets can be reasonably viewed as a floor for some segments and as a ceiling for others for the pricing of the incumbents. However, FL-LRAIC-based wholesale prices may handicap the fixed-network providers in competing with mobile or internet-based substitutes. Under excess capacity FL-LRAIC will likely increase due to the increased weight of fixed costs, resulting in inappropriately high wholesale charges.³⁴ Market contraction will reinforce concerns that competitors are squeezed out without accompanying retail obligations. At the same time, systematic market decline might even induce the incumbent to increase prices for certain (less price elastic) consumer groups ("limit pricing"). FL-LRAIC thus clearly proves to be inferior as regards criteria i) - iii) under market contraction.

³³ In analogy to "pure LRIC" one could also argue for a general shift for all termination services in fixed and mobile networks based on "Bill & Keep" with uniform wholesale prices equal to zero (~ SRMC). However, (a) actually relevant cost differences between network types may better be captured in "pure LRIC", (b) according to many experts Bill & Keep carries the risk of free riding by operators with little added value, and (c) also seen by many experts is the danger of SPIT (= SPAM over the internet) and SPAM under Bill & Keep. It follows that a balancing decision needs to be made between Bill & Keep and the "pure LRIC" concept. A decisive factor could be that the transition from FL-LRAIC to Bill & Keep would be so radical that in practice an intermediate stage would result that might look like "pure LRIC".

³⁴ Price-caps with FL-LRAIC as the maximum wholesale price may induce the incumbent to reduce wholesale prices but that alone would not solve the price-squeeze problem.

3.4 Retail minus

i) Under RM uncertainty regarding the height of interconnection charges could provide disincentives for investments by alternative long-distance carriers. RM may, however, lead to high (perhaps excessive) investment incentives downstream. The incumbent could, under this variant, most likely finance investment upstream. As we mentioned above, investment incentives are basically not an issue under contraction.

ii) RM can lead to effective downstream competition and solves – by construction – margin-squeeze problems. RM has experienced a surge through the transition from maximum to minimum price regulation in the retail sector and the increasing importance of price-squeeze regulation under market contraction. However, given the large number of retail tariffs a price-squeeze for an individual service cannot be ruled out when RM is based on average retail prices.

As regards inter-modal competition, RM appealingly addresses excess capacities in that the fixed-network incumbent and alternative operators can lower retail prices effectively and in response to the dynamics of competition. In respect thereof, distorting regulatory asymmetries will get eliminated to a large extent, in compliance with the principle of technological neutrality.

iii) If the wholesale service represents a true bottleneck the incumbent, under RM and without further end-user regulation, can still increase end-user prices and therefore exploit consumers irrespective of the prevailing market state. They will at most only be lower than without regulation to the extent that downstream costs are lowered through competition. Under RM efficiency and compatibility with the retail level would be reached only if the starting price were at a sufficiently cost-based level at the time of regulatory transition and if non-linear end-user prices could be converted into wholesale prices via adequate baskets. In an inter-temporal setting it is not ensured, though, that excessive prices can be prevented without accompanying retail control through regulation or market competition.

iv) For RM information problems relate to the determination of the amount to be subtracted as "minus", as well as to the continuous necessity to update the data for determining the "minus". But, because of experience with past price-squeeze/margin-squeeze cases and/or imposed RM obligations some pre-knowledge should be available for (most) NRAs. Apart from this, implementation issues relate to typically comprehensive retail price differentiation patterns and the resulting difficulties in appropriate basket design. If the RM calculation is based on a retail price basket, retail price discrimination e.g. between residential and non-residential customers or on-net and off-net calls cannot be implemented on the wholesale level or could lead to competitive distortions. Likewise, RM might not be feasible simultaneously for incoming (termination) and outgoing (origination) traffic. Basically, the

problem of allocation of wholesale and retail markets for termination services can be solved by deducting the "minus" from the on-net prices only.

To conclude, RM is not sufficiently effective under expansion because of danger of excessive end-user prices. However, the price-squeeze problem will be largely eliminated. The appeal of RM increases for the case of excess capacity, because the danger of price-squeeze is much greater here. At the same time RM offers necessary downward pricing flexibility in inter-modal competition by delegating discretion to the (regulated) firm and as a result facilitates much better capacity utilization for all fixed-network operators under contraction. However, the danger of excessive end-user prices may persist for some consumer segments. Thus RM alone remains an incomplete option for access regulation and with respect to the potential competition problems at the retail level, even under contraction.

With respect to practical implementability diverse additional transaction costs from moving to an RM approach exist, but they should be limited by the fact that similar techniques are currently used for determining price-squeeze cases by most NRAs.

3.5 Combination of FL-LRAIC and Retail minus

The combination of FL-LRAIC and RM means interconnection charges of the form $p = \min\{FL-LRAIC, RM\}$. Under expansion the most likely option chosen will be FL-LRAIC. In those cases the FL-LRAIC evaluation for expansion discussed above in Section 3.3 will apply. However, there will exist potential price-squeeze cases that under the option would be eliminated by exercising the RM option. As a consequence, under RM in combination with FL-LRAIC the regulation of retail markets could generally be repealed.

Under contraction the most likely option chosen will be RM. In those cases the RM evaluation for reduction discussed above in Section 3.4 will apply. However, there will exist potential excessive pricing cases that under the option would be eliminated by exercising the FL-LRAIC option. Under contraction RM with FL-LRAIC as a maximum wholesale price (serving as a price-cap) will lead to end-user price reductions compared to pure FL-LRAIC, but will not go as far as SRMC. Any anti-competitive potential for cross subsidization should be prevented depending on relevant markets and segments. The regulatory ability to project such issues from the retail level to the wholesale level is always limited, though.³⁵

Although – compared to the status quo – it will be associated with some additional transactions costs and enlarged practical implementation problems, “RM as an option with FL-LRAIC” appears to be clearly the best alternative irrespective of the overall market trend. RM guarantees in principle – provided that implementation aspects can be resolved – that a margin squeeze against alternative competitors cannot happen. RM in combination with FL-

³⁵ Vogelsang (2003), p. 844.

LRAIC as a ceiling/price-cap, such that $p = \min \{FL-LRAIC, RM\}$, can successfully prevent excessive segment-specific price level abuse. The combination of RM with FL-LRAIC therefore protects competition against both types of abuse. The comparative advantages of such optional approaches in principle also apply to growing markets. This property would save regulators from having to determine if excess capacities are temporary or persistent. Admittedly, the competitive advantages of the optional approach come out more clearly in significantly and systematically shrinking markets. In particular, the attractiveness of RM has increased with the change in regulatory focus from a maximum to a minimum price regulation. Both inter-modal and intra-modal competition have substantially reduced the problem of excessive prices in many parts. Also, RM in combination with FL-LRAIC would be the preferred way of ex ante regulation since it could, in principle, lead to full retail deregulation.

3.6 CBC as an additional feature

By experience, CBC as a fully established stand-alone obligation would hardly be implementable by NRAs, CBC, as an option based on RM or FL-LRAIC, is regarded as a complementary measure in this section.

i) To the extent that CBC allows for higher capacity utilization than under FL-LRAIC, it should provide more efficient investment incentives in general. But yet it is unlikely that low marginal costs under CBC will lead to inefficient capacity expansions under contraction.

ii) The usual benefit of optional approaches applies to combinations with CBC insofar as hereby cost asymmetries and price-setting asymmetries are eliminated and thus the competitiveness of intra-modal competitors is restored even without the backing of accompanying retail regulation. CBC could be combined with FL-LRAIC or with RM under the formula $\min \{CBC (RM), FL-LRAIC\}$ or $\min \{CBC (FL LRAIC), FL-LRAIC\}$.³⁶ The regulatory link between wholesale and retail prices created under CBC(RM) would substantially reduce the vertical cost asymmetries between incumbent operators and competitors, thus preventing predatory or exclusionary pricing strategies. Inter-modal competitiveness will in the long term only be achievable with CBC on a cost basis significantly below FL-LRAIC. As regards wholesale reselling activities, NRAs also have to consider the potential impact on fixed-mobile interconnection asymmetries, which might be enlarged if mobile termination can not be excluded successfully from the CBC arrangement.

iii) By eliminating cost asymmetries and by being compatible with flat-rate end-user charges CBC generally allows for more efficient retail prices as compared with FL-LRAIC. In shrinking

³⁶ As indicated in section 2.2.2, CBC differs with respect to the unit of access charges (capacity instead of minutes) where CBC itself can be calculated on a cost- or price-orientated basis. Under the combination formulas both billing regimes (CBC (capacity) and FL-LRAIC (minutes)) would exist in parallel.

markets CBC will lead to more efficient network utilization even if it is based on FL-LRAIC as well as to still more efficient end-user prices.

iv) Additional combinations – especially with CBC – can also lead to greater implementation problems, though. First to mention are the specific transaction costs associated with the conversion to a new payment system. Given that CBC is not just about a new billing system a number of additional technical specifications will have to be taken care of.³⁷ Furthermore, the complexity of CBC increases with the hierarchy level in the network, as the required capacity is less identifiable in advance, the higher the hierarchy level. This complexity of CBC suggests moving to a less accurate but simpler capacity-based regime given the other advantages of a capacity-based approach. This will be facilitated by the fact that interconnection services at a higher network level quite likely have already been largely deregulated in a late phase of liberalization. Thus, “only” interconnection services at the local level (local origination, local scheduling) will remain the subject of possible CBC.

Flat-rates for RM are problematic insofar as they apply on a per-customer basis and therefore the corresponding wholesale tariffs per customer would have to be based on information about the number of customers of a carrier, but this information is generally not available to the incumbent. This could be a reason to implement RM for flat-rates on the basis of CBC.

To conclude, CBC appears advantageous on efficiency grounds as well as with regard to its impact on inter- and intra-modal competition in both market states.

But, since the implementation costs for CBC are probably going to be substantial, this would lead to delay and uncertainty associated with the introduction of such a regulatory requirement. Therefore, we consider CBC only as a potential feature of the preferred FL-LRAIC-RM combination outlined above. However, in view of packet-switched (capacity-based) all-IP networks CBC will probably regain regulatory relevance as against (minute-based) FL-LRAIC which were designed for the traditional circuit-switched PSTN.

Finally, particularly in view of the termination problem, a cross-platform solution – with CBC being potentially part of it – should be contemplated. An isolated lowering of the fixed termination rates would help fixed-network utilization for fixed-to-fixed calls. By increasing the asymmetry between the termination rates for mobile and fixed-network operators, however, this would, *ceteris paribus*, increase the extent of FMS and thus lower the fixed-network utilization further.

³⁷ See, for example, the Austrian NRAs consultation document on this subject („Flexibilisierung der Festnetz-Vorleistungsregulierung“ available at: <http://www.rtr.at/de/komp/bisherigeKonsultationen>).

4 Conclusions

The increasingly observable excess capacity in the fixed-networks has in recent years led to a general questioning of established long-standing pricing standards for wholesale services. As our analysis has shown the sustained decline in overall volumes fully justifies departing from established FL-LRAIC standards that have been applied to local loop unbundling and interconnection services since the beginning of liberalization. Sub-optimality of FL-LRAIC gets reemphasized in view of the migration to all-IP based networks in the mid-term. A short-run competition perspective clearly alludes to the need for increased price flexibility. If these competitive forces lead the incumbent to set end-user prices below imputed regulated limits (based on FL-LRAIC), the efficiency benefits of RM over FL-LRAIC particularly come to bear. RM in combination with FL-LRAIC or CBC, as well as FL-LRAIC in combination with CBC, provide the best alternatives available. RM as an option with FL-LRAIC is particularly appealing since it eliminates the drawbacks of the respective stand-alone obligations and thus both forms of potential market abuse in case of expansion and contraction. Hence, implementing this option successfully at the wholesale level would eliminate the need to regulate retail markets. Admittedly, such a regime change at the wholesale level requires some conceptual and implementation work on the part of regulators, as we have illustrated at several points. The steadily increasing attractiveness of these regulatory alternatives as a result of the general market development, however, is likely to lead to a reappraisal of anticipated implementation problems, and so will also lead to greater regulatory acceptance. Moreover, the attractiveness of these options lies precisely in the fact that they provide for a broader regulatory framework to deal with the switch and habituation problems. The combination of RM and FL-LRAIC seems to be most realistic, because it is relatively simple and internationally partly tested already.

Appendix: Regulatory Background

The EU regulatory framework for electronic communications markets³⁸ requires NRAs to periodically analyse the state of competition on a certain number of markets and impose appropriate ex ante remedies in case that an operator is found to have significant market power (SMP).³⁹ To promote harmonization among Member States, the European Commission publishes a list of markets which have to be considered by each NRA, the "Recommendation on Relevant Markets".⁴⁰ This Recommendation originally included the following fixed-network voice telephony markets, which are the issue of this article (the number of the market corresponds to the number in the initial Recommendation):

Retail level:

1. Access to the public telephone network at a fixed location for residential customers.
2. Access to the public telephone network at a fixed location for non-residential customers.
3. Publicly available local and/or national telephone services provided at a fixed location for residential customers.
4. Publicly available international telephone services provided at a fixed location for residential customers.
5. Publicly available local and/or national telephone services provided at a fixed location for non-residential customers.
6. Publicly available international telephone services provided at a fixed location for non-residential customers.

Wholesale level:

7. Call origination on the public telephone network provided at a fixed location.
8. Call termination on individual public telephone networks provided at a fixed location.
9. Transit services in the fixed public telephone network.

The Recommendation from 2007 does not include markets 3-6 anymore and markets 1 and 2 have been merged to a single market. While all NRAs found SMP on the retail access markets (markets 1 and 2) and on the wholesale markets for origination and termination, a majority also found SMP on some or all of the calls markets (markets 3-6). In many cases,

³⁸ See Directives 2002/19/EC, 2002/20/EC, 2002/21/EC and 2002/22/EC, OJ L108, 24.4.2002.

³⁹ The concept of SMP is based on the concept of dominance in general competition law (see European Commission (2002)).

⁴⁰ See European Commission (2003) for the "old" recommendation and European Commission (2007) for the "new" recommendation; it is possible to deviate from the respective Recommendation, however, the European Commission has a veto right with regards to decisions on market definition and SMP designation.

therefore, not only the access to wholesale services, but also the prices of the incumbent's retail services have been regulated up to now. The main forms of access which rapidly stimulated competition on retail markets for calls were carrier selection and carrier pre-selection: The alternative operator can buy origination, termination, and possibly transit services from the incumbent at regulated prices and only needs minimal infrastructure investments to offer calls services at the retail market.

Bibliography

- Armstrong, M. (2002), „The Theory of Access Pricing and Interconnection“, in: Cave, M., S. Majumdar and I. Vogelsang, Handbook of Telecommunications Economics, Elsevier Science, 295-384.
- Armstrong, M., Doyle, C., Vickers, J. (1996), “The access pricing problem: A synthesis”, in: Journal of Industrial Economics, Vol. 44, 131-150.
- Brennan, T. (1989), “Regulating by Capping Prices”, in: Journal of Regulatory Economics, Vol. 1, 133-147.
- Briglauer, W., Götz, G., Schwarz, A. (2008a), “Do we (still) need to regulate fixed network retail markets?”, Working Paper, Vienna/Gießen, available at: <http://wiwi.uni-giessen.de/dl/det/goetz/17406/do-we-still-need-to-regulate-fixed-network-retail-markets/>.
- Briglauer, W., Götz, G., Schwarz, A. (2008b), “Margin-Squeeze in Fixed-Network Telephony Markets – competitive or anticompetitive?”, Working Paper, Vienna/Gießen, available at: <http://wiwi.uni-giessen.de/dl/det/goetz/17408/margin-squeeze-in-fixed-network-telephony-markets--competitive-or-anticompetitive/>.
- Calzada, J. (2007), “Capacity-based versus time-based access charges in telecommunications”, in: Journal of Regulatory Economics, Vol. 32, 153-172.
- Cullen International (2007), “Cross Country Analysis – Cost accounting systems for fixed wholesale services”, available at: <http://www.cullen-international.com/documents/cullen/>.
- Cullen International (2008), “EU-Level – Market analysis database”, November, available at: <http://www.cullen-international.com/documents/cullen/prindex.cfm>.
- European Commission (2002), “Guidelines on market analysis and the assessment of significant market power”, 2002/C 165/03, “SMP-Guidelines”, Brussels.
- European Commission (2003), “Recommendation of 11 February 2003 on relevant product and service markets within the electronic communications sector susceptible to ex-ante regulation in accordance with Directive 2002/21/EC of the European Parliament

- and of the Council on a common regulatory framework for electronic communications networks and services, OJ 8.5.2003 L 114/45”, Brussels.
- European Commission (2007), “Draft Commission Recommendation On Relevant Product and Service Markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communication networks and services”, second edition, Brussels.
- European Commission (2008a), “Progress Report on the Single European Electronic Communications Market 2007 (13h report)”, COM(2008) 153, Brussels.
- European Commission (2008b), “Draft Commission Recommendation of [...] on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU”, C(2008), Brussels.
- European Commission (2009), “Progress Report on the Single European Electronic Communications Market 2008 (14h report)”, COM(2008) 153, Brussels.
- Evans, L. T., Guthrie, G.A. (2005), “Risk price regulation, and irreversible investment”, in: International Journal of Industrial Organization, Vol. 23, pp. 109-128.
- Goncalves, R. (2007), “Cost orientation and xDSL services: Retail-minus vs. LRAIC”, in: Telecommunications Policy, Vol. 31, 524-529.
- Hellwig, M. (2008), “Competition Policy and Sector-Specific Regulation for Network Industries”, MPI Collective Goods Preprint, No. 2008/29, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1275285.
- IRG – Independent Regulators Group (2000), “Principles of implementation and best practice regarding FL-LRIC cost modelling”, available at: http://irgis.icp.pt/site/en/areas_doc.asp?id=277.
- IRG – Independent Regulators Group (2005), “Principles of implementation and best practice regarding the application of Retail Minus pricing methodologies”, available at: http://irgis.icp.pt/site/en/areas_doc.asp?id=277.
- Kennet, M.D., Ralph, E.K. (2007), “Efficient Interconnection Charges and Capacity-Based Pricing”, in: International Economics and Economics Policy, Vol. 4, 135-158.
- Kruse, J. (2007), „10 Jahre Telekommunikations-Liberalisierung in Österreich“, in: RTR-Series, Vol. 2, Vienna, available at: <http://www.rtr.at/de/komp/SchriftenreiheNr22007>.
- Laffont, J.J., Tirole, J. (1996), “Creating competition through interconnection: Theory and practice”, in: Journal of Regulatory Economics, Vol. 10, 227-256.
- Laffont, J.J., Tirole, J. (2000), “Competition in Telecommunications”, Cambridge, MA: MIT Press.

- Mandy, D. M. (2000), "Killing the Goose That May Have Laid the Golden Egg: Only the Data Know Whether Sabotage Pays", in: *Journal of Regulatory Economics* Vol. 17, pp. 157-172.
- OECD – (2009), "Communications Outlook 2009", available at: http://www.oecd.org/document/44/0,3343,en_2649_34225_43435308_1_1_1_1,00.html.
- Sappington, D.E. (2006), "Regulation in Vertically-Related Industries: Myths, Facts, and Policy", in: *Review of Industrial Organization*, Vol. 28, 3-16.
- Schäfer, R., Schöbel, A. (2006), "Incumbents und ihre Preisstrategien im Telefondienst – ein internationaler Vergleich", in: WIK-Discussion paper, No. 275, Bad Honnef.
- Stumpf, U. (2007), "Regulatory approach to Fixed-Mobile Substitution, Bundling and Integration", in: WIK-Discussion paper, No. 290, Bad Honnef.
- Vogelsang, I. (1989), "Price-Cap Regulation of Telecommunications Services: A Long-Run Approach", in M.A. Crew (ed.), *Deregulation and Diversification of Utilities*, Boston: Kluwer Academic Publishers, 21-42.
- Vogelsang, I. (2003), "Price Regulation of Access to Telecommunications Networks", in: *Journal of Economic Literature*, Vol. XLI, 830-862.
- Vogelsang, I. (2009), "Regulierungsoptionen bei Leerkapazitäten auf Vorleistungs- und Endkundenmärkten des Festnetzes", in: RTR-Series, Vol. 1, Vienna, available at: <http://www.rtr.at/de/komp/SchriftenreiheNr12009>.
- Vogelsang, I., Finsinger, J. (1979), "A Regulatory Adjustment Process for Optimal Pricing by Multiproduct Monopoly Firms", in: *Bell Journal of Economics*, Vol. 10, 157-171.