Competition in the Fixed Telecommunication Market Segment: Challenges and Theories

Ben Dkhil, Inès

Laboratory of Management of Innovation and Durable development (LAMIDED) Faculty of Management and Economic Sciences of Sousse, University of Sousse, Tunisia

22 December 2014

Competition in the Fixed Telecommunication Market Segment: Challenges and Theories

***Inès Ben Dkhil*[1]**

Laboratory of Management of Innovation and Durable development (LAMIDED)

Faculty of Management and Economic Sciences of Sousse,

University of Sousse, Tunisia

December 22, 2014

ABSTRACT

The persistence of the market power in the fixed telecommunication markets in both developed and developing economies is due to the technical and economic features of this industry. This paper provides an overview of these characteristics and changes. It also suggests a comparative critical survey of the access pricing theories that are "the key" to the transition to the competition in the fixed telecommunication segment. Through this overview, we aim to underline among that the central role that the regulation should play to ensure the establishment of sustainable competition in the fixed telecommunication markets.

KEYWORDS

Essential facilities, bottleneck, local loop, network externalities, economies of scale and scope, sunk costs, the marginal rule, the margin rule, the Ramsey pricing, the Price Caps policy.

[1] Corresponding author: e-mails: bendkhilines@yahoo.fr , bendkhilines@gmail.com, tel: +216 22 848 556 & +216 53 556 643; Address: "B.P. 307 - Cité Erriadh - 4023 /Sousse/Tunisie".

1 Introduction

« ***The antitrust doctrine (…) should be more interested in protecting consumers (…) than in protecting competitors (…), or to put it differently, that competition is often a means to enhance consumer welfare, but in no way an end.*** »

By the Nobel Laureate 2014, Jean Tirole :
« The Analysis of Tying Cases: A Primer »,
Competition Policy International,
Vol.1, No.1, Spring 2005, p.2.

Until the late 1980s, the telecom industry structure in most countries around the world was an integrated state public monopoly. Over this period, there is a common belief across economists and governments that competition is not convenient for telecommunication markets. Technical characteristics and economic properties of the telecom activities were the main arguments usually advanced to justify the negative position toward competition. It was argued that telecom activities have natural monopoly properties given the high costs of infrastructures and service provision, and thereby, the monopoly structure leads to more efficiencies than competition markets. Furthermore, for a long time, the telecom service remains a luxury good, especially for users with lower willingness to pay (WTP) and in the area or market segments where the provision of the telecom services is more costly (e.g., rural area, local telephony segment) compared to others (e.g., urban area, international telephony segment). The public monopoly provider is thereby argued to be the best organization which is able to reach the policy objective of serving all users, segments and areas at lower prices (Universal Service Provision). Deficit resulting from the obligation of universal service provision is, indeed, covered through cross-subsidies between different categories of services and users provided by a single public firm (Kerf and Geradin 1999; Oldale and Padilla 2004).

The rapid progress in technologies of the digitalization by the begining of 1990s results in radical change in the cost structure of telecom activities. In particular, the costs of end-users services provision are dramatically reduced. Traditional telecom services such as telegraph, telephone and Internet access, as well as the new services, including e-mails and video are available for a large part of population at lower prices. However, the establishment of installations and equipments and the construction of the fixed network lines (local loop), which serve as essential facilities (input) to provide end-user services, are still expensive and; thereby, preserve their natural monopoly features (Kerf and Geradin 1999; Cowhey and Klimenko 2001).

This transformation in the cost structure has modified substantially the traditional conception of telecom activities organization that highlights the benefits of public monopoly. Competition is at least sustainable in telecom market segments where the end-users benefit from lower prices and greater quality choices provided by different rivals. Furthermore, private companies are proved to be much better than public ones in term of efficiencies (Kerf and Geradin 1999). Therefore, in a large number of countries, the historical public monopoly (the incumbent) is partially or wholly privatized and is facing rivals in the end-user service telecom markets but, it still maintains its traditional position as monopoly in infrastructures. The rivals are, indeed, permitted to access to the incumbent's infrastructures against an access price in order to provide their services to end-users. This last form of organization of telecom activities has the advantage to avoid the waste of the resources in the segments that maintain their natural monopoly characteristics (infrastructures) and to benefit from the advantage of competition (lower prices, welfare gains) in segments where technology progress has permitted the provision of large varieties of end-users services at lower costs. However, this industry structure does not guarantee sustainable competition. The historical integrated monopoly, the exclusive provider of infrastructures, has indeed both the ability and the motivation to discriminate its rivals by setting high access price in order to preserve its historical profits of monopoly. Earlier theoretical literature provides extensive developments in this last concern. The essential of the debate seeks to determine the optimal access pricing solution that permits to ensure simultaneously two controversial policy objectives: (1) financing the infrastructure construction costs incurred by the incumbent (2) ensuring the benefits of competition (lower end-user prices, maximizing consumer welfare). In this line, Laffont and Tirole (1996) note that "the *determination of interconnection charges is the key to the introduction of competition in*

telecommunications"[2]. A large part of practical access pricing solutions suggested in the regulatory frameworks are inspired from these theoretical models. Regulatory practices including access pricing policies and others have a great role in introducing and promoting sustainable competition, by controlling the incumbent's abuse of market power in order to protect consumers and rivals.

This paper proposes to provide an overview of the technological and economic challenges and changes, as well as the theories that are the key to the transition to competition telecommunication markets. In particular, the rest of this chapter is organized as follows. In section 2, we give a description of the technological and economic characteristics and mutations in the telecommunication industry; and then we explore their implications in order to understand the difficulties that regulators actually face to control the market power of the dominant historical operator and thereby establish sustainable competition. In section 3, we review the theoretical foundations of access pricing regulatory approaches as the key to the creation of competition telecommunication markets. In section 4, we conclude.

2. The technical and economic characteristics of the telecommunication industry

The telecommunication industry has a number of characteristics that explain broadly the difficulty to introduce and ensure effective competition in these markets. First, the provision of end-user services requires to connect to network infrastructures (the local loop) which is costly to duplicate by entrants, and thereby, constitute a crucial source of market power for the historical integrated monopoly (the incumbent). Second, the telecom activities are characterized by their natural monopoly features: (1) the importance of the role of the network externalities that characterize the demand side (2) the importance of economies of scale and scope that characterize the supply side (Laffont and Tirole 2000).

2.1 The Telecommunication Technologies: key components and main changes

In this paragraph, we give a presentation of the key elements of the infrastructure network technologies and the main technology mutations in order to understand the polemic role of regulation, especially after the introduction of the competition, based on the technical Local Loop overview in Rysavy (1998), Laffont and Tirole (2000), Fornefeld, Delaunay and Elixmann (2008), Silver (2008) and Ödling et al. (2009).

Telecom network infrastructures are composed of the following three main parts:

- The Outside Plant (OP): it includes the various kinds of transmission technologies such as cables (buried and aerial), manholes, poles, terminals and equipment installed in the subscribers' locals (called Customer-premises equipment or customer-provided equipment (CPE))[3].
- The central office (CO): a construction where different equipment (switches, routers, etc.) are installed and used to connect to the CPE and to other central offices.
- Inter-Office Facilities (IOF) which consists in various equipment and cables that lay the different central offices.

Transmission technologies (or conductors) can be wireline (fixed) (e.g., pairs of copper lines, fiber optics, etc.) or wireless (mobile) (e.g., satellite, etc.)[4]. They permit the transport of signals from the terminal of customer (the CPE) to the Central Office or other remote equipment and vice versa. These signals are treated and transformed into information data (voice, video, etc.) by using different devices (switches, routers, etc.).

The traditional transmission technologies (copper telephone lines), also called Public Switched Telephone Network (PSTN), are characterized by their limited capacities[5]. They permit to provide the

[2] Laffont, J.-J., and Tirole, J. (1996):" Creating Competition Through Interconnection: Theory and Practice", *Journal of Regulatory Economic* 10, p. 227.

.

[3] The CPE consists on the terminal or equipment such as telephones, routers, switches, modems and others used to connect customer. See for further details Wikipedia available at: http://en.wikipedia.org/wiki/Customer-premises_equipment.

[4] In this thesis, we only interest in fixed infrastructure technologies.

[5] Capacity is the maximum amounts of data transferred along the network infrastructures. It is measured using as

early end-user services (e.g., telephone, telegraph and fax) and later Internet access services via dial up modems at low speeds (lower than 64kbit/s). The dial up modem has the inconvenience that it does not permit to transmit data and voice at the same time. Figure 1 gives a presentation of these traditional infrastructure technologies.

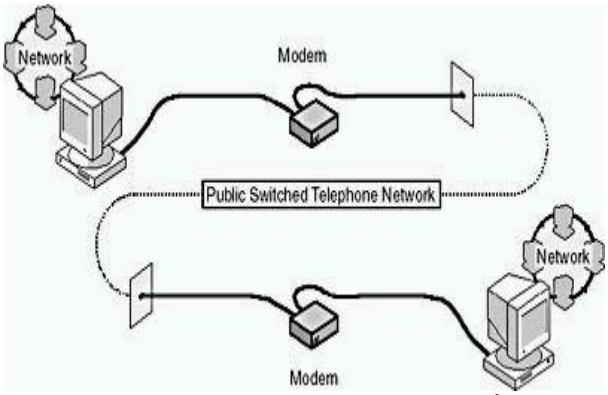

Figure 1: The traditional Infrastructure Networks[6]

The introduction of the new techniques of data compression, the various Digital Subscriber Line technologies (ADSL, HDSL, VDSL, etc.)[7], have considerably ameliorated the capacities of the copper lines by generating digital signals instead of analog signals and provided to operators more flexibility to offer new services (e.g., video) in addition to the traditional retail services (e.g., voice). Digital Subscriber Lines technologies provide speeds of connection that reach 100 Mb/s. In the begining of 1990s, more advanced infrastructure technologies of transmission emerged. These are the fiber optics lines (e.g., fiber-to-the building (FTTB), fiber-to-the-curb (FTTC)). Fiber lines are made from pure glass that permits light transmission for long distances. They provide very high capacities which permit the operators to offer large diversities of end- user services at a relatively low marginal cost and at speeds that can reach 1 Gb/s. Digital subscriber lines via traditional copper telephone lines as well as fiber optic lines refer to the so-called fixed broadband infrastructure technologies, because they provide high capacities of data transmissions that allow very high speeds of connection (that exceed 2Mbit/s). In figure 2, we give a presentation of these new telecom network infrastructures.

units of measures: the bits per second or multiples of it (bit/s, kbit/s, Mbit/s, Gbit/s, etc.).

[6] Source: http://pnb.mixxt.com/networks/files/download.144216

[7] See Ödling et al. (2009) for further details about these technologies.

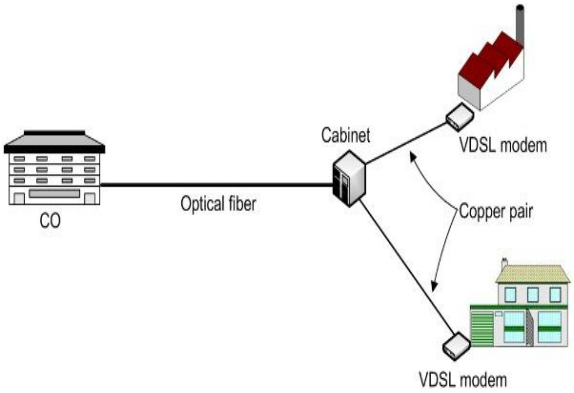

Figure 2: The current telecom network infrastructures: a representation[8]

The fixed costs (initial or one-time costs) of fiber lines are very high compared to those of copper lines. Therefore, in most countries, after the introduction of competition, the historical integrated monopolies (incumbent operators) do not replace their traditional networks (copper local loop lines) by these new advanced technologies (fiber-optic local loops[9]). Entrants are preferred to access to a part (mixed entry) or wholly (resale entry) to the existent traditional network of the incumbent against an access price (services-based entry), in order to provide their end-user services rather than building their own network infrastructures facilities (facilities-based entry)[10]. The traditional telephone networks called the Local loop, defined as the last part of the network from the incumbent's last switch to the CPE

[8] This presents an example of architecture of actual network infrastructures which are composed on a myriad of several technologies (fiber and copper lines with DSL technologies). Source: <http://www.intechopen.com/books/programmable-logic-controller/new-applications-using-plcs-in-access-networks>.

[9] Few countries use fiber optics lines. These technologies are installed in long-distance segments (Laffont and Tirole 2000).

[10] Laffont and Tirole (2000) define three forms of entry in telecom industry:

(1) Facilities-based entry: the entrant has its own network facilities and not need to access to existent infrastructure owned by the incumbent.

(2) Resale: the entrant leases the entire network infrastructure from the incumbent at access price to provide its retail services.

(3) Mixed entry: the entrant leases a part of existent facilities and builds others. The best known example is entry using digital subscriber line technologies.

The two later forms of entry (resale and mixed entry) are the most available in most countries in the globe while the first form of entry (facility-based entry) is rarely adopted given the high costs of these infrastructures.

(see figure 2), is qualified as essential facilities or bottleneck (Mason and Valletti 2001), because it is costly to duplicate by entrants and it is a necessary component to provide end-users services.

2. The economies of the telecommunication industry

Network externalities and cost structures that lead to economies of scale and scope are not unique to network industries (e.g. telecommunications, transportation, railroad, water, energy and others). They also characterize certain non-network industries. In general, these economic rules concern most vertically related industries where products delivered to end-users are composite goods (Economides 1996).

Complementarity between services is a law in the telecom industry. For example, sending an e-mail needs access to Internet through subscribing Internet connection from the Internet Service Provider ISP that in turn should purchases access to standard telephone lines from incumbent. The importance of network externalities and economies of scale and scope in telecommunication activities influences industry structures and decisions of subscriptions, pricing and investment in qualities of services made by different actors (consumers, regulators, governments and providers) in network markets. In this paragraph, we intend to present these main economic rules and their implications, in particular, in term of industry structures and regulation.

2.1 The cost structures

The telecom network activities are characterized by cost structures that reveal the properties of the *natural monopoly*[11]. The formal definition of "the Natural Monopoly" is given by Baumol (1977): The natural monopoly is an "*industry in which multiform production is more costly than production by a monopoly*"[12]. In other words, the natural monopoly is the case of an industry where the production by a single firm is more efficient than the production by several firms. Baumol (1977, p. 810) also provides a mathematical justification for the concept of the natural monopoly, which consists in the notion of sub-additively of the cost production function that is formally given by the following formula:

$C(\sum_i^n y_i) < \sum_i^n C(y_i)$ for a given vector of output levels y_i, $i = 1..n$, where n is the number of products.

The first term of the formula represents the monopoly's production costs of *n* products. The second term refers to the sum of production costs incurred by *n* distinct firms, each firm *i* produces the output *i*.

The fixed costs uncured to build the telecom infrastructure installations are significant and often irrecoverable (*sunk costs*), while the marginal costs of provision of end user services (e.g., making a call) are relatively very low. This cost structure leads to *economies of scale and scope*. The economies of scale imply that the average costs of production are decreasing on quantity of outputs (final services provided). The *economies of scope* occur when *productive efficiency* (lowest production costs) is ensured by conferring all products a single firm (a monopoly).

2.2 The network externalities

The telecom services generate positive and/or negative *network externalities* (also known as *network effects*), which means that the satisfaction (utility) that a subscriber derives from purchasing a service is respectively affected positively and/or negatively by the number of people using it in an associated network (Margolis and Liebowitz 1994). The telephone service is more valuable for a subscriber if there are more network users that can communicate with him. Similarly, each subscriber of Internet connection enjoys benefits to be able to share services with other users (communication,

[8] It is important to understand the difference between the concepts of "Monopoly" and "Natural Monopoly" before beginning. According to Gans (2012, p.2), "*A monopoly describes a situation where all (or most) sales in an industry or market are undertaken by a single firm. A natural monopoly is a characteristic of an industry or market whereby it is most efficient (that is, involves the lowest production costs), to have a single firm responsible for all production in that industry. Consequently, the condition for a natural monopoly is a technological characteristic of an industry or market rather than a description of its observed market structure. Monopolies can exist in industries that are not natural monopolies and monopolies may not arise in industries that are natural monopolies.*"

[12] Baumol, W. (1977): "On the Proper Cost Tests for Natnral Monopoly in a Multiproduct Industry", *American Economic Review* 67, p. 810.

chatting, sending and receiving emails, files, video and others, connecting to social networks such as Facebook, etc.). The higher the number of the Internet users is, the higher the satisfaction of the subscriber from the Internet connection is. Therefore, the telephone service and the Internet connection generate positive consumption externalities. However, if the number of users exceeds a certain level that the technical capacities of the network permit, the quality of the Internet connection perceived by the subscriber may deteriorate (e.g., Packet loss of data, blocking web pages) and; thereby, the satisfaction of the Internet user decreases. This last effect represents an example of the negative network externalities.

Katz and Shapiro (1985) distinguish two types of positive consumption externalities: the *direct externalities* that occur when the utility of a given subscriber increases with the number of other users and the *indirect externalities* that arise when the quality and the variety of services increase with the number of subscribers. These two types of externalities combined together lead to *double externality effect* that implies that the value of a network increases with the number of the people that have joined it (suppliers and subscribers): the benefits of a service provider increases with sales (or the number of subscribers) and the utility of a customer increases with the number of services provided (or number of providers) (Penard 2002). According to *Metcalfe's law*, the value of a network is equal or close to square of the number of its users (Mason and Valletti 2001).

2.3 The economic characteristics and the persistence of the market power in the fixed telecommunication markets

The importance of both network externalities and economies of scale and scope justify the dominance of structure of *monopoly* as industry organization in the past over countries in the world and the difficulties that policy makers actually face to ensure effective competition in whole telecom markets (see, Mason and Valletti 2001; Boylaud and Giuseppe 2001; Penard 2002).

Two arguments are often advanced against opening telecom markets to competition. The first one is the *Schumpeter's hypothesis*. It is usually argued that the larger firms, in particular a monopoly, profit better from *economies of scale and scope* than the smaller firms[13] and; therefore, they are more able to reach allocative efficiency (the maximum total welfare of the industry) because they have the largest production and market shares, which implies more resources to innovate (see Valleti 2003) . Sharing sales revenue between several service telecom providers raises problems of financing these significant and irrecoverable fixed costs of establishment of network infrastructures facilities.

The second argument is that the economies of scale and scope combined with network externalities create *a positive feedback mechanism* that can be summarized as follows: a new service generates initially low positive consumption externalities. Once the demand for this service increases, its price decreases because of economies of scale. Therefore, demand increases (the law of demand). This mechanism repeats to infinity. According to Shapiro and Varian (1998), the great challenge for a provider, after introducing a new network service, is to reach the "critical mass" (i.e. sufficient numbers of clients) and then, the demand for this service will increase dramatically in presence of positive externalities and economies of scale and scope[14]. It is obvious that this mechanism works in favor of firm already has the largest market share and the lowest average costs of production (the historical integrated monopoly) in detriment of entrants that face to important entry costs of infrastructure building and smaller market shares. Shapiro and Varian (1998) note that "*Positive feedback is the dynamic process by which the Strong gets stronger*", Chapter 7, p. 224.

The economic characteristics of telecommunication industry (network externalities and economies of scale and scope) explain broadly the difficulties to ensure effective competition. In particular, number of regulatory concerns has risen. The main question is the access problem of entrants to existent network facilities owned by the historical integrated monopoly (the incumbent). In the next paragraph, we give a review of the different responses of the theory to this access problem.

---

[13] See Henderson and Cockburn (1996), p.33.

[14] Shapiro and Varian (1998, p. 14) note that *"Network effects lead to of scale and positive feedback. The key challenge is to obtain critical mass—after that, the going gets easier. Once you have a large enough customer base the market will build itself. "*.

3. The access pricing approaches: the theoretical foundations

The determination of reasonable access price to incumbent's facilities is a central question to introduce and then ensure sustainable competition. Indeed, a low access price increases consumer welfare, and promotes competition; but it raises the question of recovery of infrastructure fixed costs incurred by incumbent and problem of efficient entry (*one-way access problem*) (Armstrong 2002).

In general, the one way access problem arises in vertically integrated industries, where there are essential inputs provided by a monopoly to entrants to can offer their end-user services. This is, in general, the case of all fixed segments in telecom industry in most countries in the world, where entrants need to access to whole or a part of the incumbent's local loop in order to provide their final services[15] (e.g., Internet connection, long distance telephone service, etc.). Various problems may result from such situation, where the price of this vital access service plays the major role. A too high access price may deter or even avoid entry (foreclosure), while a relatively low access price may lead to inefficient entry (Valleti 2003).

The theoretical access pricing approaches suggest different solutions that correspond to different situations and various regulatory objectives and settings (e.g., promoting competition, encouraging efficient entry, covering the incumbent's fixed costs, etc.). Excellent and extensive reviews of this literature are given by Valleti and Estache (1998), Laffont and Tirole (2000), Armstrong (2002), Valleti (2003) and Vogelsang, (2003). In the rest of this paragraph, we give the key results of these benchmark access pricing theories and main associated critiques.

3.1 The marginal pricing rule

The marginal pricing rule corresponds to the first best solution. It suggests pricing the access service to marginal cost of its provision. This requires that there are no types of imperfections (distortions) in the markets. This solution is derived in a particular setting when the monopolist bottleneck owner is vertically integrated. It operates in wholesale markets by providing a vital input (access service) to its rivals in the retail markets. The provision of one unit of retail service is assumed requiring exactly one unit of access service. The marginal costs of production of both retail and access services are constants and the retail services are perfect substitutes (homogenous goods). Further, it is assumed that the fixed costs (due to join and common costs of establishment of network infrastructures and others costs related to universal service obligations) are too low or financed by any other instruments outside the markets (e.g., government subsidies). The first-Best theory say that if all these hypothesizes are satisfied, the access price should be equal to marginal cost of the provision of the access service and the retail price should be equal to the sum of the access price and the marginal cost of the provision of the retail service. These solutions correspond to efficient prices that maximize the total surplus of the industry that is assumed to be computed as the sum of the consumer surplus and the profits of all providers.

3.2 The Ramsey pricing Rule

In practice, the fixed costs uncured by the bottleneck provider are too high. In the absence of any state transfers (subsidies, etc.) to cover these fixed costs, the application of the first-best marginal rule pricing leads to important losses (access deficit) for the bottleneck owner. The Ramsey rule which corresponds to the second best solution suggests overcoming this problem of fixed costs recovery by maximizing the total welfare of the industry under the incumbent's break-even constraint (total costs and revenue of the incumbent are equal - i.e. there are neither deficits nor benefits). This yields to *the average pricing rule*, which consists to price the access service at the marginal cost of its provision majored by a mark-up equal to the ratio of fixed costs to the total demand for retail services.

However, the marginal rule is based on strong assumption that retail services are valued equally by end users. In the reality, consumers' valuations differ even if the qualities of retail services are identical. *The Ramsey Rule second best solution*[16]

[15] The literature distinguishes the case of one-way access (access problem) from the two-way access (interconnection problem) in vertically industries where all providers need to purchase essential inputs (access to rival network) "from each other" to offer their final services (see e.g., Armstrong 2002). This later situation is generally the case of operators in mobile segments. In our study, we interest only on the access problem.

[16] The Ramsey Access Pricing rule is suggested by Laffont and Tirole (1993) and Laffont and Tirole (1994). It is an extension of the original formula derived by

suggests taking into account these demand characteristics by majoring the marginal cost of the access provision by a Ramsey term. This latter accounts for the demand changes due to a unit retail price variation (price elasticity of demand) and substitution and complementarity among services provided in wholesale and retail markets (see equation 2).

$$a_{Ramsey\_rule} = c + \underbrace{\frac{\lambda}{1+\lambda}\frac{p_r}{\hat{\eta}_r}}_{\text{The Ramsey term}} \quad (1)$$

Where:

c refers to the marginal costs of production of the access service

λ is the shadow price that balances the incumbent's budget constraint

$\mathbf{p_r}$ is the price of the retail service provided by the incumbent's rival

$\hat{\boldsymbol{\eta}}_{\mathbf{r}}$ is the price "super-elasticity" of demand for the retail service provided by the incumbent's rival

The formula, given by equation (1), refers to the *Ramsey access pricing rule.*

Retail prices can be obtained by applying the following Ramsey formulas[17] which are inversely proportional to their corresponding super-elasticities:

$$\frac{p_{inc}-c_{inc}-c}{p_{inc}} = \frac{\lambda}{1+\lambda}\frac{1}{\hat{\eta}_{inc}} \quad (2)$$

$$\frac{p_r-c_r-c}{p_r} = \frac{\lambda}{1+\lambda}\frac{1}{\hat{\eta}_r} \quad (3)$$

Where:

$\mathbf{p_{inc}}$ is the price of the retail service provided by the incumbent

$\hat{\boldsymbol{\eta}}_{\mathbf{inc}}$ is the price "super-elasticity" of demand for the retail service provided by the incumbent

Ramsey approach is therefore a *global optimal pricing rule* since it suggests determining simultaneously the optimal prices of all services in both retail and wholesale segments of the industry. Following the Ramsey formulas, the incumbent's access deficit (fixed costs) is financed by the contribution of end-users that depend on their corresponding price super-elasticities of demand for retail services. Customers that are more sensitive to price variation participate less in financing these fixed costs. The intuition behind the Ramsey approach that the total costs of the industry will be covered by aggregating the prices of all services. In other words, the revenue (over the marginal costs) generating from the more inelastic services compensates the losses that are due to pricing elastic service under their marginal costs. The access deficit (the incumbent's fixed costs) is then covered without reducing the consumer surplus[18].

From theoretical perspective, Ramsey approach seems to give a complete answer to the access pricing problem by considering both allocative and productive efficiency objectives. The total consumer surplus is maximized. Further, the incumbent has no incentive to foreclosure the markets since it covers its costs. At the same time, only the efficient entry is encouraged since the prices reflect the true costs. From practical perspective, the Ramsey solution is difficult to be implemented although it reflects the complexity of the reality that characterizes costs and demand in the industry. Regulators cannot obtain sufficient information about costs and demand given the rapid technology changes in telecom industries. It is also argued that there are technical difficulties to determine the price elasticities of demand. Beside the important informational problem that the Ramsey rule presents, this approach is broadly criticized because it leads to the discrimination problems among both users and rivals in retail segments by requiring pricing rule based on the elasticities.

Laffont and Tirole (1996) acknowledge the practice complexity, and the informational and technical problems of the Ramsey pricing rule. As a regulatory remedy, they propose the Global Price Caps policy, which consists in inducing the regulated firm (the monopolist bottleneck owner) to voluntary choose the Ramsey pricing solutions through imposing price ceilings for all goods (both access and retail services) with correspondent weights that should be proportional to actual quantities of outputs and determined exogenously

---

Ramsey (1927) and Boiteux (1956) to determine prices of final goods provided by a multiproduct unregulated monopoly (Laffont and Tirole 1996).

[17] In addition to these formulas (2) and (3) , Laffont and Tirole (1994) obtain at equilibrium another formula by assuming that the access service is another final good , that is given by: $\frac{p-c}{p}\frac{\lambda}{1+\lambda}\frac{1}{\hat{\eta}}$, *where the superelasticity for the access service is*: $\hat{\eta} = \eta$

The problem of maximization of the total welfare of the industry under the incumbent's break-even constraint is therefore reduced to the model suggested by Ramsey (1927) and Boiteux (1956) to determine prices of final goods provided by a multiproduct unregulated monopoly. Formula given by equation (1) is immediately obtained from (3) (see Laffont and Tirole 1996).

[18] The demand is still unchanged by considering these super-elasticities.

by the regulator[19]. As pointed out by these authors, this Global price cap remedy has some limitations in practice. First, in order to achieve Ramsey pricing through this Global price cap policy, regulators must be able to compute correct weights based on actual quantities of outputs. This requires precise information about actual demand for goods. Second, there is the risk of predation problem, which occurs when incumbent sets appropriate access price but too low retail price (below the marginal costs) (or appropriate retail prices but too high access price) so as the global price cap is achieved. This may deteriorate the competitor's margin and therefore discourage competition.

3.3 The Baumol-Willig Efficient Component-Pricing Rule (ECPR)

This access pricing approach is proposed by Willig (1979) and Baumol (1983) and then elaborated in Baumol and Sidak (1994)[20]. The ECPR states pricing the essential intermediate service (the access to the bottleneck) at the direct (per-unit incremental / marginal) cost[21] of its provision majored by the incumbent's opportunity costs. This latter corresponds to the loss of the incumbent's retail sales which is due to the provision of access to entrants.[22] The ECPR suppose that the following three assumptions hold. First, the markets are perfectly contestable (absence of externalities, no barriers to enter, no sunk costs). Second, the integrated monopolist bottleneck owner (the incumbent) and its rivals (entrants) in the retail segment provide perfect substitute services at a given incumbent's retail price p_{inc} assumed to be determined optimally outside the model. Third, the sole way for an entrant to obtain the essential input is to buy it from the incumbent ("no bypass possibilities"). In the particular case where the provision of one unit of retail service requires exactly one unit of access service, the *ECPR Access pricing rule* is given by the following formula[23]:

$$a_{ECPR} = \underbrace{\mathbf{c}}_{} + \underbrace{(\mathbf{p_{inc}} - \mathbf{c} - \mathbf{c_{inc}})} \qquad (4)$$

$\mathbf{c}$: The direct marginal cost of providing access

$\underbrace{(\mathbf{p_{inc}} - \mathbf{c} - \mathbf{c_{inc}})}$: The bottleneck owner's opportunity costs (by a unit of access provided)

The ECPR formula can be re-written as the price minus the marginal cost of the retail service provided by incumbent. This may be immediately deduced from (4) as follows:

$$a = \underbrace{\mathbf{p} - \mathbf{c_{inc}}} \qquad (5)$$

The incumbent's margin in the retail market (by unit of output)

The ECPR is also called *the margin rule* because it states that the *margin available to entrant* $(P - a)$ before deducing its retail costs c_r , is equal to the incumbent's marginal costs c_{inc} in the retail segment. Therefore, the ECPR access price gives correct information about the market profitability to firms aiming at entering the market. Entry decision depends on the possibility of earning a positive margin $\underbrace{\mathbf{P} - \mathbf{a}}_{\mathbf{c_{inc}}} - c_r \geq 0$. In particular, only firm that is more efficient than the incumbent $(c_r \leq c_{inc})$ can enter. The ECPR therefore ensures that the provision of the complementary good (final service) in the competitive segment cannot be made by an entrant less efficient than the integrated bottleneck owner.

The ECPR formula (5) is also known as the *Access Pricing Parity –Principle Rule.* Indeed, as advocated by Baumol, Ordover and Willig (1997), it comes from "obvious" equity logic based on the efficiency principle. The price charged by entrant p_r should be equal to the marginal cost incurred to provide its retail service ($a + c_r$). This means that $p_r = a + c_r$ (A) .At the same time, under the assumptions that the incumbent and entrant provide perfect

[19] The formula of this Global price cap $\bar{p}$ is the following $wa + w_{inc}p_{inc} + w_r p_r \leq \bar{p}$ $/w = \bar{q}$, $w_{inc} = \bar{q}_{inc}$ and $w_r = \bar{q}_r$ where w, w_{inc} *and* w_r correspond respectively to weights of the access service, the retail services provided by incumbent and its rival, and a, p_{inc} *and* p_r are respectively the prices of the access service, the retail services provided by incumbent and its rival while $\bar{q}$, $\bar{q}_{inc}$ and $\bar{q}_r$ *are* respectively the expected quantities of the access service, the retail services provided by incumbent and its rival.

[20] See Armstrong (2002).

[21] The term "direct cost" corresponds to all costs incurred by the bottleneck owner to provide access service that are not included in the opportunity costs. The incremental cost is the increase in total costs of the firm when it provides additional unit of output (increment) while the marginal cost is the rise in their total costs due to small increase in its outputs. In particular, if the increment is small the marginal cost is equal to the incremental cost (Baumol and Sidak 1994).

[22] See Baumol and Sidak (1994); Baumol, Ordover, and Willig (1997); Armstrong, Doyle, and Vickers (1996) and Armstrong (2002).

[23] When the provision of one unit of the retail service requires any portion α of the access service, the ECPR rule is generalized as follows: $a = c + \alpha(p_{inc} - c - c_{inc})$ (Armstrong 2002).

substitute final services and that the incumbent pay the same charge a to purchase the bottleneck input from itself, we must have $p_r - c_r = p_{inc} - c_{inc} \xrightarrow{yields} p_2 = p_{inc} - c_{inc} + c_r$ (B). Therefore (5) is obtained from combining (A) and (B). The *Access Pricing Parity –Principle Rule* simply says that the bottleneck owner prices the input for itself at the same price that charges for its competitors.

From practical perspective, the ECPR appears a simple cost-based approach. It is simply the difference between the incumbent's retail price assumed optimally fixed and the retail marginal cost. This explains broadly its popularities in practice compared to Ramsey rule that requires greater volume of information about costs and elasticities of demand. In October 1994, the New Zealand Appeal Court considers the ECPR as the best appropriate access pricing rule to promote efficient competition in telecom markets (Laffont and Tirole 1996). This pricing rule is also suggested in other telecom legislations under the name "retail minus" (e.g., in mobile sector in United Kingdom) (Valleti and Estache 1998).

From theoretical perspectives, economists show some reservations about the ECPR role in promoting effective competition under more realistic market circumstances. Economides and Lawrence (1995) point out that the ECPR violates the allocative efficiency principle and it only focuses on the productive efficiency goal. Precisely, these authors say that this approach protects monopoly rents and extracts consumer surplus since it does not require any rules on the incumbent's retail price determination. In the absence of any additional regulatory instruments such as final price controls, the bottleneck owner may charge monopolist's price for the retail service, which exceeds broadly the marginal cost of its provision. In this case, consumers do not benefit from competition since the incumbent continue to benefit from supernormal rents even in the presence of competitors. In line with these critiques, Laffont and Tirole (1996) and Armstrong, Doyle and Vickers (1996) underline this ECPR limit and consider that this pricing rule is *a partial rule* because it does not objectively specify how retail prices are fixed (it just assumes that incumbent sets optimally its retail prices). Laffont and Tirole (1996) note that in related markets, an optimal access pricing rule should be a part of "an overall regulatory scheme" that takes into account both demand and supply aspects and integers policies and tools that also permit to ensure optimality of final prices (oriented to marginal costs) . They also show that the ECPR is in fact a special ideal case of the Ramsey approach. In particular, when demand and costs of the incumbent and its rivals in the competitive segment have symmetric properties (same cost structures and demand functions), the Ramsey rule yields the ECPR[24]. However, under the case of asymmetric demand or costs (presence of switching costs, incumbent's technological superiority, etc.), the ECPR is inefficient. Armstrong, Doyle and Vickers (1996) also criticize the non-realistic assumptions of the ECPR approach and propose important extensions. Considering a setting of complete information and assuming that the incumbent's retail price is given, they show that the ECPR is closely related to the Ramsey approach. Under the ECPR assumptions, the Ramsey formula coincides exactly with the margin rule. However, when many ECPR assumptions are relaxed including the retail market contestability, the no bypass possibilities and homogenous retail services hypothesis, the optimal access price can be defined as the incumbent's marginal cost of the retail service plus a term that consists on a *more relevant definition* of the ECPR opportunity costs[25] majored by a Ramsey term based on normal (not super) price elasticities of demand.

To summarize, the ECPR appears an efficient practical solution in the absence of retail price distortions and market imperfections. The Ramsey approach is strong theoretically and convenient under several market circumstances but it is complex in practice. Further, basing tariffs only on costs raises concern of access deficit recovery and may lead to inefficient entry. Price cap solution covers access deficit of incumbent. But, it presents some limitations in practice, and it may also encourage the anti-competitive behavior (predation problem). In sum, there is no ideal solution. Nevertheless, basing on these access pricing approaches, regulatory frameworks have leaded to more practical solutions.

---

[24] Under the assumption on "fully symmetric" demand and cost functions, $\hat{\eta}_{inc} = \eta_r$. By replacing this last in (2) and (3), we obtain $p_{inc} - c_{inc} - c = \overbrace{p_r - c_r}^{a} - c \xrightarrow{yields} a = p_{inc} - c_{inc}\ (ECPR)$. (see Laffont and Tirole (1995), p. 242).

[25] These authors suggest a new notion of the ECPR opportunity costs that is the reduction of the incumbent's profits due to provide a ***marginal unit*** **of access** to rivals.

4. Concluding remarks

In this paper, we have provided a survey of the technical and economic characteristics of the telecommunication industry, and a comparative critical analysis of the main access pricing approaches that are served as benchmarks to build the regulatory frameworks after opening the telecom markets to competition.

The economies of scale and scope combined with the network externalities explain broadly the dominance of the monopoly structure in telecom industry in the past. After the introduction of competition, the technology mutations do not remove the large costs of network deployment and therefore the historical integrated monopoly (the incumbent) is still in most countries the sole owner of the infrastructure facilities that constitute essential input to provide end-users services. Entrants are permitted access to these infrastructures at regulated terms because access negotiations between entrant and incumbent usually do not permit to reach successful agreement. This explains why the regulation must have an important role even after the introduction of competition.

A central part of these access negotiations concern the price of access to the essential infrastructures. Facts show that the incumbent usually sets high access price (relatively to the cost of the access service provision) in order to protect its profits of monopoly and thereby extract consumer surplus. The role of the regulator consists to prevent this anti-competitive behavior. Nevertheless, setting low access price may lead to incumbent's access deficit and inefficient entry.

The earlier theoretical contributions suggest different access pricing solutions that provide excellent benchmarks for regulators but present important limitations. The first best theoretical outcome, also called the marginal rule (cost-based pricing) which in practice leads to pure LRIC or FDC regulatory methods, rises problem of incumbent's fixed cost recovery. Theoretically, the second best solution (the Ramsey rule) is considered the strongest because it leads to optimal retail and access prices that satisfy both the objective of allocative efficiency by covering incumbent's access deficit and the objective of productive efficiency by maximizing consumer welfare. However, the Ramsey rule has the limitation to be complex to implement in practice because it requires great information about costs and demand. The alternative practical solution to Ramsey prices, the global price cap (i.e. price ceilings for both access and final services), does not present a complete remedy to this informational problem. The global price cap raises other concerns such as the predation problem. The simplicity of Baumol-Willig margin rule, also known as the Efficient Component –Pricing rule (ECPR), that consists in pricing the access service as the difference between the incumbent' retail price and the marginal cost of the provision of the retail service is practical (it is applied under the name "retail minus"). However, the ECPR violates the allocative efficiency principle since there is a risk that the incumbent charges monopoly retail prices and extracts the consumer surplus and thereby remove the benefits of competition.

In practice, in addition to access price regulation, policy makers use other instruments to control the abuse of the market power of the incumbent firm. These instruments consist in the unbundling (different technical modalities of access to incumbent's facilities) and separation policies (structural or behavioral organization of the incumbent's firm)[26].

Recent literature on one-way access extends the debates on issues of access regulation after introduction of competition and focuses on more realistic settings. Further, this literature is also interested in impacts of unbundling and separation policies in addition to effects of access pricing policies.

[26] For a recent review of the regulatory practices in the fixed telecom sector see BEN DKHIL (2014 a). For further understanding of these reforms, their classification and impacts on the broadband infrastructure deployment and innovation see Ben Dkhil (2014 b).

REFERENCES

Armstrong, M. (2002). “The theory of access pricing and interconnection”. In M. Cave, S. Majumdar, and I. Vogelsang, *Handbook of Telecommunications Economics*. Amsterdam, *Elsevier*, 295-384.

Armstrong, M., Doyle, C., and Vickers, J. (1996). “The access pricing problem: a synthesis”. *The Journal of Industrial Economics XLIV* (2), 131-150.

Baumol, W. (1977). “On the proper cost tests for natnral monopoly in a multiproduct industry”. *American Economic Review* 67(5), 809-822.

Baumol, W., and Sidak, J. (1994). “The pricing of inputs sold to competitors”. *Yale Journal on Regulation* 11(2), 171-202.

Baumol, W., Ordover, J., and Willig, R. (1997). “Parity pricing and its critics: necessary conditions for efficiency in provision of bottleneck services to competitors”. *Yale Journal on Regulation* 14 (1), 145-164.

Baumol. (1983). “Some subtle issues in railroad regulation”. *International Journal of Transport Regulation* 10 (1-2), 341-355.

Ben Dkhil, I. (2014 a): “Computing an overall Index for regulatory reforms required in the fixed telecommunication segment over the world”, International Journal of Innovation and Scientific Research, ISSN 2351-8014 Vol. 13 No. 2 Feb. 2015, pp. 414-431, © 2015 Innovative Space of Scientific Research Journals

Ben Dkhil, I. (2014 b). “Investment in Fixed Broadband Networks and Access Regulation in Developed and Developing Countries: Panel Data Applications”, presented in « Coopération régionale, transformations structurelles et insertion internationale des pays d'Afrique du Nord », 01 Novembre 2014, Hammamet/ Tunisia. This paper is also accepted to be presented at « 16th International Symposium on Econometrics, Operations Research and Statistics (ISEOS 2015), Edirne-Turkey, May 7-12, 2015 ». Available at SSRN: <http://ssrn.com/abstract=2511514> or <http://dx.doi.org/10.2139/ssrn.2511514> and at the Munich Personal RePEc Archive (MPRA) : <http://mpra.ub.uni-muenchen.de/59337/>.

Boiteux, M. (1956). “Sur la gestion des monopoles publics astreints à l'équilibre Budgétaire”. *Econometrica* 24(1), 22-40.

Boylaud , O., and Nicolleti , N. (2001). “Regulation, market structure and performance in telecommunications”. *OECD Economic Studies* N°32, 99-142. Available at:< http://www.oecd.org/eco/outlook/2736298.pdf>.

Cowhey , P., and Klimenko, M. (2001). “The XTO agreement and telecommunication policy reforms”. University of California in San Diego, Graduate School of International Relations and Pacific Studies, 1-67. Available at:< http://siteresources.worldbank.org/INTRANETTRADE/Resources/Cowhey_Klimenko1.pdf>.

Economides, N. (1996). “The economics of networks”. *International Journal of Industrial Organization*, 673-699.

Economides, N., and Lawrence, J. (1995). “Access and interconnection pricing: how efficient is the "Efficient Component Pricing Rule"”. *Anttrust Bulletin* XL (3), 557-579.

Fornefeld, M., Delaunay, G., and Elixmann, D. (2008). “The impact of broadband on growth and productivity”. *European Commission*. Available at: < http://www8.gsb.columbia.edu/citi/sites/citi/files/Panel%203.Martin%20Fornefeld%20paper.pdf>.

Gans, J. (2012). “Natural Monopoly”. *The Palgrave Encyclopedia of Strategic Management*, 1-6. Available at: <http://research.joshuagans.com/files/2012/10/Natural-Monopoly1.pdf>.

Henderson, R., and Cockburn, I. (1996). “Scale, scope, and spillovers: the determinants of research productivity in drug discover”. *The RAND Journal of Economics* 27(1), 32-59. Available at: < https://faculty.fuqua.duke.edu/~charlesw/s591/Bocconi-Duke/Papers/C10/HendersonCockburnRAND.pdf>.

Katz, M., and Shapiro, C. (1985). “Network Externalities, Competition and Compatibilities”. *The American Economic Review* 75 (3), 424-440.

Kerf, M., and Geradin, D. (1999). “Controlling market power in telecommunications: antitrust vs. sectorspecific regulation - an assessment of the United States, New Zealand and Australian experiences”. *Berkeley Technology Law Journal* 14(3), 921-1020. Available at: < http://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=1254&context=btlj>.

Laffont, J. -J., and Tirole, J. (1994). “Access pricing and competition”. *European Economic Review* 38, 1673-1710.

Laffont, J. J., Tirole, J. (2000). “Competition in Telecommunications”. Cambridge, *MIT Press*.

Laffont, J.-J., and Tirole, J. (1996). “Creating competition through interconnection: theory and practice”. *Journal of Regulatory Economic 10*, 227-256.

Margolis, S. E., and Liebowitz, S. (1994). “Network Externality: An Uncommon Tragedy”. *The Journal of Economic Perspectives* 8 (2), 133-150.

Martha, G. -M. (2005). “International broadband deployment: the impact of unbundling”. *Communications and Strategies*, 83-104.

Mason, R., and Valletti, T. (2001). “Competition in communication networks: pricing and regulation”. *Oxford Review of Economic Policy*, 389-415.

Oldale, A., and Padilla, J. (2004). “Form the state monopoly to the "investment ladder": competition policy and the NRF”. In “*The pros and Cons of Antitrist in Deregulated Markets”*, *Swedish Competition Authority series,* 51-77. Available at: < http://www.konkurrensverket.se/upload/Filer/Trycksaker/Rapporter/Pros&Cons/rap_pros_and_cons_Deregulated_markets.pdf>.

Ödling, P., Magesache, T., Höst, S., Börjesson, P., O., Berg, M., and Areizaga, E. (2009). “The fourth generation broadband concept”. *IEEE Communications Magazine*. Available at: < http://www1.ericsson.com/res/thecompany/docs/journal_conference_papers/broadband_and_transport/the_fourth_generation_broadband_concept.pdf>.

Penard, T. (2002). “Stratégies et concurrence dans la Net-Economie”. In M., Basle, and T., Penard, *eEurope : la société européenne de l'information en 2010*, 13-50. Economica. Available at : < http://perso.univ-rennes1.fr/thierry.penard/biblio/europe1.pdf>.

Ramsey, F. (1927). “A contribution to the theory of taxation”. *Economic Journal* 37 (145), 47-61.

Rysavy, P. (1998). “Wireless Broadband and Other Fixed-Wireless Systems”. *Network Design Manual*, Available at:< http://www.rysavy.com/Articles/1998_Wireless_Broadband_Other_Fixed.pdf>.

Shapiro, C., and Varian, H. (1998). “Information rules: a strategic guide to the network economy”. USA, Harvard Business School Press. Available at: < http://mbauninorte.files.wordpress.com/2009/08/information-rules.pdf>.

Silver, R. U. (2008). “Local Loop Overview”. *National Communication Systems*. Available at: <http://wsrl.org/pdfs/local_loop1.pdf>.

Valleti , T., and Estache, A. (1998). “The Theory of Access Pricing: An overview for Infrastructure Regulators”. *World Bank Institute*. Available at: < http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-2097>.

Valleti, T. M. (2003). “The theory of access pricing and its linkage with investment incentives”. *Telecommunication Policy* 27 , 659-675.

Vogelsang, I. (2003). “Price regulation of access to telecommunication networks”. *Journal of Economics Literature* 41(3), 830-862.

Willig, R. (1979). “The Theory of network access pricing”. H.M. Trebing (Ed.) RegulationMichigan State University, *Papers Issues in Public Utility*.