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MOBILE NUMBER PORTABILITY: TECHNICAL SOLUTIONS CHOICE AND THE USE OF BERTRAND'S DUOPOLISTIC MODEL OF COMPETITION IN MOBILE TELEPHONY MARKET WITH HIGH PENETRATION DENSITY.

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ABSTRACT

The mobile numbers portability (MNP) regulation exists for two decade. His regulation has been object of multiple studies in economy. These studies are mainly focused on his costs. Whereas these costs are function too the technical solutions utilized. This article focuses on the regulation of PNM in terms of the choice of ONS or IN technical solutions in mobile markets that do not practice PNM but have reached maturity in terms of density as in some countries of West African Economic and Monetary Union (WAEMU). In order to reach our results we use Bertrand's model in duopoly context where each operator formulates that the conjectural variations of his rival are null in a static game with one round. Our results show that in such markets the implementation of MNP by sectoral regulation authorities must pass by the choice of IN technical solution to the detriment of ONS technical solution. And more, they must opt for symmetric regulation in terms of technical solutions choice.

Keywords: mobile number portability, Bertrand's model, WAEMU.

1. INTRODUCTION

2017 inaugurates the 20th anniversary of mobile number portability implementation (MNP) in mobile telecommunication sector. Twenty years after this first experimentation of MNP implementation many countries in the world haven't experimented this practice in their respective telecommunications sector among them many sub-Saharan African countries singularly many countries of West African Economic and Monetary Union (WAEMU). In these countries the mobile telephony markets have reached maturity stage and record penetration rate near in the majority 100% in 2016 (UIT, 2016). In such a context the implementation of the mobile number portability (MNP) can contribute to increase competition by lowering switching costs and improving the quality of services offered by operators. This positive impact of MNP

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depends all so to the level of charges induced by the implementation of the MNP which can be considered as a « new service » supplied by operators. Consequently the regulation method uses within this context by the sectoral regulator depend all so to the level of that implementation charges. By implementing the PNM, the sectoral regulator has the choice between several technical solutions which can be divided in terms of cost in two groups of technical solutions. Technical solution with high fix costs and generating low variable costs and technical solution with low fix cost of which the variable costs are high. The choice of one of the groups of technical solutions impacts logically the charges induced by the implementation of the mobile number implementation. According to Buehler and al works in 2016, the technical solution On-Switch (ONS) presents weak fix costs and important variable costs while the technical solution Intelligent Network (IN) presents important fix costs with weak variable costs. In the presence of such description the countries of WAEMU where the telecommunication markets are mature as underlined in table 1 below, the choice of technical solution for MNP implementation by the regulatory board becomes decisive.

This paper studies the regulation of mobile number portability (MNP) under the angle of technical solution choice for his implementation in mobile telephony markets which are reached maturity like West African Economic and Monetary Union (WAEMU) countries. In other words we seek to determine in the context of WAEMU telecommunications market which technical solution the regulator board must operate when he has the choice between ONS technical solution and IN technical solution in order to implement MNP? In the aim to answer efficaciously at this interrogation we formulate hypothesis relating to the nature of portability service; the structure of the market concerned and to the game nature in which operators are implicated. It's in this optic we consider that mobile number portability is as the supply of a new service supplies by operators present in the mobile telephony market of different countries. To supply this new service we suppose the structures of markets are duopolistic and more operators in these markets do competition in price according to Bertrand's competition model because we suppose there are no capacity constraints which limit the two operators present in the market in their supply of the service of PNM. We suppose finally that each operator considers that the conjectural variation of his rival is nil. The two operators are supposed to be engaged in a static game with one round as in the Bertrand's original model.

The paper is organised as follow: the section 2 focuses on number portability as presented in recent economic literature by considering the aspects of his implementation costs and the regulation mode. The third section presents our model grounded on Bertrand's model. In the last section we discuss our results and present the conclusions.

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Table 1: recapitulative of mobile telephony penetration rates in WAEMU's countries in 2016.

Countries	Mobile penetration rate in 2016	Mobile Number Portability (MNP)	Year of MNP implementation	Number of Mobile Network Operator (MNO)
Bénin	**79,6%**	NO		4
Burkina	**83,6%**	NO		3
Guinée-Bissau	**70,3%**	NO		3
Côte d'Ivoire	**126,%**	NO		3
Mali	**120,5%**	NO		2
Niger	**43,5%**	NO		4
Sénégal	**98,7%**	YES	2016	3
Togo	**74,9%**	NO		2

Source: UIT (2017). *Measuring the information society and Internet sites of regulators authorities of different countries.*

2. NUMBER PORTABILITY IN MOBILE TELECOMMUNICATIONS SECTOR

Portability is among the panoply of measures that the authorities of regulation use in telecommunications sector to assure some level of competition and quality service on certain telecommunication markets of which the voice market. The first country having implemented the mobile number portability was Singapore in 1997 (Buehler & Haucap, 2004). Singapore was followed by European Union (UE) at the beginning of 2000 through the Universal Service Directive of 7 march 2002 (Buehler, et al., 2006) ; then United-States introduce in their tour number portability in November 2003 (Shin, 2006). For the African countries even if some among them have implemented the number portability as Senegal in 2015 there are many others countries for which the MNP has not implemented. (ARTP (Sénégal), 2013).

The concept of portability can cover tree (3) forms: the location portability, service portability and at last the number portability or operator portability (Lin, et al., 2003). The number portability or operator portability is considered as having the more impact in terms of improving the level of competition and the quality of electronic communication services (Buehler, et al., 2006). In other words the number portability is wanted for his benefits on subscribers' welfare in terms of low prices, quality of services and the diversity of choices. The number portability or operator portability or portability simply allows subscribers of telecommunication services fix or mobile to change operator without changing their phone numbers (Shin & Kim, 2008).

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2.1 Mobile number portability vs switching costs

Number portability is implemented to minimize the inconveniences linked to switching operator. The switching costs are defined as being all the economic and psychologic costs supported by consumers and induced at the time of the switching to an alternative to another one. In other terms, switching costs can be considered as any barrier which maintains a consumer in a specific commercial relationship. (Lee, et al., 2006). Switching costs are studied for the first time by (Klemperer, 1987), (Kim, et al., 2003) and (Gabrielsen & Vagstad, 2003) these authors shown the capacity of important switching costs to reduce the degree of competition between competitors on a given market. Switching costs can act also as barriers which prevent consumers to leave suppliers. (Jones, et al., 2002). And in 2006 Shin D. H has concluded that the level of switching cost of American operators was very high and that prevented the American consumers to switch operators. . This situation has reduced the impact of mobile number portability in American market (Shin, 2006). These switching costs are defined as all the costs supported by the consumer when he changes operator. In the specific case of mobile telecommunication market the switching costs are constituted mainly by time of switching, money and the psychologic costs which can be classified in three categories: learning cost, contractual cost and the transaction cost. The learning costs and the transaction costs and are considered as social costs while the contractual costs represent pecuniary costs that consumers support when they switch from operators (Shin & Kim, 2008). These switching costs are considered as one of the important forces which affect the competition on telecommunications market. Theoretical and empirical studies have shown mainly that important switching costs reduce competition by leading to high prices, products and services of inferior quality thus to low surplus for consumers (Maicas, et al., 2009).

The telecommunications sector generates switching costs which are real and psychologic. These cost can be endogenous that is coming from the consumers loyalty (for example through fidelity programs or promotional programs implemented by operators) or contractual clause which make the operator switching by the consumers very difficult (penalties supported at the time of switching for example). They are also exogenous that is transaction cost supported when consumers change operators. The introduction of mobile number portability eliminates at least a part of these switching costs.

Definitively we can note that number portability aims at lowering the switching costs of operators by making mobile telecommunications market more competitive in one side but his implementation induce in other side costs for operators. Consequently, a regulation of charges induces by the implementation of mobile number portability by operators can be envisaged.

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In front of such description a study of induced costs by the implementation of number portability on mobile telecommunications market can't be useless. Because the positive effects that can generate the practice of portability in such sector can be annihilated by the level of charges supported by operators during the implementation phase of the number portability above all if these charges are not oriented towards costs. These costs according to Buehlera et al can be direct and indirect. The direct costs in number three (3) and are mainly system development and implementation costs which fix costs; the costs generated by the real porterage of individual numbers are varialbe costs of induced by portability implementation. In addition to this there are additionnal transfert costs. The indirect costs are mainly due to the loss of tariff transparency (Buehler, et al., 2006).

The costs of induced by the mobile number portability depend also to the choice of technology to implementing it. If some technical solutions require important fix costs compared to their variable costs; others present the advantage of requiring small fix cost compared to the high level of variable costs they require. In such situation the choice of technical solution is also decisive in the practice of mobile number portability because this choice conditions costs level supported by operators (Lin, et al., 2003). In the same sense Aoki and Small in 2010 in their paper, after demonstrated that the widespread presumption in favour of number portability is not necessarily in the interests of society in general, or even of consumers have sustained if the fix and variable costs due to portability implementation are important and in that case the portability can produce negative effects (Aoki & Small, 2010).

The link between switching costs and portability is evident. Through empirical and theoretical studies it's become obvious that mobile number portability introduction impacts positively switching costs from operators. But in regard to the impact of number portability on market global surplus the consensus is not the rule.

2.2 The regulation of mobile number portability costs

The regulation which involves all the notions leading to the well-functioning of an organism or an economy is necessary on a market particularly when the market forces' aren't able to ensure without any exterior intervention social optimum (Levêque, 2004). On this base any market which not satisfying real or potential competition conditions can be submitted to regulation measures. That why some markets of telecommunications sector is generally submitted regulation measures.

Considering that mobile number portability (MNP) is a new service supplied by operators to consumers raises the questions of charges repartition induced by that new service among participants of the market. Answers to these questions brought by scientific studies are divergent

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(Lin, et al., 2003). Questions of charges repartition and the level of induced charges by mobile number portability set the crucial problem of de charges regulation. It's for this reason que European Union (EU) in her universal service directive stipulated that charges induced by MNP must be oriented towards their costs (European Parliament, 2002). In the practice, regulation of charges caused by MNP varies from a country to another. In some countries the charge is entirely supported by operators' receiver and giver while in others the charge is paid by consumers. Dans certains pays la charge est entièrement supportée par les opérateurs destinataire et donneur tandis que dans d'autre c'est l'abonné qui en supporte (Buehler, et al., 2006) ; (ARTP (Sénégal), 2013) ; (Mengze, et al., 2006).

The success of mobile number portability implementation depends in some measure of the regular framework designed by the authorities of regulation concerning the choice of technologies, the computation method of charges induced by MNP and market structure on which the competition takes place among operators.

3. THE MODEL

The essence of our model is rooted in our research objective. This objective consists to determine the technical solutions choice must operate the sectorial regulatory authority facing two technical solutions which are On-Switch (ONS) and Intelligent Network (IN) technical solution when he regulates mature markets as those of West African Economic and Monetary Union (WAEMU). That means, markets having reached maturity in terms of penetration because characterized penetration rate near to 100%. The two technical solutions are asymmetric in terms of costs. The ONS is characterized by weak fix costs and important variable costs compared to IN technical solution which characterized by weak variable costs with important fix costs. Intuitively, we can admit that the choice of a technical solution will impact logically the prix level of the new service of mobile number portability (MNP).

In others words, the choice that the sectorial regulator authority will do in terms of technical solution will impact the costs supported by operators when they implement MNP and in the logic of cost-benefice analyse this will impact in fine the price level this new service can be supplied to subscribers of different networks present on that market.

We supposed supra that the market is duopolistic and the game in which operators are implicated by supplying the service of MNP is static and is a one round game end in this game operators are competing in price. It's on the basis of these elements we formulate our model as follow.

Let's consider two (2) mobile networks respectively named 1and 2. These two networks compete with each other on the voice communication market. They are interconnected and supply voices on-net and off-net communication service.

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In first time, let's suppose that mobile number portability is not implemented on that market as it's the case in WAEMU majority countries (see table 1). The two operators are supposed to evolve in a national telephony voice market which is mature. On that market the regulation authority has set up symmetric interconnection charge among operators and in addition the rate of mobile penetration is close to 100% as in all the WAEMU countries too.

3.1 Costs and price of the model

Let's suppose now that the regulator authority decides to implement mobile number portability in a second time. In order to do that the regulator authority has choice between two types of technical solutions which are ONS technical solution and IN technical solution. These technical solutions are different in terms of costs. These costs are formed by three mains components: initial costs or installation cost of MNP, the transfer costs of subscribers and routing costs.

Initial costs or installation cost: these costs are the MNP implementation cost, management costs; operators 'services costs, information costs, billing costs, the development cost of software, the updating costs. These costs are fixed costs.

The transfer and routing costs of calls: they represent the necessary costs for customer transfer from the donor network to the recipient network; costs of closing and opening counts and costs supported by an operator to enable calls effective. These costs are variable costs of the total cost to implement mobile number portability.

From the development presented supra we assert that ONS technical solution presents weak initial costs (fixed cost) and important transfer and routing costs (variable costs) in relation to IN technical solution which generates important initial costs (fixed costs) with weak transfer and routing costs (variable costs).

Then, total costs induced by each of the technical solutions for the implementation of MNP for q_1 and q_2 mobile numbers become respectively:

$$CT_{ONS}(q_1) = aq_1 + A_{ONS}$$

Where, a and A_{ONS} represent respectively the marginal cost and initial costs of MNP implementation using ONS technical solution.

$$CT_{IN}(q_2) = bq_2 + A_{IN}$$

Where, b and A_{IN} represent respectively the marginal cost and initial costs of MNP implementation using IN technical solution.

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From these technical solutions used in our model we can infer following inequalities relative to production costs:

$$\boldsymbol{A_{ONS} < A_{IN}} \quad et \quad \boldsymbol{a} > b$$

Now let's suppose the sectorial regulator decides to introduce MNP. But he opts for an asymmetric regulation feature which requires for the two operators present on the portability market the implementation of different technical solutions. In this perspective we suppose that operators 1 and 2 are present in that market and the sectorial regulator requires to the operator 1 the implementation of ONS technical solution while he requires to operator 2 the implementation of IN technical solution when they supply MNP service.

By admitting there's no constrains capacities in terms of number portability; we can suppose in this case that the two operators are competing in price in that market first to maintain their own subscribers captive and second to attract news subscribers to the mobile telephony market. In absence of constrains capacities on a market Bertrand's competition model is recommended. We utilise this mode of competition in order to study behaviours of operators 1 and 2 which seek each one in these market conditions to maximize their respective profits.

Each operator by maximizing his profit compares his supplying cost of mobile number portability to his revenue which he gains in MNP implementation.

Supposing that operator 1 fixes the price P_1 to offer the mobile number portability; and operator 2 fixes price P_2 on his network.

When MNP is implemented the two operators face to a market demand written as follow:

$$D(P_1, P_2) = D(P) = Q$$

Where, $Q = q_1 + q_2$ represents the total mobile number which is ported by de operators and market demand is a linear function of prices fixed by the two operators (which are respectively P_1 and P_2).

Operator 1's demand is:

$$D_1(P_1, P_2) = q_1 = B - \alpha P_1 + \beta P_2$$

Operator 2's demand is:

$$D_2(P_1, P_2) = q_2 = B - \alpha P_2 + \beta P_1$$

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B, α and β, are parameters which determine the maximal price for which mobile number portability demand is nil and positive parameters; then, $\alpha > 0$ and $\beta > 0$.

In logic of cost-benefit analyse each operator compares the supplementary cost that the supply of an extra unit of MNP generates to the extra return this service generates. Said in others words, each one of the two operators' presents in the mobile number portability maximizes his own profit gained on that market. And we can write in this context the profit function of each operator as follow:

Operator 1's profit function:

$$\boldsymbol{\pi_1(P_1, P_2) = P_1 q_1 - A_{ONS} - a q_1 = q_1(P_1 - a) - A_{ONS}} \\ \boldsymbol{= (B - \alpha P_1 + \beta P_2)(P_1 - a) - A_{ONS}}$$

Operator 2's profit function:

$$\boldsymbol{\pi_2(P_1, P_2) = P_2 q_2 - A_{IN} - b q_2 = q_2(P_2 - b) - A_{IN} = (B - \alpha P_2 + \beta P_1)(P_2 - b) - A_{IN}}$$

3.2 Model equilibrium

The equilibrium prices of operators 1 and 2 are determined under hypothesis of the maximisation of their respective profits. The two operators are competing in price in a simultaneous game with one round.

In these conditions each operator maximizes his economic profit by assuming that the conjectural variation of his rival is nil as written below.

$$\frac{dP_2}{dP_1} = \frac{dP_1}{dP_2} = 0$$

The market equilibrium prices are obtained when the first and second conditions written below are respectively fulfilled for each of the two operators present on the market.

$$\frac{\partial \pi_1(P_1, P_2)}{\partial P_1} = 0 \; et \; \frac{\partial \pi_2(P_1, P_2)}{\partial P_2} = 0$$

$$\frac{\partial \pi_1^2(P_1, P_2)}{\partial P_1^2} < 0 \; et \; \frac{\partial \pi_2^2(P_1, P_2)}{\partial P_2^2} < 0$$

From the first conditions of maximisation presented above we find the reaction functions of the two operators and these reaction functions are respectively written below for the operators 1 and 2.

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Operator 1:

$$P_1 = \frac{B}{2\alpha} + \frac{a}{2} + \frac{\beta}{2\alpha} P_2$$

Operator 2:

$$P_2 = \frac{B}{2\alpha} + \frac{b}{2} + \frac{\beta}{2\alpha} P_1$$

From these 2 reaction functions we infer the equilibrium prices that operators i and j fix on the market and these prices are written below:

$$P_1 = \frac{\alpha(b\beta + 2a\alpha) + B(2\alpha + \beta)}{(2\alpha - \beta)(2\alpha + \beta)} \quad avec\ \alpha > \frac{\beta}{2}$$

$$P_2 = \frac{\alpha(a\beta + 2b\alpha) + B(2\alpha + \beta)}{(2\alpha - \beta)(2\alpha + \beta)} \quad avec\ \alpha > \frac{\beta}{2}$$

3.3 Analysis of market equilibrium

In Bertrand's "original" model the firm which fixes low price among the both will have all de market demand while the other will not have any demand. This conclusion of Bertrand's model is obtained under rigorous assumptions such as marginal tariffication conditions and the absence of capacity constrain for firms to satisfy all the market demand.

In order to analyse the results of our equilibrium we calculate the difference between equilibrium prices obtained above. By doing so we can write the following expression:

$$\boldsymbol{P_1 - P_2} = \frac{\alpha(b\beta + 2a\alpha) + B(2\alpha + \beta)}{(2\alpha - \beta)(2\alpha + \beta)} - \left[\frac{\alpha(a\beta + 2b\alpha) + B(2\alpha + \beta)}{(2\alpha - \beta)(2\alpha + \beta)}\right] = \frac{\boldsymbol{\alpha(a - b)}}{\boldsymbol{2\alpha + \beta}}$$

$$\boldsymbol{P_1 - P_2} = \frac{\boldsymbol{\alpha(a - b)}}{\boldsymbol{2\alpha + \beta}}$$

This price difference is positive because we have set up supra that marginal costs of supplying mobile number portability by the implementation of the technical solution ONS are superior to those supported by the operator using technical solution IN (then, $a > b$) and more parameters α and β are positive. This conclusion implies that $\boldsymbol{P_1 - P_2}$ is positive then $\boldsymbol{P_1}$ is superior à $\boldsymbol{P_2}$.

This result allow us to notice that the prices proposed are function of parameters α and β and function of marginal costs of transfer and routing of mobile numbers a and b. Operator which

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will have the highest transfer and routing marginal costs will propose at finish the highest supply price of mobile number portability. Specifically in the present case, operator 1 which implements ONS technical solution will propose the highest supply price P_1 relatively to operator 2 which implements IN technical solution (that means P_1).

If the two operators implement the same technical solution such as ONS/ONS or IN/IN, they will support the same level of marginal cost because $a = b$.

In this situation we can write the following expression:

$$\boldsymbol{P_1 - P_2 = \frac{\alpha(a-b)}{2\alpha+\beta} = \frac{\alpha(a-a)}{2\alpha+\beta} = 0 => P_1 = P_2}$$

In this eventuality where the two operators have the same level of transfer and routing marginal costs induce by the number portability, operators will share equitably the primo-accedant demand of mobile telephony service. This result is in accordance with to those announced by Bertrand in his "original" model. For the subscribers already customers of the two operator before the implementation of number portability can be indifferent between carry or not their numbers. This situation can contribute to improve competition degree on the market in general and the quality of the service; and leads to more market stability.

The implementation of identical technical solution which leads to the same transfer and routing marginal costs for number portability allow to have optimal equilibrium conditions than situation where asymmetric technical solution is implemented which leads to different transfer and routing marginal costs.

The results of our equilibrium allow understanding that the implementation of IN technical solution leads to weak mobile number portability service prices for consumers than the ONS technical solution. In addition, even in symmetric regulation eventuality requires by the sectorial regulator leading to the fixation of the same level price; IN technical solution seems to be more optimal than the ONS technical solution because prices induced by ONS technical solution are superior to those induced by the IN technical solution.

4. DISCUSSION AND CONCLUSIONS

This present study focuses on mobile number portability (MNP) regulation. The regulator authority to implement MNP is facing several technical solutions which mainly differ from fix and variable costs importance. In such a context the choice of technical solutions impacts logically costs induced by MPN which at the end impact also network switching costs and these casts are considered as exit barriers for consumers (Buehler & Haucap, 2004). Then the success

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of mobile number portability (MNP) depends to a certain extent of technical solutions choice made by the regulator authority. In this paper we have studied different possible choice that can make the regulator authority facing two principal technical solutions when it's implementing MNP and the consequences of its choice on price of MNP service in national communications voice markets having reached maturity stage as the mobile telephony market of the 8 countries of WAEMU. After having used Bertrand's model of competition in order to determine the technical solution choice that must implement the national sectorial regulators for the implementation of the mobile number portability (MNP) on markets like those of the WAEMU's countries, we arrive to the conclusion that IN technical solution which is characterized by weak variable costs with high fix costs must be chosen to the detriment of ONS technical solution which characterized by high variable costs with weak fix costs. Our model equilibrium analyse allows us to notice that the price at which the mobile number portability can be supplied by operators depends mainly to the transfer and routing marginal costs which are considered as variable costs induced by the supply of MNP service. More these marginal costs are important more le price of portability service is too. That will lead in fine to the augmentation of networks switching cost for subscribers of different operators present on the market; and will contribute to raise exit barriers for consumers and finally reduce their surplus when they will switch networks. This result is in accordance with those underlined in previous researches. (Lee, et al., 2006) ; (Shin, 2006) ; (Maicas, et al., 2009).

In a second time the results of our model show that in addition to IN technical solution choice to the detriment of ONS technical solution; the regulator authority must opt for a symmetric regulation mode relatively to the choice of technical solution for the implementation of mobile number portability. In other terms, whatever is the technical solution chosen in the goal to implement MNP the sectorial regulator must require to operators the implementation of the same technical solution. Such a regulation mode leads always according to our results to establish by operators present on national communications voice market the same level of price when they supply mobile number portability service. That will lead to stabilize market and contribute to reinforce the competition degree between operators.

In eventuality where an asymmetric regulation mode will be implemented by the regulator through different technical solutions by different operators, the market becomes less competitive because prices proposed by operators become divergent and consequently those which have high prices of MNP service will see their network switching costs increasing comparatively to those which have small prices. Say in other words, operators implementing IN technical solution propose smaller supplying prices than those implementing ONS technical solution. This situation reinforces the level of barriers out for subscribers present on these networks (those using ONS technical solution) before the implementation of mobile number portability. The asymmetric

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regulation mode will lead to reduce expected level of competition because market has reached maturity stage before the implementation of MNP by regulator as it's the case in the 8 countries of WAEMU where the penetration rates of mobile telephony are near to 100% in most of these countries. In these countries where market is mature, operators implementing ONS technical solution can record weak level of "primo-accedant" adhesion comparatively to those implementing IN technical solution. Because the "primo-accedant" consider the MNP price as one of determinants of their network choice before to subscribe at a service of a network. On the other hand operators implementing IN technical solution and propose weaker service prices will allow them in WAEMU's countries case to record high level of "primo-accedant". An more, asymmetric mode regulation create on national communications voice markets more market power for operators using ONS technical solution towards their subscribers already present before the implementation of MNP by the sectorial regulator. This situation reinforces barriers out for subscribers and then reinforces the influence of operators on them and they become captive of these networks.

Development presented supra allowed us to understand that the choice of IN technical solution to the detriment of ONS technical solution in sight of MNP implementation is more optimal for consumers; because such a choice leads to the fixation of weak supplying price of mobile number portability service. In addition, we arrived to the conclusion that the choice of symmetric regulation mode of market by sectorial regulators and whatever the technical solution chosen appears better than an asymmetric regulation mode. These conclusions are more valid for countries as those of the West African Economic and Monetary Union (WAEMU) which have mature mobile telephony markets recording penetration rates being near 100% and don't have until now implemented mobile number portability in their majority.

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