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Regulated termination rates and competition among Tunisian mobile network operators. *Barriers, bias, and incentives*

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ABSTRACT

Since 2006, the Tunisian National Regulatory Authority has been imposing multiannual mobile-to-mobile termination rates, first on the duopoly of *Tunisie Télécom* and *Tunisiana*, and then on all three providers once *Orange Tunisie* entered the market in 2010. This research studies the interplay between interconnection rates for mobile call termination and the retail price competition for prepaid SIM cards, predominantly chosen by Tunisian consumers. We show that the duopoly was practicing "price alignment" for off-net calls, and that subsequently, the third provider entering the market sparked a decisive initial price drop associated with the non-reciprocal rate it enjoyed. However, the price war, which benefited consumers, only occurred when the Regulatory Body eliminated differential tariffs between on and off-net calls in the retail market. It follows that, everything else being equal, an interconnection rate drop alone will not lead to a decrease in retail prices.

1. Introduction

The telecommunications sector is a network industry characterized by high fixed costs and low marginal costs, and the preservation of an efficient mix of market sustainability both for providers and consumers; as such, it has extensive regulatory issues. Providers "meet" in the market where calls terminate, considered an interconnection node (among others interconnection nodes such as co-location, facility sharing sites, etc.), but also an *economic* one. We consider this wholesale market in the Tunisian mobile phone industry through mid-2016, reviewing the changes caused by liberalization.

Our study researches the interplay between the wholesale mobile-to-mobile termination rates (MMTRs) and the per-minute retail prices of prepaid voice calls. Indeed, the main object of this study is the regulated MMTRs with no cap regulation (retail price regulation) in Tunisia, regardless of the data transiting through the 3G technology. We consider the demarcation bounds in the Tunisian case a relevant market to evaluate the degree of competition among mobile network operators (MNOs) in order to carefully examine retail pricing offers. We consider only the voice services of the incumbent's mobile network, and similar services offered by its competitors, independently of their fixed networks, even if the *waterbed effect* (Genakos & Valletti, 2011, 2015) could (exist and) modulate the strategies of these companies. Those restrictions could introduce some distortions in this study given that the incoming and outgoing calls on the fixed networks are inseparable in competitive market strategies.

The seminal works of Armstrong (1998) and Laffont, Rey, and Tirole (1998a, 1998b) analyzing high termination fees as leverage to increase market power, which can evolve to retail price collusion, have been taken into consideration by regulators for their potential anti-competitive implications (Baranes, Benzoni, & Hung Vuong, 2011; European Parliament & European Council, 2002; European Regulatory Group, 2008; Kongaut & Bohlin, 2014).

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Subsequently, regulatory bodies have requested the supervision of termination rates under the calling-party-pays principle (CPPP), and mandated implementation, in a transitory period, of non-reciprocal termination fees between mobile operators (Carter & Wright, 2003).

This is the case in Tunisia. The *Instance Nationale des Télécommunications* (INT), the Tunisian National Regulatory Authority of the telecommunications sector, ensures that the operators do not infringe on competition rules and safeguards, through several instruments, and among other duties, has been setting the MMTRs since 2006.

The paper is structured as follows. Section 1 is an overview of the telecommunication sector in Tunisia. Section 2 studies the evolution of the mobile market. Section 3 considers the soft regulation of the MMTR, mutually negotiated by the duopoly without INT guidelines. Section 4 expounds on the regulations of the duopoly with the MMTR imposed by the INT. Section 5 examines price competition while the third provider enjoys a better MMTR, and Section 6 reports on the implications of the strict directives on equalization of the off-net and on-net retail prices (off-net: calls terminating on another network and on-net: calls within the operator's network) decreed by the regulatory body. Finally, Section 7 introduces concluding remarks for further analysis.

2. Overview of Tunisian liberalization in the mobile network market

The liberalization of communication services in Tunisia (Boughzala, 2005; Mezouaghi, 2005; Van Assche & Konan, 2004) has evolved over several stages, beginning as a monopoly market and moving to competition between three providers. It began when the incumbent, government owned company *Tunisie Télécom* (TT), started operations in 1996 and converted to a joint-stock company, after the separation of the telecommunications services from the Postal, Telegraph & Telephone (PTT) administration. Two years later, TT launched, through its subsidiary Tunicell, a 2G mobile phone service.

The effective date of the Tunisia legal and regulatory framework was 2001. The INT, the Tunisian regulatory body, was established even though the market was still a monopoly, in order to set guidelines, directives and rules to safeguard competition when the market was liberalized. The newly-adopted fundamental Telecom Code (2001) authorized the licensing of private providers, and on May 11, 2002, a new concession purchased for TND[1] 680 million (about US$ 470 million) was granted to *Orascom Télécom Tunisie*, a consortium of Kuwaiti and Egyptian private interests. The new company, operating under the brand name *Tunisiana*, was bought by *Qatar Telecom* (*Qtel*) and rebranded *Ooredoo Tunisie*.[2] Presently, *Qtel* holds 90% of *Ooredoo* shares, while the Tunisian State holds the remaining 10% through its subsidiary *Telecom Zitouna*.

The sector's liberalization process continued in 2004 when the *Telecom Code* compelled the conversion of the incumbent into a limited public company, subject to trade legislation. This meant that the state-owned enterprise TT became open to private participation, and in April 2007, the Emirate telecommunications company, *Tecom DIG*, took a 35% stake in it.

At the same time, the *Telecom Code* allowed all telecommunications providers to access the nationwide “backbone” network (pairs of copper wires and fiber optic) managed by the incumbent TT.

For more than seven years, the mobile market was a duopoly, regulated by the INT. As TT anticipated the end of that era, in 2009, it launched a subsidiary, *Elissa*, a mobile virtual network operator (MVNO), targeting young consumers. The mobile phone market became more competitive with the entry of *Orange Tunisie* in 2010, a third mobile provider (formerly *Divona* owned by *Monaco Telecom* and *Planet Tunisia*). After multiple financial arrangements, *France Telecom/Orange* secured a 49% stake in *Orange Tunisie* and the Tunisian State became the controlling shareholder with 51% of the capital after incorporating the ownership of *Planet*'s securities. Thus, *Orange Tunisie* launched Tunisia's first commercial 3G mobile service, followed by TT in 2011, and Ooredoo in 2012.

Although, *Ooredoo* and *Orange* were licensed as fixed-line operators, having launched the DSL and Fiber-to-the-Premises (FttP) service, the strategic fixed phone segment remained a *de facto* monopoly by TT.

According the World Bank Report (2014, p. 8), as part of the international high-speed fiber optic networks handling traffic to and from Internet service providers and end-users, TT and its rivals sold international voice traffic at the highest prices.

In October 2015, the telecom market opened to *LycaMobile*, an international MVNO; this represented the full maturity of the Tunisian mobile phone sector. *LycaMobile*, a UK-based company, is present in 19 countries, and in Tunisia, it uses TT's network capacity to enable its commercialization of international calls at low prices.

In March 2016, the Tunisian State granted concessions to TT, Ooredoo, and Orange for 4G licenses based on very close financial bids, TND 155 million, 160 million and 156.3 million, respectively (ranging from approximately 76 to 78 million US$). The three providers launched commercial LTE services (4G) in mid-2016.

3. Mobile phone penetration and *ex-ante* regulation

In a population slightly larger than 11 million inhabitants with a median age around 31, the total number of mobile phone subscriptions reached more than 14.5 million units at the end of 2015 (Fig. 1).

3.1. Prevalence of prepaid SIM cards

According to the GSMA report (2016, pp. 17–18), *unique subscribers*, referred to as users of mobile services, are about 6.6 million

[1] The exchange rate TND/US $ slid continuously between 2002 and 2016 from approximately 0.68 to 0.49.

[2] In April 2014, Tunisiana became Ooredoo and hereinafter, we will retrospectively quote Ooredoo instead of Tunisiana.

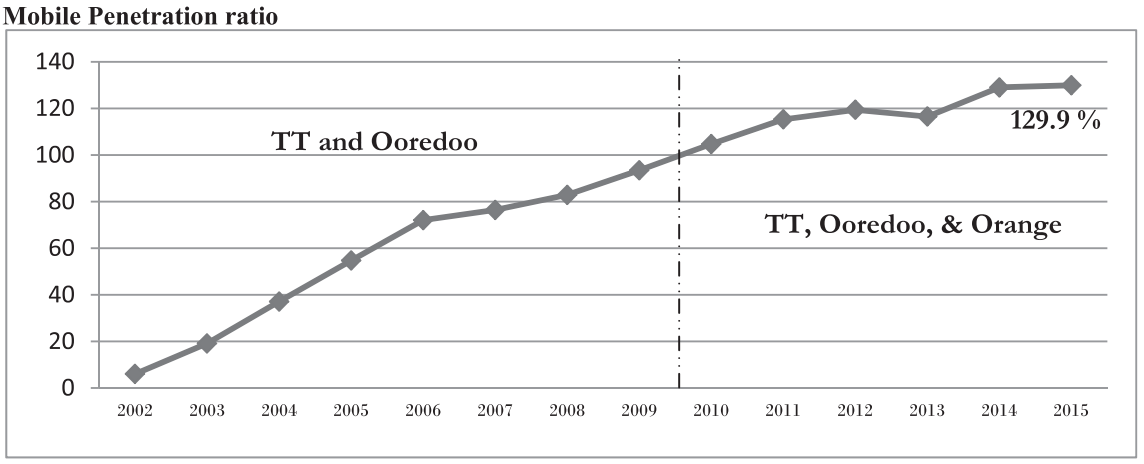

Fig. 1. Evolution of the subscription ratio for mobile phone services (no. of subscriptions/100 inhabitants).
Source: INT data

(58% of the inhabitants), and conversely, around 4.6 million people do not own a mobile phone.

It is noteworthy that the majority of the users are equipped with phones having multiple SIM cards to substitute providers when advantageous tariffs are offered by TT, Ooredoo, or Orange.

In addition, residential customers prefer to use a pre-paid service for its ease and flexibility. Considering that the prepaid packages constitute more than 94% of the subscriptions, customers also have more control over their mobile phone budgets.

Ooredoo has dominated the market by number of subscriptions since 2008, but its market share recently appeared to hit a ceiling; this has meant a trend reversal, apparently, that is benefiting Orange (Fig. 2).

The sustained penetration rate hides market upheavals resulting from providers' strategic behaviors. Indeed, since the entry of Ooredoo in the market in 2002, the incumbent has experienced an inexorable drop in market share. This erosion was also further observed with the entry of Orange in 2010. However, the TT market share began to improve in 2014, although, it is difficult to predict whether this is sustainable.

3.2. *Interoperability of rival networks*

The interconnection between mobile phone networks in the Tunisian market is governed by the CPPP, whereby the service provider of the caller pays a termination rate to the service provider of the network where the call ends (Harbord & Pagnozzi, 2010; Littlechild, 2006). Therefore, the adjustment of wholesale mobile termination rates has become a relevant regulatory issue for market competition. Indeed, the CPPP reinforces the market power of the receiving party, consequently causing regulatory interventions to safeguard competition rules and to prevent abuse of market dominance and monopolization (Economides, Lopomo, & Woroch, 1996).

"The implementation of the calling-party-pays-principle (CPPP) in most countries is seen as the main reasons for the competitive

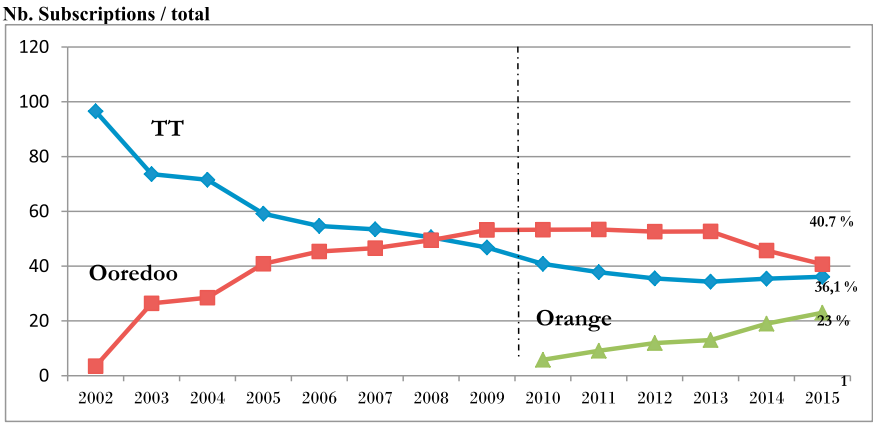

Fig. 2. The market share evolution of the mobile phone operators. 1. The remaining market share (0.2%) is held by LycaMobile, an international mobile virtual network operator, leasing network capacity from TT under a roaming agreement.
Source: INT data

problems related to mobile termination and the consequential governmental *ex-ante* regulation" (Kruse, 2009, p. 226).

Therefore, it is beneficial to study the interconnection regime and MMTRs under the CPPP in the Tunisian market to identify these "competitive problems".

The regulatory framework in Tunisian was implemented in late 2002, and the INT, among its various roles, is responsible for endorsing agreements on termination rates between providers, and exerting the powers of public authority in litigation resolution, especially any concerning network interconnection (Telecom Code, 2001; *op. cit.*).

Nonetheless, for three years (2003–2005) the regulatory body played only a mediating role between TT and Ooredoo for bilateral agreements on mobile network interoperability, especially for MMTRs; however, since 2006, it has played a more active role in setting these rates.

In order to achieve a comprehensive view of the regulated MMTRs to analyze their interplay with the retail price competition, we divided the 2006–2015 decade into three periods. The entry of Orange in 2010, the third provider in the market, first separates this multi-annual time period into two phases.

Subsequently, the end of the asymmetric MMTR in 2013, conferred by the regulatory body on Orange, introduces the next distinction, leading to the three relatively independent periods. Indeed, those three periods of regulated MMTRs have separate characteristics, linked to related retail price dynamics (Fig. 3).

4. The soft regulatory interventions of 2002–2005

From the end of 2002–2005, the providers freely negotiated the terms and conditions of the interconnection regime (INT, Annual Reports, 2003–2005). The INT implemented procedures for the exchange of technical proposals to enable annual agreements between the two companies. Moreover, the INT created the Conciliation Committee that included representatives from both companies in the aim of reaching agreement on network interoperability. At the end of the negotiation process between TT and Ooredoo, and to become an enforceable agreement, the deal needed the prior approval of the INT Board.

4.1. Bilateral MMTR negotiation

During those three years, TT and Ooredoo had a strong incentive to coordinate on termination rates, but their interests were in such conflict that the compromises on MMTRs were reached only after the regulator threatened to set the rates itself. Indeed, INT reiterated to the providers their obligations to negotiate and sign the agreements on interconnection tariffs within 60 days or, if not, INT would prescribe the rates (INT, Annual Report, 2004, p. 8).

Eventually, INT instituted its authority to establish the interconnection rates between both companies. In other words, the regulatory body became more closely involved in setting rates (INT, Annual Report, 2004, p. 8).

TT, the incumbent, having the first mobile phone network and a nationwide fixed line network with a significant number of users, received a relatively large volume of incoming calls from rival provider Ooredoo. TT, therefore, desired a relatively high MMTR since it

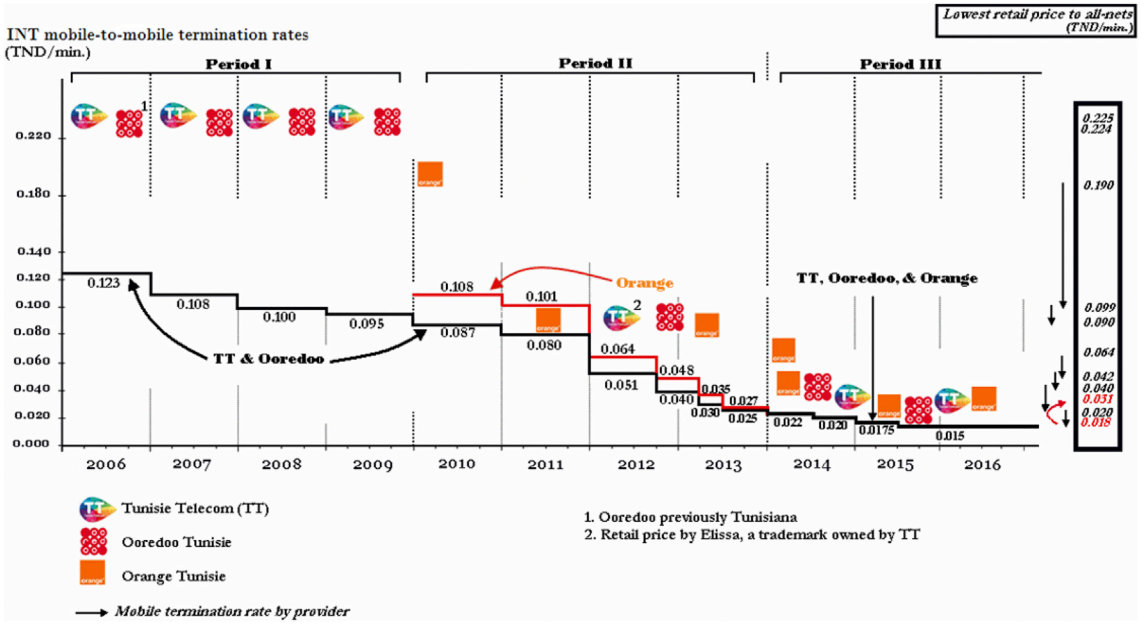

Fig. 3. Regulated mobile-to-mobile termination rates and the dynamics of the retail price of the per-minute voice call in the Tunisian market.
Source: INT data and various press releases

represented a major source of revenue. In contrast, Ooredoo, the new entrant, having a lower number of subscribers and a relatively large volume of outgoing calls to the TT network, desired the lowest wholesale termination rates in order to reduce such financial charges. The related INT Annual Reports during these three years do not share the calculation method of the MMTR, neither in terms of its reciprocity nor its asymmetry, let alone its value.

4.2. Antagonistic corporate cultures

Jean-Pierre Roeland, General Manager of Ooredoo said: "If we had to describe the Tunisiana [Ooredoo] commercial offers in a few words, I will quote the four values that bind our corporate culture: transparency, professionalism, customer oriented-approach and innovation" (Tunisiana [rebranded Ooredoo], 2002). Implicitly, Roeland suggested that those values were absolutely unfamiliar to his competitor, state-owned TT.

Indeed, previously, at the retail market level, a customer had to wait two to three months and pay TND 150 to purchase a prepaid cellphone line from the incumbent, while the per-minute price reached TND 0.250. Ooredoo launched its brand in late 2002, *Marhbé*, the prepaid pack, with a subscription fees of TND 120, and a per-minute voice call price to all-nets (off-net or on-net) set at TND 0.240. In March 2003, the TT per-minute price fell to TND 0.225 which Ooredoo then matched.

Less than a year later, the cost of a prepaid TT or Ooredoo line was further reduced to TND 99, then TND 60 and finally stabilized at TND 10 in 2005.

Until then, thanks to its strong commercial momentum, Ooredoo managed to gain market share of more than 40%, while the TT market share fell to below 60%. This trend was not due to any price competition, as the prepaid voice call price charged by the two operators leveled off at around TND 0.225 per-minute.

5. Period I: regulated MMTR in a market duopoly (2006–2009)

From 2006 onward, the INT no longer played the role of mediator between the providers. Instead, it received the provider proposals for interconnecting their mobile networks then issued its own MMTRs.

Surprisingly, TT and Ooredoo requested (and obtained) an increase in reciprocal MMTRs for 2006 of 7%, compared to 2005, while setting the rates themselves (INT, 2006a, p. 7; INT, 2006b, p. 7). It seemed that anticipating the entry of a third provider pushed the duopoly to implement a barrier to market entry for the future and common competitor.

5.1. Suspicion of collusion

In period I, INT imposed a multiannual regulation of the MMTRs (INT Annual Reports, 2006–2009) as a discrete reduction in the cost of termination rates, similar to the steps in a stair (*see* Fig. 3). Surprisingly, this reduction in termination costs was not passed on the off-net retail pricing from both companies.

A quasi-identical retail price of the per-minute voice call was maintained for all of period I. For these four years, the hypothesis of "consciously parallel practices" cannot be rejected, meaning that the "conscious parallelism among the largest firms in a highly concentrated industry shall constitute *prima facie* evidence of a conspiracy to monopolize[3] " (Vaska, 1985, p. 514).

The central issue here is the following: does the multiannual parallel-retail pricing practice illustrate a tacit collusion of these companies, TT and Ooredoo?

Thus, INT requested TT and Ooredoo to "pass any decrease of the interconnection rates into retail prices. It believe [d] that these measures are positive elements in the implementation of the convergence of termination rates towards costs, and should benefit consumers" (INT, 2006a, 2006b, *op. cit.*, p. 6). However, both providers failed to comply with this request from the regulatory body, whether separately or by tacit agreement.

The suspicion of a tacit agreement to maintain retail prices was corroborated through 2009. Indeed, the regulator decreed again in two separate decisions the obligations of both TT and Ooredoo "to pass in their entirety the decrease of call termination rates recorded in 2006, 2007 and 2008 on retail prices of the off-net calls" (INT, 2008a, p. 9; INT, 2008b, p. 3). Yet, the duopoly ignored this explicit demand during all of period I. Moreover, the anti-trust literature states that "Several market factors have been identified that facilitate collusion; these include product homogeneity, inelastic product demand, concentration of economic power, fewness of firms, and the conviviality of interfirm relationships" (Posner & Easterbrook, 1981, pp. 1064-65).

In the latter argument, it is clear that there is a sharp distinction between the two suppliers' corporate cultures. Historically, TT, as a state-owned enterprise, and Ooredoo, held by foreign capital and often run by French managers, were in full conflict rather than friendly. Indeed, in the duopoly era, the INT handled several litigation proceedings between the companies: 10 complaints from Ooredoo against TT for alleged abuse of its dominant position or restrictive practices, and reciprocally, TT complained six times to the INT, essentially for allegedly the anticompetitive behaviors of Ooredoo (INT Annual Reports, 2003–2010).

However, price matching can also result from "noncoordinated motivation." Both providers could have identical marginal costs for the per-minute call, and, in such a case, the profit maximization would result in similar selling prices.

On another level, assuming that the demand elasticity for mobile services in Tunisia was similar to that estimated for several Middle

[3] Under the Sherman Act U.S. Code § 2 (2004), "Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a felony …".

Table 1
Retail price grid of the prepaid mobile phone voice call, 2006–2009.

Prepaid retail price per-minute (TND)	TT	Ooredoo
Off-net	0.225	0.224
On-net	**0.180**	**0.160**

Source: INT data

East and North African (MENA) countries between 1995 and 2007, where "[t]he elasticities hover around unity and are strongly statistically significant in terms of their influence on the average demand of mobile demand" (Hakim & Neaime, 2014, p. 11), the duopoly strategy of lowering the off-net retail prices would be neutral in terms of sales earnings.

Indeed, when the demand elasticity is estimated around unity, total revenue remains substantially constant when prices change.

Moreover, it seems that the duopoly did not pass on the per-minute price drop in the termination rate for the simple reason that the ratio of incoming/outgoing minutes of voice calls for both firms was close to unity. In this case, the balance of the payment account to the rival is negligible. Indeed, the termination fees account would be considered neither revenue nor cost.

In fact, suspicion of collusion only becomes credible when both companies maximize common profit by reducing call traffic and setting prices well above marginal costs. Undoubtedly, this monopolistic mechanism, constituting anticompetitive behavior, was not implemented by either provider.

The duopoly neither rationed subscriptions nor denied network access, but rather Ooredoo sought to densify its own on-net offering to attract more subscribers. Indeed, tariffs differentiating off-net calls from on-net calls state that the wider the gap, the greater the incentive to call customers on the same network. Identified as the "club effect" by the regulatory body, a proper valuation of the on-net/off-net price gap should take into consideration the overall price grid.

5.2. *Differentiating on-net and off-net per-minute retail prices*

The duopoly price grid reports that the Ooredoo offers are, in both relative and absolute terms, considerably better than those from TT, both on-net and off-net (Table 1).

Ultimately, new subscribers are more strongly attracted to Ooredoo's service, which intended to densify its customer set. The Ooredoo strategy seems sensible, as at the beginning of period I, the mobile penetration rate was only 54%, indicating that the market was not yet saturated.

Moreover, the price grid of the two providers shows that a tacit market sharing or an explicit collusion is, again, only weakly credible; additionally, it appears that Ooredoo set directly competitive pricing targets.

At the end of period I, the Tunisian government negotiated the granting of 2G and 3G licenses to a third mobile provider. Anticipating the end of the duopoly era, TT introduced its new subsidiary, Elissa, a MVNO, dedicated to subscribers under the age of 25. While Elissa subscription fees were TND 4 per line, its per-minute on-net price appeared to be intensely competitive at TND 0.100. Moreover, Elissa offered 6 h of on-net "unlimited calls" a day in particular time slots for TND 5. On the other hand, Ooredoo responded with its Amigos service, which was a similar offer. For TND 3 per day, a customer could have unlimited calls up to 23 h per day on-net. Again, in the last quarter of 2009, Ooredoo extended such an option to all of its subscribers with "unlimited calls" for TND 3 per day for on-net calls (11 h nightly: from 9 p.m. to 8 a.m.).

Disregarding the Elissa or Ooredoo profit margins, the per-minute price suggests that the true cost of sending/receiving a minute voice call was far below the regulated termination rates.

The price grid suggests as well that the duopolistic competitors having excess capacity, wanted to recover a fraction of their fixed costs. Each provider established a gap of on-net/off-net calling prices as a means not only to extend its own network but also to lock-in subscribers by raising exit costs. This is exactly and precisely the behavior of a monopolistic competitor aimed at having the greatest number of *captive* customers.

Between 2008 and 2010, on-net calls increased by over 30%, in contrast with the near stagnation of off-net calls. INT denounces such "club effect" pushing consumers to maintain up to three SIM cards to take advantage of the on-net provider tariffs. However, INT notes that the high retail prices of the off-net calls and their deviation from the on-net prices were mainly due to the high termination rates, which were not cost-oriented. Thus, this contributed to the share of on-net calls exceeding 75% of the total number of call minutes in late 2010 (INT, 2012, pp. 3–4).

As a strategic barrier to the third provider entry into the retail market (Calzada & Valletti, 2008; Gabrielsen & Vagstad, 2008; Hoernig, 2007), the on-net/off-net differential pricing of TT and Ooredoo was not punishable by INT but rather by another national state authority, the Competition Council of Tunisia (*Conseil de la Concurrence de Tunisie*, CCT). This was because under the *Telecom Code*, the regulatory framework of the INT was not intended to implement price cap regulation.

From the perspective of the CCT,[4] TT and Ooredoo implemented discriminatory prices by giving their own customers conditions for termination of mobile-mobile calls on their networks that were more favorable than those given to Orange, creating a "club effect" for the subscribers inside each network.

[4] In November 2011, after the complaint of Orange, the CCT fined TT and Ooredoo each an amount of TND 600,000 (about US$ 432,000) for differentiating on-net/off-net tariffs. "The existence of differentials in price of the calls made inside and outside the network connections marketed in the various commercial offers by TT and Ooredoo is not justified" (Conseil de la Concurrence de Tunisie, 2011; Decision n° 101238).

6. Period II: the non reciprocal MMTRs (2010–2013)

The INT opened up a new phase of MMTR regulation in the mobile-to-mobile market with three competitors in period II (Fig. 3). A higher MMTR was granted to the new entrant, Orange, for incoming calls to its network from TT and Ooredoo for the period 2010–2013.

6.1. Transitory bias

The INT pursued regulation of wholesale call termination but with asymmetric rates to minimize the financial burden on the smaller entrant since its outgoing/incoming call ratio (in minutes) might be significantly higher than the other providers. This competitive advantage was assigned by the regulatory body, justifying this non-reciprocal rate as follows: "Indeed, the fact that an operator has entered the telecommunications market later and therefore its market share is smaller than the other operators justifies the application of an asymmetry in its favor for a transient period" (INT, 2011a, p. 3).

As a result, the termination charges for the outgoing calls from Orange to the TT and Ooredoo networks, the former duopoly, could have a negative effect on its financial outcomes, and Orange would not be able to compete on equal terms in the retail market.

Nevertheless, the non-reciprocal rates granted to the third provider could be considered by TT and Ooredoo as an unfair competitive advantage and a market bias.

However, for the INT, the "International experience has shown that a new entrant can benefit from tariff asymmetry of call termination in its favor for a period ranging between three and five years" (INT, 2013a, p. 6). INT referred explicitly to the European Regulatory Group which substantiated the effects of non-reciprocal rates.

"Under some circumstances asymmetric mobile termination rates may be justified for example […] to encourage the growth of a new entrant in the market, which suffers from a lack of scale due to late market entry" (European Regulatory Group, *op. cit.*, 2008, p. 82).

However, in 2010, Orange decided to introduce its retail price for a mobile voice call at a lower level than its competitors.

Moreover, it established its subscription fees at minimum amounts with two prepaid SIM cards sold for only TND 5, and off-net/on-net grid per-minute voice call prices at TND 0.190/0.150, respectively, thereby becoming more attractive than its competitors (*see* Table 1).

In addition, after customers complete TND 10 of voice calls, they have access to the "unlimited calls" offer (2 h per call or 50 h per month) to another Orange mobile number until the end of the month. In 2011, the off-net per-minute price offered by Orange fell to TND 0.099, less than the regulated non-reciprocal MMTR, TND 0.101, that TT and Ooredoo pay for Orange (*see* Fig. 3). Obviously, for this small discrepancy, the former duopolistic providers did not react, but once the INT further reduced the non-reciprocal rate in 2012 to TND 0.064, they began to significantly decrease their off-net prices.

The market entrance of Orange has frankly paved the way for a genuine drop in prices, and caused an intense struggle between the MNOs to preserve their market shares. For example, Table 2 shows the commercial offers introduced in 2012 and the dozens rejected by INT as threats to the competition rules.

In fact, the regulatory framework requires the submission of commercial products prior to their being offered to the market. The *ex-ante* endorsement by the INT constitutes a mandatory rule for all providers.

After declining steadily, the off-net retail prices per-minute for all MNOs stabilized in mid-2013, at around TND 0.090, relatively close to the MMTRs (*see* Fig. 3), and in clear contrast with the price freeze in period I.

6.2. Regulated MMTRs vs. long-run average of incremental costs (LRAIC)

Since 2001, the *Telecom Code* has required that the interconnection tariffs proposed by the operators be established based on relevant estimated average accounting costs each year, allowing a period of three years with one renewal, for the operators to set up accounting records in accordance with this requirement. Although this deadline expired on April 14, 2007, the providers had not yet implemented this regulated accounting (INT, 2007, p. 3).

The fact remained that despite the several reminders sent to the providers to abide by this obligation, "they continue to present interconnection tariffs based on revenue considerations and not on regulatory audited accounts" (INT, 2008b; *op. cit.*, p. 3).

The operators' refusal to disclose their analytical accounting costs continued even after the entrance of Orange in the market in 2010. Indeed, the INT "proceeded, in the lack of accounting elements that enable it to verify the [interconnection] tariffs with the actual costs, and the adequacy of costs by the model of long-run average incremental costs in accordance with the regulations in force, to the study of tariff packages offered [by the providers] through the means at its disposal including international benchmarks" (INT, 2011b, p. 2). However, although simulations and international benchmarks (Debbichi & Ben Khalifa, 2013) can provide cost estimates, they cannot accurately identify the actual costs borne by the MNOs.

Table 2
Commercial offers and packages endorsed and rejected by the INT.

2012	TT	Ooredoo	Orange	Total
Accepted	76	62	41	*179*
Rejected	**28**	**13**	**20**	***61***
Total	*104*	*75*	*61*	*240*

Source: INT, Annual Monitoring Report, 2015, p. 16

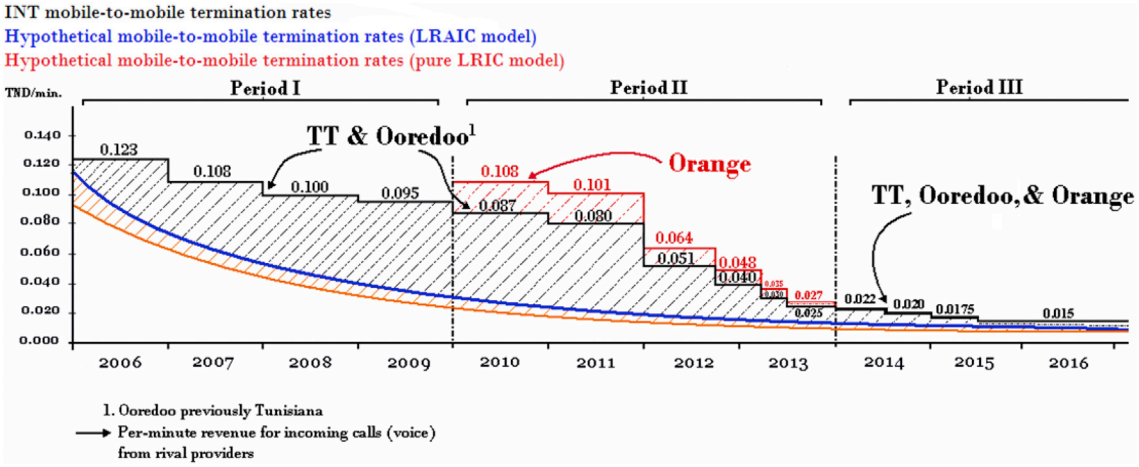

Fig. 4. Financial transfers under LRAIC and pure LRIC models related to the regulated MMTRs.

The regulatory body reported that Orange points out that: "under the retail tariffs carried by [Ooredoo], and its EBITDA margin, the level of termination rates of the dominant provider [Ooredoo] is estimated at TND 0.016 [nearly half of each regulated MMTR at mid-2013]" (INT, 2013a; *ibid*, p. 4).

If we consider the report by Orange of the real cost of the termination to be accurate, then the drop in the regulated MMTRs beginning in 2006 was at a slow pace.

In such a case, INT should continue dropping the regulated MMTRs since it agrees "that the mobile call termination rates approved in 2012 may produce financial transfers between operators since these rates are above cost reported from the audited financial statements and released by the providers' accounting" (INT, 2013a; *idem.*, p. 7).

The financial transfers between providers, mentioned by the INT, are due to regulated MMTRs higher than the LRAIC. Indeed, INT emphasized that: "The long run average of incremental costs (LRAIC) is that adopted by the INT [but not yet fully implemented] as tariff control mode to ensure the cost-basis of interconnection rates […]. The targeted termination rate should be that of an efficient operator, prompting all market players to effectiveness" (INT, Guidelines, 2009, pp. 30–31).

The persistent gap between off-net and on-net tariffs allows for additional provider revenues and impedes the fulfillment of an adequate consumer surplus. Indeed, based on an analytical study of the call prices commissioned by the INT, the average revenue per minute (ARPM) of an off-net call in the Tunisian market "exceeds at least twice the current [on-net and off-net] ARPM" (INT, 2012; *idem*, pp. 5–6).

As a matter of fact, the regulated MMTRs are greater than the MMTRs established from the LRAIC model, which are, quite high themselves in comparison of rates estimated from the pure LRIC model.[5] Even though there is no consensus for the pure LRIC as the adequate termination rates (Growitsch, Marcus, & Wernick, 2010; Valletti & Houpis, 2005), the regulated MMTRs by the INT are still high and allow the provider whose incoming/outgoing call ratio is higher than unity the cashing of a (n undue) financial transfer. In addition, the practice of regulating termination rates above LRAIC increases the tendency for dominance of the larger network provider (Cabral, 2010), Ooredoo, in the Tunisian case.

In Fig. 4, the hypothetical LRAIC curve, located below the official rates, and the pure LRIC curve, underneath the LRAIC curve, show the undue financial transfers (dashed zones) to the network that receives the net volume of voice calls.

The black shaded area represents the per-minute financial markup granted by the INT to providers receiving calls. In addition, the red shaded area represents the cost gap between the LRAIC and pure LRIC. Obviously, the financial markup of Orange is situated in the hatched area above the MMTR of its rivals.

During that time, Orange desired to continue the lower regulated MMTR that it paid to its rivals. It incurred financial losses since its entry in the Tunisian market for the entire period 2010–2014 (Orange, Annual Financial Report, 2015, p. 71), and apparently bore the costs of its outgoing calls to TT and Ooredoo networks.

According to the available data on voice call traffic, for the year 2015, Orange had to pay a net amount higher than TND 25 million (about US$ 12.5 million) to TT and Ooredoo to cover the differential costs between its outgoing and incoming calls. This amount represented more than 7% of the company's annual sales of mobile voice services (INT, Dashboard Mobile, 2015).

Obviously, Orange still requires the continuation of its favorable non-reciprocal MMTR, but this was scheduled to be discontinued from December 31, 2013 at midnight.

Indeed, the INT resumed its line of argument and assessed that "The asymmetric rates in favor of Orange are no longer appropriate since it is successfully positioned in the market by having a large subscriber base (2 million) in a short period of time (almost 3 years)" (INT, 2013b, p. 4).

[5] As a first approximation, and previously referred to as the Long Run Marginal Cost (LRMC), the "pure LRIC is an avoidable cost method which calculates the cost that could be avoided by the operator by no longer providing termination services to third parties" (Ofcom, 2011, p. 214).

7. Period III: symmetric MMTR for the three competitors (2014-)

The multiannual regulation of the interconnection rate was finally imposed with full reciprocity among all providers. Its acute path was immediately seized on by Orange to revisit the drop in retail prices, proposing a prepaid off-net per-minute price of TND 0.064. Its rivals responded more fiercely and prices followed a downward spiral to TND 0.042, TND 0.040 then TND 0.036 (Fig. 3).

However, most of those prepaid packages offering these low prices were applicable only for calls within 15 days. After the expiration date of automatic bonuses, the price per-minute became an inordinate TND 0.280, and even more than TND 0.300, and the subscriber only had a stockpile of less than 20 min to refill a card for TND 5. Other than heavy users, those packages were detrimental for light users who tended to refill a prepaid card twice a month.

7.1. The on-net traffic hypotrophia of Ooredoo

In May 2014, the World Bank published its own evaluation of the Tunisian telecommunications sector, reporting that the: "high price paid by consumers and firms translates into oligopolistic profits for Tunisie Telecom and Ooredoo Tunisie (formerly Tunisiana), and to a lesser extent Orange" (World Bank, 2014; *op. cit.*, p. 8). A few weeks later, the INT compelled providers to immediately convert their on-net bonus offerings to both nets. "All promotional offers, permanent options for each basic offer and the benefits grafted on core offerings as bonus must be marketed to all-net", and "unlimited" calls capped to 1 h per day.

Moreover, "Suppliers must reduce the gap in prices between off-net and on-net up to their equalization before January 1, 2016" (INT, 2014a; Decision n° 45, p. 5).

In practice, the INT directive led to the elimination of the so-called "club effect" even for bonus services. Its benefits were abruptly cancelled, consumers no longer chose sending calls only to others on the same network. The INT guidelines significantly altered the market structure, leading to the *hypotrophia* of the on-net voice traffic of Ooredoo, the dominant provider (Fig. 5).

Thus, a significant volume of its on-net calls rerouted towards off-nets calls. It suffered the most from the opposite variation of the on-net and off-net voice traffic. In April 2016, its ratio of minute calls fell to 3, whereas it had exceeded 12 two years earlier (Fig. 6).

The deflection of the traffic has been substantial for Ooredoo since it offered the highest volume of on-net bonus services, which were then converted to all-net call minutes by the INT directive. Indeed, the off-net voice traffic almost doubled, rising from 17.4% of all national voice traffic in 2014, to more than 31% in 2015.

The fierce fight among providers to preserve their market shares was not interrupted but rather reignited after the INT decision impacted the monopolistic segments of the market, namely, the networks of each provider. As a result, the providers could only keep their customers through low cross-net tariffs and/or innovative offers.

7.2. The ridge of the price war

The INT Decision caused the mobile market to overheated and experience its most intense price war yet. In early 2015, the per-minute price to all-nets offered by the operators in bonuses moved down from TND 0.036 to TND 0.031 then to TND 0.020, very

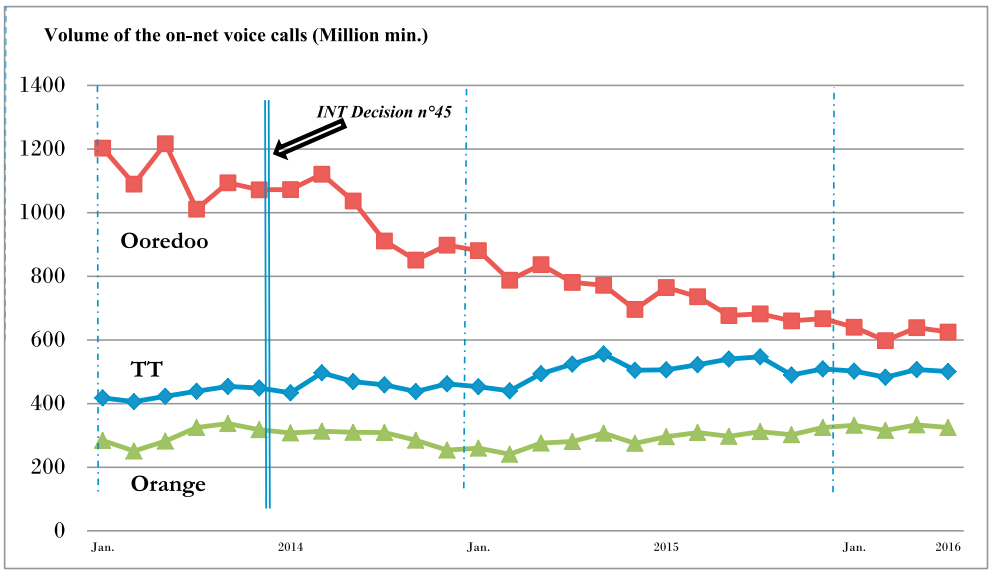

Fig. 5. Trends of the monthly mobile on-net voice calls in minutes for TT, Ooredoo, and Orange (January 2014 to April 2016).
Source: INT, Dashboard Mobile, 2014–2016

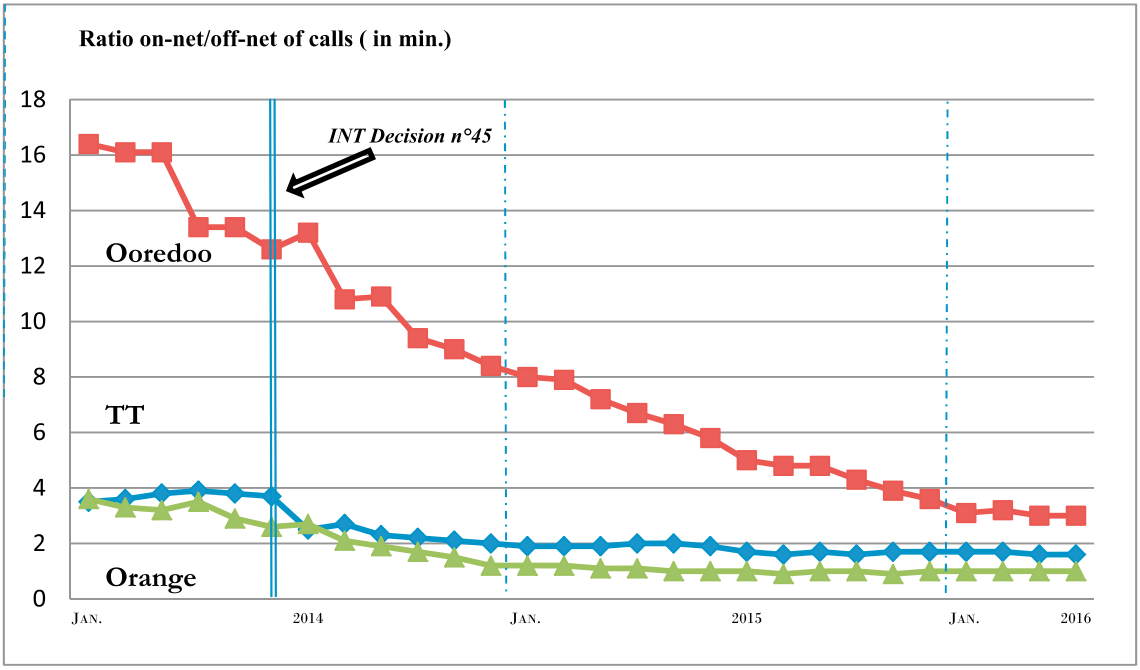

Fig. 6. Trends of the monthly ratio of the mobile on-net/off-net voice calls in minutes for TT, Ooredoo, and Orange (January 2014 to April 2016).
Source: INT, Dashboard Mobile, 2014–2016

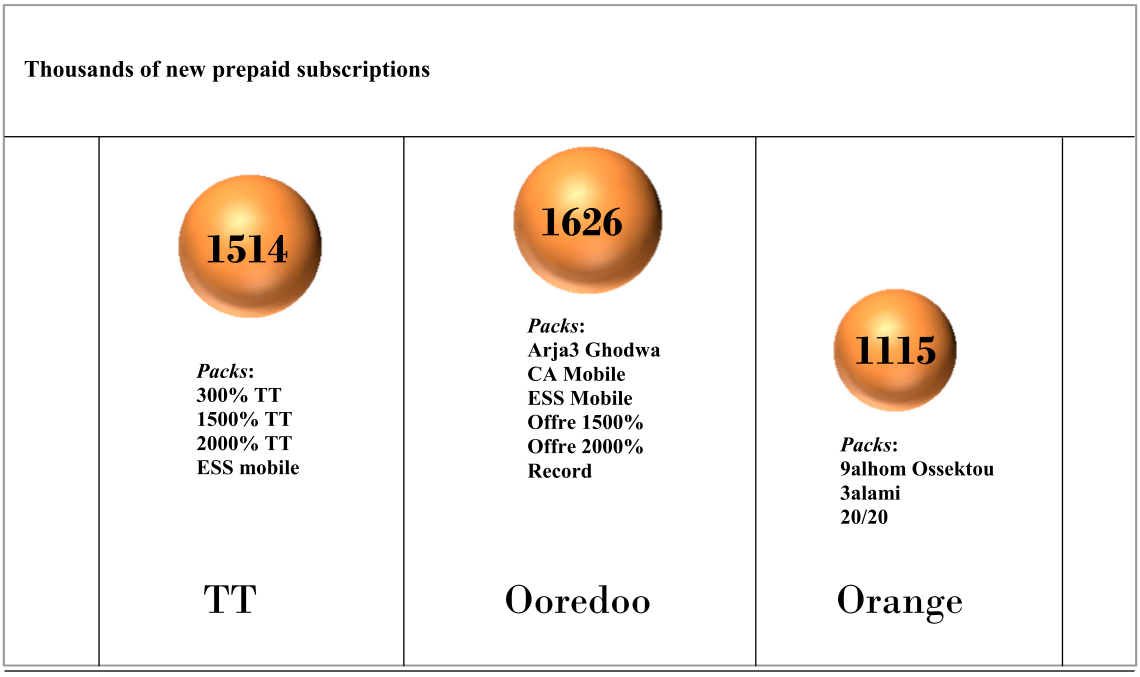

Fig. 7. Number of subscribers for the new commercial offerings introduced in 2015.
Source: INT, Dashboard Mobile, 2014–2016

close to the MMTR (Fig. 3). Ooredoo, the dominant provider, marketed the lowest per-minute price ever offered at TND 0.018 (SIM cards in a Limited Edition), just a few thousandths above the MMTR. Thereby, the MNOs flooded the market with new prepaid mobile packages to spur subscriber migration to their networks.

The commercial offers introduced in 2015 by rivals boosted the sales trends with more than 4.5 million new subscriptions (Fig. 7).

Table 3
The increase in the churn ratio by provider between 2014 and 2015. Nb. of subscription lost/no. of total subscriptions.

Churn ratio (%)	2014	2015	Variation %
TT	56,9	62,4	9,6
Ooredoo	35,0	42,2	20,5
Orange	68,2	75,1	10,1
Market ratio	*49,0*	*57,0*	*16,3*

Source: INT, Annual Monitoring Report, 2015, p. 16

Ooredoo attracted the greatest number of new subscriptions among the three operators, and the incumbents "1500% TT" registered more than 1.2 million subscriptions in the year. Given that the Tunisian mobile market had a total of 14.5 million subscriptions in 2015, this sales dynamic involved nearly 30% of the market.

Obviously, the new mobile phone sales included not only new customers, but also migrated subscriptions from the same MNO or from rivals.

This phenomenon of attrition, measured by *churn rate*, affected the providers differently (Table 3). However, the INT report does not distinguish the origin of the attrition that may be associated with the termination of one subscription with (or without) the implementation of a new subscription on a rival network, or the simple changeover to another offer from the same MNO.

Indeed, multiple subscriber transfers among MNOs have hidden subscription net losses and gains. At the end 2015, the price war led to a net loss of 580,000 prepaid subscriptions for Ooredoo and a net increase of subscriptions for TT and Orange of 219,000 and 653,000, respectively. This put the number of new subscriptions in 2015 at about 312,000 (INT, Dashboard Mobile, 2015).

This price war has clearly exhausted the rivals. Bouguila, the CEO of TT declared in April 2016 that: "The three operators suffer from the price war […] It is in nobody's interest that this downward spiral continues. […] The price per-minute that was between 2011 and 2012, of TND 0.180 would now be 0.031. The market cannot continue in this downward trend" (Boumiza, 2016).

This public statement was seemingly acknowledged as the end of the price war by TT, and agreed to by Ooredoo and Orange. Todays, the price per-minute of new subscriptions is normalized at TND 0.031 and the daily options at TND 0.025. These price levels will probably remain unchanged for the medium-term.

However, during the price war, total traffic moved in opposite directions for on-net and off-net calls (Fig. 8).

The increase in off-net traffic for both incoming and outgoing calls benefitted from the ban on the off-net and on-net price differentiation. A massive volume of calls flooded the Ooredoo network when TT and Orange marketed new cross-net-based offerings to their subscribers. Indeed, Ooredoo's extensive network coverage (45.7% in 2014) played a major role in the increase in its incoming calls. On the other hand, the relatively less density of the TT and Orange customers did not lead to a major increase in their incoming calls from Ooredoo's network when it marketed identical offerings (Fig. 9).

The dominance of the market defined Ooredoo's greater market share was decisive in the change of traffic. However, Ooredoo's incoming/outgoing call ratio was dampened after the end of the market upheaval in 2015 with the emergence of a uniform price.

Eventually, Ooredoo received positive revenue from the wholesale termination market as its incoming/outgoing call ratio (measured in minutes) remained, significantly, above one.

TT and Orange, having incoming/outgoing call ratios significantly under that, record negative cash balances in the wholesale market where the MMTR is identical for all operators as of 2014.

However, despite the positive earnings extracted from the wholesale market, Ooredoo complained to the INT regarding the determination of the MMTR. Notwithstanding the implementation of the quasi-LRAIC by the regulator, Ooredoo considered the method inadequate to estimate the real cost.

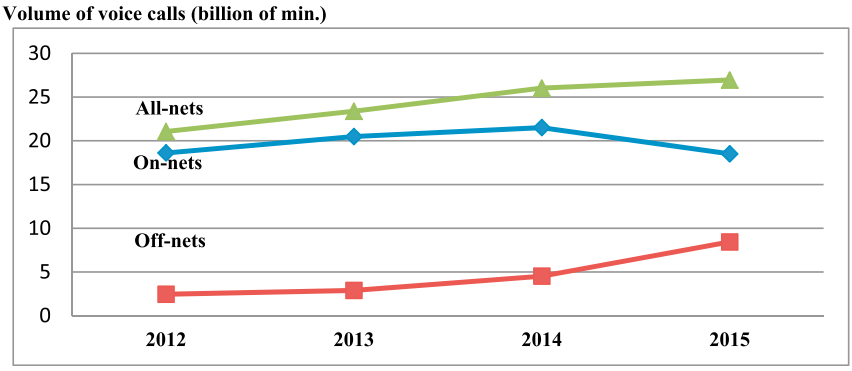

Fig. 8. Annual evolution of total on-net and off-net mobile voice calls in minutes.
Source: INT, Dashboard Mobile, 2016

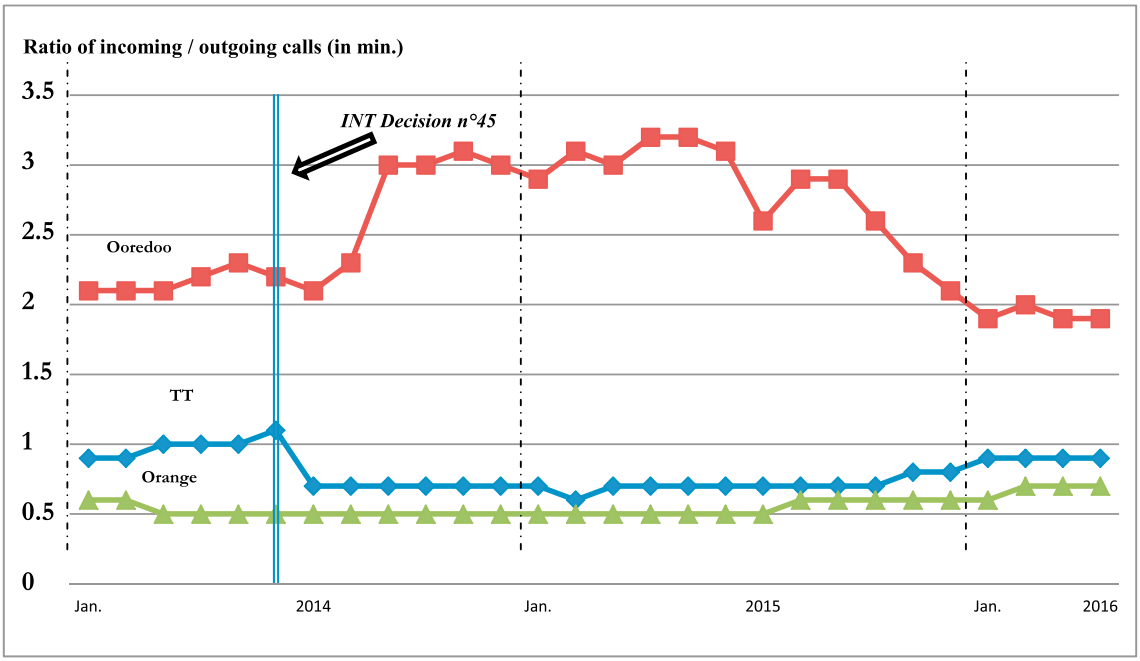

Fig. 9. Trends of the monthly ratio of mobile incoming/outgoing calls in minutes for TT, Ooredoo, and Orange (January 2014 to April 2016).
Source: INT, Dashboard Mobile, 2014–2016 & INT Annual Monitoring Report, 2015

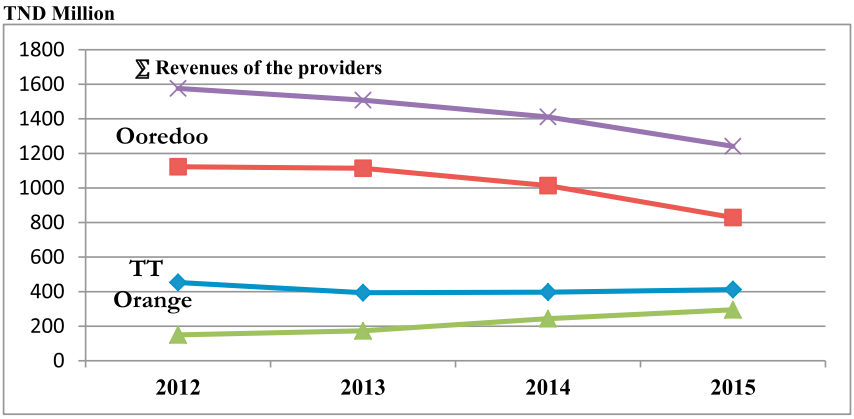

Fig. 10. Annual evolution of TT, Ooredoo, and Orange revenues in the mobile phone market (voice calls).
Source: INT, Dashboard Mobile, 2016

Thus, Ooredoo proposed that any license[6] acquired for the concession in the Tunisian mobile market should be integrated as a cost into the assessment of termination rates. It seems that as Ooredoo was seeing a decrease in its total revenues (Fig. 10), it not only wanted to maintain its positive revenues from the wholesale market, but also to increase these by pushing the regulated MMTR to the highest level. In contrast, "Orange considers that the application of the cost-oriented tariffs gives off a call termination rate less than TND 0.007 per-minute" (INT, 2014b, p. 3), and knowing that it is a cost source, suggested against a drop in the regulated MMTR.

The growth of the total mobile voice call traffic in 2015 associated with strong price reductions has certainly improved any consumer surplus, and reduced by the same amount the oligopolistic profit of the MNOs, pointed to by the World Bank.

[6] Mobile providers still have to pay annual license fees, the spectrum management flat fee to the *Agence Nationale des Fréquences*, and the numbering flat fee to INT, which amounts to a total of TND 45 million, about US$ 24 million (GSM Association, op. cit., p. 26).

8. Concluding remarks

To the best of our knowledge, this study is the first to report on the Tunisian mobile market experience and the wholesale MMTRs coupled with the dynamics of retail pricing. The facts were reviewed in order to offer unbiased assessments on the nature of mobile phone market competition. Indeed, the retail price competition was highlighted in terms of chronological events.

The study also provided a description of the MMTRs after the liberalization of the Tunisian mobile sector through current day.

However, to present a clear valuation of the relevant market for mobile voice calls, we ignored Internet offers included in commercial products. This is the case of Orange since its market entry, followed by its competitors with similar 3G licenses.

On another level, the Tunisian experience has shown the reluctance of the providers in a duopoly market to lower retail prices even when the *ex-ante* regulated MMTRs were decreasing. The struggle among the MNOs was only initiated when a third entrant drove the fall in prices.

In addition, when the new entrant enjoyed a beneficial MMTR vis-à-vis its rivals, this constituted, simultaneously, a competitive incentive or bias, depending on the viewpoint of the new entrant or its rivals, leading to a market upheaval.

Ultimately, the trigger for the contraction of the oligopolistic profit was indisputably the INT Decision n° 45. The elimination of the incentives for on-net calls and their bonuses significantly transformed the market dynamics, leading to the mitigation or even the cancellation of the monopolistic nature of the on-net traffic.

It is worth noting that the providers ensured more intense voice traffic at the end of the price war, and, as this lowered their earnings, it follows that the price elasticity of demand was not, in absolute value, unitary, but rather slightly less than one. This then gives more credence to the value calculated for the Tunisian market by the GSM Association (2016, *op. cit.*, p. 46), which is: $e = -0.88$ and reduces the scope of our previous argument on the absence of collusion.

The price war, although intense, lasted only a few months and the final per-minute price for all-nets nonetheless remained profitable as all the providers generated profits in 2015.

Eventually, the instrument of the *ex-ante* regulation of the MMTRs by the multiannual regulation of interconnection rates seems to have been insufficient to implement dynamic competition in the retail market. The Tunisian mobile market, currently competitive, with three mobile network operators, TT, Ooredoo, and Orange, matured only after imposing regulation on the providers and strict market adjustments carried out by the INT.

Our study avoids the consideration of termination rates for traffic involving fixed networks and as such, this might affect our arguments and findings. This could be addressed in further studies.

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