Essais in economics of telecommunications : competition between services and between firms

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Essays in economics of telecommunications: competition between services and between firms

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General introduction

Imagine today's world without any information and communication technologies (ICT). Societies would not use Internet, smartphones or computers. People would not communicate via easy and quick E-mail and visioconferences would actually take place in one and the same room. Many things people nowadays consider as perfectly integrated in everyday life would simply not be available.

By simply looking, in contrast, at the reality of today, the impact of ICT on people's life becomes strikingly clear. The ICT, as a general purpose technology, turn out to be a pillar of the economic development of our societies.

From an economic point of view, many studies have provided the empirical evidence: 37 % of the growth of the gross domestic product generated in the US between 2005 and 2010 are attributed to the ICT. For the German case, this number is about 32 % and 26 % in France (Arlandis *et al.*, 2011). But not only does the consumption and usage of ICT affect economic growth, but it also has considerable spill-over and network effects. For instance, by learning how to efficiently use the ICT, the labour force in general increased its productivity by 1.3 percentage points in the US and by 0.7 percentage points in the EU during the period 1997 - 2005 (Welsum *et al.*, 2012). Also, as Maliranta *et al.* (2010) showed, the high Finnish labour productivity, linked among others to the development of ICT, induced a beneficial creative destruction and a more efficient use of resources.

Closely behind the device manufacturing ranks the telecommunications sec-

tor as the most important component of the ICT industry, with up to 37 % of the GDP generated by the European ICT industry in 2010 and almost 20 % of ICT employment (approximately 1 million jobs).[1]

Alongside the political will to unleash the potentials of ICT and the telecommunications sector - see for instance the EU's Digital Agenda from 2000 and the Commission's proposal for a Connected Continent from 2013 -, public decision makers largely relied on sector-specific regulation. In their view, the introduction of a competitive setting could release those potentials and thus benefit the whole society. But, since the formerly vertically integrated monopoly has no private incentive to encourage competition, public decision makers relied on regulatory power to achieve their objectives.

It is a well-known fact that the duplication of a nation-wide network infrastructure that builds on an identical technology as the existing one is economically not viable because of the extremely high sunk costs. The latter may constitute insurmountable barriers to entry for new market players and induced the idea of the ladder of investment, which has been theorised by Cave (2006a): competition in the whole industry should be encouraged in a stepwise manner. It should first take place on the service layer via regulated access to the incumbent's physical fixed infrastructure. This should allow new entrants to provide telecommunications services offers by using the incumbent's network. Once this is achieved, competition should climb up to the next industry level, namely the infrastructure layer, thus creating facility-based competition. To that end, downstream competitors should invest in their own infrastructure using new technologies.

Whereas service-based competition is undeniably achieved in Europe, the recent emergence national subsidy plans to help the deployment of new broadband technologies indicate that the mechanism behind the ladder of investment

[1] Source: `Eurostat`'s *Statistics Explained*. Accessed last: 19/11/2014. Similar numbers are found for the data provided by the US Bureau of Economic Analysis (`BEA`).

does not perfectly work.[2] Facility-based competition in the fixed communications market is thus not yet achieved and it seems that competitive forces are insufficient to achieve this objective. Some papers investigate the relevance of Cave's concept for achieving broadband investment. Whereas some of them state that service-based competition is necessary for reach facility-based competition (Oldale and Padilla, 2004), others put its mere existence into question (Bacache *et al.*, 2013).

A first area of application of sector-specific regulation is thus price regulation of the access to the incumbent's fixed network. But the market of mobile communications is subject to regulatory intervention on prices, too, even though much later than the fixed counterpart. In particular, the mobile termination rates, basically under the network operator's scrutiny and thus monopolistic, were, for some time, unregulated because competition in the mobile market was thought a sufficiently strong force to drive them down. Though, these rates remained at a high level until regulators intervened. But, the waterbed effect, i.e. an effect under which end prices for communications increase due to termination rates reductions in order to keep profits unchanged, occurred. However, with the evolution of the calling pattern, in particular the increase of mobile usage and thus the number of mobile-to-mobile calls, the waterbed-effect vanished and final prices decreased. Similarly to the mobile termination rates regulation on a national basis, regulatory instances seek to push roaming costs, i.e. costs for calling when traveling abroad, down to 0.

As the European Digital Agenda and the Commission's regulatory proposal for a Connected Continent show, sector-specific regulation does no longer almost exclusively deal with the proper enhancement of competitive forces in order to achieve lower end user prices. In effect, regulators and legislators are

[2] See for instance the `website` of the German federal ministry for traffic and digital infrastructure, providing information on the financing of broadband deployment. Similar information is provided by the relevant French ministry's `website` and by the relevant Belgian `ministry`.

appealed to attack several fronts, such as effectively promote a single digital market and the emergence of pan-EU mobile service operators or protecting the Open Internet.

Regarding the single digital markets, many challenges lie ahead, among which the most complicated are going to be the creation of a harmonised environment in spectrum allocation matters, a unified pricing schemes and pan-EU consolidation. At present, the 28 member states often have very complex auction designs for assigning the spectrum, an essential facility for mobile communications. This complexity incurs considerable transaction costs and end up in very high expenditures for mobile operators. With a single, harmonised environment, mobile operators could more easily implement their business outside their national market. Although, to date, Europe's mobile communications market appears highly fragmented if the number of service providers may be used as an indicator. In Europe, the Herfindahl-Hirschmann index for the mobile industry ranges from ± 2500 (Poland) to ± 4400 (Malta), whereas that index for the whole US yields ± 2300 (GSMA, 2013b). The investment capacity necessary for eventual market consolidation, and thus for increased success probability of a pan-european undertaking, may not be present. Finally, a unified pricing scheme for each operator throughout the EU seems a highly complicated task. Indeed, aligning prices in Romania (average cost of 2.2 € cents for a domestic call) and in France (12.7 € cents) may reveal challenging.[3]

The core of the problem relative to the protection of the Open Internet is the concept of net neutrality, introduced by Wu (2003). The idea behind this concept is the non-discrimination of any data packet that travels through the Internet. More specifically, a network operator should not be allowed to discriminate contents sent over its network, even if they require many resources. Since these resources are represented by bandwidth available through the ca-

[3] See Commission's press `release` on average call price in the EU from 6th August 2013.

bles paid and deployed by the network operator, the latter sees itself entitled to monetise the usage of its *pipes*.[4] Moreover, the irrevocable evolution of end user pricing towards flat-rates, which additionally know considerable price decreases, has led network operator to turn towards applications and content providers for new revenue streams.[5] Network operators and applications and contents providers evidently disagree, as neither side wants to be the only one to contribute to the network expansion and each side invokes arguments relative to investment and innovation incentives.[6]

Finally, it should be noted that the debate also raises problems from a judicial point of view. For instance, in its 2013 proposal the European Commission, defined *specialised services* that may benefit from a prioritised treatment by network operators. The underlying definition invokes *enhanced quality of service* for these specialised services, without defining any threshold, leaving thus many space for interpretation and many ahead lying discussions.

In the US, the problem does not lie in the definition of some service allowed to benefit from a favoured treatment, but in the question as to who has the relevant regulatory power. Indeed, the Federal Communication Commission (FCC) released in 2010 an order aiming to prohibit any unequal treatment

[4] Expression used by Ed Whitacre, former CEO of AT&T in a `Bloomberg` interview on the competitive and regulatory environment in the American Broadband industry.

[5] The two-sided market literature showed that the platform (which here are the Internet service providers) prefers to set low prices for the side that is most valued, while the other side somehow cross-subsidises (Armstrong, 2006; Rochet and Tirole, 2006). It is often mentioned that end users are the most valued side, as they provide advertising revenues to content providers. In this light, the fact that network operators turn towards content providers in order to monetise the latters' access to consumers appears consistent.

[6] Several academic paper are also dedicated to this debate with the idea to describe the incentive to innovate and invest of network operators as well as content and applications providers. For instance, Wu (2003) considers that innovation at the applications and contents layer is more important than innovation at the network layer and concludes that a net neutrality regime is welfare superior. On the contrary, Yoo (2010), considers that a non-neutral regime is superior, since the allocation of scarce bandwidth to the most efficient is simply the *natural evolution of a network trying to respond to an ever-growing diversity of customer demands* (Yoo, 2010). Other authors also conclude on welfare superiority of a discriminatory regime, because of a larger variety of quality of service and contents, reducing thus the risk of exclusion of applications that only need a low quality of service Hermalin and Katz (2007) or because investments at the network layer is enhanced, reducing thus the network congestion Bourreau *et al.* (2014).

by Internet service providers.[7] This order, however, has been annulled by the US court of appeals, arguing that the FCC chose not to classify broadband as an telecommunications services, but as an information service.[8] Following the US Telecommunications Act of 1996, though, the FCC's power is restricted to telecommunications services. Informations services are thus not under the scrutiny of the American federal regulator. There is now on ongoing reflexion on whether to reclassify broadband services, so that they fall under the FCC's mandate, and more generally on the FCC's mission in the Internet age.

As mentioned above, many discussion lie yet ahead, as solution to important issue are still unclear. Although, the telecommunications sector has been conferred an important role and it is therefore of crucial significant to analyse and understand the underlying economic specificities of that industry. The aim of this thesis is thus to contribute in that it focussed on two major topics that can be classified within the area relative to the competition in the telecommunications sector.

Competition between communication services

The first two chapters of this thesis focus on the competition between fixed and mobile communications services. This competition arose as an increasing number of fixed communications services have also become available on mobile networks.

The emergence of Fixed-Mobile substitution

On the demand side, service competition began in voice services. As mobile telecommunications services are experiences goods and due to both price and non-price factors (e.g. poorer quality of service, geographical network coverage or simply the handiness of the mobile phones available at that time), mo-

[7] The FCC's "Open Internet Order" can be found here.
[8] See here for a Reuter's article on the subject.

bile subscription rates were low.[9] As network coverage and quality improved, Fixed-Mobile substitution (FMS) took place and began with the substitution of the subscription of a second fixed telephony line by the subscription of a mobile plan. Then, FMS in voice service matters continued to expand. But this expansion has also been fostered by technological advances. Marketing and pricing strategy like on-net calling (where a user incurred no costs when the call was placed within the same network) or as is nowadays often the case, unlimited calling regardless of the terminating network are also explaining factors. Most recently, mobile operators introduced unlimited calling from mobile to fixed networks. Consequently, national calls, whether terminated on a fixed or a mobile network, are increasingly originated on a mobile network. Following the European Commission, mobile voice traffic overtook fixed voice traffic during 2008 - 2009.

The number of services available simultaneously on both infrastructures continued to expand as technology evolved. Within 40 years, 4 technological evolutions have been developed and successfully marketed. But the most impressing evolution took place in the last 15 years with the emergence of three technologies: GSM, UMTS and finally LTE.[10]

Technological evolution in mobile communications matters

Such technological evolution did not only impact voice services, but also allowed to introduce new and innovative services, with mobile broadband upfront. Mobile broadband has benefitted from the technological evolution as connection and transmission speeds have constantly improved. The latest tech-

[9] At the beginning of the 1990's, the weight of a mobile phone ranged from 250 gr. up to 500 gr.

[10] GSM: *Global System for Mobile Communications*, arrived at the beginning of the 1990, is the basis for the more efficient GPRS (*General Packet Radio Service*), introduced around 2001 and EDGE (*Enhanced Data rates for GSM Evolution*), introduced around 2004.
UMTS: *Universal Mobile Telecommunications System*, with the extension HSPA (*High Speed Packet Access*), introduced by 2010.
LTE: *Long Term Evolution*

nology, LTE will allow mobile users to surf the web at theoretical download speeds approaching 100 Mbps when in motion.[11] Such data rates are sufficient to allow for instance, IP-TV on mobile devices or mobile visioconferencing.

The most widespread mobile broadband technology to date is HSPA (commonly known as 3G+), which covers practically 100 % of Europe's population (Commission (2013), p. 73). Although, Europe's penetration rate is, on average, relatively low compared to other parts in the worlds: considering all the possible connecting devices (smartphones, tablets and laptops), 54 % of Europeans have subscribed to a mobile broadband plan by the end of 2012 (*idem*, p. 74), whereas, for instance, South Korea's penetration rate is approaching 110 % (GSMA (2013a), p. 30).[12] Note however the diverging picture in Europe: the Nordic countries announce a mobile broadband penetration rate of close or above 100 % (Danemark: 98 %, Sweden 106 %, Finland: 107 %) and 18 of 27 EU member states have penetration rates below the EU average (Commission (2013), p. 74).

Increasing mobile subscription and evolving pricing schemes

With increasing mobile subscription take-up rates, network operators enjoyed economies of scale and scope, ending up in a decrease of average cost of services and hence mobile plans. But economies of scale and scope were not the sole factor for decreasing mobile communications prices. Increasing competition also plays a major role. For instance, in January 2012, Free Mobile entered the French mobile communications market as the fourth mobile network operator.[13] Free Mobile was launched with an aggressive pricing policy and triggered

[11] However, such download speeds rate are contingent to many factors, e.g. the consumers' handset, the operators' frequency used for LTE deployment, the type of antenna installed by operators, the number of consumers connected to a given cell, etc.

[12] GSMA (*GSM Association*) is an association representing the interests of over 1000 mobile telecommunications operators using the GSM standards and aiming to elaborate and promote cross-network standards such as e.g. the usage of SIM-cards.

[13] If mobile virtual network operators are added, the French metropolitan market counts not less than 47 operators (all markets confounded, residential and professional). Even

the low-cost era in the French mobile industry. In order to illustrate, the average monthly bill for mobile services can be mentioned: the average bill was approximatively 23 € before Free's market entry and, following ARCEP, about 18 € by the end of September 2013 (Arcep, 2014b). Another reason explaining the decrease of mobile communications plans is regulatory intervention that induced a considerable decrease in mobile termination rate.[14]

The aforementioned technological evolutions have also come together with evolving pricing schemes. For instance, with the packeting technique introduced with GPRS, the tariff scheme passed from a connection basis towards a consumption basis. Said otherwise, before GPRS, the consumer had to pay for the time he was connected as his connection required the occupation of a full "line" during his connection time, which was due to the *circuit-switching* technique. With GPRS, the network evolved towards *packet-switching* which allows the sharing of the line between several connected users. The fee to pay by the user in a packet-switching infrastructure is therefore based on the information effectively sent or received, and thus based on the effective consumption.

It should however be noted that evolution in communications networks does not constitute the only factor responsible for the evolution of the communications' ecosystem. In order to fully benefit from the advantages provided by improved networks, consumers need compatible handsets. The industry of mobile devices such as smartphones and tablets has reacted towards new possibilities provided by mobile communications networks and developed handsets that are no longer simple telephones. This new generation of handsets offers

though most of the MVNOs are specialised in a given market segment (e.g. seniors, foreigners, etc.), they altogether represented 11,6 % of the French market by june 2014 (Arcep, 2014a).

[14] Mobile termination rates can be defined as the fee an operator $\mathcal{A}$ has to pay operator $\mathcal{B}$, when a call, originated in $\mathcal{A}$'s network, is terminated in $\mathcal{B}$'s network. Relying on figures provided by the Body of European Regulators for Electronic Communications (BEREC), GSMA indicates an annual decrease of up to 18 % of mobile termination rates during the period 2006 - 2012 (GSMA (2013a), p. 36).

usage possibilities similar to desktop computers thanks to increasing user-friendliness (e.g. illustrative icons) or technical efficiency (e.g. more efficient processors, displays with higher resolution). Users experience thus a higher quality of service when for instance watching a film on their tablet or smartphone. Furthermore, content providers such as social networks, video or music streaming developed applications that allow users to consume these contents on any mobile device, which increases consumers' utility of subscribing to a mobile offer.

Increasing mobile data consumption

Alongside increasing mobile subscription penetration, mobile device penetration rates are strongly increasing and are assumed to contribute greatly to the increase of mobile data traffic. Cisco provides a report and forecast of mobile data traffic and indicates that, in 2012, it increased by 70 % and that 885 petabytes per month have travelled over mobile networks, which corresponds to *18 times the size of the entire global Internet in 2000* (Cisco (2014), p. 1).[15] Moreover, Cisco estimates mobile data traffic to grow at a rate of 66 % per year during the period 2012 - 2017 (*idem*, p. 3). This traffic growth will be fostered by i) further deployment of LTE network ("*In 2012, a [...] 4G-connection generated 19 times more data traffic on average than a non-4G connection*, (*idem*, p. 2)) and ii) the increasing importance of smartphone penetration (about 68 % of global mobile traffic will be generated by smartphones (*idem*, p. 7)).

Although mobile broadband will continue to gain in importance, it will only represent a fraction of global Internet traffic. As Cisco (2013b) reports, mobile data traffic does merely represent 2 % of global IP traffic in 2012 and about 9 % in 2017. Most of the Internet traffic will thus be put through

[15] 1 petabyte (Pb) = 1000 terabyte (Tb) = 1000 Gigabytes (Gb). For comparison, a 2 hour film in HD needs about 4 Gb.

the fixed Internet access, resp. fixed broadband, which has the undeniable advantages of i) offering higher connection speeds than mobile broadband and ii) unlimited data volume.[16] This latter advantage, however, is due to the scarcity of the radio spectrum available to mobile operators for providing their mobile services, which reduces their capacity to offer high volume caps of mobile data.

Technological evolution if fixed communications matters

As did mobile networks; fixed networks have been upgraded as well. The traditional copper network, which, in its early beginning allowed for analogue voice services and narrowband Internet access, has also been subject to constant evolution. The copper pair benefitted from the digitalisation and the information sent over a fixed network is thus converted into data relying on the *Internet Protocol* (IP). This allowed steadily increasing bandwidth efficiency and an enhanced range of services: *Voice over IP* (VoIP), *IP-TV* with *catch-up TV* or *VoD* and high-speed Internet.[17] With the upgrade towards optical fibre network, fixed networks will be able to offer connection speeds up to 1 Gbps for downlink and 10 Mbps for uplink.

With the latest technologies deployed in mobile and fixed networks, both infrastructures converge. This convergence towards *all IP* implies a changing relation between fixed and mobile services. As mentioned above, voice services are subject to increasing substitution between fixed and mobile: in early 2011, around 27 % of the Europeans stated to use mobile voice services exclusively against 21 % by the turn of 2005 / 2006 (Eurobarometer, 2006, 2011). As for the US, a NHIS survey reveals that almost 45 % of American households were

[16] In its report from 2012, only one of the surveyed operators had a data volume cap on fixed data volume (OECD (2012), pp. 22).

[17] *Video on Demand* is a service allowing consumers to watch any TV Show at any time they want, provided that the show is comprised in operator's VoD catalogue. *Catch-up TV* is defined as the possibility to replay a TV show even shortly after its first airing, although only for a short period of time.

wireless-only in the first semester of 2013, against approximatively 6 % by the turn 2005 / 2006 (Blumberg & Luke, 2007, 2014).

As for broadband, the relation between fixed and mobile is less clearcut as it can go in either direction.

Fixed-Mobile substitution in broadband matters

Assessing this relation on the demand side is delicate given the heterogeneity of consumers' needs. Some consumers are able to satisfy their consumption needs by using only a mobile offer. For instance, according to an international comparison made by the british regulator OFCOM in 2012, more than a quarter of Italian households only have mobile broadband at home (OFCOM (2013), p. 213).[18] Similarly, one in five Australian households indicate to be mobile-only broadband users. On the other hand, some consumers are *heavy-players* in Internet usage and are subscribing to both fixed and mobile in order to enjoy more data capacity.

The only evidence for actual FMS in broadband matters, that is approved by a national authority, is provided by the Austrian market. During its revision of relevant markets in 2009, the Austrian national regulatory authority TKK considered mobile broadband to be "[...] *a sufficiently close substitute for DSL and cable connections* [so as] *to include all of them in the same retail market.*" (Berec, 2011).[19] Given this finding, TKK decided to withdraw ex-ante regulatory constraints on residential wholesale broadband access.

[18] *Office of Communications.*

[19] *Telekom-Control-Kommission.* TKK based their finding on i) a forward-looking consumer switching behavior and ii) their past switching behavior. The forward-looking approach relies on the *hypothetical monopolist*-test which assesses whether a 5 to 10 % price increase would be profitable for the concerned undertaking. Under such a price evolution of all available DSL and cable offers, 25 % of respondents said they would switch away from DSL, resp. cable, among which almost half would switch for mobile broadband. Analysing the past switching behavior revealed that the flow from DSL and cable towards mobile has been stronger the flow in the opposite direction. Moreover, TKK reports that 31 % of households without Internet access would subscribe a mobile broadband offer, whereas only 17 % would subscribe to DSL and 13 % to cable.

Fixed-Mobile substitution on the supply side

On the supply side, mobile and fixed networks are most likely to be complements, because mobile networks only allow for limited capacity and putting the global data traffic only through mobile networks would likely to be unsustainable. As consumers' demand in data traffic is increasing steadily, telecommunications operators need fixed networks to discharge their mobile networks and to ensure a given level of quality of service. They can do so by diverting data traffic that has been initiated on a mobile network to a fixed network.[20]

Evidently, consumers could not benefit from the technological evolutions described above if telecommunications operators had not invested in infrastructures. Deploying such network infrastructures bears tremendous investments costs.[21]

High investment costs and fierce competition in both service markets pushed operators to adopt strategies that allow i) to attract new consumers, respectively to reduce existing consumers' willingness to churn and ii) to foster adoption of new infrastructures. This latter point is especially important when taking into consideration the *wireless-only* consumers and the investment costs in fixed network infrastructures. Moreover, its importance increases even more given the fact that, so far, no innovative services (the so-called *killer services*)

[20] Diverting mobile data traffic is possible through promoting *Wi-Fi Offload*, by which the consumers connect a handset device, via Wi-Fi, on a fixed broadband network. In some countries, operators offer their fixed broadband subscribers the possibility to "open" their fixed broadband access, creating thus a Wi-Fi-community, which allows mobile users from the same operator to connect their handsets to that "opened" access via Wi-Fi. Another means of traffic diversion is *FemToCell*, which can be defined as an extension of fixed broadband network. Via a "miniature base-station" connected to the fixed access, operators can increase or improve the mobile network signal. The demanded data is, however, handed over to the fixed network.

[21] In France, total investment costs for the deployment of a nation-wide optical fibre network are estimated around 20 to 30 billion €. The costs of upgrading the mobile network to LTE is delicate to estimate as this depends on each operator's existing equipment in the base stations. However, consultants from PolyConseil estimate the upgrade to cost around 2 billion € for the incumbents Orange, SFR and Bouygues and about 1 billion for the entrant Free Mobile. Besides the costs for this infrastructure upgrade, the necessary licenses had to be acquire, for which the four operators paid 3,5 billion €. Find PolyConseil's report here.

have been developed that create a consumer's need and thus an incentive for him to subscribe.[22]

Service bundling as marketing innovation

One adopted strategy is service bundling. In the telecommunications sector, service bundling exists under various forms. In the mobile segment, almost any offer can be considered as a bundle of a given amount of minutes for calling, text messages and a some limited data volume cap. Similarly, in the fixed market, almost every operator offers a complete range of service bundles that combines two out of three or all three possible services (fixed voice, fixed broadband and TV). Dual-play offers, i.e. a basket of two out of three services, are most popular in Europe with around 25 % of Europeans followed by triple-play offers (16 %, Eurobarometer (2013), p. 26).

The latest evolution in bundling practises is the combination of mobile and fixed services in one offer. On a European level, such offers have yet not been massively subscribed (approx. 4 %), but many divergences exist between European Member States. In some countries, quadruple-play offers do not seem to attract much of consumers' interest, as, following a report Analysys Mason report of 2013, it is estimated to see around 10 % of fixed services subscriptions to be bundled with mobile services in Germany, Poland or the UK.[23] However, in other countries, quadruple-play offers get much attention from consumers. In Spain, for instance, the commercialisation of Telefònica's quadruple play offer *Fusiòn* incited 21 % of Spanish households to bundle mobile and fixed broadband by 2012 (and its adoption rate is estimated to double in 2017).[24] French households also seem to be fond of quadruple-play offers, as the subscription rate is estimated at 42 % in 2012 with potential to

[22] Examples for such killer services in mobile communications are voice services for 2G and mobile broadband for 3G.

[23] See `here` for a brief summary of Analysys Mason's report.

[24] *idem.*

increase up to 75 % in 2017.[25]

For consumers, the interest of purchasing a bundle of services is multiple. Besides increased simplicity, transparency and a reduced number of bills, they also pay less, since bundles are offered with the discount on the individual (stand-alone) prices. For undertakings, however, the effects of discounting are not always clear-cut. The (short-run) success of Telefònica's Fusiòn and also in the French market Orange's quadruple play offer Open and Free Mobile' offer is although palpable. In particular, Telefònica managed to recoup all its 2011 / 2012 losses in terms of customer base within a few months after launching *Fusiòn*.[26] As for the French market, within approximatively 3 years after launching its quadruple-play offer, Orange claims to have around one third of its fixed broadband customer base switched to the quadruple offer and it is estimated that around half of Free's customer base subscribed to the bundle.[27]

Although, the practise of discounting may have an important drawback. More specifically, mobile broadband has been the value-added service for operators when mobile plans with 3G access have been marketed. Now, this value-added service is part of a competitive race for market shares and increased consumer loyalty. As consumers are rational in the sense that they choose the least expensive offer that best suits their needs, discounting may lead to reduced market value of broadband services. But, all operators in a (given) market introduce bundled offers, which raises the question whether such pricing strategies are profitable or not.

[25] *idem.*

[26] In 2011 / 2012, the Spanish incumbent abandoned the system of terminal subsidies, upon which over 1 million consumers left Telefònica for one of the competitors. See for instance here.

[27] Source: LaTribune.

Chapter 1: Service bundling and Fixed-Mobile substitution

The first chapter of this thesis addresses this issue and analyses the potential impacts of service bundling in the telecommunications industry given FMS. In particular, via a micro-economic modelling, it analyses the impact of introducing a bundle discount on consumer demand for the Fixed-Mobile bundle, fixed and mobile as stand-alone services and the demand for *wireless-only*. Moreover, the effects on operators' profits are analysed as well as social welfare.

This analysis considers two multi-market firms and shows that, under symmetry, service bundling is a situation akin to a prisoner's dilemma: in equilibrium, neither firm wants to, but both have to offer a bundle as a consequence of individual incentive to do so.[28] Firms lose profits even though the share of consumers subscribing to both services increases (i.e. the number of wireless-only consumers decreases upon introducing a discount). But, with the discount acting as a competitive tool, operators attract more consumers towards their bundle. Since the bundled price is lower than the sum of stand-alone services, profits are reduced. Consumers on the other hand are better off, precisely because of the discount. Hence, consumer surplus increases and the increase of consumer surplus more than compensates the operators' profits losses, such that, at the end, social welfare increases.

Although, if one firm is able to provide a higher-valued fixed service (i.e. if firms are not symmetric), the analysis shows this firm always increases its profits when offering a discount, whereas bundling is a *Maximin* strategy for the competitor: it minimises its losses when it bundles as well. Notwithstanding, the firm with the higher-valued fixed service has no incentive to induce all the wireless-only consumers to subscribe to fixed service as well. Indeed, the presence of wireless-only consumers implies that the fixed services market

[28] Symmetry between firms is assumed to occur when consumers have the same valuation for fixed services regardless the firm that offers the product.

is not fully covered. With a fully covered fixed market, bundling would not be a profitable strategy. Hence in equilibrium, operators will not offer a discount when both markets are fully covered. Moreover, if both services were perfectly substitutable, bundling would again not be profitable. This shows that bundling is profitable for at least one firm, provided that fixed and mobile service are neither too strong complements, nor perfect substitutes. Similarly to the symmetric case, consumer surplus and social welfare increases.

Chapter 2: Socio-demographics and telecommunications

Fixed-Mobile Substitution is also at the core of the second chapter of this thesis. Chapter 2 attempts to empirically assess the impacts of socio-demographic variables on the demand for telecommunications services in France.

Data from a consumer's experience survey is fitted using a multinomial logit model. This work seeks to identify what characteristics influence the probability of a consumer to be wireless-only, to purchase a bundled offer or several stand-alone service offers. Primary results confirm the findings of the existing literature: the less revenue a consumer has, the more likely he/she is to be wireless-only which suggest the existence of a stronger budget constraint for these consumers. Another result suggest an incumbency advantage, especially in rural areas, in the sense that Orange's consumers are less likely to be wireless-only as customers from other market players.

The interaction of sector-specific regulation and competition law: the case of margin squeeze

Chapters 1 and 2 focus on competition between services, which can also be considered as inter-platform competition or infrastructure-based competition. But, at the beginning of the liberalisation process in the late 1990's, competition took place on the fixed infrastructure, as mobile networks had, to that

date, not yet been sufficiently deployed to exert a competitive pressure on fixed networks. Thus, intra-platform competition was the first notable form of competition in the telecommunications sector. Sector-specific regulation has its part in this event.

Besides regulatory constraints, firms must also comply with common competition law. However, the interaction between regulation and competition law can have important impacts on the industry outcome. The next chapter aims at analysing this interaction and its impacts by looking specifically on margin squeeze regulation.

The telecommunications sector is greatly shaped by sector-specific regulation. The aim of sector-specific regulation is to create and promote a competitive environment using different tools such as access obligations and price regulation. Even though, these tools could concern both sectors, mobile and fixed, this chapter will focus on regulatory intervention in the fixed sector.

Sector regulation has been set up when the liberalisation process of the telecommunications industry has been initiated.[29] Prior this process, fixed networks were in the hands of a legal or private monopoly, as it was more economically rational to have the network deployed by one single firm, rather than several competing firms. With the introduction of competition in fixed telecommunications, the main concern of authorities was how to best create a competitive environment in the downstream market, given the fact that the network infrastructure had been inherited by the former legal monopoly, which became thus monopolist over an essential facility. This configuration,

[29] Several authorities are implicated in the process of liberalisation. First, the European Commission, in light of its goal to create a single internal market at European level, sets targets to achieve and provides a regulatory framework and remedies for eventual market failures. See for instance the Commission's notice on the application of the competition rules to access agreements in the telecommunications sector (Commission (1998), henceforth *access notice*). Second, at a national level, national competition authorities (henceforth *NCAs*) survey the application of European and national competition law and the proper functioning of the competitive process. Finally, also at a national level, national regulatory authorities (henceforth *NRA*) are specifically invested to set up a national regulatory framework according to the prescriptions provided by the Commission.

a vertically integrated upstream monopolist that competes in the downstream market with rivals that must rely on the integrated firm's network, raised (and still raises) concerns of abuse of dominance by the integrated firm and may call for regulatory intervention.[30]

Some regulatory tools

A first move towards effective downstream competition has been made by the access obligation laid upon the vertically integrated firm. More specifically, the incumbent firm has been obliged to unbundle its local loop, i.e. to grant access to the part of the network that connects the consumer to the main distribution frame.[31] *Local loop unbundling* (henceforth *LLU*) can be understood as leasing the lines that connect customers to the rest of the network at a price called the access charge.

However, LLU did not suffice to avoid potential abuses of dominance via *excessively* high access charges. As such behavior may possibly impede the proper functioning of the competitive process, it is prohibited by competition law, whether European or national.[32] Furthermore, NRAs draw on *ex ante* access price regulation.[33] In order for this latter tool to be efficient, the verti-

[30] Due to economic unfeasibility of duplicating the existing infrastructure and huge, sunk investment costs of deploying an alternative network, infrastructure-based competition in the fixed market has been weak. Therefore, potential competitors *must* rely on the incumbent's network (note, however, that many governments foster the deployment of New Generation Access Networks (henceforth *NGAN*) which could lead to infrastructure-based competition). Similarly, at that time, mobile network were no competitive alternative to fixed networks. As for today, in only in Austria mobile network are considered as a sufficiently competitive alternative. There, infrastructure-based competition is ongoing, which also lead TKK to alleviate regulatory restriction on some fixed networks segments. See *supra* note 19.

[31] The main distribution frame is an equipment which collects all the wires that connect clients to the telecommunications operator and that establishes the interconnection between two communicating parties.

[32] See in particular The Treaty of the Function of the European Union, Art 102 (2008). A equivalent law exist in the United States with the Sherman Act, §2 (1890).

[33] Several price regulation rules exist. The most common are the *rate of return* pricing rule (henceforth, *RoR*) and the *price cap* regulation (henceforth, *PC*). Whereas the former aims at setting a price level such that investors earn a fixed rate of return on the capital they invested, the latter set a price maximum level that may not be exceeded. The RoR-rule has been continuously abandoned in favour to the PC, because RoR may incite the regulated firm to be cost-inefficient (low incentive to reduce cost and a high incentive to over-invest, as

cally integrated firm is subject to a further obligation: accounting separation (Commission, 2005). Under this obligation, the incumbent firm is required to share any information about its costs underlying the exploitation of its network (deployment and maintenance costs, depreciation of assets, etc.) with its NRA. This requirement should allow NRAs to determine, in a transparent manner, relevant cost elements that should be covered by the incumbent's access price and also to provide accurate information

> "*ensur*[ing] *that there has been no undue discrimination between the provision of services internally and those provided externally* [...]" (Commission (2005), Art. 5, p. 266:67).[34]

On the top of upstream price regulation, the relation between upstream and downstream prices is also a concern. As mentioned above, the provision of the upstream service ought not to involve any discriminatory treatment between the incumbent's downstream arm and its downstream rival. The authorities are therefore vigilant in what regards the spread between the incumbent's upstream price and its downstream price. In particular, they consider the possibility for anticompetitive behavior stemming from the incumbent if the above-mentioned spread is too narrow for an unintegrated downstream firm

this raises the needed revenue for recouping the investment which ultimately raises prices) the PC-rule has its shortcoming such as informational asymmetry between the regulatory authority and the regulated firm or the incentive to reduce cost via quality reduction, it has been widely adopted. A third, less applied regulation rule is the *earning sharing rule* (ESR). It defines a range of RoR where, whenever the effective RoR lies in this range, the firm can keep all its earning and, whenever the effective RoR is outside, earnings are shared with consumers, by e.g. a price decrease, resp. increase (when the RoR is above the upper boundary, resp. below the lower boundary).

[34] Accounting separation is a widespread practise in Europe. Outside the old continent, incumbents' upstream and downstream entities often operate under stronger forms of separation. For instance, in the UK in 2005, the British incumbent British Telecom's (BT) plan for a stronger vertical separation has been approved by OFCOM, the British NRA (and NCA). From that date on, some wholesale activities are managed by a distinct unit from BT, where managers have *localised incentives*, i.e. seek to maximise their unit's profits rather than the whole group's profits (Cave, 2006b). Other examples for stronger forms of (vertical) separations are Australia's incumbent Telstra (with an approach similar to OFCOM's) or the USA with strict structural separation of telecommunications operations. In 2006, however, the US were reconsidering the approach towards structural separation (OECD, 2006).

to be economically viable. Such a too narrow spread between upstream and downstream prices typically defines a margin squeeze.

The debate on margin squeeze

An OECD roundtable on margin squeeze gave a generally accepted definition of margin squeeze:

> "*A margin squeeze can arise only when (a) an upstream firm produces an input for which there are no good economic substitutes, (b) the upstream firm sells that input to one or more downstream firms and (c) the upstream firm also directly competes in that downstream market against those firms.*" (OECD (2009c), p. 7)

There is a vivid debate on whether a margin squeeze constitutes a standalone infringement of competition law or whether it should be treated as an existing theory of harm (i.e. predatory pricing or refusal to deal). This debate opposes two strikingly different positions taken by the US and the EU.

The US approach: the *Trinko* judgment.

A first key feature of the US approach towards margin squeeze is that US Courts see sector-specific regulation and competition law as substitutes. Moreover, regulation, whenever it exists, primes over competition law. The landmark judgement in Trinko made this point quite clear.[35] In 2004, New York's incumbent Verizon was accused of providing its downstream rivals with an upstream input of lesser quality on the regulated wholesale market, thereby hindering its competitors to compete efficiently in the downstream market. In this case, the accused undertaking had the regulatory obligation to provide access to its unintegrated downstream competitors. The plaintiff invoked a

[35] *Verizon Communications, Inc.* v. *Law Offices of Curtis V. Trinko*, 540 U.S. 398 (2004), (henceforth *Trinko*).

violation of both the regulatory framework set up by the Federal Communications Commission (FCC) and the antitrust law as stated in section 2 of the Sherman Act.

The Supreme Court of the US has investigated in this case whether regulatory duty to deal induces an antitrust duty to deal.[36] The Court held that a regulatory duty to deal, in the form of access obligation laid on the vertically integrated upstream monopolist, does neither induce nor is it equivalent to an antitrust duty to deal. Furthermore, in its opinion, the Court showed itself reluctant to apply competition law in presence of sector-specific regulation: the existence of "[sector-specific regulation is] *designed to deter and remedy anticompetitive harm*" (Trinko, p. 12). It considers special regulatory agencies and enacted regulatory rules to be more appropriate and capable of ruling the competitive environment as general antitrust laws and points out several possible drawbacks linked to concurrent application. For instance, the Court was concerned that imposing an antitrust duty to deal could refrain the upstream monopolist, as well as the downstream competitor, from competition-enhancing investments. Also, imposing two or more parties to negotiate may end up in a collusive agreement, inducing thus reduced competition at the expense of consumer welfare.

[36] Following a statement of the US during the OECD roundtable on margin squeeze, a doctrinal difference between a regulatory and an antitrust duty to deal, provided by the Trinko judgement, is that under the former, the competitor is already established in the market. An institutional difference is that regulators are better suited to impose duties to deal, given their proximity to the sector in question and a better ability of balancing short-term effects on competition against long-term dynamic effects such as investments (OECD (2009c), p. 294). Finally, the US delegate to the OECD roundtable stated that, even if an antitrust duty to deal exists, a margin squeeze claim will have to be filed as a predatory pricing claim (OECD (2009c), p. 251.

The *linkLine* judgement

The US's reluctant attitude towards margin squeeze as a stand-alone infringement is illustrated by the linkLine case.[37] In 2009, California's incumbent AT&T has been accused of squeezing its rivals' margins and of denying them access to the AT&T's essential facility (its DSL network), even though there is a regulatory obligation of access. The Supreme Court considered that, based on the Trinko ruling, AT&T had no antitrust duty to deal and thus has not been obliged to offer terms and conditions that *preserve its rivals' margins*.[38]

Moreover, the Court considered that the margin squeeze claim should be declined into a predatory pricing claim. The Supreme Court invoked an argument of "*institutional concerns*" for not recognising a margin squeeze as a stand-alone abuse of antitrust law whenever sector-specific regulation is set up (linkLine judgement, p. 4). It sees itself ill-suited to constantly supervise both the upstream and downstream prices, as well as the spread between them, since this task would amount to act like a regulatory agency, which is outside a Court's missions.

The EU approach

The EU approach is in striking opposition. First, even though the Commission's recommendation on accounting separation confers an equivalent task to sector-specific regulation than the U.S. does - namely to "[...] *identify potential anticompetitive behavior* [...]" (Commission (2005), Art. (6), 266/64) - the access notice clearly defines both tools as complementary:

> "*The Commission considers that competition rules and sector specific regulation form a coherent set of measures to ensure a lib-*

[37] *Pacific Bell* v. *linkLine Communications, Inc.*, 555 U.S. 438 (2009), (henceforth *linkLine*).
[38] *linkLine*, p. 3.

> *eralised and competitive market environment for telecommunications markets in the Community."* (Commission (1998), Art (149), 265/23).

This complementarity has further been backed up by European case law relative to margin squeezes. The most important and clarifying judicial decisions in margin squeeze matters have been taken in the telecommunications sector.

The *Deutsche Telekom* judgement

For instance, the Deutsche Telekom (henceforth *DT*) case, the Commission found that the dominant operator DT, via its pricing scheme, did not leave a sufficient margin to its competitors which found themselves in the impossibility to cover product-specific costs (i.e. downstream cost for providing the final retail service/product).[39]

The Court of First Instance (henceforth *CFI*), backed up later on by the European General Court (henceforth *GC*), consent with the Commission that a margin squeeze constitutes an independent infringement of competition law, emphasising that DT's

> "*conduct is connected with the unfairness of the spread between its* [wholesale] *prices for* [local loop] *access* [services] *and its retail prices* [for end-user access services]*, which takes the form of a margin squeeze.*"[40]

. This implies that the Commission is not required to prove that neither the upstream price nor the downstream price are eventually unlawful, but the unfairness of the spread between these two price elements constitutes by

[39] Commission's Decision in DT of 21/05/2003 (2003/707/EC), Case T-271/03 *Deutsche Telekom AG* v. *Commission*, 10 April 2008, and Appeal C-280/08 P, 14 October 2010.
[40] Appeal C-280/08 P, 14 October 2010, recital 142.

itself the infringement of Art. 102 of the TFEU. This ruling has further been reaffirmed by the Telefónica-case and TeliaSonera-case.

The Commission based its analysis on the *equally efficient competitor*-test. The aim of this test is to verify whether the incumbent's downstream price allows to cover its own specific costs of the relevant product if the access price charged to its competitors was imputed to its own downstream operations arm. The Courts confirmed the lawfulness of the EEO-approach because it provides legal certainty as all cost parameters are known to the incumbent.[41]

Another important element derived from the DT judgement is that sector-specific regulation does not provide immunity from competition law. The Commission and the GC acknowledge that the regulatory environment is based on the price cap principle, which leaves the defendant with sufficient scope of action for reduction of the margin squeeze by adjusting its retail price.[42] As mentioned above, the PC-rule established a maximum level of the regulated price that may not be exceeded. As DT's price was not set at the maximum level, it had means to increase its price and thus to avoid a margin squeeze. By its inactivity to that regard, DT has exposed itself to liability for anticompetitive behavior. This point in the DT judgment also highlights the Commission's view of complementarity between regulatory interventions and competition law.

The *Telefónica* judgement

In Telefónica, the Commission adopted an additional, more sophisticated calculation methodology.[43] The Spanish vertically integrated incumbent has been accused of leaving an insufficient margin to its upstream customers with whom it competed in the downstream market. In order to allege a margin squeeze, the

[41] DT, judgement under appeal, ¶201 and ¶202.
[42] *idem*, ¶11.
[43] Case C-295/12 P *Telefónica & Telefónica de España* v. *Commission*, 2007, T-336/07 and T-398/07 *Telefónica & Telefónica de España* v. *Commission*, 29 March 2012.

Commission used, besides the *year-on-year* margin squeeze calculus, the *discount cash flow* method (DCF) so as to verify the long run profitability of the accused firm. Despite possible drawbacks of using the DCF method (e.g. false positive due to important future cash flows that outweigh initial losses; ¶333 of the Commission's decision in Telefónica), the ECJ rejected Telefónica's appeal against the use of DCF. The ECJ considered the Commission to be right in applying the DCF as both methods yielded the presence of a margin squeeze.

In its appeal, Telefónica claimed that upstream investment induced high upstream input prices, while in the mean time, the downstream market has been subject to intense competition between convergent offers, implying price discounting, and therefore low retail prices. In contrast to Judge Scalia in Trinko, the GC did not recognise an impediment of investment incentives when applying competition law to a regulated environment. On the contrary, in the light of the desired infrastructure-based competition in the EU, the GC agreed with the Commission in that the regulatory duty to deal imposed on Telefónica "[...]*result*[ed] *from a balancing by the public authorities of the incentives of Telefónica and its competitors to invest and innovate*".

Further clarifying ruling has been brought by the TeliaSonera-case.[44] In this case, the Swedish incumbent has been accused by the Swedish NCA of abusing its dominant position. Before delivering its judgement, the Swedish Court addressed a set of questions to the ECJ relative to the correct interpretation of Art. 102 of the TFEU.

The *TeliaSonera* judgement

The Court's ruling in TeliaSonera made a clear cut between a refusal to deal and a margin squeeze. In Bronner, the Court ruled that the existence of an essential facility creates a duty to deal for its owner and any refuse of granting

[44] Case C-52/09 *Konkurrensverket* v. *TeliaSonera Sverige AB*, 17 February 2011.

access to it is an attempt to reduce rivals' ability to efficiently compete.[45] In TeliaSonera, the GC highlighted that the characteristic of *essentiality*, or *indispensability*, of the upstream input for the provision of downstream services is not predominant for a margin squeeze to exist. It held that, given the significant market power of the vertically integrated firm in the upstream market, the upstream input does not need to be indispensable for anticompetitive effects to emerge via a margin squeeze. In particular, if the upstream input is essential for downstream competition, than *anticompetitive effects are probable*, whereas if the input is not indispensable, *potential anticompetitive effects* may exist and need to be proven.[46] It follows from the TeliaSonera ruling that the scope of applicability of margin squeeze as an antitrust liability doctrine is greatly enlarged.

US vs. EU: opposing view on liability for margin squeeze.

The above exposition of US and EU case law shows that, today, there exist two strikingly opposed views as to whether in a regulated environment a margin squeeze is to consider as a liability doctrine or not. For the US, it is clearly not. For the EU, it is and recent rules even loosen the conditions under which it can be applied. Each position may have its merits, but a profound understanding of the impacts of applying competition rules and regulatory restrictions jointly is of great importance as either tool impacts the strategic behavior of the concerned firms.

[45] *Oscar Bronner GmbH & Co. KG* v *Mediaprint Zeitungs- und Zeitschriftenverlag GmbH & Co. KG*, case C-7/97,1998.

[46] Supra 44, par. 69 - 72.

Chapter 3: Interaction between sector regulation and competition law

In the last chapter of this thesis, the joint application of competition law and upstream market regulation will be analysed from a theoretical point of view.

In a duopolistic model with differentiated products, a vertically integrated firm sells an upstream input to an unintegrated downstream rival. Demand asymmetry is introduced by allowing for differences in downstream efficiency between the integrated and the unintegrated firm and/or differences in product quality. Moreover, the modelling allows to compare the US view to the European view, as it compares different scenarii. The first scenario is that of competitive environment without either a prohibition of squeeze nor upstream regulation. In a second scenario, a ban on margin squeeze is introduced via the EEO margin squeeze test, i.e. the spread between the integrated firm's price and access charge must allow for recovering downstream product-specific costs. Scenarii three and four rerun this exercise but with a regulated upstream market.

The analysis shows that absent upstream market regulation, the incumbent's downstream price does not satisfy the EEO test whenever the unintegrated firm is relatively more efficient (this is, is either more cost efficient, offers a higher quality or any combination of both). However, in this case, the downstream competitor does not incur negative profits and is thus not excluded from the market. This insight shows that the efficiency of the EEO-test is strongly dependent on the market conditions both firms face downstream.

Comparing the first scenario to the second reveals that a ban on margin squeeze as stand-alone policy may have a welfare-enhancing effect. Indeed, as the integrated firm's price is ruled by the EEO-test, its only remaining profit-optimising variable is the upstream price. The incumbent maximises its overall profits by reducing the upstream price which in turn acts positively on

the price set by the rival in the downstream market. The latter's price shrinks and its demand increases. On the other hand, the incumbent's downstream price increases, penalising thus its consumers. Analysing social welfare, however, shows that the increased competitor's profits outweigh the incumbent's depressed profits. Moreover, as more consumers benefit of the rival's reduced price, consumer surplus increases. As a final result, a ban on margin squeeze as stand-alone policy has a welfare beneficial effect.

In contrast to this, the analysis in the presence of upstream market regulation shows opposite results. First, when competition law is applied via a ban on margin squeeze, the above-mentioned *decreasing rivals' cost*-effect vanishes and both downstream prices increase. Consumers do no longer benefit from the competitor's higher efficiency. Due to higher prices, industry profits increase, whereas consumers are strictly worse off. The impact on social welfare is ambiguous.

Finally, as a ban increases the burden laid on the regulated incumbent firm, the latter may manifest less initiatives in the downstream market. Indeed, at some level of inefficiency (relative to its competitor), the incumbent may prefer to withdraw from the downstream market and let the more efficient rival serve the retail market alone.[47]

The analysis in this chapter suggests that, by its way of dealing with margin squeezes, the Commission's goal to promote competition and ultimately protect consumers from abusive conduct by undertakings is likely to be jeopardised. US Courts seem to have the right intuition regarding liability under a margin squeeze doctrine.

[47] As such a behavior has not yet been observed in the real world, the incumbent's withdrawal has to be put in perspective. It is, however, conceivable that the incumbent firm may leave some market segments, while remaining active in others.

Bibliography

ARCEP (2014a). Observatoire des marchés des communications électroniques (services mobiles). 2ème trimestre 2014. Available here.

ARCEP (2014b). Observatoire des marchés des communications électroniques en France Q2 2014 - Observatoire des investissements et de l'emploi. 2ème trimestre 2014 - Résultats définitifs. Available here.

Arlandis A., Ciriani S., Koleda G. (2011). L'économie numérique et la croissance, poids, impact et enjeux d'un secteur stratégique, Document de travail Nř 24. Available here. Accessed last: 19/11/2014.

Armstrong M., (2006). Competition in two-sided markets, *RAND Journal of Economics*, 37(3), 668-691.

Berec (2011). Berec Report on impact of Fixed-Mobile Substitution in Market Definition, 8 December 2011, available here.

Blumberg S. J., Luke J. V. (2007). Wireless substitution: Early release of estimates based on data from the National Health Interview Survey, July - December 2006. National Center for Health Statistics, May 2007., available here

Blumberg S. J., Luke J. V. (2014). Wireless substitution: Early release of estimates from the National Health Interview Survey, January - June 2014. National Center for Health Statistics, December 2014, available here.

Bacache M., Bourreau M., Germain G., (2013). Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Fixed Broadband Industry. *Review of Industrial Organization*, 44(2), 179-209.

Bourreau M., Kourandi F., Valletti T., (2014). Net Neutrality with Competing Internet Platforms, CEIS Research Paper 307, Tor Vergata University, CEIS, revised 14 Feb 2014.

Cave M. (2006), Encouraging infrastructure competition via the ladder of investment. *Telecommunications Policy*, 30(3-4), 223-237.

Cave M. (2006), Six Degrees of Separation: Operational Separation as a Remedy in European Telecommunications Regulation, MPRA Paper No. 3572, posted 14/06/2007, available here.

Cisco (2014), Visual Networking Index: Global Mobile Data Traffic Forecast Update 2013 - 2018, February 4, 2014, available here.

Cisco (2013b), Visual Networking Index: Forecast and Methodology 2012 - 2017, May 29, 2013, available here.

European Commission (1998), Notice on the Application of the Competition Rules to Access Agreements in the Telecommunications Sector, (98/C), OJ C 265, 22/08/1998:2-28.

European Commission (2005), Recommendation on accounting separation and cost accounting systems under the regulatory framework for electronic communications, (2005/698/EC), OJ L 266, 11/10/2005:64-69.

European Commission (2013), Commission Staff Working Document Digital Agenda Scoreboard SWD (2013) 217 final.

Dogan P., Bourreau M., Manant M, (2009). A Critical Review of the "Ladder of

Investment" Approach. Scholarly Articles 4777447, Harvard Kennedy School of Government. Available here.

Eurobarometer (2006), E-Communicatins Household Survey Report, Fieldwork: December 2005 - January 2006, July 2006.

Eurobarometer (2011), E-Communicatins Household Survey Report, Fieldwork: December 2011, June 2012,

Eurobarometer (2013), E-Communicatins Household Survey Report, Fieldwork: February-March 2011, July 2011, available here.

GSM Association (2013a), Mobile Economy Europe 2013, available here.

GSM Association (2013b), Mobile Wireless Performance in the EU & the US, May 2013, available here.

Hermalin B. E., Katz M. L., (2007). The economics of product-line restrictions with an application to the network neutrality debate, *Information Economics and Policy*, 19(2), 215-248.

Jullien, B., Rey, P., Saavedra, C. (2013), The Economics of Margin Squeeze, IDEI Report, available here.

Maliranta M., Rouvinen P., Ylä-Anttila P., (2010), Finland's Path to the Global Productivity Frontier through Creative Destruction, *International Productivity Monitor*, Centre for the Study of Living Standards, 20, Fall, 68-84. Available here.

OECD (2006), Report on experiences with structural separation, 07/06/2006, available here.

OECD (2009a), Information Economy Product Definitions Based On The Central Product Classification (Version 2), available here.

OECD (2009b), Mobile Broadband: Pricing and Services, available here.

OECD (2009c), Policy Roundtables Margin Squeeze, 2009, DAF/COMP(2009)36, available here.

OECD (2011), Broadband Bundling: Trends and Policy Implications, OECD Digital Economy Papers, No. 175, OECD Publishing, available here.

OECD (2012), Fixed and Mobile Networks: Substitution, Complementarity and Convergence, OECD Digital Economy Papers, No. 206, OECD Publishing, available here.

OFCOM (2013), International Communications Market Report, Research Document, 12 December 2013, available here.

Oldale, A., Padilla, J. (2004). From state monopoly to the “investment ladder": Competition policy and the NRF. *in* The Pros and Cons of Antitrust in Deregulated Markets, Swedish Competition Authority.

Rochet J.-C., Tirole J., (2006). Two-sided markets: a progress report, *RAND Journal of Economics*, 37(3), 645-667.

RTR (2009), Abgrenzung des Marktes für breitbandigen Zugang auf Vorleistungsebene.

Welsum D., Overmeer W., Van Ark B., (2012). Unlocking the ICT growth potential in Europe: Enabling people and businesses. A study prepared for the European Commission DG Communications Networks, Content & Technology. Available here. Accessed last: 19/11/2014.

Wu T., (2003). Network Neutrality, Broadband Discrimination, *Journal on Telecommunications and High-Technology Law*, 2, 141-176.

Yoo C., (2010). Network Neutrality or Internet Innovation? Regulation, 33(1), 22-29. Available on SSRN.

CHAPTER 1

Fixed-Mobile substitution and bundling[1]

1.1 Introduction

Fixed-Mobile substitution (FMS) refers to the fact that mobile telecommunications services replace their fixed counterparts. It is driven by technological progress and, in particular, by the convergence of mobile network performance towards fixed network performance. For instance, call services are of equal quality regardless which network is used. Also, the third and fourth generation of mobile technology allow for similar mobile broadband quality of service as with the widespread DSL or cable access.

Each service has its advantage, though. While mobile services have the undeniable convenience of mobility, fixed services offer abundance (unlimited allowance of data usage and call minutes). The mobility feature procured by mobile services implies further that the relation between fixed and mobile is one of *one-way substitution*, meaning that mobile may replace fixed services, but the opposite is unlikely to occur. Another point of divergence it that mobile services are rather personal (mostly used by the subscriber himself), whereas fixed services are used by all the members of a household and therefore more collective. On these grounds, fixed and mobile are considered as imperfect

[1] This chapter relies on a collaboration with Julienne Liang from the department of regulatory affairs of Orange. Thanks again, Julienne!

substitutes.

Despite this, an increasing number of consumers throughout the world reports to use exclusively their mobile to satisfy their needs for electronic communications. As such, at the end of 2013, 38 % of the US households indicated in a NHIS survey to be mobile-only for placing calls (Blumberg and Luke, 2013). Following the Eurobarometer (2014), the EU counted around 31 % of wireless-only households.

As for broadband matters, a similar trend seems to occur. In an international comparison by OFCOM (2013), more than 25 % of Italian households, respectively around 20 % of Australian households, claimed mobile to be their only means for broadband access. In Austria, broadband FMS is even more advanced. The national regulatory authority for electronic communications considered in 2009 mobile broadband to be a "*sufficiently close substitute*" to fixed broadband over DSL or cable access. This finding induced the Austrian regulator to consider that ex-ante wholesale regulation on broadband access is no longer necessary (Berec, 2011; RTR, 2009).

In some countries, however, a contradicting trend is observed. Namely, service providers operating in both fixed and mobile markets have introduced bundled offers that comprise fixed services (IPTV, IP telephony, broadband internet access) and mobile services (voice and data services). Moreover, such quadruple play offers become increasingly popular. Within approximately three years after their market introduction, the subscription rate to such offers is estimated around 42 % in France and 20 % in Spain by the end of 2012. These rates are also forecasted to nearly double in the next 3 or 4 years.[2]

But the increase of mobile-only subscription raises the question whether fixed-mobile bundling is the adequate response by providers present on both

[2] See for instance an `article` by *La Tribune* (2013) for information on the French quadruple-play subscription. For a general overview and forecast of the European quadruple play offers, see the `report` by *Analysis Mason* (2013).

markets. Does bundling allow such multi-market operators to counter the possible threat of reduced revenues stemming from fixed offers? Is bundling a means to reduce intermodal competition exerted by mobile on fixed services?

As academic literature has not yet focussed on a joint analysis of FMS and bundling, this work attempts to fill this gap. A theoretical framework is developed that reconsiders the profitability of bundling strategies given the presence of FMS. It draws upon two multi-market operators that compete à la Hotelling. It adopts the "straight-to-mobile" view, which is one possibility of how mobile-only consumers emerge. An alternative would be the "cut-the-cord" view, where consumers decide to terminate or do not reconnect their fixed service subscription. The straight-to-mobile view reflects the idea that consumers choose at first a mobile offer and, thereafter, have the possibility to choose a fixed offer. This view seems interesting, because merely everyone born after 1980 has first subscribed to a mobile offer before having possibly subscribed to a fixed offer.[3] The "straight-to-mobile" view is also appropriate if one considers young people leaving their parents' house. Already mobile subscriber, they may choose not to subscribe at all (or at least not immediately) to a fixed offer. Moreover, since the presence of FMS implies the presence of mobile-only consumers, the model also considers partial coverage of the fixed market.

The decision to subscribe to an additional fixed service offer is modelled to depend on the additional utility that consumers expect from having both (substitutable) services simultaneously. The introduction of expected utility is new to the bundling literature, but has its motivations. Firstly, this uncertainty might be interpreted as a learning-by-doing effect: mobile-only users may learn their needs for, e.g. data volume only after having exclusively used

[3] Using the example of the UK, market trends show that 99 % of consumers between 15 and 44 years have a mobile subscription (OFCOM, 2013). Finding a similar figure for fixed subscriptions is difficult, especially on the subscriber level because a fixed service subscription is used by all members of a household and not only by the subscriber.

mobile services for a while. In that case, they may subscribe to a fixed offer so as to complement their mobile data allowance. Secondly, some mobile-only consumers may anticipate subscribing to a fixed offer because some new features in the fixed offer are announced by operators (e.g. forthcoming change of TV-channels comprised in the bundle, more user-friendly equipment, higher connection speeds, etc).

Finally, the model introduces an equivalent approach to Thanassoulis' *firm-specific* and *product-specific* preferences (Thanassoulis, 2007). FSP (firm-specific preferences) appear in the fixed market if consumers have the same reservation price for fixed services. Alternatively, PSP (product-specific preferences) appear if reservation prices differ from one operator to another. Since in the setting used in this chapter FSP leads to perfect symmetry between firms, the present work denotes that case the *symmetric case*.

The analysis reveals that if consumers have product-specific preferences and if fixed and mobile services are neither too strong substitutes nor too strong complements, at least one operator earns higher profits by bundling its services. Hence, the prisoners' dilemma situation, often revealed in the bundling literature, disappears. The higher profits stem from the increased demand for the discounted bundled offer. Consumer surplus, as well as social welfare, increases when bundling strategies are employed. Moreover, the discount turns the imperfect substitutes into stronger complements and reduces the number of mobile-only consumers. Bundling may therefore induce full coverage of the fixed market. However, with the fixed market fully covered, selling both services as a package would not be profitable and therefore not introduced, implying then a foregone consumer surplus and welfare increase.

The remainder of this chapter is the following. Section 1.2 briefly presents the literature on FMS and on bundling. Section 1.3 presents the model specifications. The results are presented in section 1.4, which is divided in two sub-

sections. Subsection 1.4.1 focusses on the perfectly symmetric setting where consumers have identical valuations for either operator's fixed, respectively mobile services. The case of product-specific preferences is analysed in subsection 1.4.2. Finally, section 1.5 discusses the results and concludes.

1.2 Literature review

The relevant literature for this chapter is twofold: the one on FMS and the one on service bundling. Since these two topics have always been treated separately, the strands are presented distinctly.

Fixed-Mobile substitution Academic literature on FMS is mostly empirical and attempts to assess the sign of cross-price elasticities between fixed and mobile services. Evidently, elder papers addressed the issue of FMS on the level of voice services, as broadband FMS is quite a recent issue.

Although fixed and mobile services were originally conceived as complements (mainly for businessmen), the increasing and rapid diffusion of mobile services turned the relation of complementarity into one of substitution. Gruber and Verboven (2001) estimated that the diffusion of mobile services is negatively impacted by the stock of fixed telecommunications lines per capita in EU15 countries in the period 1984 - 1997. Yoon and Song (2003) also found substitution between calls for the years 1997 - 1998 in Korea. Similarly, Rodini, Ward and Woroch (2003) found moderate substitution between the second fixed line usage and mobile usage for the period 1999 - 2001 in the US.

A more recent series of papers provided evidence of sufficiently strong FMS on either calls access or usage level, which allows to address the problem of defining the relevant markets. An accurate definition of relevant market constitutes a cornerstone for efficient ex-ante market regulation. Among these papers are Briglauer *et al.* (2011a) and Barth and Heimeshoff (2011). Whereas the

first considered the Austrian market, the later used data of the EU27 countries. For the period 2004 - 2009, Barth and Heimeshoff (2011) proved the existence of a one-way substitution that is sufficiently strong so that the asymmetric regulation laid upon fixed services must be challenged.[4] Alternatively, the Austrian study by Briglauer *et al.* (2011a), based on a 5-year-dataset (2002 - 2007), suggested that national fixed and mobile calls might belong to the same market, as the authors found significant positive cross-price elasticities.[5] On the contrary, at access level, FMS did not appear.[6]

Also, some studies analysed broadband FMS. For instance, Cardona et al. (2009) investigated demand for broadband Internet access in Austria. Although, due to too low a penetration rate of mobile broadband during the analysed time period, the authors could not conclude on FMS in the Austrian broadband segment. Srinuan, Srinuan and Bohlin (2012) analysed Sweden's broadband segment. They concluded on significant substitutability between fixed and mobile broadband access.

The most recent data has been used by Grzybowski and Verboven (2013), who used Eurobarometer household survey data from 2005 to 2011. As the authors show, central and eastern Europe's member states consider fixed and mobile voice services as stronger substitutes than their western neighbours.[7] Moreover, they estimated an even stronger voice service FMS when the household has a mobile broadband connection. However, if the type of Internet broadband (fixed or mobile) is taken into account, the results show that fixed and mobile access become stronger substitutes if the household disposes over a mobile broadband connection. On the contrary, both accesses become com-

[4] Asymmetric regulation has been set up in order to foster mobile service take-up and achieve intermodal competition.

[5] The study of Briglauer *et al.* (2011a) only focussed on calls by private persons. Called placed by firms have not been considered.

[6] The authors mentioned the possibility of cheaper international calls over fixed network as a reasonable explanation for the complementarity of access.

[7] A strong level of FMS in central and eastern Europe has been also found on firm level by Vagliasindi, Güney and Taubman (2006).

plements if the household disposes over fixed broadband.

Profitability of bundling Two pricing strategies relative to the practice of bundling have been considered in the large literature on product bundling: *i*) pure bundling strategy, involving the bundling firm to sell its products only as packages and *ii*) mixed bundling strategy, involving, on the contrary, to sell products both as a package and stand-alone items.

Mixed bundling has revealed itself to be a very powerful tool for implementing improved market segmentation (respectively price discrimination) because of the *sorting effect* (Stigler, 1963), or using the terms of Adams and Yellen (1976), the *self-selection effect*. It induces consumers to reveal their preferences for the different offers, enabling the monopolist to extract higher rents on consumers, whereas the latter are worse off.

In a monopolistic context, where the monopolist considers any form of bundling, Adams and Yellen (1976) showed that pure bundling is dominated by mixed bundling, since the latter form can procure profits at least as high.[8]

Long (1984) considered demands addressed to a multi-product monopolist to be interrelated. More specifically, in its extension of Schmalensee (1984), Long explains that the profitability of mixed bundling as discriminatory pricing tool works best when products are either substitutes or independent. The reason is that bundling reduces the heterogeneity of consumers valuations (via the sorting / self-selection effect).[9]

With complements, a multi-product monopolist may not find it profitable to bundle. However, as Nalebuff (2004) showed, if the bundle components are complements, bundling may serve for raising barriers to entry or relax competition. More specifically, a multi-product monopolist, that faces potential

[8] This finding has been confirmed by Schmalensee (1984) or McAfee, McMillan and Whinston (1989), among others.

[9] Long's analysis has been generalised by Armstrong (2013) who summarised the results by the simple statement that "[...bundling is profitable if] *demand for a single item is less elastic than the demand for the bundle*[...]" (p. 455).

entry in the market for one of its components, may use bundling so as to reduce the competitor's ability to reach out for the monopolist's consumers. Based on a similar reasoning, bundling may also facilitate collusive behavior in the (post-entry) competitive market (Spector, 2007).

Carbajo, De Meza and Seidman (1990) gave another strategic motivation for product bundling. In their paper, a multi-product monopolist bundles its two complements, one of which is in competition with a rival's product. Analysing whether prices or output as strategic variable yields higher efficiency, the authors showed that pure bundling in a Bertrand setting reduces competitiveness.[10] Introducing bundling provides the monopolist with an additional product differentiation device, which in turn leads to higher end prices in the competitive market. If, on the other hand competition is à la Cournot, bundling again disables the single-product rival to poach consumers. Therefore, the rival's output decreases and prices increase.

In a more competitive setting, Matutes and Régibeau (1992) focussed on a duopoly where consumer valuations for complementary goods are decisive for market coverage. Here, consumers are supposed to buy a system of two complementary components, whether as *mix-and-match* (one component from each duopolist) or as *pure system* (both components from the same firm). First, it is shown that pure bundling is always dominated by mixed bundling. Next, with low market coverage, a prisoner's dilemma arises when firms allow for compatibility. Bundling decreases the price of the pure system and induces the demand for bundle to increase.[11] However, as the latter effect dominates the former, revenues from the stand-alone sales and thus, bundling is not profitable. Moreover, as market coverage increases, price cuts (via a bundle discount) on pure systems trigger a more aggressive reaction from the rival, leading to fiercer

[10] In their paper, mixed bundling is not considered. However, even though the paper of Chen (1997) has another aim (namely, providing an equilibrium theory of product bundling), it provides equivalent results for mixed bundling as Carbajo, De Meza and Seidman (1990).

[11] Similar results are found by Economides (1993) and Reisinger (2006) for substitutes.

competition and therefore unprofitable bundling. If consumers valuations are too high, market coverage is too high and competitive response too aggressive. Firms then prefer not to bundle.

Thanassoulis (2007) suggests that the profitability of introducing bundled offers at a reduced price depends on whether consumers have firm-specific (FSP) or product-specific (PSP) preferences. The difference is that under FSP, the disutility (of not consuming the ideal product) does not increase with the quantity bought from one firm. Under FSP, buyers of multiple components are cross-subsidised by single-component buyers. This leads to increased profits and reduced consumer surplus. Alternatively, under PSP, price competition for the multi-component buyers is too fierce, leading to reduced profits and increased consumer surplus. However, social welfare decreases under PSP because of allocative inefficiencies: some consumers that would prefer to cross-purchase do now buy the bundle even though this is not the closest to their ideal.

Thanassoulis has showed the interest for the bundling literature of distinguishing FSP from PSP. This analysis here applies a similar approach to the fixed market, i.e. the market for the imperfect substitute. Specifically, whereas Thanassoulis focusses on the level of Hotelling's transportation costs for distinguishing both preferences, the model presented in this chapter places the consumer reservation prices for fixed and mobile services in the center for the distinction between FSP and PSP. This approach allows for a simpler representation of FMS. PSP then appear when consumer have distinct valuations for both fixed services offered by either firm. This can also be interpreted as inter-platform competition in the fixed market (e.g. FTTH vs. ADSL, etc). Alternatively, considering equal valuations for fixed services would represent FSP and interprets competition in the fixed market as one of intra-platform

competition (e.g. ADSL from operator $\mathcal{A}$ vs. ADSL from operator $\mathcal{B}$, etc).[12] Although, as will be seen below, with this definition of FSP, firms are perfectly symmetric. Consumers will be equally satisfied with either one of them. This case will henceforth be called the symmetric case.

The distinction between the symmetric case and the case with product-specific preferences adopted in this present model allows to contribute to the bundling literature in the following way: if consumer have product-specific preferences, the mixed bundling equilibrium is no longer a prisoners' dilemma. Indeed, at least one firm earns higher profits (even though at industry level profits do not vary). Also, in contrast to Thanassoulis' results, social welfare (as well as consumer surplus) increases.

Another difference is that the consumers' decision between single and multiple services consumption depends on the expected additional utility consumers anticipate to enjoy if both services are consumed. In Thanassoulis' study, the distribution of consumers of a single service ("*small*" buyers in the cited paper) and consumer of both services ("*large*" buyers) is given and a small buyer does not become a large buyer. This does not allow to analyse the possible migration streams between single service consumers and multi-service consumers that may be induced by bundling. Here, the bundle discount impacts expected additional utility and thus the distribution of consumers.

[12] A possible justification for this alternative approach may be found in shops like *The Phone House* or *Internity*. Such shops have commercial agreements with different operators and are thus able to provide consumers a more global information about the offers available. An advantage for consumers is that travel costs are clearly reduced as only one shop is visited even though a wide range of offers is readily available. Hence, if the consumer is only interested in an ADSL offer (e.g. because FTTH is not yet deployed in his residential area), the choice would depend on its preferences for an operator (i.e. FSP). For instance, the experienced quality of consumer care in mobile service matters may then be key for subscribing (or not) to a given fixed services operator. Alternatively, if the consumer has the choice between a FTTH or an ADSL offer, his choice will then (mainly) depend on its product-specific preferences.

1.3 Model specifications

The supply side is composed by two multi-market operators, denoted by $k = \mathcal{A}, \mathcal{B}$, which are both able to provide one fixed and one mobile services offer, indexed by $j = f, m$, at linear price p_j^k.[13] Each operator is assumed have his own fixed and his own mobile infrastructures. Under this assumption, the issue of incumbency with the associated network access problem does not arise and allows to focus on the effects of bundling. A typical example of such a competitive setting related to telecoms is competition between a cable operator and an operator using copper network, with both having either their own mobile network or an roaming agreement with another mobile network owner.

Furthermore, operators are assumed to offer their services separately as well as a bundle of both (that is, to practise mixed bundling) and to compete in prices in a Hotelling setting. Each service represents a different market within which services are maximally differentiated. Each market is represented by a Hotelling line of unitary length where operators are located at either end ($\mathcal{A}$ is in 0 and $\mathcal{B}$ in 1). Finally, marginal costs are denoted c_f and c_m for fixed and mobile services respectively. Without loss of generality, marginal costs are set equal to 0.

Concerning the consumers' choice, the model uses the straight-to-mobile view. It is therefore assumed that consumers subscribe to a mobile plan in first place. Next, it is assumed that consumers anticipate the additional utility derived from having fixed services along with mobile services. If they subscribe to an additional fixed service, they must anticipate a supplementary and strictly positive net utility. In any other event, the concerned consumer considers fixed and mobile as being too strong substitutes and remains single-service user, i.e.

[13] In many countries, operators offer flat-rate tariffs rather than multi-part tariff schemes. This supports the usage of linear prices.

mobile-only user. Finally, consumers' preferences are assumed uniformly distributed along the Hotelling lines.

Fig. 1.1 gives a graphical representation of the model specifications. As

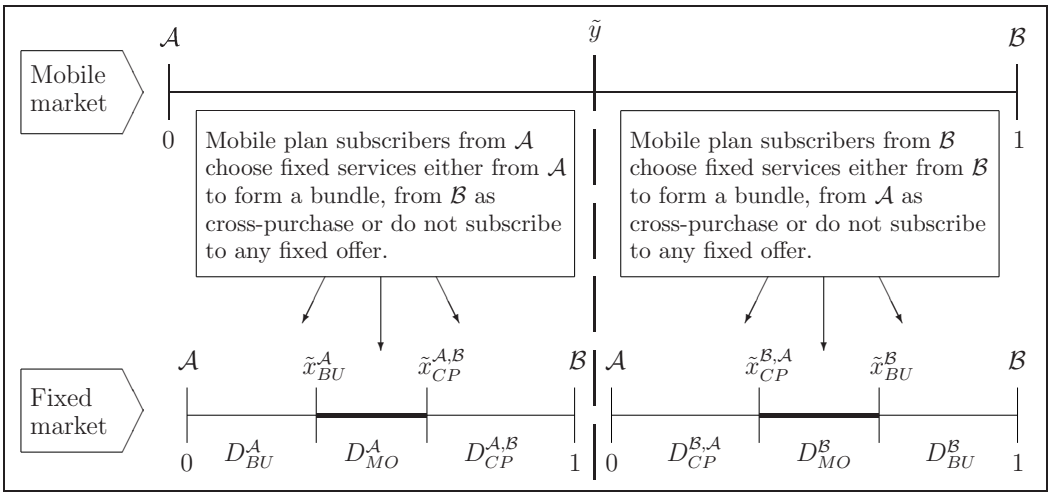


Fig. 1.1 Representation of model specifications. $\mathcal{D}^k_{BU}$ denotes the demand for the bundle addressed to operator k and $\mathcal{D}^k_{MO}$ stands the demand for mobile-only addressed to operator k. Finally, $\mathcal{D}^{k,-k}_{CP}$ denotes the demand for $-k$'s fixed services stemming from consumers of k's mobile service.

can be seen on the figure, the fixed market is represented by two segments in order to allow the distinction between bundled sales and cross-purchased sales (i.e. each service bought from a different operator).[14] On the lower left segment fixed services offers are proposed to consumers of mobile services from $\mathcal{A}$. This segment can be interpreted as $\mathcal{A}$'s bundle market, since only $\mathcal{A}$'s bundle is available on this segment. Similarly, the lower right segment would then be $\mathcal{B}$'s bundle market.

Moreover, there are two marginal consumers on each segment in the fixed market: $\tilde{x}^k_{BU}$ and $\tilde{x}^{k,-k}_{CP}$. BU stands for bundle and CP for cross-purchase. The first superscript indicates the mobile service provider and the second the fixed service provider. $\tilde{x}^k_{BU}$ represents the consumer who is indifferent between a bundle from operator k and remaining mobile-only. $\tilde{x}^{k,-k}_{CP}$ represents the con-

[14] Indeed, would there only be one segment, consumers located, e.g., between 0 and $\tilde{x}^{\mathcal{A}}_{BU}$ could then have subscribed to mobile services from either $\mathcal{A}$ or $\mathcal{B}$ and no distinction between them would be possible and thus, no distinction between bundlers or cross-purchasers.

sumer who is indifferent between being mobile-only and cross-purchasing mobile services from k and fixed services from $-k$. The presence of two marginal consumers on each segment illustrates the fact that the fixed market is not fully covered, allowing for mobile-only users to emerge.

Maximal differentiation and the presence of mobile-only consumers between $\mathcal{A}$ and $\mathcal{B}$ inherently leads to local monopolies. This might appear as a strong assumption, particularly in the fixed telecommunications market where competition is rather fierce. Nevertheless, this representation is a first step towards the distinction between the symmetric case and product-specific preferences (respectively intra and inter-platform competition): the symmetric case could represent market segmentation in terms of consumer age.[15] Product-specific preferences might be valid for inter-modal competition in the fixed market, e.g. where the copper network competes with a fibre or cable network.[16]

Turning to the consumers' utility function, the assumption of expected utility implies that the total utility function is the sum of a given utility and an expected utility. Total utility writes $\mathcal{U} = U_m + EU_{mf}$, where U_m is the given utility from mobile services and EU_{mf} the expected additional utility from having both mobile and fixed services.

Denote the consumer's valuation for data service quality (or volume) by v_j^k and his valuation for telecommunications services on the go by g_j^k, for $k = \mathcal{A}, \mathcal{B}$ and service $j = f, m$. Some simplifying assumptions on valuations are made. First, the valuation of mobile data volume, v_m, is assumed to be

[15] Relative to the symmetric case and market segmentation in terms of consumer age: elder people more often mention incumbent operators rather than newcomers, which testifies of a certain degree of perceived differentiation.

[16] Some empirical works estimated access demand for different technologies (FTTH, ADSL, narrowband and possibly mobile) in different countries, such as e.g. Cardona et al. (2009) for Austria or Ida and Kuroda (2006) for Japan. Their results show, among other things, that substitution between fixed access technologies is not absolute. For instance, Cardona et al. indicate that Austria's narrowband users might not consider broadband "[...] *as an equally good substitute*". Similarly, Ida and Koruda's study reveals that Japan's ADSL users can be regrouped according to their price sensitivities: medium-speed ADSL user ("*normally price sensitive*") and low and high-speed ADSL user ("*extremely price sensitive* s"). Hence, the assumption of local monopolies might be surprising but is not unfounded.

the same for each operator. This is a reasonable assumption, as it seems implausible for an operator to compete, at least in the long run, using an older technology than its competitor.[17] Furthermore, it is assumed that mobile networks are of the same quality and have the same geographic coverage, which leads g_m to be the same for each operator.

Given these specifications, the utility of mobile services from operator k, U_m^k, then writes $v_m + g_m - p_m^k - \gamma|y^k - \tilde{y}|$, where $\tilde{y}$ is the position of the marginal consumer, y^k is operator k's position and γ represents the disutility a consumer incurs when not consuming its ideal mobile services (i.e. transportation costs).

When it comes to the decision of subscribing to a fixed service, two points are to emphasise. First, g_f^k is by definition close or equal to 0, because fixed service cannot provide much mobility. Therefore, the expected additional utility does only stem from excess valuation for data volume of fixed over mobile. Define by $\theta^k = v_f^k - v_m$ the measure of the excess valuation operator k's fixed service can offer a consumer. This measure θ^k can be seen as the expression of the magnitude of FMS observed in the telecommunications industry. Due to technological superiority of fixed networks (e.g. regarding connection speed of data transmission capacity), it follows that $\theta^k > 0$, $\forall k = \mathcal{A}, \mathcal{B}$. Increasing substitutability is represented by θ^k approaching 0. Alternatively, a high θ^k indicates a large spread between v_f^k and v_m which in turn implies stronger complementarity between both services.

A second point to notice is that, when the consumer actually buys fixed services, he has the choice between buying them from the same operator he bought his mobile plan from (thus, forming a bundle) and cross-purchasing. In the case of bundling, a discount δ^k will be granted by his operator. Otherwise,

[17] For instance, if one operator deploys a new technology (e.g. 4G LTE), it seems implausible for a competitor to maintain its 3G network, but will most likely invest in the 4G technology, too. Furthermore, newcomers, for which entry barriers may be very high, might benefit from a roaming agreement with an incumbent operator and, hence, compete on the same level with identical quality.

the consumer has to pay the full price for each service.

Given these specifications, a consumer of mobile services from operator k anticipates his expected additional utility of having both services by considering all the purchase possibilities (this is, either as a bundle or as cross-purchase). Thus, the expected additional utility yields

$$\begin{aligned} EU^k_{mf} &= \int_{x^k}^{\tilde{x}^k_{BU}} U^k_{BU} + \int_{\tilde{x}^{k,-k}_{CP}}^{x^{-k}} U^{k,-k}_{CP} \qquad (1.1) \\ &= \int_{x^k}^{\tilde{x}^k_{BU}} \left[\theta^k - (p^k_f - \delta^k) - t|x^k - z|\right] \mathrm{d}z + \int_{\tilde{x}^{k,-k}_{CP}}^{x^{-k}} \left[\theta^{-k} - p^{-k}_f - t|x^{-k} - z|\right] \mathrm{d}z \end{aligned}$$

In the above, the first integral stands for bundled purchase and the second for cross-purchase. Similarly to the utility function for mobile services, x^k denotes operator k's location on the Hotelling line, $\tilde{x}^k_{BU}$, respectively $\tilde{x}^{k,-k}_{CP}$ is the position of the marginal consumer and t the transportation cost. It is assumed that the disutility of not consuming their preferred service is the same for fixed as for mobile services, this is, $t = \gamma$. Expression (1.1) is equivalent to consumer surplus. As a matter of fact, it is the surplus subscribers of a mobile plan from a given operator expect from having mobile and fixed services (bundled or not). Regarding FMS, it can be seen that the smaller θ^k (or equivalently θ^{-k}), the smaller the expected utility.

Finally, as mentioned above, symmetry appears when $v^k_f = v^{-k}_f = v_f$. This implies a symmetric setting where $\theta^k = \theta^{-k} = \theta$ and thus an equal magnitude of FMS among operators. All the consumers see fixed and mobile services as equally strong substitutes and have an equally high expected additional utility.[18] Consequently, the equilibrium will be symmetric. On the other hand, an asymmetric setting and, thus, asymmetric equilibrium appear with product-specific preferences where $v^k_f \neq v^{-k}_f$. In this setting, consumers see one operator's fixed services as a better alternative (say operator k), which grants that

[18] Recall that mobile-only consumer appear when they do not incur a positive net utility.

operator a competitive advantage. Furthermore, this latter operator has also a lower FMS ($\theta^k > \theta^{-k}$), providing consumers a higher expected utility.

The subsequent analysis relies on the following game:

1) Operators decide whether to introduce a bundled offer or not

2) Operators set simultaneously prices for mobile and fixed services (p_m^k, p_f^k)

3) Consumers choose a mobile plan

4) Consumers learn their preferences and i) decide whether to subscribe to a fixed service or not offer and ii) in the case of subscription, they decide to which operator.

The game is solved by backward induction and the results are presented in the next section.

1.4 Results

Before turning to the analysis of equilibria, market shares and the different consumption (i.e. mobile-only, bundle or cross-purchase) types are derived. Stages 3 and 4 are solved using product-specific preferences, rather than the symmetric case. This allows for insights in mobile demand matters, which would be hidden otherwise. In subsection 1.4.1, respectively 1.4.2, stages 1 and 2 are then solved for the symmetric case, respectively for product-specific preferences.

Stage 4: Consumers' decision regarding fixed services

The position of the marginal consumers in the fixed market are needed in order to calculate the expected additional utilities EU_{mf}. According to the model setup above, the marginal consumer $\tilde{x}_{BU}^k$ (that is, who is indifferent between a bundle and mobile-only consumption) is determined by equalising the corresponding utility to 0, where 0 is the anticipated utility incurred by a consumer whose excess valuation for fixed services is insufficient given the

price p_f^k and therefore remains mobile-only. A similar reasoning applies to $\tilde{x}_{CP}^{k,-k}$. Thus, from $U_{BU}^k \equiv \theta^k - (p_f^k - \delta^k) - t|x^k - \tilde{x}_{BU}^k| = 0$ and $U_{CP}^{k,-k} \equiv \theta^{-k} - p_f^{-k} - t|x^{-k} - \tilde{x}_{CP}^{k,-k}| = 0$, the locations of the marginal consumers are given by[19]

$$\begin{aligned} \tilde{x}_{BU}^{\mathcal{A}} &= \tfrac{\theta^{\mathcal{A}} - \left(p_f^{\mathcal{A}} - \delta^{\mathcal{A}}\right)}{t}, \quad & \tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} &= 1 - \tfrac{\theta^{\mathcal{B}} - p_f^{\mathcal{B}}}{t} \\ \tilde{x}_{CP}^{\mathcal{B},\mathcal{A}} &= \tfrac{\theta^{\mathcal{A}} - p_f^{\mathcal{A}}}{t}, & \tilde{x}_{BU}^{\mathcal{B}} &= 1 - \tfrac{\theta^{\mathcal{B}} - \left(p_f^{\mathcal{B}} - \delta^{\mathcal{B}}\right)}{t} \end{aligned} \tag{1.2}$$

The first line of (1.2) represents the marginal consumers in the fixed market that already have a mobile plan from $\mathcal{A}$ (the lower left segment on Fig. 1.1) and the second line corresponds to the marginal consumers that have a mobile plan from $\mathcal{B}$ (the lower right segment). Using expression (1.1), the expected additional utility is integrated over the corresponding $\tilde{x}$. Hence, subscribing to a fixed offer when having a mobile offer from operator $\mathcal{A}$ yields

$$\begin{aligned} EU_{mf}^{\mathcal{A}} &= \int_0^{\tilde{x}_{BU}^{\mathcal{A}}} \left[\theta^{\mathcal{A}} - \left(p_f^{\mathcal{A}} - \delta^{\mathcal{A}}\right) - tz\right] \mathrm{d}z + \int_{\tilde{x}_{CP}^{\mathcal{A},\mathcal{B}}}^1 \left[\theta^{\mathcal{B}} - p_f^{\mathcal{B}} - t(1-z)\right] \mathrm{d}z \\ &= \frac{1}{2t}\Bigg\{\left(p_f^{\mathcal{A}} - v_f^{\mathcal{A}} - \delta^{\mathcal{A}}\right)^2 + \left(p_f^{\mathcal{B}} - v_f^{\mathcal{B}} - \delta^{\mathcal{B}}\right)^2 + 2\delta^{\mathcal{B}}\left(p_f^{\mathcal{B}} - v_f^{\mathcal{B}}\right) - \delta^{\mathcal{B}^2} \\ &\qquad + 2v_m^{\mathcal{A}}\left[\left(p_f^{\mathcal{A}} - \theta^{\mathcal{A}} - \delta^{\mathcal{A}}\right) + \left(p_f^{\mathcal{B}} - v_f^{\mathcal{B}}\right)\right]\Bigg\} \end{aligned} \tag{1.3}$$

Similarly, with a mobile plan from operator $\mathcal{B}$

$$\begin{aligned} EU_{mf}^{\mathcal{B}} &= \int_0^{\tilde{x}_{CP}^{\mathcal{B},\mathcal{A}}} \left[\theta^{\mathcal{A}} - p_f^{\mathcal{A}} - tz\right] \mathrm{d}z + \int_{\tilde{x}_{BU}^{\mathcal{B}}}^1 \left[\theta^{\mathcal{B}} - \left(p_f^{\mathcal{B}} - \delta^{\mathcal{B}}\right) - t(1-z)\right] \mathrm{d}z \\ &= \frac{1}{2t}\Bigg\{\left(p_f^{\mathcal{B}} - v_f^{\mathcal{B}} - \delta^{\mathcal{B}}\right)^2 + \left(p_f^{\mathcal{A}} - v_f^{\mathcal{A}} - \delta^{\mathcal{A}}\right)^2 + 2\delta^{\mathcal{A}}\left(p_f^{\mathcal{A}} - v_f^{\mathcal{A}}\right) - \delta^{\mathcal{A}^2} \\ &\qquad + 2v_m^{\mathcal{B}}\left[\left(p_f^{\mathcal{B}} - \theta^{\mathcal{B}} - \delta^{\mathcal{B}}\right) + \left(p_f^{\mathcal{A}} - v_f^{\mathcal{A}}\right)\right]\Bigg\} \end{aligned} \tag{1.4}$$

Stage 3: Consumers' decision regarding mobile services

[19] Recall that operator $\mathcal{A}$ is located in 0 (thus, $x^{\mathcal{A}} = 0$) and $\mathcal{B}$ in 1 ($x^{\mathcal{B}} = 1$).

After the expected additional utilities being derived, the third stage of the game is solved by defining the marginal consumer $\tilde{y}$ in the mobile market. With operator $\mathcal{A}$ located in 0, $\tilde{y}$ implicitly defines the demand for $\mathcal{A}$'s mobile services and is solution of

$$U_m^{\mathcal{A}}(y,\cdot) + EU_{mf}^{\mathcal{A}} = U_m^{\mathcal{B}}(y,\cdot) + EU_{mf}^{\mathcal{B}} \tag{1.5}$$
$$g_m^{\mathcal{A}} + v_m^{\mathcal{A}} - p_m^{\mathcal{A}} - \gamma\tilde{y} + EU_{mf}^{\mathcal{A}} = g_m^{\mathcal{B}} + v_m^{\mathcal{B}} - p_m^{\mathcal{B}} - \gamma(1-\tilde{y}) + EU_{mf}^{\mathcal{B}}$$

leading to

$$\tilde{y} = \frac{g_m^{\mathcal{A}} - g_m^{\mathcal{B}} + v_m^{\mathcal{A}} - v_m^{\mathcal{B}} + p_m^{\mathcal{B}} - p_m^{\mathcal{A}} + \gamma + EU_{mf}^{\mathcal{A}} - EU_{mf}^{\mathcal{B}}}{2\gamma} \tag{1.6}$$

Given the assumptions of equal valuations v_m and g_m, as well as equal transportation costs $t = \gamma$ and plugging (1.3) and (1.4) into (1.6), $\tilde{y}$ yields:[20]

$$\tilde{y} = \frac{1}{2} + \frac{p_m^{\mathcal{B}} - p_m^{\mathcal{A}}}{2t} + \frac{\delta^{\mathcal{A}^2} - \delta^{\mathcal{B}^2}}{4t^2} - \frac{\delta^{\mathcal{A}}\left(p_f^{\mathcal{A}} - \theta^{\mathcal{A}}\right) - \delta^{\mathcal{B}}\left(p_f^{\mathcal{B}} - \theta^{\mathcal{B}}\right)}{2t^2} \tag{1.7}$$

The above expression provides first interesting insights. First of all, it shows how the bundle discount acts as a competitive tool. The third term shows that the operator able to offer the highest discount attracts a higher demand for its mobile services. Hence, the discount acts as a competitive tool as it increases the number of potential bundle sales. Secondly, the demand for mobile services depends on the magnitude of FMS, θ. For instance, the demand for $\mathcal{A}$'s mobile services, $\tilde{y}$, depends positively on $\theta^{\mathcal{A}}$: $\frac{\partial\tilde{y}}{\partial\theta^{\mathcal{A}}} = \frac{\delta^{\mathcal{A}}}{2t^2}$. Thus, the higher $\theta^{\mathcal{A}}$, the less substitutable (or equivalently. more complementary) operator $\mathcal{A}$'s fixed and mobile services are and therefore, the higher operator $\mathcal{A}$'s demand for mobile services. The intuition behind this is that, due to complementarity, more consumers are willing to subscribe to $\mathcal{A}$'s mobile service in light of a potential

[20] Operator $\mathcal{B}$'s demand for mobile services is equal to $1 - \tilde{y}$.

subscription of a bundle and of benefitting from a reduced price via the bundle discount $\delta^{\mathcal{A}}$. On the other hand, $\tilde{y}$ depends negatively on $\theta^{\mathcal{B}}$: the more $\mathcal{B}'s$ services are complementary, the lower is the demand for $\mathcal{A}$'s mobile services.

It is seen that under symmetry, the mobile market is split evenly among operator: $\tilde{y} = 1/2$.

Given that all the marginal consumers in each market are now defined, the different consumption types can be characterised which are given in table 1.1 below. This table also gives notations for the different demands.

Fixed market \ Mobile market	$[0\ \tilde{y}]$	$[\tilde{y}\ 1]$
$[0\ \tilde{x}^{\mathcal{A}}_{BU}]$	Bundlers from $\mathcal{A}$: $\mathcal{D}^{\mathcal{A}}_{BU}$	/
$[\tilde{x}^{\mathcal{A}}_{BU}\ \tilde{x}^{\mathcal{A},\mathcal{B}}_{CP}]$	mobile-only-consumers from $\mathcal{A}$: $\mathcal{D}^{\mathcal{A}}_{MO}$	/
$[\tilde{x}^{\mathcal{A},\mathcal{B}}_{CP}\ 1]$	Cross-purchasers: Mobile from $\mathcal{A}$ and fixed from $\mathcal{B}$: $\mathcal{D}^{\mathcal{A},\mathcal{B}}_{CP}$	/
$[0\ \tilde{x}^{\mathcal{B},\mathcal{A}}_{CP}]$	/	Cross-purchasers: Mobile from $\mathcal{B}$ and fixed from $\mathcal{A}$: $\mathcal{D}^{\mathcal{B},\mathcal{A}}_{CP}$
$[\tilde{x}^{\mathcal{B},\mathcal{A}}_{CP}\ \tilde{x}^{\mathcal{B}}_{BU}]$	/	mobile-only-consumers from $\mathcal{B}$: $\mathcal{D}^{\mathcal{B}}_{MO}$
$[\tilde{x}^{\mathcal{B}}_{BU}\ 1]$	/	Bundlers from $\mathcal{B}$: $\mathcal{D}^{\mathcal{B}}_{BU}$

Table 1.1 The different consumption types according to the marginal consumers. *BU* denotes bundlers, *CP* denotes cross-purchasers, *MO* denotes mobile-only consumers. For demands of cross-purchasers, the first superscript indicates the mobile operator, the second superscript the fixed operator.

Operators face the following maximisation problems:

$$\max_{p_f^{\mathcal{A}},p_m^{\mathcal{A}}} \Pi^{\mathcal{A}} = p_m^{\mathcal{A}}\ \mathcal{D}_{MO}^{\mathcal{A}} + \ p_m^{\mathcal{A}}\ \mathcal{D}_{CP}^{\mathcal{A},\mathcal{B}} + \ p_f^{\mathcal{A}}\ \mathcal{D}_{CP}^{\mathcal{B},\mathcal{A}} + \ (p_m^{\mathcal{A}} + p_f^{\mathcal{A}} - \delta^{\mathcal{A}})\ \mathcal{D}_{BU}^{\mathcal{A}} \tag{1.8a}$$

$$\begin{aligned} &= p_m^{\mathcal{A}} \left(\tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} - \tilde{x}_{BU}^{\mathcal{A}}\right) \tilde{y} + p_m^{\mathcal{A}} \left(1 - \tilde{x}_{CP}^{\mathcal{A},\mathcal{B}}\right) \tilde{y} + p_f^{\mathcal{A}}\ \tilde{x}_{CP}^{\mathcal{B},\mathcal{A}} \left(1 - \tilde{y}\right) \\ &\quad + \left(p_m^{\mathcal{A}} + p_f^{\mathcal{A}} - \delta^{\mathcal{A}}\right) \tilde{x}_{BU}^{\mathcal{A}}\ \tilde{y} \end{aligned}$$

$$\max_{p_f^{\mathcal{B}},p_m^{\mathcal{B}}} \Pi^{\mathcal{B}} = p_m^{\mathcal{B}}\ \mathcal{D}_{MO}^{\mathcal{B}} + \ p_m^{\mathcal{B}}\ \mathcal{D}_{CP}^{\mathcal{B},\mathcal{A}} + \ p_f^{\mathcal{B}}\ \mathcal{D}_{CP}^{\mathcal{A},\mathcal{B}} + \ (p_m^{\mathcal{B}} + p_f^{\mathcal{B}} - \delta^{\mathcal{B}})\ \mathcal{D}_{BU}^{\mathcal{B}} \tag{1.8b}$$

$$\begin{aligned} &= p_m^{\mathcal{B}} \left(\tilde{x}_{BU}^{\mathcal{B}} - \tilde{x}_{CP}^{\mathcal{B},\mathcal{A}}\right) \left(1 - \tilde{y}\right) + p_m^{\mathcal{B}}\ \tilde{x}_{CP}^{\mathcal{B},\mathcal{A}} \left(1 - \tilde{y}\right) + p_f^{\mathcal{B}} \left(1 - \tilde{x}_{CP}^{\mathcal{A},\mathcal{B}}\right) \tilde{y} \\ &\quad + \left(p_m^{\mathcal{B}} + p_f^{\mathcal{B}} - \delta^{\mathcal{B}}\right) \left(1 - \tilde{x}_{BU}^{\mathcal{B}}\right) \left(1 - \tilde{y}\right) \end{aligned}$$

The first term represents revenues from mobile-only sales. The second and third terms correspond to revenues stemming from separate sales of either services when consumers cross-purchase. Finally, the last term represents revenues from bundled sales.

1.4.1 Symmetry among operators

When consumers have the same reservation price for fixed services regardless the provider, the environment is said to be symmetric. This subsection analyses this case. It is assumed that consumers have the same valuation for fixed services: $v_f^{\mathcal{A}} = v_f^{\mathcal{B}} = v_f$. Since mobile services are also equally valued by all the consumers ($v_m^{\mathcal{A}} = v_m^{\mathcal{B}} = v_m$), it follows that $\theta^{\mathcal{A}} = \theta^{\mathcal{B}} = \theta$.

The analysis begins with the regime without bundling, then provides the equilibria with bundling, and terminates with a comparison of both regimes.

Stage 2: Price setting stage

No bundling Suppose first that operators do not bundle. The model is easily adapted by setting the bundle discounts $\delta^{\mathcal{A}}$ and $\delta^{\mathcal{B}}$ equal to 0. Then, the

profit maximisation problems in (1.8a) and (1.8b) yield the following equilibria, $\forall k = \mathcal{A}, \mathcal{B}$:[21]

$$p_f^{k*} = \frac{\theta}{2} \tag{1.9a}$$

$$p_m^{k*} = t \tag{1.9b}$$

$$\Pi^{k*} = \frac{t}{2} + \frac{\theta^2}{4t} \tag{1.9c}$$

In contrast to the fixed market, the market for mobile services is fully covered and operators compete head-on. Thus, the price for mobile services is equal to the standard Hotelling price. In the partially covered fixed market, prices are independent of any transportation cost, and are negatively impacted by increasing substitutability: the stronger the FMS (this is, θ closer to 0), the smaller p_f^k, $\forall k = \mathcal{A}, \mathcal{B}$. Moreover, profits are also negatively impacted by stronger substitutability.

In the no bundling regime, operators face the following equilibrium demands, $\forall k = \mathcal{A}, \mathcal{B}$:

$$\mathcal{D}_{MO}^{k*} = \frac{1}{2} - \frac{\theta}{2t} \tag{1.10a}$$

$$\mathcal{D}_{BU}^{k*} = \mathcal{D}_{CP}^{k*} = \frac{\theta}{4t} \tag{1.10b}$$

Obviously, the demand for mobile-only, D_{MO}^k, increases with stronger FMS. With fixed and mobile becoming stronger substitutes, an increasing consumer mass does not see the point in paying for a similar service when their needs are satisfied with the service they already possess. On the other hand, all demands for fixed services, whether as a bundle or as cross-purchase, decrease with θ.[22]

Note that if fixed and mobile services were perfect substitutes (i.e. $v_f = v_m$

[21] The detailed profit maximisation can be found in appendix A.1.1.

[22] The term "bundle" is somehow abusive in the sense that this paragraph considers the no-bundling regime. Here, bundling is merely "*one-stop shopping*", where both services are subscribed from the same operator, although no discount is granted.

and thus $\theta = 0$), there would be no demand for fixed services and operators have symmetric market shares in the mobile market only: $D^k_{MO} = 1/2, \forall k = \mathcal{A}, \mathcal{B}$.

Before turning the mixed bundling regime, recall from the model setup that the operators are maximally differentiated, i.e. located at either end of the Hotelling lines. Formally, local monopolies arise, in $\mathcal{A}$'s bundle market (the lower left segment of Fig. 1.1), when the marginal consumer $\tilde{x}^{\mathcal{A}}_{BU}$ is to the left of $\tilde{x}^{\mathcal{A},\mathcal{B}}_{CP}$: $\tilde{x}^{\mathcal{A}}_{BU} < \tilde{x}^{\mathcal{A},\mathcal{B}}_{CP}$ Similarly in $\mathcal{B}$'s bundle market: $\tilde{x}^{\mathcal{B},\mathcal{A}}_{CP} < \tilde{x}^{\mathcal{B}}_{BU}$. Then, assuming that both operators have a strictly positive market share in the fixed market (whether in its own bundle market or the rival's) the condition for local monopolies in the fixed market yields:

$$\begin{cases} 0 < \tilde{x}^{\mathcal{A}}_{BU} & < & \tilde{x}^{\mathcal{A},\mathcal{B}}_{CP} < 1 \\ 0 < \tilde{x}^{\mathcal{B},\mathcal{A}}_{CP} & < & \tilde{x}^{\mathcal{B}}_{BU} < 1 \end{cases} \tag{1.11}$$

Solving these inequalities together yields the following:[23]

Condition 1.1. *Without any discount granted on bundled sales, local monopolies arise if fixed and mobile services are neither too strong substitutes, nor too strong complements:* $0 < \theta < t$.

The first inequality, $0 < \theta$, is natural, given the technological superiority of fixed services. It indicates that substitutability should not be too strong. The second inequality yields the opposite: fixed and mobile services should not be too complementary. If θ was too large, fixed and mobile services would be too complementary and no consumer would remain mobile-only. The fixed market would then be fully covered and the marginal consumers, who are indifferent between bundling and cross-purchasing would be one and the same. Consequently, the operators would compete head-on in the fixed market, too.

[23] See appendix A.1.3 for detailed calculus.

Mixed Bundling In a mixed bundling regime, operators can offer their services as a bundle or separately. Before turning to equilibria, another assumption is briefly discussed.

Due to perfect symmetry, it is reasonable to assume that each operator's total profits have the same reaction towards an increase of the rival's discount. As appendix A.1.2 formally shows, the marginal impact on $\mathcal{A}$'s profits caused by a marginal increase of $\mathcal{B}$'s discount is exactly the same than a marginal increase of $\mathcal{A}$'s discount has on the $\mathcal{B}$'s profits. Hence, it is assumed that both operators grant the same level of discount for bundled sales in a symmetric environment:

Assumption 1.1. *In the case of perfect symmetry, the multi-market operators will set identical bundle discounts:* $\delta^{\mathcal{A}} = \delta^{\mathcal{B}} = \delta$.

Under this assumption, equilibrium *stand-alone* prices and total profits in a bundling regime (labelled by a "hat") yield:

$$\hat{p}_f^k = \frac{\theta}{2} + \frac{\delta}{4} \tag{1.12a}$$

$$\hat{p}_m^k = t + \frac{\delta^2}{2t} \tag{1.12b}$$

$$\hat{\Pi}^k = \frac{t}{2} + \frac{\theta^2}{4t} - \frac{\delta^2}{16t} \tag{1.12c}$$

The impact of introducing a bundle discount on prices are easily seen by comparing equilibria in (1.12a) to (1.9a), respectively (1.12b) to (1.9b): all individual prices increase by a fraction of δ. This is a standard result in the bundling literature. When products or services under consideration are substitutable and when firms introduce a bundled offer alongside their existing stand-alone offers, prices for stand-alone offers increase in order to recoup at least partially the cost of bundling.

Comparing profits in both regimes reveals that bundling is ultimately not

profitable. In effect, comparing (1.9c) and (1.12c) shows up negative:

$$\begin{aligned}\hat{\Pi}^k - \Pi^k &= \frac{t}{2} + \frac{\theta^2}{4t} - \frac{\delta^2}{16t} - \left(\frac{t}{2} + \frac{\theta^2}{4t}\right) \\ &= -\frac{\delta^2}{16t}\end{aligned} \tag{1.13}$$

Such a profit decline is explained as follows. Due to the discount granted on bundled sales, an increasing mass of consumers subscribes to the bundled offer at a price equal to $p_m^k + p_f^k - \delta$. This is verified by looking at the equilibrium demands, $\forall k = \mathcal{A}, \mathcal{B}$:

$$\hat{\mathcal{D}}_{MO}^k = \frac{1}{2} - \frac{\theta}{2t} - \frac{\delta}{4t} \tag{1.14a}$$

$$\hat{\mathcal{D}}_{BU}^k = \frac{\theta}{4t} + \frac{3\delta}{8t} \tag{1.14b}$$

$$\hat{\mathcal{D}}_{CP}^k = \frac{\theta}{4t} - \frac{\delta}{8t} \tag{1.14c}$$

The increase of D_{BU}^k and the decreases of D_{MO}^k and D_{CP}^k can be observed by the following difference. Define by $\Delta\mathcal{D}_l^k = \hat{\mathcal{D}}_l^k - \mathcal{D}_l^k$ the variation of demand $l = \{MO, BU, CP\}$ addressed to operator k when passing from a no-bundling regime ($\mathcal{D}_l^k$) to a bundling regime ($\hat{\mathcal{D}}_l^k$). It then is easily verified that:

$$\Delta\mathcal{D}_{BU}^k + \Delta\mathcal{D}_{MO}^k + \Delta\mathcal{D}_{CP}^{-k,k} = \frac{3\delta}{8t} + (-\frac{\delta}{4t}) + (-\frac{\delta}{8t}) = 0 \tag{1.15}$$

Hence, bundling has the effect of diverting demand from the more expensive separate sales (which allow to cover the costs of bundling) towards the cheaper bundled sales. This diversion then leads to a decrease in profits.

Note, at this stage that, due to the presence of a discount on bundled sales, the condition 1.1, ensuring local monopolies in the fixed market, adapts as follows:

Remark 1.1. *Under assumption 1.1 the condition for local monopolies to arise*

becomes: $0 < \theta < t - \frac{\delta}{2}$.

The corresponding interpretation remains unaffected: FMS should not be too strong, nor too weak. In other words, fixed and mobile services should not be too substitutable, nor too complementary. Although, in presence of δ, the condition is logically strengthened. As mentioned above, the demand for bundled sales increases, whereas other demands (for mobile-only and cross-purchases) decrease, implying that the discount turns the substitutes into stronger complements.[24]

Stage 1: The operators' decision to bundle or not

A natural question that arises from the comparison of pricing equilibria is that of the individual incentive to introduce a bundle discount, given that operators are aware of the negative outcome when competing via bundling. As a matter of fact, depending on the magnitude of θ (i.e. on the magnitude of FMS), a multi-market operator has an individual incentive to bundle its two services. When operator k unilaterally decides to introduce a bundle discount, its profits, $\Pi^k_{\text{unilateral}}$, are equal to

$$\Pi^k_{\text{unilateral}} = \frac{t}{2} + \frac{\theta^2}{4t} + \frac{\theta\delta^k\nu\left(2\lambda + \theta\delta^k\right) - \delta^{k^2}\left[3t^4 + \left(9t^2 - \delta^{k^2}\right)^2\right]}{4t\mu^2} \tag{1.16}$$

expression where $\nu = (8t^2 - \delta^{k^2})$, $\lambda = (6t^2 - \delta^{k^2})$ and $\mu = (12t^2 - \delta^{k^2})$. The first two terms in the above, $t/2$ and $\theta^2/4t$, correspond to profits in a no-bundling regime given by (1.9c). The third term therefore equals the difference in profits operator k earns with unilateral bundling compared to the no-bundling regime. The difference between both regimes is equal to $\Pi^k_{\text{unilateral}} - \Pi^{k*}$. Then, checking for a value of θ for which $\Delta\Pi^k$ is positive and that complies with condition 1.1

[24] This means that the marginal consumers in the fixed market draw closer to each other, reducing the mobile-only segment and increasing the operators' bundle market share. Since the demand for mobile-only decrease at a higher rate than the demand for cross-purchases, firms come closer to each other, which leads to the strengthened condition.

yields:

$$\Pi^k_{\text{unilateral}} - \Pi^{k*} = \frac{\theta\delta^k\nu\Big(2\lambda + \theta\delta^k\Big) - \delta^{k^2}\Big[3t^4 + \Big(9t^2 - \delta^{k^2}\Big)^2\Big]}{4t\mu^2} > 0$$
$$\Leftrightarrow t - \frac{\delta}{2} > \theta > \sqrt{2}\sqrt{\frac{t^2\mu^2}{\delta^2\nu}} - \frac{\lambda}{\delta} \equiv \underline{\theta} \tag{1.17}$$

$\underline{\theta}$ is strictly larger than 0 for any $t > 0$ and $\delta > 0$. Thus, too strong a substitutability between fixed and mobile services (that is, $\theta \in (0, \underline{\theta}]$) does not allow for unilateral bundling to be profitable. On the other hand, for any $\theta \in (\underline{\theta}, t - \frac{\delta}{2})$, unilateral bundling is profitable. Hence, if FMS is of intermediate magnitude operator k has an individual incentive to offer a fixed-mobile bundle.

The best response towards unilateral bundling by a rival is to counter-bundle, because losses are minimised. Indeed, the difference in profits of the (initially) non-bundling operator, $\hat{\Pi}^k - \Pi^k_{\text{unilateral}}$, yields:[25]

$$\hat{\Pi}^k - \Pi^k_{\text{unilateral}} = \frac{t}{2} + \frac{\theta\Delta\nu\Big(2\lambda + \theta\Delta\Big) - \delta^{k^6}}{4t\mu} - \frac{2t\Big[36t^4 - \delta^{-k}\theta\Big(12t^2 - \delta^{-k}\theta\Big)\Big]}{(12t^2 - \delta^{-k^2})^2}$$
$$+ \frac{2t^2\Big[6t^2\Big(4\delta^{-k^2} - 7\delta^{k^2}\Big) - \Big(\delta^{-k^2} + \delta^{k^2}\Big)^2 + 10\delta^{k^2}\Big]}{4t\mu} \tag{1.18}$$

with ν, μ and λ as defined above and $\Delta = (\delta^k - \delta^{-k})$.

Because the above is a continuous function of θ for any $\theta \in (\underline{\theta}, t - \frac{\delta}{2})$ and strictly positive at the boundaries of this interval, it appears that counter-bundling is always the best response. Hence, if one operator unilaterally decides to bundle, its rival will always counter-bundle.

Finally, as both operators are symmetric and have the same strategic behavior, it is immediate to see that the equilibrium outcome involves strictly positive bundle discounts. Multi-market operators will incur profits as given in (1.12c).

The following can therefore be stated:

[25] It is important to remark that now k is the initially non-bundling firm.

Proposition 1.1. *If multi-market operators are perfectly symmetric, unilateral bundling is always profitable if FMS is neither too strong, nor too weak, i.e.* $\theta \in (\underline{\theta}, t - \frac{\delta}{2})$*. The non-bundling rival's best response is counter-bundling, such that the equilibrium outcome involves both firms to offer a strictly positive bundle discount.*

Since both operators incur losses when competing via bundling, it appears that they are in prisoners' dilemma as they could incur higher profits than they do in equilibrium. Unsurprisingly, industry profits (IP), decrease:

$$\begin{aligned}\Delta IP &= \sum_{k}^{\mathcal{A},\mathcal{B}} \hat{\Pi}^k - \sum_{k}^{\mathcal{A},\mathcal{B}} \Pi^k \\ &= \left(t + \frac{\theta^2}{2t} - \frac{\delta^2}{8t}\right) - \left(t + \frac{\theta^2}{2t}\right) \\ &= -\frac{\delta^2}{8t}\end{aligned} \tag{1.19}$$

On the other hand, consumers benefit from this competition. As has been discussed above, bundling induces a larger consumer mass to consume a bundled offer which comes at a lower price. This is clearly reflected by equilibrium consumer surplus (CS):

$$\begin{aligned}\Delta CS &= \widehat{CS} - CS \\ &= \left(g_m + v_m + \frac{\theta(\delta+\theta)}{2t} + \frac{\delta^2}{8t} - \frac{5t}{4}\right) - \left(g_m + v_m + \frac{\theta^2}{2t} - \frac{5t}{4}\right) \\ &= \frac{\theta\delta}{2t} + \frac{\delta^2}{8t}\end{aligned} \tag{1.20}$$

Summing up (1.19) and (1.20) gives the difference in social welfare (W), which clearly increases: $\Delta W = \frac{\theta\delta}{2t}$. But the stronger FMS ($\theta$ close to 0), the smaller the welfare-beneficial effect induced by the bundle discount. The reason for this is that the less consumers feel the need to subscribe to a second service, the less convincing is the bundling discount.

1.4.2 Product-specific preferences

Consider in this subsection the possibility that consumers' preferences differ for the different fixed services, such that $v_f^k \neq v_f^{-k}$.[26] This may occur, for instance, if one operator offers fixed services over FTTH while the rival operator uses a cable network. Another example consists in both operators using the same infrastructure, but offering differentiated TV channel baskets, VOD catalogues, or different volume of space for cloud computing.

Without loss of generality, assume that $v_f^k > v_f^{-k}$ and thus $\theta^k > \theta^{-k}$. For convenience, operator k will be called the *higher valued operator*, as it enjoys the higher consumers' valuation for fixed services. On the contrary, operator $-k$ is called the *lower valued operator*.

The interest in analysing this case is to show that the prisoner's dilemma does not emerge and the higher valued operator will always earn higher profits with bundling. The lower valued operator's profits, however, decrease, but bundling allows to minimise the losses. Albeit, even if the higher valued operator's profits increase, it has no incentive to induce full market coverage in the fixed market, since, in this case, profits would decrease.

Similarly to the symmetric case, the present analysis first derives the equilibrium without bundling and then, in a second time, the equilibrium outcome with mixed bundling.

Stage 2: Price setting stage

[26] In most of the subsequent analysis, the operators will simply be denoted by k. Only when appropriate, so as to enhance comprehension of the advanced ideas, the operators will be distinguished by $\mathcal{A}$ and $\mathcal{B}$.

No Bundling When neither operator offers its services as a bundle, the equilibrium outcome yields

$$p_f^k = \frac{\theta^k}{2} \tag{1.21a}$$

$$p_m^k = t \tag{1.21b}$$

$$\Pi^k = \frac{t}{2} + \frac{\theta^{k^2}}{4t} \tag{1.21c}$$

and demands become

$$D_{MO}^k = \frac{1}{2} - \frac{\theta^k + \theta^{-k}}{4t} \tag{1.21d}$$

$$D_{BU}^k = \frac{\theta^k}{4t} \tag{1.21e}$$

$$D_{CP}^{k,-k} = \frac{\theta^{-k}}{4t} \tag{1.21f}$$

Since $\theta^k > \theta^{-k}$, the higher valued operator sets a higher price for its fixed service. Despite the higher price, it has a larger market share in its bundle market, as well as in its rival's bundle market. Hence, it also earns higher profits.

Mixed Bundling Consider now the mixed bundling regime. Before turning to the core of the analysis, it should be noted that, due to asymmetry induced by product-specific preferences, the discounts can no longer be assumed to be identical. Firms will adopt distinct strategic behaviour and an identical level of discount for both firms does no longer seem plausible.

Similarly to the previous subsection, local monopolies arise if $0 < \tilde{x}_{BU}^{\mathcal{A}} < \tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} < 1$ and $0 < \tilde{x}_{CP}^{\mathcal{B},\mathcal{A}} < \tilde{x}_{BU}^{\mathcal{B}} < 1$. Several solutions ensure this set of inequalities to hold and each solution can be interpreted as a different competitive setting. In the following, these different settings will be briefly presented.

First, one can distinguish the scenario where the consumers' valuation $v_f^{\mathcal{A}}$

is considerably higher than $v_f^{\mathcal{B}}$, leading to a stronger FMS for operator $\mathcal{B}$, from the alternative case where the difference between valuations is relatively small and $\theta^{\mathcal{A}}$ therefore close $\theta^{\mathcal{B}}$. Both scenarios appear plausible, if one considers competition between narrowband and broadband, represented by the first scenario, or competition between two broadband networks like fibre vs. cable. Although, the second scenario seems to be more relevant for most of today's telecommunications markets, especially given the fact that narrowband access demand is rather low and generally declining compared to broadband access demand.

Second, within each scenario, each operator can be more or less aggressive in its pricing strategy when it comes to the level of its bundle discount. This means that either the higher or the lower valued operator can offer a larger discount than its rival. Possible interpretations are:

i) when the higher valued operator offers a larger discount, it does so in order to exert a supplementary competitive pressure on its rival. Indeed, the latter already competes against stronger complements, whereas its own services are relatively strong substitutes (that is, $\theta^{\mathcal{B}} < \theta^{\mathcal{A}}$). Thus, if $\mathcal{A}$ adds a pricing constraint on $\mathcal{B}$ by offering stronger price reductions, competition increases.

ii) when the higher valued operator offers a smaller discount, it makes use of the information that, if consumers choose to subscribe to a fixed service, some of them will prefer having it from $\mathcal{A}$ since they value it more. This may confer a considerable advantage: the higher valued operator knows that these consumers are subscribing to its fixed service even with a smaller discount than its rival.

The subsequent analysis considers the case where consumer valuations do not differ much and where the higher valued operator offers the higher discount.

Condition 1.2. *If consumers have product-specific preferences and consumers' valuations $\theta^{\mathcal{A}}$ and $\theta^{\mathcal{B}}$ are close, then, local monopolies arise whenever:*

$$2\theta^{\mathcal{B}} < \theta^{\mathcal{A}} + \theta^{\mathcal{B}} < \frac{4t - 3\left(\delta^{\mathcal{A}} - \delta^{\mathcal{B}}\right)}{2} \equiv \bar{\theta}$$

The condition states that FMS, and more specifically $\theta^{\mathcal{A}} + \theta^{\mathcal{B}}$ cannot be too strong, nor to weak. Would FMS be to strong, consumers would not be interested in fixed services and thus remain mobile-only. Alternatively, with too weak a FMS, no consumer would remain mobile-only and the corresponding segment (that is, $x_{CP}^{k,-k} - x_{BU}^{k}$) on the Hotelling lines would then not exist, leading to head-on competition between operators in the fixed market.

Note finally that the above condition satisfies both assumptions of $\delta^{\mathcal{A}} > \delta^{\mathcal{B}}$. As a matter of fact, it must be that $\delta^{\mathcal{A}} > 3\delta^{\mathcal{B}}$ in order for $\bar{\theta}$ to be positive.[27]

The mixed bundling equilibrium, expressed as first order Taylor approximations around $\delta^{\mathcal{A}}$ and $\delta^{\mathcal{B}}$, is given by

$$\hat{p}_m^{\mathcal{A}} = t + \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} + O \tag{1.22a}$$

$$\hat{p}_m^{\mathcal{B}} = t - \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} + O \tag{1.22b}$$

$$\hat{p}_f^{\mathcal{A}} = \frac{\theta^{\mathcal{A}}}{2} + \frac{\delta^{\mathcal{A}}}{4} + O \tag{1.22c}$$

$$\hat{p}_f^{\mathcal{B}} = \frac{\theta^{\mathcal{B}}}{2} + \frac{\delta^{\mathcal{B}}}{4} + O \tag{1.22d}$$

$$\hat{\Pi}^{\mathcal{A}} = \frac{t}{2} + \frac{\theta^{\mathcal{A}^2}}{4t} + \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} + O \tag{1.22e}$$

$$\hat{\Pi}^{\mathcal{B}} = \frac{t}{2} + \frac{\theta^{\mathcal{B}^2}}{4t} - \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} + O \tag{1.22f}$$

where O represents the omitted terms.[28] Under condition 1.2, the impacts of bundling on prices and profits can be summarised by the lemma below:

[27] Moreover, the transportation costs t must be sufficiently large (that is, $t > (3\delta^{\mathcal{A}} - \delta^{\mathcal{B}})/4$) for $\bar{\theta}$ to be positive.

[28] $O = O\left[\delta^{k}\right]^2 + O\left[\delta^{-k}\right]^2 + O\left[\delta^{-k}\right]^2 \delta^{k}$.

Lemma 1.1. *If consumers have product-specific preferences are predominant, consumers' valuations for fixed services close and $\delta^{\mathcal{A}} > \delta^{\mathcal{B}}$, the adoption of a bundling strategy implies that*

i) both prices for fixed services, $\hat{p}_f^k$, increase, $\forall k = \mathcal{A}, \mathcal{B}$,

ii) the price for the higher valued operator's mobile service, $\hat{p}_m^{\mathcal{A}}$, increases*,*

iii) the price for the lower valued operator's mobile service, $\hat{p}_m^{\mathcal{B}}$, decreases*,*

iv) the higher valued operator earns higher *profits,*

v) the lower valued operator earns lower *profits.*

Proof. The proof is contained in appendix A.1.5. □

It appears that some of the results from the symmetric case do also hold in the setting with product-specific preferences. The prices for fixed services increase. The intuition is the same as in the symmetric case: stand-alone prices increase in order to recoup the costs of bundling.

In contrast, prices for mobile services vary differently from one operator to another. Whereas the higher valued operator's price increases, the lower valued operator's price decreases, which is the latter's reaction towards the *business-stealing* effect in the mobile market. To see this effect, it can be verified that the increase of $\mathcal{A}$'s bundle market equals the increase of its share in the mobile market. Define $\Delta\tilde{y} = \tilde{y}_{\text{No bundling}} - \tilde{y}_{\text{Mixed bundling}}$ the displacement of the marginal consumer in the mobile market induced by the introduction of a bundle discount:

$$\begin{aligned} \Delta\tilde{y} &= \tilde{y}_{\text{No bundling}} - \tilde{y}_{\text{Mixed bundling}} \\ &= \frac{1}{2} + \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{12t^2} - \frac{1}{2} \\ &= \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{12t^2} \end{aligned} \tag{1.23}$$

Note that the above is positive, since $\theta^{\mathcal{A}} > \theta^{\mathcal{B}}$ and $\delta^{\mathcal{A}} > \delta^{\mathcal{B}}$. There is thus a displacement to right of the marginal consumer in the mobile market, which

implies an increase of $\mathcal{A}$'s share in that market.

Define moreover, in a similar vain as in section 1.4.1, $\Delta\mathcal{D}_l^{\mathcal{A}} = \hat{\mathcal{D}}_l^{\mathcal{A}} - \mathcal{D}_l^{\mathcal{A}}$ as the variation of demand $l = \{MO, BU, CP\}$. The sum of the three different $\Delta\mathcal{D}_l^{\mathcal{A}}$ for $\mathcal{A}$'s bundle market yield:

$$\begin{aligned}
\sum_l \Delta\mathcal{D}_l^{\mathcal{A}} =& \Delta\mathcal{D}_{BU}^{\mathcal{A}} + \Delta\mathcal{D}_{MO}^{\mathcal{A}} + \Delta\mathcal{D}_{CP}^{\mathcal{A},\mathcal{B}} \\
=& \left[\frac{\theta^{\mathcal{A}}}{4t} + \frac{\delta^{\mathcal{A}}}{8t}\Big(3 + \frac{\theta^{\mathcal{A}^2}}{3t^2}\Big) - \frac{\delta^{\mathcal{A}}\delta^{\mathcal{B}}\theta^{\mathcal{B}}}{24t^3}\right] - \left[\frac{\theta^{\mathcal{A}}}{4t}\right] \\
&+ \left[\frac{1}{2} - \frac{\theta^{\mathcal{A}} + \theta^{\mathcal{B}}}{4} - \frac{3\delta^{\mathcal{A}} - \delta^{\mathcal{B}}}{8t} + \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{12t^2}\Big(1 - \frac{(\theta^{\mathcal{A}} + \theta^{\mathcal{B}})}{2t}\Big)\right] \\
&- \left[\frac{1}{2} - \frac{\theta^{\mathcal{A}} + \theta^{\mathcal{B}}}{4}\right] \\
&+ \left[\frac{\theta^{\mathcal{B}}}{4t} + \frac{\theta^{\mathcal{B}}(\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}})}{24t^3} - \frac{\delta^{\mathcal{B}}}{8t}\right] - \left[\frac{\theta^{\mathcal{B}}}{4t}\right] \\
=& \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{12t^2} \\
=& \Delta\tilde{y}
\end{aligned} \tag{1.24}$$

Hence, operator $\mathcal{A}$'s bundle market increases at the expense of its competitor's bundle market. This business-stealing effect is amplified by $\mathcal{A}$'s higher discount, which turns both services into stronger complements and thus encourages even more consumers to subscribe to the higher valued operator's mobile and fixed services. The lower valued operator $\mathcal{B}$ reacts towards this increased competition by lowering the stand-alone price of its mobile services. Although, by doing this, it loses one source of revenue that could allow to recoup its costs of bundling. $\mathcal{B}$ therefore earns reduced profits.

Stage 1: Operators' decision to bundle or not

From the discussion above follows that, since the higher valued operator earned higher profits if both operators bundle, it will also earn higher profits if it is the only operator to bundle. In this case, it would not face a bundling rival and thus less fierce competition. The equilibrium in stage 1 therefore relies on

the decision of the lower valued operator whether or not it counter-bundles or not.

Similarly to the symmetric case, counter-bundling is more profitable than letting the rival (here, the higher valued operator) bundle unilaterally. Indeed, let the variation in $\mathcal{B}$'s profits when passing from a situation with unilateral bundling by $\mathcal{A}$ to a situation where both operators bundle be denoted by $\Delta\Pi^{\mathcal{B}} = \hat{\Pi}^{\mathcal{B}} - \Pi^{\mathcal{B}}_{\mathcal{A}\text{ unilateral}}$.[29] It can be shown that under condition 1.2, the lower valued operator mitigates the reduction of its profits via counter-bundling:

$$\begin{aligned}\hat{\Pi}^{\mathcal{B}} - \Pi^{\mathcal{B}}_{\mathcal{A}\text{ unilateral}} =& \left(\frac{t}{2} + \frac{\theta^{\mathcal{B}^2}}{4t} + \frac{\theta^{\mathcal{B}}\delta^{\mathcal{B}} - \theta^{\mathcal{A}}\delta^{\mathcal{A}}}{6t}\right) \\ & - \left(\frac{t}{2} + \frac{\theta^{\mathcal{B}^2}}{4t} - \frac{\theta^{\mathcal{A}}\delta^{\mathcal{A}}}{6t} + \Psi\right) \\ =& \frac{\theta^{\mathcal{B}}\delta^{\mathcal{B}}}{6t} \\ >& 0 \end{aligned} \tag{1.25}$$

The last line follows since $\theta^{\mathcal{B}}$, as well as $\delta^{\mathcal{B}}$ are strictly positive. Hence, both operators bundle in equilibrium. Therefore:

Proposition 1.2. *If consumers have product-specific preferences, consumers' valuations for fixed services close and $\delta^{\mathcal{A}} > \delta^{\mathcal{B}}$, bundling two substitutable products does not involve a prisoner's dilemma. Bundling increases profits of the operator with the lower FMS (this is, the operator with the higher fixed service valuation), whereas it acts as a* ***Maximin*** *strategy for the operator with the stronger substitutability.*

The results above are in opposition with those of Thanassoulis (2007). In his paper, when consumers have product-specific preferences, bundling involves a prisoners' dilemma and operators incur revenue losses. Also, as will be shown below, in Thanassoulis' setting, social welfare decreases, because of allocative

[29] $\hat{\Pi}^{\mathcal{B}}_{\mathcal{A}\text{ unilateral}}$ stands for $\mathcal{B}$'s profit when $\mathcal{A}$ bundles unilaterally and $\hat{\Pi}^{\mathcal{B}}$ are $\mathcal{B}$'s profits when both operators bundle (i.e. equation (1.22f)).

inefficiencies: some consumers switch for a bundle even though their needs would be better off with cross-purchases. Here, social welfare will be pulled by the increased consumer surplus as consumers benefit from the bundle discount, as well as from lower stand-alone mobile prices from the lower valued operator.

This reversal of the results can be explained by the possibility for the operators to expand their sales in the fixed market, as this market is not fully covered. In the cited paper, all markets are fully covered, preventing thus any possible expansion. In addition, in Thanassoulis' work, consumers of a single product (the "*small buyers*"), do not change their consumption behavior and remain small buyers. Only "*large buyers*" (i.e. consumers of both products) may switch from cross-purchases to a bundle of both products. In contrast to this, in the present work, single-service consumers, i.e. mobile-only consumers, can switch to multi-service consumers. Hence, because of this migration from single to multi-service consumption, the operators can expand their market and increase their market shares (at least the higher valued operator).

Considering equilibrium profits of both operators shows that the higher valued operator gains what its competitor looses. This implies that bundling is neutral at an aggregated level. Indeed, summing up individual profits so as to get profits industry level yields a 0 variation.

$$\begin{aligned}\Delta IP &= \sum_{k}^{\mathcal{A},\mathcal{B}} \hat{\Pi}^k - \sum_{k}^{\mathcal{A},\mathcal{B}} \Pi^k \\ &= \left[t + \frac{\theta^{\mathcal{A}^2} + \theta^{\mathcal{B}^2}}{4t}\right] - \left[t + \frac{\theta^{\mathcal{A}^2} + \theta^{\mathcal{B}^2}}{4t}\right] \\ &= 0 \end{aligned} \tag{1.26}$$

On the other hand, consumer surplus increases, because consumers do not only benefit from the bundle discount, but consumers of $\mathcal{B}$'s mobile services

are better off due to lower stand-alone prices. Hence:

$$\begin{aligned}\Delta CS =& \widehat{CS} - CS \\ =& \left(g_m + v_m - \frac{5t}{4} + \frac{\theta^{\mathcal{A}^2} + \theta^{\mathcal{B}^2}}{2t} + \frac{\theta^{\mathcal{A}}\delta^{\mathcal{A}} + \theta^{\mathcal{B}}\delta^{\mathcal{B}}}{2t} \right) \\ & - \left(g_m + v_m - \frac{5t}{4} + \frac{\theta^{\mathcal{A}^2} + \theta^{\mathcal{B}^2}}{2t} \right) \\ =& \frac{\theta^{\mathcal{A}}\delta^{\mathcal{A}} + \theta^{\mathcal{B}}\delta^{\mathcal{B}}}{2t} \end{aligned} \tag{1.27}$$

Finally, summing up (1.26) and (1.27) yields the difference in social welfare. It is easily seen that with product-specific preferences, social welfare strictly increases:

$$\begin{aligned}\Delta W &= \Delta CS + \Delta IP \\ &= \frac{\theta^{\mathcal{A}}\delta^{\mathcal{A}} + \theta^{\mathcal{B}}\delta^{\mathcal{B}}}{2t}\end{aligned}$$

Full market coverage in the fixed market As point iv) of lemma 1.1 indicates, bundling shows up to be an efficient strategy for the higher valued operator to increase its profits. However, since the bundle discount turns services into stronger complements, it may cause the fixed market to end up fully covered. This raises the question of whether or not the higher valued operator has an incentive to avoid a fully covered market, which means the disappearance of stand-alone sales of fixed services and, thus, a source of revenue for recouping the costs of bundling.

In order to answer this, consider a fully covered fixed market. The assumption $v_f^{\mathcal{A}} > v_f^{\mathcal{B}}$ still prevails but it is assumed that $v_f^{\mathcal{A}}$ is not excessively higher than $v_f^{\mathcal{B}}$, so that operator $\mathcal{A}$ can not monopolise the fixed market.[30] Formally,

[30] Appendix A.1.7 provides equilibrium expressions in the fully covered fixed market scenario.

the no-monopoly condition yields $0 < \omega < \frac{6t-3(\delta^{\mathcal{A}}+\delta^{\mathcal{B}})}{2}$, $\omega = v_f^{\mathcal{A}} - v_f^{\mathcal{B}}$.

In this case, the difference in profits when unilaterally offering a strictly positive bundle discount (compared to a situation without bundling) never yields a positive outcome:

$$\begin{aligned}\Delta\Pi^k &= \Pi^k_{\text{unilateral}} - \Pi^{k*} \\ &= t + \frac{\omega}{3}\left(1 + \frac{\omega}{6t} + \frac{\delta^k}{12t}\right) - \frac{\delta^k}{4} - \left[t + \frac{\omega}{3}\left(1 + \frac{\omega}{6t}\right)\right] \\ &= \omega\frac{\delta^k}{36t} - \frac{\delta^k}{4} \\ &< 0 \forall \omega \in \left(0; \frac{6t - 3(\delta^{\|})}{2}\right)\end{aligned}$$

Therefore, the higher valued operator has no incentive to induce full market coverage in the fixed market.

1.5 Discussion and conclusion

The aim of this study is to reassess the profitability of bundling substitutable services. The motivation for this work comes from the telecommunications industry where two contradicting trends are observed: due to increasing substitutability between fixed and mobile services, an increasing number of consumers do no longer feel the need for subscribing to any fixed services, while thepopularity of fixed-mobile service bundles is increasing.

A theoretical framework is developed for analysing jointly fixed-mobile substitutability and fixed-mobile bundling. It is showed that the individual incentive for multi-market operators to offer a bundle discount is contingent on the degree of substitutability between fixed and mobile services. Moreover, if the operators are perfectly symmetric, they find themselves in a prisoners' dilemma. This situation, however, disappears with product-specific preferences. In particular, the operator that enjoys the higher valuation can in-

crease its profits by bundling its services, whereas its rival will incur losses in the bundling equilibrium.

The increase in profits of the higher valued operator has to be put in perspective, though. Despite the revenue growth procured by bundling, the operator earns lower margins. Indeed, the discount on bundled sales induces more consumers to buy the "cheaper" product, reducing therefore the sources of revenue for recouping the costs of bundling. In the short term, increased revenue growth might seem appealing, but may jeopardise long term interest like e.g. network investments. Moreover, because the discount turns services into stronger complements, the fixed market is subject to an increasing market coverage. Since, operators have no incentive to bundle services when both markets are fully covered, they must be on guard not too offer too high a discount.

If the degree of substitutability incites operators to bundle, then bundling is consumer surplus increasing and ultimately welfare beneficial. Hence, should services be too complementary, or equivalently, too substitutable, multi-market operators would avoid bundling and consumers would not benefit from competitive bundling.

The analysis has shown that bundling leads to a prisoners' dilemma and furthermore to a decrease of industry profits when consumers have the same reservation price for either fixed service. Such a decrease could therefore be an incentive for collusive behaviour. For instance, firms could coordinate on not to bundle which would imply a foregone increase in social welfare. Further research could address this subject and check whether or not a collusive outcome is stable and under which conditions. With product-specific preferences, collusion is evidently unlikely, since at least one operator gains in profits and is, therefore, not willing to agree on not to bundle, nor on sharing its profits. However, in the asymmetric case, further research could focus on exclusionary

conduct by the higher valued operator.

Further research could also integrate regulatory issue by, for instance, considering an vertically integrated incumbent (multi-market) operator that owns a widely spread copper network, as well as its own mobile network and competes with a mobile incumbent that seeks to offer fixed services. This possible extension raises the question of how access regulation is impacted by fixed-mobile bundling, FMS and possibly by the combination of both. Moreover, it would also be interesting to analyse whether the mobile incumbent is better off by merging with a competing fixed operator (e.g. cable) or by seeking access to the incumbent's copper network.

After having considered one aspect of Fixed-Mobile substitution from a theoretical point of view, FMS will be considered from an empirical aspect in the next chapter. In particular, the next chapter attempts to determine socio-demographic factors that influence the consumption choices of French consumers in communications services matters.

Bibliography

Adams W., Yellen J. L., (1976). Commodity bundling and the burden the monopoly, *Quarterly Journal Of Economics*, 90(3): 475-498.

Armstrong M., (2013). A general theory of commodity bundling. *Journal of Economic Theory*, 148(2): 448-472. Available here.

Barth A., Heimeshoff U., (2011). Does the growth of mobile markets cause the demise of fixed networks? Evidence from the European Union, DICE discussion paper, No. 42, ISBN 978-3-86304-041-3. Available here.

Berec, (2011). Berec Report on impact of Fixed-Mobile Substitution in Market Definition, 8/12/2011. Available here.

Blumberg S. J., Luke J. V., (2013). Wireless substitution: Early release of estimates from the National Health Interview Survey, January - June 2013. National Center for Health Statistics, December 2013. Available here.

Briglauer W., Schwarz A., Zulehner C., (2011a). Is fixed-mobile substitution strong enough to de-regulate fixed voice telephony? Evidence from the Austrian markets. *Journal of Regulatory Economics*, 39(1), 50-67. DOI: 10.1007/s11149-010-9132-1.

Carbajo J., De Meza D., Seidman D. J., (1990). A strategic motivation for commodity bundling, *Journal Of Industrial Economics*, 38(3), 283-298.

Cardona M., Schwarz A., Yurtoglu B. B., Zulehner C., (2009). Demand estimation and market definition for broadband internet services, *Journal of Regulatory Economics*, 35(1), 70-95. DOI: 10.1007/s11149-008-9076-x.

Chen Y., (1997). Equilibrium Product Bundling, *Journal of Business*, 70(1), 85-103. Available here.

Economides N., (1993). Mixed bundling in duopoly, *mimeo*.

Eurobarometer, (2014). E-Communications Household Survey Report, Fieldwork: January 2014, March 2014. Available here.

Gruber H., Verboven F., (2001). The diffusion of mobile telecommunications services in the European Union. *European Economic Review*, 45(3), 577-588. http://dx.doi.org/10.1016/S0014-2921(00)00068-4.

Grzybowski L., Verboven F., (2013). Substitution and complementarity between fixed-line and mobile access. NET Institute Working Paper No. 13-09. Available here.

GSM Association, (2013). Mobile Economy Europe 2013. Available here.

Ida T., Kuroda T., (2006). Discrete choice analysis of demand for broadband in Japan. *Journal of Regulatory Economics*, 29(1), 5-22. DOI:10.1007/s11149-005-5124-y.

Long J. B. Jr., (1984). Comments on "Gaussian demand and commodity bundling", *Journal of Business*, 57(1), Part 2: Pricing Strategy, 235-246.

Matutes C., Régibeau P., (1992). Compatibility and bundling of complementary goods in a duopoly. *Journal Of Industrial Economics*, 40(1), 37-54.

McAfee R., McMillan J., Whinston M. D., (1989). Multiproduct monopoly, commodity bundling and correlation of values, *Quarterly Journal Of Economics*, 104(2), 371-383.

Nalebuff B., (2004). Bundling as an Entry Barrier, *Quarterly Journal Of Economics*, 119(1), 159-187. DOI: 10.1162/003355304772839551.

OFCOM, (2013). International Communications Market Report, Research Document, 12/12/2013. Available here.

Reisinger M., (2006). The effects of product bundling in duopoly. *mimeo*, Munich.

Rodini M., Ward M. R., Woroch G. A., (2003). Going Mobile: Substitutability between fixed and mobile access, *Telecommunications Policy*, 27(5-6), 457-476. http://dx.doi.org/10.1016/S0308-5961(03)00010-7.

RTR, (2009), Abgrenzung des Marktes für breitbandigen Zugang auf Vorleistungsebene.

Scherer F. M., (1976). Predatory Pricing and the Sherman Act: A comment, *Harvard Law Review*, 89(5), 869-890.

Schmalensee R., (1984). Gaussian Demand and Commodity Bundling, *The Journal of Business*, 57(1), Part 2: Pricing Strategy, 211-230.

Singh N., Vives X., (1984). Price and Quantity Competition in a Differentiated Duopoly, *The Rand Journal of Economics*, 15(4), 546-554.

Spector D. (2007). Bundling, tying and collusion. *International Journal of Industrial Organization*, 25(3), 575-581. http://dx.doi.org/10.1016/j.ijindorg.2006.06.003.

Srinuan P., Srinuan C., Bohlin E., (2012). Fixed and mobile broadband substitution in Sweden,*Telecommunications Policy*, 36(3), 237-251. http://dx.doi.org/10.1016/j.telpol.2011.12.011.

Stigler G. J., (1963). United States v. Loew's Inc.: A note on Block-Booking, *The Supreme Court Review*, 152-157.

Thanassoulis J., (2007). Competitive Mixed Bundling and Consumer Surplus, *Journal Of Economics & Management Strategy*, 16(2), 437-467. DOI: 10.1111/j.1530-9134.2007.00145.x.

Vagliasindi M., Güney I., Taubman C., (2006). Fixed and mobile competition in transition economies, *Telecommunications Policy*, 30(7), 349-367. http://dx.doi.org/10.1016/j.telpol.2006.02.002.

Yoon C., Song Y., (2003). Telecom development in Korea: Substitution and integration of fixed-mobile services and regulatory implications. *Communications & Strategies*, 52, 4th quarter 2003, 257-270.

Appendix Chapter 1

A.1.1 Profit maximisation in the symmetric case

This appendix provides detailed calculations for the operator's profit maximisation when both operators enjoy equal valuations from consumers and thus bear the same level of FMS. The profit maximisation problem for any $k = \mathcal{A}, \mathcal{B}$ is given by the following expression:

$$\max_{p_m^k, p_f^k} \Pi^k = p_m^k \, \mathcal{D}_{MO}^k + \, p_m^k \, \mathcal{D}_{CP}^{k,-k} + \, p_f^k \, \mathcal{D}_{CP}^{-k,k} + \, (p_m^k + p_f^k - \delta^k) \, \mathcal{D}_{BU}^k \tag{A.1.1}$$

The corresponding first order conditions are as follows:

$$\begin{aligned} \frac{\partial \Pi^k}{\partial p_m^k} &= \mathcal{D}_{MO}^k + p_m^k \frac{\partial \mathcal{D}_{MO}^k}{\partial p_m^k} + \mathcal{D}_{CP}^{k,-k} + p_m^k \frac{\partial \mathcal{D}_{CP}^{k,-k}}{\partial p_m^k} + p_f^k \frac{\partial \mathcal{D}_{CP}^{-k,k}}{\partial p_m^k} \\ &\quad + \mathcal{D}_{BU}^k + (p_m^k + p_f^k - \delta^k) \frac{\partial \mathcal{D}_{BU}^k}{p_m^k} \\ &\stackrel{!}{=} 0 \end{aligned} \tag{A.1.2a}$$

and

$$\begin{aligned} \frac{\partial \Pi^k}{\partial p_f^k} &= p_m^k \frac{\partial \mathcal{D}_{MO}^k}{\partial p_f^k} + p_m^k \frac{\partial \mathcal{D}_{CP}^{k,-k}}{\partial p_f^k} + \mathcal{D}_{CP}^{-k,k} + p_f^k \frac{\partial \mathcal{D}_{CP}^{-k,k}}{\partial p_f^k} \\ &\quad + \mathcal{D}_{BU}^k + (p_m^k + p_f^k - \delta^k) \frac{\partial \mathcal{D}_{BU}^k}{p_f^k} \\ &\stackrel{!}{=} 0 \end{aligned} \tag{A.1.2b}$$

The marginal consumers and different demands:

$$\tilde{x}_{BU}^{\mathcal{A}} = \frac{\theta - \left(p_f^{\mathcal{A}} - \delta^{\mathcal{A}}\right)}{t} \tag{A.1.3a}$$

$$\tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} = 1 - \frac{\theta - p_f^{\mathcal{B}}}{t} \tag{A.1.3b}$$

$$\tilde{x}_{CP}^{\mathcal{B},\mathcal{A}} = \frac{\theta - p_f^{\mathcal{A}}}{t} \tag{A.1.3c}$$

$$\tilde{x}_{BU}^{\mathcal{B}} = 1 - \frac{\theta - \left(p_f^{\mathcal{B}} - \delta^{\mathcal{B}}\right)}{t} \tag{A.1.3d}$$

$$\tilde{y} = \frac{1}{2} + \frac{p_m^{\mathcal{B}} - p_m^{\mathcal{A}}}{2t} + \frac{\delta^{\mathcal{A}^2} - \delta^{\mathcal{B}^2}}{4t^2} - \frac{\delta^{\mathcal{A}}(p_f^{\mathcal{A}} - \theta) - \delta^{\mathcal{B}}(p_f^{\mathcal{B}} - \theta)}{2t^2} \tag{A.1.3e}$$

$$\begin{aligned} \mathcal{D}_{MO}^{k} &= \mathcal{D}_{MO}^{\mathcal{A}} = \left(\tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} - \tilde{x}_{BU}^{\mathcal{A}}\right) \times \tilde{y} \\ &= \mathcal{D}_{MO}^{\mathcal{B}} = \left(\tilde{x}_{BU}^{\mathcal{B}} - \tilde{x}_{CP}^{\mathcal{B},\mathcal{A}}\right) \times (1 - \tilde{y}) \\ &= \frac{\left(2\theta - p_f^{k} - p_f^{-k} + \delta^{k} - t\right)(-\phi)}{4t^3} \end{aligned} \tag{A.1.3f}$$

$$\begin{aligned} \mathcal{D}_{BU}^{k} &= \mathcal{D}_{BU}^{\mathcal{A}} = \tilde{x}_{BU}^{\mathcal{A}} \times \tilde{y} \\ &= \mathcal{D}_{BU}^{\mathcal{B}} = \left(1 - \tilde{x}_{BU}^{\mathcal{B}}\right) \times (1 - \tilde{y}) \\ &= \frac{\left(\theta - p_f^{k} + \delta^{k}\right)\phi}{4t^3} \end{aligned} \tag{A.1.3g}$$

$$\begin{aligned} \mathcal{D}_{CP}^{k,-k} &= \mathcal{D}_{CP}^{\mathcal{A},\mathcal{B}} \left(1 - \tilde{x}_{CP}^{\mathcal{A},\mathcal{B}}\right) \times \tilde{y} \\ &= \mathcal{D}_{CP}^{\mathcal{A},\mathcal{B}} = \tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} \times (1 - \tilde{y}) \\ &= \frac{\left(\theta - p_f^{-k}\right)\phi}{4t^3} \end{aligned} \tag{A.1.3h}$$

where $\phi = \left[2t\left(p_m^{-k} - p_m^{k} + t\right) - 2\left(p_f^{k}\delta^{k} - p_f^{-k}\delta^{-k}\right) + \left(\delta^{k} - \delta^{-k}\right)\left(2\theta + \delta^{k} + \delta^{-k}\right)\right]$.

Their partial derivatives with respect to p_m^k and p_f^k are given by

$$\frac{\partial \mathcal{D}_{MO}^k}{\partial p_m^k} = \frac{2\theta - \left(p_f^k + p_f^{-k}\right) - t + \delta^k}{2t^2} \tag{A.1.4a}$$

$$\frac{\partial \mathcal{D}_{MO}^k}{\partial p_f^k} = \frac{t\left(p_m^k - p_m^{-k} - t - \delta^k\right) + \delta\left(2p_f^k + p_f^{-k} - 3\theta\right) - \delta^{-k}\left(p_f^{-k} - \theta\right)}{2t^3} - \frac{3\delta^{k^2} - \delta^{-k^2}}{4t^3} \tag{A.1.4b}$$

$$\frac{\partial \mathcal{D}_{BU}^k}{\partial p_m^k} = \frac{p_f^k - \theta - \delta^k}{2t^2} \tag{A.1.4c}$$

$$\frac{\partial \mathcal{D}_{BU}^k}{\partial p_f^k} = \frac{2t\left(p_m^k - p_m^{-k} - t\right) + \delta^k\left[4\left(p_m^k - \theta\right) - 3\delta^k\right] - 2\left(p_f^{-k} - \theta\right)\delta^{-k} + \delta^{-k^2}}{4t^3} \tag{A.1.4d}$$

$$\frac{\partial \mathcal{D}_{CP}^{k,-k}}{\partial p_m^k} = \frac{p_f^{-k} - \theta}{2t^2} \tag{A.1.4e}$$

$$\frac{\partial \mathcal{D}_{CP}^{k,-k}}{\partial p_f^k} = \frac{\left(p_f^{-k} - \theta\right)\delta^k}{2t^2} \tag{A.1.4f}$$

Plugging the relevant derivatives into equation (A.1.2a) and/or (A.1.2b) and solving then simultaneously for mobile prices p_m^k and fixed service prices p_f^k, $\forall k = \mathcal{A}, \mathcal{B}$ provides the following equilibrium:

$$p_m^{k^*} = t + \frac{5t^2\delta^k + \left(t - \delta^k\right)\left(t + \delta^k\right)\delta^{-k^2} + \left(2t^2 - \delta^2\right)\Delta\theta}{t\mu} \tag{A.1.5a}$$

$$p_f^{k^*} = \frac{1}{2}\left[\theta + \frac{\delta^k\left(6t^2 - \delta^2 + \theta\Delta\right)}{\mu}\right] \tag{A.1.5b}$$

$$\begin{aligned}\Pi^{k^*} &= \frac{t}{2} + \frac{\theta^2}{4t} + \frac{1}{2\mu^2}\Big\{t\left[8\delta^{k^4} - 2\delta^{-k^4} + \left(\delta^{k^2} - \delta^{-k^2}\right)^2\right] - 6t^3\left(7\delta^{k^2} - 4\delta^{-k^2}\right) \\ &= \qquad\qquad + \frac{\theta\Delta\nu\left(2\lambda + \theta\Delta\right) - \delta^{k^6}}{2t}\Big\}\end{aligned} \tag{A.1.5c}$$

where $\mu = \left(12t^2 - \delta^{k^2} - \delta^{-k^2}\right)$, $\lambda = \left(6t^2 - \delta^{k^2}\right)$, $\nu = \left(8t^2 - \delta^{k^2}\right)$ and $\Delta = \left(\delta^k - \delta^{-k}\right)$.

Plugging equilibrium prices into demand functions (A.1.3f) - (A.1.3h) pro-

vides equilibrium demands:

$$\mathcal{D}^k_{MO} = \frac{\Delta\theta}{\mu} + \frac{1}{2t\mu}\Bigg\{\theta\Big\{12t^2\Big[\delta^k\Delta + \big(\delta^k + \delta^{-k}\big)^2\Big] - \big(\delta^k + \delta^{-k}\big)\Big[\delta^k\big(\delta^{k^2} + \delta^{-k^2}\big) + \Delta^3 - 144t^4\Big]\Big\}$$
$$+ \big(6t^2 - \delta^{k^2}\big)\Big\{\big[4t + \delta^k\big]\big[6t(t - \delta^k) + \delta^{k^2}\big] + \delta^{-k}\big[6t^2 - \delta^{-k}\big(2t - 2\delta^k - \Delta\big)\big]\Big\}$$
$$+ \theta^2\Delta\Big[\big(\delta^k + \delta^{-k}\big)^2 + 2\Delta^2 - 24t^2\Big]\Bigg\} \tag{A.1.6a}$$

$$\mathcal{D}^k_{BU} = \frac{3t\theta}{\mu} + \frac{1}{2t\mu^2}\Bigg\{\theta\Big[\delta^k\Big(2\delta^{-k}(6t^2 - \delta^{-k}) - \delta^k\Delta(2\delta^{-k} + \Delta)\Big)\Big]$$
$$- \Delta\theta^2\big(\mu - \delta^k\Delta\big) - \delta^k\lambda\big[\mu + \big(6t^2 - \delta^{-k^2}\big)\big]\Bigg\} \tag{A.1.6b}$$

$$\mathcal{D}^{k,-k}_{CP} = \frac{\theta(6t^2 + \Delta\theta)}{2t\mu} + \frac{1}{2t\mu^2}\Big\{\big[2\delta^k\lambda + 2\delta^k\delta^{-k}\Delta + \Delta^2\big(5\delta^k\delta^{-k} + \Delta^2\big)\big]\theta$$
$$- \delta^{-k}\big[\theta^2\Delta^2 - \lambda\big(6t^2 - \delta^{-k}\big)\big]\Big\} \tag{A.1.6c}$$

with ν, μ, Δ and λ as defined above.

Finally the equilibrium with and without a bundle discount stated in the text are readily found as follows:

In the no bundling regime: Setting δ^k and δ^{-k} equal to 0 leads to equations (1.9a)-(1.10b). Indeed, the results follow by noticing that

$$\begin{aligned} \mu = \tfrac{1}{12t^2} \quad &, \lambda = 6t^2 \\ \nu = 8t^2 \quad &, \Delta = 0 \end{aligned} \tag{A.1.7}$$

In the mixed bundling regime: Equations (1.12a)-(1.14c) appear with the assumption 1.1 of identical discounts: $\delta^k = \delta^{-k} = \delta$. In effect, the results are obtained since

$$\begin{aligned} \mu = \tfrac{1}{12t^2 - 2\delta^2} \quad &, \lambda = 6t^2 - \delta^2 \\ \nu = 8t^2 - \delta^2 \quad &, \Delta = 0 \end{aligned} \tag{A.1.8}$$

The unilateral incentive to bundle and counter-bundle: In stage 1 of the game, the operators decide whether to introduce a bundle discount or not.

As explained in the text, the two multi-market operators earn lower profits if both grant a discounts, which leads to the question of the unilateral incentive. In what follows, the relevant equations, that is (1.16), (1.17) and (1.18), are provided.

Equation (1.16) yields profits for operator k if it is the only one to bundle. It can be readily derived from equation (A.1.5c) above by setting δ^{-k} equal to 0. In this case,

$$\begin{aligned} \mu &= \tfrac{1}{12t^2-2\delta^{k^2}} \quad , \lambda = 6t^2 - \delta^{k^2} \\ \nu &= 8t^2 - \delta^{k^2} \quad , \Delta = \delta^k \end{aligned} \tag{A.1.9}$$

Then, equation (A.1.5c) falls back to

$$\Pi^k_{\text{unilateral}} = \frac{t}{2} + \frac{\theta^2}{4t} + \frac{\theta\delta^k\nu\big(2\lambda + \theta\delta^k\big) - \delta^{k^2}\big[3t^4 + \big(9t^2 - \delta^{k^2}\big)^2\big]}{4t\mu^2} \tag{A.1.10}$$

as stated in the text.

The unilaterally bundling firm's profit variation, $\Pi^k_{\text{unilateral}} - \Pi^{k*}$, follows by substracting (1.9c) from (1.16).

Equivalently, the profits earned by the firm that initially did not bundle, are found by setting δ^k equal to 0, which yields:[31]

$$\begin{aligned} \mu &= \tfrac{1}{12t^2-2\delta^{-k^2}} \quad , \lambda = 6t^2 - \delta^{-k^2} \\ \nu &= 8t^2 - \delta^{-k^2} \quad , \Delta = \delta^{-k} \end{aligned} \tag{A.1.11}$$

and

$$\Pi^k_{\text{unilateral}} = \frac{t}{2} + \frac{\theta^2}{4t} - \frac{t\delta^{-k}\big[4\theta\big(12t^2 - \delta^{-k}\theta\big) - \delta\big(24t^2 - \delta^{-k^2}\big)\big]}{2\mu^2} \tag{A.1.12}$$

[31] Note here that $-k$ is the bundling firm.

Profit variation induced by counter-bundling is equal to:

$$\hat{\Pi}^k - \Pi^k_{\text{unilateral}} = \frac{t}{2} + \frac{\theta\Delta\nu\big(2\lambda+\theta\Delta\big) - \delta^{k^6}}{4t\mu} - \frac{2t\big[36t^4 - \delta^{-k}\theta\big(12t^2 - \delta^{-k}\theta\big)\big]}{(12t^2-\delta^{-k^2})^2} + \frac{2t^2\big[6t^2\big(4\delta^{-k^2} - 7\delta^{k^2}\big) - \big(\delta^{-k^2}+\delta^{k^2}\big)^2 + 10\delta^{k^2}\big]}{4t\mu} \tag{A.1.13}$$

This is equation (1.18) as stated in the text.

A.1.2 Assumption 1.1: Identical bundle discounts in the symmetric environment.

As already discussed in the text on page 56, the symmetry between firms (that is, equal consumer reservation prices for either service) induces a symmetric strategic behavior, or symmetric reactions towards any action taken by the competitor. The fact that the reactions are identical can be seen by deriving the equilibrium profits (A.1.5c), $\forall k = \mathcal{A}, \mathcal{B}$, from above with respect to the competitor's bundle discount:

$$\begin{aligned}
\frac{\partial\Pi^k(\delta^{-k},\cdot)}{\partial\delta^{-k}} &= \frac{\partial}{\partial\delta^{-k}}\left[\frac{t}{2} + \frac{\theta^2}{4t} + \frac{1}{2\mu^2}\left\{t\left[8\delta^{k^4} - 2\delta^{-k^4} + \big(\delta^{k^2}-\delta^{-k^2}\big)^2\right] - 6t^3\big(7\delta^{k^2} - 4\delta^{-k^2}\big)\right.\right. \\
&= \left.\left. + \frac{\theta\Delta\nu\,(2\lambda+\theta\Delta) - \delta^{k^6}}{2t}\right\}\right] \\
&= \frac{2\nu\lambda^2\delta^{-k} - \theta\nu\Big[\lambda\big(12t^2 - 2\delta^{k^2} + \Delta(\delta^k - 3\delta^{-k})\big) + \theta\Delta\big(12t^2 - 2\delta^{k^2} + \Delta^2\big)\Big]}{2t\mu^3} \\
&= \frac{\partial\Pi^{-k}}{\partial\delta^k}
\end{aligned} \tag{A.1.14}$$

with ν, μ, Δ and λ as defined above.

This shows that a marginal change in δ^{-k} yields the same impact on operator k's profits as operator $-k$ would be impacted by a marginal change in δ^k. It therefore seems reasonable to assume that operators settle around a given discount level δ.

A.1.3 Condition 1.1: Local monopolies in the fixed market

In order to derive the stated condition, the marginal consumer at equilibrium are provided. Similarly to appendix A.1.1, the generic expressions are provided first and are then adapted to the relevant bundling regimes.

Plugging equilibrium prices (A.1.5a) and (A.1.5b) into expressions (1.2), the marginal consumers yield:

$$\tilde{x}_{BU}^{\mathcal{A}} = \frac{\theta + 2\delta^{\mathcal{A}}}{2t} - \frac{\delta^{\mathcal{A}}\Big[\Big(6t^2 - \delta^{\mathcal{A}^2}\Big) + \Big(\delta^{\mathcal{A}} - \delta^{\mathcal{B}}\Big)\theta\Big]}{2t\Big(12t^2 - \delta^{\mathcal{A}^2} - \delta^{\mathcal{B}^2}\Big)} \tag{A.1.15a}$$

$$\tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} = 1 - \frac{\theta}{2t} + \frac{\delta^{\mathcal{B}}\Big[\Big(6t^2 - \delta^{\mathcal{B}^2}\Big) + \Big(\delta^{\mathcal{B}} - \delta^{\mathcal{A}}\Big)\theta\Big]}{2t\Big(12t^2 - \delta^{\mathcal{A}^2} - \delta^{\mathcal{B}^2}\Big)} \tag{A.1.15b}$$

$$\tilde{x}_{CP}^{\mathcal{B},\mathcal{A}} = \frac{\theta}{2t} + \frac{\delta^{\mathcal{A}}\Big[\Big(6t^2 - \delta^{\mathcal{A}^2}\Big) + \Big(\delta^{\mathcal{A}} - \delta^{\mathcal{B}}\Big)\theta\Big]}{2t\Big(12t^2 - \delta^{\mathcal{A}^2} - \delta^{\mathcal{B}^2}\Big)} \tag{A.1.15c}$$

$$\tilde{x}_{BU}^{\mathcal{B}} = 1 - \frac{\theta + 2\delta^{\mathcal{B}}}{2t} - \frac{\delta^{\mathcal{B}}\Big[\Big(6t^2 - \delta^{\mathcal{B}^2}\Big) + \Big(\delta^{\mathcal{B}} - \delta^{\mathcal{A}}\Big)\theta\Big]}{2t\Big(12t^2 - \delta^{\mathcal{A}^2} - \delta^{\mathcal{B}^2}\Big)} \tag{A.1.15d}$$

Local monopolies with each operator serving a strictly positive share of the market are provided whenever the following inequalities hold simultaneously:

$$\begin{cases} 0 < \tilde{x}_{BU}^{\mathcal{A}} & < & \tilde{x}_{CP}^{\mathcal{A},\mathcal{B}} < 1 \\ 0 < \tilde{x}_{CP}^{\mathcal{B},\mathcal{A}} & < & \tilde{x}_{BU}^{\mathcal{B}} < 1 \end{cases} \tag{A.1.16}$$

In the no bundling regime: If neither operator offers a bundle discount, the set of inequalities above falls back to

$$\begin{cases} 0 < \frac{\theta}{2t} & < & 1 - \frac{\theta}{2t} < 1 \\ 0 < \frac{\theta}{2t} & < & 1 - \frac{\theta}{2t} < 1 \end{cases} \tag{A.1.17}$$

and the unique solution is $0 < \theta < t$ as stated in the text.

In the mixed bundling regime: When the two symmetric operators offer identical bundle discounts, the set of inequalities above falls back to

$$\begin{cases} 0 < \frac{\theta+3\delta}{4t} & < 1 - \frac{2\theta-\delta}{4t} < 1 \\ 0 < \frac{2\theta-\delta}{4t} & < 1 - \frac{2\theta+3\delta}{4t} < 1 \end{cases} \tag{A.1.18}$$

and the unique solution is $0 < \theta < t + \frac{\delta}{2}$ as stated in the text.

A.1.4 Profit maximization in the case of product-specific preferences

Subsection 1.4.2 analyses the profitability of bundling when consumers have product-specific preferences for fixed services, meaning that their reservation prices for fixed services differ: $v_f^k \neq v_f^{-k}$. Without loss of generality, assume $v_f^{\mathcal{A}} > v_f^{\mathcal{B}}$, which implies that $\theta^{\mathcal{A}} > \theta_f^{\mathcal{B}}$.

The operators' objective functions, resp. FOCs, are equivalent to equation (A.1.1), resp. (A.1.2a) and (A.1.2b) above. The marginal consumers can be found in the text (see equations (1.2) and (1.7)). Then, the different demand yield the following:

$$D_{MO}^k = \frac{\left[t + \left(p_f^k - \theta^k - \delta^k\right) + \left(p_f^{-k} - \theta^{-k} - \delta^{-k}\right)\right]\phi}{4t^3} \tag{A.1.19a}$$

$$D_{BU}^k = \frac{\left(\theta^k - p_f^k + \delta^k\right)\phi}{4t^3} \tag{A.1.19b}$$

$$D_{CP}^{k,-k} = \frac{\left(\theta^{-k} - p_f^{-k}\right)\phi}{4t^3} \tag{A.1.19c}$$

where $\phi = 2t^2 + \delta^{k^2} - \delta^{-k^2} + 2\Big[t\Big(p_m^{-k} - p_m^k\Big) + \delta^{-k}\Big(p_f^{-k} - \theta^{-k}\Big) - \delta^k\Big(p_f^k - \theta^k\Big)\Big]$.

The corresponding derivatives are equal to:

$$\frac{\partial \mathcal{D}^k_{MO}}{\partial p^k_m} = \frac{\left(\theta^k - p^k_f + \delta^k\right) + \left(\theta^{-k} - p^{-k}_f\right) - t}{2t^2} \tag{A.1.20a}$$

$$\frac{\partial \mathcal{D}^k_{MO}}{\partial p^k_f} = \frac{1}{2t} + \frac{t\left(p^{-k}_m - p^k_m\right) + \delta^{-k}\left(p^{-k}_f - \theta^{-k}\right) - \delta^k\left[2\left(p^k_f - \theta^k\right) + \left(p^{-k}_f - \theta^{-k}\right)\right]}{2t^3} - \frac{\delta^k}{2t^2} + \frac{3\delta^{k^2} - \delta^{-k^2}}{4t^3} \tag{A.1.20b}$$

$$\frac{\partial \mathcal{D}^{k,k}_{BU}}{\partial p^k_m} = \frac{p^k_f - \theta^k - \delta^k}{2t^2} \tag{A.1.20c}$$

$$\frac{\partial \mathcal{D}^{k,k}_{BU}}{\partial p^k_f} = -\frac{1}{2} - \frac{t\left(p^{-k}_m - p^k_m\right) + \delta^{-k}\left(p^{-k}_f - \theta^{-k}\right) - 2\delta^k\left(p^k_f - \theta^k\right)}{2t^3} - \frac{3\delta^{k^2} - \delta^{-k^2}}{4t^3} \tag{A.1.20d}$$

$$\frac{\partial \mathcal{D}^{k,-k}_{CP}}{\partial p^k_m} = \frac{p^{-k}_f - \theta^{-k}}{2t^2} \tag{A.1.20e}$$

$$\frac{\partial \mathcal{D}^{k,-k}_{CP}}{\partial p^k_f} = \frac{\delta^k\left(p^{-k}_f - \theta^{-k}\right)}{2t^3} \tag{A.1.20f}$$

Plugging next the corresponding derivatives into the FOCs and solving simultaneously for p^k_f and p^k_m yields the following equilibrium prices and profits:

$$p^k_m = \frac{12t^4 + \delta^{k^2}\left(4t^2 - \delta^{-k^2}\right) + \delta^k\theta^k\left(2t^2 - \delta^{k^2}\right) - \delta^{-k}\theta^{-k}\left(2t^2 - \delta^{k^2}\right)}{t\mu} \tag{A.1.21a}$$

$$p^k_f = \frac{\delta^k\left(\lambda - \delta^{-k}\theta^{-k}\right) + \theta^k\left(12t^2 - \delta^{-k^2}\right)}{2\mu} \tag{A.1.21b}$$

$$\Pi^k = \frac{\theta^{k^2}}{4t} + \frac{\nu\left[\lambda^2 + \left(\delta^k\theta^k - \delta^{-k}\theta^{-k}\right)\left(2\lambda + \delta^k\theta^k - \delta^{-k}\theta^{-k}\right)\right]}{4t\mu} \tag{A.1.21c}$$

with ν, μ and λ as defined in A.1.1.[32]

The equilibrium expressions provided in the text are found in the following way:

In the no bundling regime: Setting δ^k and δ^{-k} equal to 0 leads to (1.9a) - (1.9c), because μ, λ and ν are the same as in the no bundling regime in the symmetric case (see (A.1.7) above).

[32] $\mu = \left(12t^2 - \delta^{k^2} - \delta^{-k^2}\right)$, $\lambda = \left(6t^2 - \delta^{k^2}\right)$, $\nu = \left(8t^2 - \delta^{k^2}\right)$.

Mixed bundling: The expressions in the text are linear first order Taylor approximations of equilibrium prices and profits (given in (A.1.21a) - (A.1.21c)) near $(\delta^k, \delta^{-k}) = (0, 0)$.

The first order Taylor approximation of a function $f(x, y)$ about the point (a, b) is given by the following formula:

$$T(x, y) = f(a, b) + \frac{\partial f}{\partial x}|_{(a,b)}(x - a) + \frac{\partial f}{\partial y}|_{(a,b)}(y - b) + O \tag{A.1.22}$$

In the above, $\frac{\partial f}{\partial x}|_{(a,b)}$ denote the partial derivative of $f(x, y)$ with respect to x and evaluated at the point of interest (a, b). Similarly for $\frac{\partial f}{\partial y}|_{(a,b)}$. Finally, O denotes the omitted higher order terms.

Applying this formula to equations (A.1.21a) - (A.1.21c) near $(\delta^k, \delta^{-k}) = (0, 0)$ yields the expressions stated in the text:

$$\begin{aligned}
\hat{p}_m^k(\delta^k, \delta^{-k}) &= p_m^k(0,0) + \frac{\partial p_m^k}{\partial \delta^k}|_{(0,0)}(\delta^k - 0) + \frac{\partial p_m^k}{\partial \delta^{-k}}|_{(0,0)}(\delta^{-k} - 0) \\
&= t + \frac{\theta^k}{6t}\delta^k - \frac{\theta^{-k}}{6t}\delta^{-k} \\
&= t + \frac{\delta^k\theta^k - \delta^{-k}\theta^{-k}}{6t} \qquad \text{(A.1.23a)} \\
\hat{p}_f^k(\delta^k, \delta^{-k}) &= p_f^k(0,0) + \frac{\partial p_f^k}{\partial \delta^k}|_{(0,0)}(\delta^k - 0) + \frac{\partial p_f^k}{\partial \delta^{-k}}|_{(0,0)}(\delta^{-k} - 0) \\
&= \frac{\theta^k}{2} + \frac{1}{4}\delta^k + 0\delta^{-k} \\
&= \frac{\theta^k}{2} + \frac{\delta^k}{4} \qquad \text{(A.1.23b)} \\
\hat{\Pi}^k(\delta^k, \delta^{-k}) &= \Pi^k(0,0) + \frac{\partial \Pi^k}{\partial \delta^k}|_{(0,0)}(\delta^k - 0) + \frac{\partial \Pi^k}{\partial \delta^{-k}}|_{(0,0)}(\delta^{-k} - 0) \\
&= \frac{t}{2} + \frac{\theta^{k^2}}{4t} + \frac{\theta^k}{6t}\delta^k - \frac{\theta^{-k}}{6t}\delta^{-k} \\
&= \frac{t}{2} + \frac{\theta^{k^2}}{4t} + \frac{\delta^k\theta^k - \delta^{-k}\theta^{-k}}{6t} \qquad \text{(A.1.23c)}
\end{aligned}$$

A.1.5 Proof of lemma 1.1.

Recall that $\theta^k > \theta^{-k}$ and that $\delta^k > \delta^{-k}$. Moreover, define by Δx the difference between x in the mixed bundling regime and x in the no bundling regime, where x is to substitute by either a price (p_m, p_f) or profits (Π).

Both prices for fixed services increase: The variation of either $\hat{p}_f^k$ or $\hat{p}_f^{-k}$ is strictly positive:

$$\begin{aligned}\Delta p_f^k &= \frac{\theta^k}{2} + \frac{\delta^k}{4} - \frac{\theta^k}{2} \\ &> 0\end{aligned} \tag{A.1.24}$$

The price for the higher valued operator's mobile service, $\hat{p}_m^{\mathcal{A}}$, increases: Here, $\Delta p_m^{\mathcal{A}}$ yields

$$\begin{aligned}\Delta p_m^{\mathcal{A}} &= t + \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} - t \\ &> 0\end{aligned} \tag{A.1.25}$$

The price for the lower valued operator's mobile service, $\hat{p}_m^{\mathcal{B}}$, decreases: In contrast to the higher valued operator, $\Delta p_m^{\mathcal{B}}$ is always negative because $\theta^k > \theta^{-k}$ and $\delta^k > \delta^{-k}$:

$$\begin{aligned}\Delta p_m^{\mathcal{B}} &= t - \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} - t \\ &< 0\end{aligned} \tag{A.1.26}$$

The higher valued operator earns higher profits: Again, since $\theta^k > \theta^{-k}$ and $\delta^k > \delta^{-k}$:

$$\begin{aligned}\Delta\Pi^{\mathcal{A}} &= \frac{t}{2} + \frac{\theta^{\mathcal{A}^2}}{4t} + \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} - (\frac{t}{2} + \frac{\theta^{\mathcal{A}^2}}{4t}) \\ &> 0\end{aligned} \tag{A.1.27}$$

The lower valued operator earns lower profits: Similarly,

$$\begin{aligned}\Delta\Pi^{\mathcal{B}} &= \frac{t}{2} + \frac{\theta^{\mathcal{B}^2}}{4t} - \frac{\delta^{\mathcal{A}}\theta^{\mathcal{A}} - \delta^{\mathcal{B}}\theta^{\mathcal{B}}}{6t} - (\frac{t}{2} + \frac{\theta^{\mathcal{B}^2}}{4t}) \\ &< 0\end{aligned} \tag{A.1.28}$$

A.1.6 Condition 1.1: Local monopolies in the fixed market with product-specific preferences

In this section, the non-monopolisation condition is derived for the mixed bundling regime only.

Using the approximated equilibrium prices (that is (1.22a) - (1.22d)), the marginal consumer at equilibrium yield:

$$\begin{array}{ll} x_{BU}^{\mathcal{A}} = \frac{\theta^{\mathcal{A}}}{2t} + \frac{3\delta^{\mathcal{A}}}{4t} & , x_{CP}^{\mathcal{A},\mathcal{B}} = 1 - \frac{\theta^{\mathcal{B}}}{2t} + \frac{\delta^{\mathcal{B}}}{4t} \\ x_{CP}^{\mathcal{B},\mathcal{A}} = \frac{\theta^{\mathcal{A}}}{2t} - \frac{\delta^{\mathcal{A}}}{4t} & , x_{BU}^{\mathcal{B}} = 1 - \frac{\theta^{\mathcal{B}}}{2t} + \frac{3\delta^{\mathcal{B}}}{4t} \end{array} \tag{A.1.29}$$

The system of inequalities to solve is then:

$$\begin{cases} 0 < \frac{\theta^{\mathcal{A}}}{2t} + \frac{3\delta^{\mathcal{A}}}{4t} & < 1 - \frac{\theta^{\mathcal{B}}}{2t} + \frac{\delta^{\mathcal{B}}}{4t} \\ 0 < \frac{\theta^{\mathcal{A}}}{2t} - \frac{\delta^{\mathcal{A}}}{4t} & < 1 - \frac{\theta^{\mathcal{B}}}{2t} + \frac{3\delta^{\mathcal{B}}}{4t} \end{cases} \tag{A.1.30}$$

which is solved when the condition stated in the text holds, namely,

$$2\theta^{\mathcal{B}} < \theta^{\mathcal{A}} + \theta^{\mathcal{B}} < \frac{4t - 3\left(\delta^{\mathcal{A}} - \delta^{\mathcal{B}}\right)}{2} \tag{A.1.31}$$

A.1.7 Equilibria in a fully covered markets - Fixed and mobile complementarity

This appendix provides equilibria when fixed and mobile services are complements. When both services are complementary, the fixed, as well as the mobile market, is fully covered. Hence, on either segment of the fixed market, only one marginal consumer exist who is indifferent between buying mobile and fixed services as bundle or to cross-purchase. Denote by $\tilde{x}^{\mathcal{A}}$ the marginal consumer in $\mathcal{A}$'s bundle market (this is, the lower left segment on Fig. 1.1) and by $\tilde{x}^{\mathcal{B}}$ the indifferent consumer in $\mathcal{B}$'s bundle market. Then, equalising the following utility functions

$$U_{BU}^{k} = U_{CP}^{k,-k}$$

$$v_f^k - v_m - (p_f^k - \delta^k) - t|x^k - \tilde{x}| = v_f^{-k} - v_m - p_f^{-k} - t|x^{-k} - \tilde{x}|$$

the marginal consumers are located in:

$$\tilde{x}^{\mathcal{A}} = \frac{1}{2} + \frac{v_f^{\mathcal{A}} - v_f^{\mathcal{B}} - (p_f^{\mathcal{A}} - \delta^{\mathcal{A}} - p_f^{\mathcal{B}})}{2t} \tag{A.1.32}$$

$$\tilde{x}^{\mathcal{B}} = \frac{1}{2} - \frac{v_f^{\mathcal{B}} - v_f^{\mathcal{A}} - (p_f^{\mathcal{B}} - \delta^{\mathcal{B}} - p_f^{\mathcal{A}})}{2t} \tag{A.1.33}$$

The marginal consumer on the mobile market is derived by plugging $\tilde{x}^{\mathcal{A}}$ and $\tilde{x}^{\mathcal{B}}$ into expected utility expression from (1.1):

$$\begin{aligned}\tilde{y} =& \frac{1}{2} + \frac{(g_m^{\mathcal{A}} - p_m^{\mathcal{A}}) - (g_m^{\mathcal{B}} - p_m^{\mathcal{B}})}{2t} + \frac{(\delta^{\mathcal{A}} - \delta^{\mathcal{B}})}{4t} + \frac{\delta^{\mathcal{A}^2} - \delta^{\mathcal{B}^2}}{8t^2} \\ &+ \frac{(\delta^{\mathcal{A}} + \delta^{\mathcal{B}})\big[(v_f^{\mathcal{A}} - p_f^{\mathcal{A}}) - (v_f^{\mathcal{B}} - p_f^{\mathcal{B}})\big]}{4t^2}\end{aligned}$$

The objective function of the operators is equal to:

$$\begin{aligned}\Pi^k &= (p_f^k + p_m^k - \delta^k)\mathcal{D}_{BU}^k + p_m^k \mathcal{D}CP^{k,-k} + p_f^k \mathcal{D}_{CP}^{-k,k} \\ &= (p_f^k + p_m^k - \delta^k)\tilde{y}\tilde{x}^k + p_m^k \tilde{y}(1 - \tilde{x}^k) + p_f^k (1 - \tilde{y})\tilde{x}^{-k}\end{aligned} \tag{A.1.34}$$

In the no bundling regime: Writing $v_f^k - v_f^{-k} = \omega$, then a no bundling regime yields the following equilibrium prices and profits:

$$p_m^{k*} = t \tag{A.1.35a}$$

$$p_f^{k*} = t + \frac{\omega}{3} \tag{A.1.35b}$$

$$\Pi^{k*} = t + \frac{\omega}{3}\big(1 + \frac{\omega}{6t}\big) \tag{A.1.35c}$$

Unilateral bundling: Suppose next unilateral bundling by operator k. General formulas of equilibria are:

$$p_m^k = t + \frac{\delta^{k^2}}{4t} + \omega\delta^k \frac{\big(4t^2 - \delta^{k^2}\big)}{t\rho^k} \tag{A.1.36a}$$

$$p_f^k = t + \omega\frac{\big(12t^2 + \delta^{k^2}\big)}{\rho^k} \tag{A.1.36b}$$

$$\Pi^k = t - \frac{\delta^k}{4} + \frac{\omega}{4t\rho^k}\left\{2\omega\frac{16t^2(9t^2 + \delta^{k^2})}{4t\rho^k} + \left[t(12t + \delta^k) - \frac{\delta^k}{4t}\big(1 + \frac{2\delta^k\omega}{\rho^k}\big)\right]\right\} \tag{A.1.36c}$$

$$\begin{aligned}\Pi^{-k} =& t - \frac{\delta^k}{2} + \frac{\delta^{k^2}}{8t} \\ &+ \frac{\omega}{2t\rho^k}\left[2t\big(12t^2 - 2t\delta^k - \delta^{k^2}\big) + \frac{8t^2\omega(18t^2 - \delta^{k^2})}{\rho^k} + \delta^3\big(1 + \frac{\delta^k\omega}{\rho^k}\big)\right]\end{aligned} \tag{A.1.36d}$$

where $\rho^k = \Big(36t^2 - \delta^{k^2}\Big)$.

First degree Taylor approximations near $\delta^k = 0$ of unilateral bundling equilibria are equal to:

$$p_m^k = t + \omega\frac{\delta^k}{9t} \tag{A.1.37a}$$

$$p_m^{-k} = t + \omega\frac{\delta^k}{18t} - \frac{\delta^k}{2} \tag{A.1.37b}$$

$$p_f^k = t + \frac{\omega}{3} \tag{A.1.37c}$$

$$p_f^{-k} = t + \frac{\omega}{3} - \frac{\delta^k}{2} \tag{A.1.37d}$$

$$\Pi^k = t + \frac{\omega}{3}\left(1 + \frac{\omega}{6t} + \frac{\delta^k}{12t}\right) - \frac{\delta^k}{4} \tag{A.1.37e}$$

$$\Pi^{-k} = t - \frac{\omega}{3}\left(1 - \frac{\omega}{6t} - \frac{\delta^k}{6t}\right) - \frac{\delta^k}{2} \tag{A.1.37f}$$

Mixed bundling: If both operators bundle, equilibrium prices and prices are:

$$\hat{p}_m^k = t - \frac{\alpha^k\omega}{2t\rho} + \frac{\big(\delta^k + \delta^{-k}\big)^2}{4t} - \frac{\delta^{-k}}{2} \tag{A.1.38a}$$

$$\hat{p}_f^k = t - \omega\left(\frac{12t^2 + \delta^{-k^2} - \delta^{k^2}}{\rho}\right) - \frac{\delta^{-k}}{2} \tag{A.1.38b}$$

$$\begin{aligned}\hat{\Pi}^k =& t - \frac{\delta^k + 2\delta^{-k}}{4} + \frac{\delta^{-k}\big(\delta^k + \delta^{-k}\big)}{8t} + \frac{\omega\big(4t + \delta^k - 2\delta^{-k} + 2\omega\big)}{4t} \\ &- \frac{\omega}{t\rho}\big(\omega\frac{\beta^k}{\rho} + t\kappa^k\big)\end{aligned} \tag{A.1.38c}$$

where $\alpha^k = (2\delta^k - \delta^{-k})\Big[4t^2 - (\delta^k + \delta^{-k})^2\Big]$, $\rho = 36t^2 - \Big(\delta^k + \delta^{-k}\Big)^2$, $\beta^k = 576t^4 + \delta^k(\delta^k + \delta^{-k})^3 - 4t^2(\delta^k + \delta^{-k})(11\delta^k + 8\delta^{-k})$ and $\kappa^k = 24t^2 + 8t\Big(\delta^k - 2\delta^{-k}\Big) - \delta^k(\delta^k + \delta^{-k})$.

The corresponding first order Taylor approximations around $(\delta^k, \delta^{-k}) = (0, 0)$ are:

$$p_m^k = t + \omega\frac{(2\delta^k - \delta^{-k})}{18t} - \frac{\delta^{-k}}{2} \tag{A.1.39a}$$

$$p_f^k = t + \frac{\omega}{3} - \frac{\delta^{-k}}{2} \tag{A.1.39b}$$

$$\Pi^k = t - \frac{(\delta^k + 2\delta^{-k})}{4} + \frac{\omega}{3}\left[1 + \frac{(\delta^k - 2\delta^{-k})}{12t}\right] + \frac{\omega^2}{18t} \tag{A.1.39c}$$

Next, the condition for both operators to be active (i.e. neither operator can monopolise the fixed market) is found by substituting equilibrium prices

(A.1.38a) and (A.1.38b) into $\tilde{x}^{\mathcal{A}}$ and $\tilde{x}^{\mathcal{B}}$ from (A.1.32) and (A.1.33) and solving $0 < \tilde{x}^{\mathcal{A}} < 1$ and $0 < \tilde{x}^{\mathcal{B}} < 1$ for ω. Taylor approximations near $(\delta^k, \delta^{-k}) = (0, 0)$ of marginal consumers are

$$\tilde{x}^{\mathcal{A}} = \frac{1}{2} + \frac{\omega}{6t} + \frac{\delta^{\mathcal{A}} + \delta^{\mathcal{B}}}{4t}$$
$$\tilde{x}^{\mathcal{B}} = \frac{1}{2} + \frac{\omega}{6t} - \frac{\delta^{\mathcal{A}} + \delta^{\mathcal{B}}}{4t}$$

The solution to $0 < \tilde{x}^{\mathcal{A}} < 1$ and $0 < \tilde{x}^{\mathcal{B}} < 1$ then yields

$$-\frac{6t - 3(\delta^{\mathcal{A}} + \delta^{\mathcal{B}})}{2} < \omega < \frac{6t - 3(\delta^{\mathcal{A}} + \delta^{\mathcal{B}})}{2} \tag{A.1.40}$$

or, since $\omega = v_f^k - v_f^{-k} > 0$

$$0 < \omega < \frac{6t - 3(\delta^{\mathcal{A}} + \delta^{\mathcal{B}})}{2} \tag{A.1.41}$$

To see that there is no individual incentive to introduce a bundle discount, define $\Delta\Pi^k$ as the difference in operator k's profits when it passes from a no bundling to a unilateral regime:

$$\begin{aligned}\Delta\Pi^k &= \Pi^k_{\text{unilateral}} - \Pi^{k*} \\ &= t + \frac{\omega}{3}\left(1 + \frac{\omega}{6t} + \frac{\delta^k}{12t}\right) - \frac{\delta^k}{4} - \left[t + \frac{\omega}{3}\left(1 + \frac{\omega}{6t}\right)\right] \\ &= \omega\frac{\delta^k}{36t} - \frac{\delta^k}{4}\end{aligned} \tag{A.1.42}$$

If condition (A.1.41) holds, then $\Delta\Pi^k$ is never positive. As a matter of fact, evaluating $\Delta\Pi^k$ at either boundary yields[33]

$$\Delta\Pi^k \begin{cases} = -\frac{\delta^k}{4} & < 0 \quad \text{if } \omega = 0 \\ = -\frac{\delta^k(4t+\delta^k)}{24t} & < 0 \quad \text{if } \omega = 3t - \frac{3}{2}\delta^k \end{cases} \tag{A.1.43}$$

This shows that at neither boundary of the non-monopolisation condition the higher valued operator would not unilaterally offer a bundle discount. A sim-

[33] Note that with one discount, say δ^{-k}, equal to 0, the condition (A.1.41) becomes

$$0 < \omega < 3t - \frac{3\delta^k}{2}$$

ilarly reasoning allows to state the same for the lower valued operator.

CHAPTER 2

Socio-demographics and telecommunications services: Some empirics

2.1 Introduction

The aim of the previous chapter was to provide a theoretical framework that allows for analysing telecommunications service bundling in presence of Fixed-Mobile substitution.

In this chapter, the context of FMS is upheld but provides an empirical analysis of the consumption behavior of French users of telecommunications services. The goal of this analysis is to draw consistent portraits of three different consumption types. In particular, this study raises the question as to know which personal characteristics are most influential for a consumers' choice. Furthermore, a particular interest is put on the question whether these profiles vary from one operator to another.

Behind this work is the notice of the impressive dynamics that rules the telecommunications market in France. In the last five or six years, the French market has seen many evolutions caused by different reasons. For instance, the first commercialisation in 2009 of Bouygues Télécom's quadruple play offer "Ideo" can be seen as a pricing innovation. With a price advantage up to 16 € compared to a stand-alone mobile and triple play offer, a clear incentive for

consumers to change has been introduced. Another reason for the evolution relies on the triggering of the low-cost era provoked by the market entry of Free Mobile in early 2012. Indeed, its market entry triggered an highly aggressive and until then unseen pricing policy: mobile plans are now priced up to 20 % below the prices charged before (ARCEP, 2014). Moreover, abundance of voice calls, texting and very competitive data allowances became the market standard. In order to escape competition, the incumbent operators Orange, SFR and Bouygues Télécom not only introduced similarly competitive offers, but also accelerated their deployment of new network technologies (e.g. optical fibre or LTE).[1] Despite the accelerated investment, the path towards low-cost offers did not break and its course reached out to other segments such as the quadruple play segment.

Of course, there are also other technological reasons that explain the dynamics of the market and probably also the evolution of the consumers' behavior. Steadily increasing performance of mobile devices and networks and subsequently the increasing number of applications or possibilities of usage also influence the market dynamics.

Market dynamics are thus the result of an evolving demand side as well as supply side. As has been described previously, an increasing number of persons stop consuming fixed telecommunications services, since their mobile services appear sufficient for their needs. On the other hand, as the theoretical analysis in chapter 1 showed, service bundling is likely to induce consumers to switch for a convergent offer. The consumption behavior has thus changed in the last years. For any service provider, it is of crucial importance to keep trace off these changes and not only within its own customer base, but within the whole market.

This constitutes the starting point of the present study: to identify what

[1] See for instance here for ARCEP's observatory of investments.

the driving forces of consumers' choice are. In order to achieve this objective, a micro-econometric model is introduced. Survey data of French interviewees is fitted in a conditional logit model where the individuals are confronted with three alternative consumption choices: i) using only a mobile offer, ii) complementing their mobile offer by one or several stand-alone fixed services or iii) subscribe to a bundle of at least two services. As explanatory variables, the model uses mostly individuals' characteristics, such as their age or income, but also integrates a price proxy.

This study does not introduce any variables relative to the consumer's habits of how she uses her different services, as the relevant information is not provided by the survey. Hence, with individual characteristics as only source of information, this study provides an additional explanation for the occurrence of FMS in the French market.

In particular, the results reveal the option of mobile-only as a tool for budget controlling. This means that, without information on consumption habits, mobile-only users are consumers who are subject to a strong budget constraint. As a matter of fact, persons in a situation of unemployment, low income or who use prepaid cards have a higher probability of mobile-only usage than using several services. This finding can be generalised as it holds for the three operators (Orange, SFR and Bouygues Télécom).

Another result relates to the idea that service providers are largely differentiated, specifically Orange and Bouygues Télécom. This is especially true for people living in rural areas: in contrast a Bouygues client, an Orange customer who lives in a rural area (rather than in a large city) has a significantly higher probability of choosing a bundle from Orange rather than being mobile-only. The reverse is true for a Bouygues customer: the probability of choosing a bundle from Bouygues is significantly lower. This finding suggests different preferences between Orange and Bouygues Télécom customers.

The remainder of this chapter is as follows. Section 2.2 provides a brief revue of the existing literature and section 2.3 gives the theoretical framework used in this chapter. The data is presented in section 2.4 and the results in section 2.5. Finally, sections 2.6 gives concluding remarks.

2.2 Literature review

The relevant existing literature to be reviewed here focusses on the characteristics of demand for telecommunications services. Early academic literature on this issue (in the 1970's) was most often concerned with the estimation of demand elasticities with respect to prices in times of high inflation and upward pressure of call rates (Taylor, 2002). With the increasing popularity of mobile services and thus the upcoming substitution between fixed and mobile services, the literature also considered to integrate non-price factors, like socio-demographic ones, to profile the consumers conditional on which service they use.

As for telephony services, Rodini, Ward and Woroch (2003) used a logit model in order to estimate cross-price elasticities between fixed and mobile voice services. Their study relies on micro-level data from 2000-2001 in the US. Besides statistical significant impacts of usage, as well as access and prices, the authors also find that socio-demographic variables such as income, education or household size have a positive impact on the probability of mobile subscription, to the detriment of second fixed line subscription. In contrast, the older the surveyed person, the less high the probability of subscribing to a mobile voice service.

Following a similar idea, Ward and Woroch (2004) analysed substitution patterns in the US during 1999 to 2001 and conclude that non-price factors like mobile network coverage and quality also plays a major role in mobile subscription take-off.

Using data from 2004 to 2006, Schejter *et al.* (2010) performed a cluster analysis on wireline and wireless market segments separately in order to identify the characteristics of consumers belonging to either segment. Their results show that wireless users are predominantly young people with low income. Moreover, house owners are more likely to be fixed line users. The authors also conclude that

> wireless only consumers are [...] newcomers to the markets, who can be seen as the emergence of a new consumer and not as an expression of switching by an existing one.[2]

With the emergence of broadband Internet access, several studies focus on estimating the demand for the different Internet access technologies and derive consumers' willingness to pay for different component of the available offers. For instance, Savage and Waldman (2005) provide evidence that subscribing to a high speed broadband connection is more likely for high income household and persons with higher education. They show moreover that people's online experience is an influencing factor, too.

In Rosston, Savage and Waldman (2010), the authors design a discrete choice experience to show that consumers willingness to pay of Internet service improvements like increase Internet connection speed. In particular, their results reveal that US citizens are willing to pay 3 $ more in order to enjoy very fast Internet rather then fast Internet. This is an interesting result as it raises the question of whether deploying a nationwide optical fibre network is economically justifiable.[3]

Broadband access demand estimation in Europe also identified, among

[2] Although, it should be noted that in the analysed period, the mobile market has not yet been at maturity. Many new consumers arrived to the market and went "straight-to-mobile", given the benefits of mobile services (mobility, decrease of costs, increasing diffusion of usage possibilities,...).

[3] In an unpublished manuscript, Rappoport, Kridel, Taylor and Alleman used data on the US for the year 2000 and showed that fixed broadband diffusion is boosted by the household size, education and income. See `here` for the relevant paper.

others, income, education and household size as variables that influence consumers' decision process. For instance, Srinuan, Srinuan and Bohlin (2012) illustrate these findings for Sweden using data from 2009 and Cardona et al. (2009) analyse the Austrian market with 2006 data. The former show that swedish people living in area with a high density of populations (e.g. Stockholm or Gothenburg) have a higher probability of using mobile broadband rather than fixed (fibre or DSL), whereas this probability is less high in rural areas. A similar result is found for the Austrian market: people living in Vienna are more likely to subscribe to a mobile broadband offer. On the contrary, educational considerations seem to play a less important role in Sweden than in Austria.

Also relevant are the reports issued by governmental instances like national regulatory authorities, consulting agencies national research centres. For instance, a report issued by DotEcon (2001) studies fixed-mobile substitution in 2001 and drew consumer profiles for UK mobile-only consumers, fixed-only users, and fixed-and-mobile users. A similar study is produced in France by CREDOC (2013) or at European level by the Eurobarometer reports.[4] Both studies basically provide the same insights: single-service usage is influenced by low income (for mobile-only usage) or higher age (for fixed-only usage). However, these studies mostly provide inventories and descriptive statistics on the phenomenon discussed here, rather econometric analysis.

The contribution of this chapter is that it uses an original dataset of over 22000 observations from French consumer. The analysed period spans from September 2008 to June 2012. The results are similar to those described in the existing literature, namely that mobile-only usage is mostly due to financial considerations.In contrast, the interviewees age does not appear as a influencing factor of single-service usage, as it people of all categories of age

[4] Centre de Recherche pour l'Étude et l'Observation des Conditions de Vie

bear a higher probability of using fixed and mobile services rather than only mobile. Moreover, unlike in Macher, Mayo, Ukhaneva and Woroch (2012), French part time employees are less likely to use several services than their US counterparts.

2.3 Model framework and estimation methodology

The model used in this study is one of discrete choice. In such a model, a decision maker faces a set of alternatives among which she chooses one and only one. Essentially, these models estimate a probability for a given alternative to be chosen. Since a probability is always comprised between 0 and 1, an linear regression model is inappropriate.

Discrete choice models rely either on a logistic distribution of choice probabilities (in which case the model is called *Logit model*) or a normal distribution (*Probit model*). Since the first is computationally simpler, it is the most widely used in the literature.

In essence, there exist two kinds of discrete choice models. In the first one, the choice set, i.e. the set of alternatives presented to the individual is composed of only two alternative. These models are called "binary (or dichotomic) discrete choice models". If, on the other hand, the choice set comprises more than two alternatives, the model is called "polytomic discrete choice model".

Among these models, it is convenient to distinguish between *multinomial* logit model, where the exogenous variables vary with the individuals (e.g. age, occupational status, etc.), and *conditional* logit model, where the exogenous variables vary with the alternatives in the choice set. Prices are the archetype of a variable in a conditional discrete choice model, but the data allowance in mobile subscriptions (which may differ from one offer to another) can also be

cited.[5]

There exists also the possibility of some mix of the multinomial and conditional model. In this case, the set of exogenous variables contains both alternative-specific and individual-specific variables. However, these models should not be confounded with the *mixed logit*, which allows to take into account the heterogeneity between individuals.[6] The study presented in this chapter uses both alternative-specific and individual-specific variables. In order to be able to estimate such a model, the individual-specific variable have to be coded as alternative-specific variables, i.e. induce variability for variable like age. This is achieved in the following way. Each observation is duplicated as many times as there are alternatives. Then, variability of individual-specific variables (e.g. age) is achieved by setting the age equal to the actual age in the row representing the chosen alternative and 0 in the other rows.

In a discrete choice model, the decision maker chooses one alternative from a given choice set. Her chosen alternative is the one that maximises her utility. Her utility is determined by her preferences and depends on i) her characteristics (i.e. individual-specific variables) and/or ii) attributes of the different offered choices.

If an individual n, $n = 1, \ldots, N$, faces a choice set with $j = 1, \ldots, J$ alternatives, her direct utility function writes U_{nj}. In most cases however, it is impossible to observe every relevant characteristic of either the individual or the alternative. Therefore, the observed characteristics, which are used for the

[5] Among the multinomial and conditional logit models, other classifications exist: ordered logit (e.g. an evaluation on a Lickert scale), non-ordered or also nested logit (where the choice in the first step determines the alternatives available in a second step; e.g. choosing a quadruple play offer in the second step, provided that mobile and fixed services have been chosen from the same provider in the first step.). The present study uses a non-ordered logit.

[6] The key difference between mixed logit and other logit models is that the former decomposes the error term into two parts: the first part is related to all or a part of the observed variables and allows, by estimating a mean and a standard deviation for these variables, to attribute a statistical distribution. The second part corresponds to the standard random error term.

estimation of the choice probability, form a representative utility, denoted by V_{nj}. Thus, with ε_{nj} denoting the unobserved factors, the direct utility writes:

$$U_{nj} = V_{nj} + \varepsilon_{nj} \tag{2.1}$$

The utility maximisation therefore implies that the probability of choosing alternative j over any other available alternative yields:

$$\begin{aligned} P_{nj} &= \text{Prob}(U_{nj} > U_{ni}) \\ &= \text{Prob}(V_{nj} - V_{ni} > \varepsilon_{ni} - \varepsilon_{nj}) \, , j \neq i \, , \forall j \in \{1, \ldots, J\} \end{aligned} \tag{2.2}$$

From (2.2), it appears that the individual chooses alternative j if the excess utility provided by that alternative compared to another alternative is higher than the difference between unobserved characteristics. To be more explicit, recall that ε represents the unobserved characteristics that influence the decision maker's choice. Then, even though it is not explicable by the retained variables, $\varepsilon_{ni} - \varepsilon_{nj}$ represents what alternative i has to offer to individual n in excess to alternative j. It then follows that individual n chooses alternative j whenever the known (and observed) advantages of j over i exceed the unknown (and unobserved) advantages of i over j.

2.3.1 Conditional logit specification

Since the unobserved factors ε_{nj} represent essentially an random error term, a statistical distribution is attributed to them in order to be able to infer the choice probability P_{nj}. In the case of a logistic model, the ε_{nj} are assumed independent and identically distributed (*iid*) and to follow a Gumble extreme value distribution. The Gumble distribution has the following density function,

$f(\cdot)$, and cumulative distribution, $F(\cdot)$:

$$f(\varepsilon_{ni}) = exp(-\varepsilon_{ni})\, exp[-exp(-\varepsilon_{ni})] \tag{2.3a}$$

$$F(\varepsilon_{ni}) = exp[-exp(-\varepsilon_{ni})] \tag{2.3b}$$

Then, using $f(\varepsilon_{ni})$ and $F(\varepsilon_{ni})$, expression (2.2) can be rewritten as follows:

$$\begin{aligned} P_{nj} &= Prob(V_{nj} - V_{ni} > \varepsilon_{ni} - \varepsilon_{nj}) \\ &= Prob(V_{nj} - V_{ni} + \varepsilon_{nj} > \varepsilon_{ni}) \\ &= \int_{-\infty}^{+\infty} \prod_{j \neq i} F(\varepsilon_{nj})\, f(\varepsilon_{nj})\, d\, \varepsilon_{nj} \\ &= \frac{e^{(V_{nj})}}{\sum_i e^{(V_{ni})}} \end{aligned} \tag{2.4}$$

The last is line follows after some algebraic manipulation which is provided detailed in appendix A.2.1. However, it closely follows Train (2009).

Finally, let x denote the vector containing the observed variables and β the coefficients to be estimated. The representative utility V_{nj} can then be expressed as $V_{nj} = \beta'\, x_{nj}$ and the choice probability (2.4) becomes:

$$P_{nj} = \frac{e^{\beta'\, x_{nj}}}{\sum_i e^{\beta'\, x_{ni}}} \tag{2.5}$$

Estimation methodology In order to estimate the coefficients in the expression above, it is common practise to use the method of the maximum likelihood. This proceeding searches the coefficients β that maximise the likelihood of the probability of observing that the decision maker n actually chooses alternative j among all the available alternatives. Assuming that the decision makers are independent, this likelihood yields:

$$\mathcal{L}(\beta) = \prod_{n=1}^{N} \prod_{j}^{J} (P_{nj})^{y_{nj}} \tag{2.6}$$

In the above, y_{nj} is equal to 1 if the decision maker n chose alternative j and 0 otherwise.[7] Plugging now (2.5) into (2.6) and taking the logarithm yields the log-likelihood function to be maximized:

$$\mathcal{LL}(\beta) = \sum_n \sum_j y_{nj} \ln\Big(\frac{e^{\beta' x_{nj}}}{\sum_i e^{\beta' x_{ni}}}\Big) \tag{2.7}$$

The estimated coefficients β are such that the expression above is maximised.

Identification issue At this point, it is important to have another look at expression (2.2), which stated that alternative j is chosen over alternative i if the observed utility (estimated by means of observed characteristics) allow for higher utility than the unobserved:

$$P_{nj} = \text{Prob}(V_{nj} - V_{ni} > \varepsilon_{ni} - \varepsilon_{nj}) \, , j \neq i \, , \forall j \in \{1, \ldots, J\}$$

It is important to note that this probability only depends on the difference in representative utilities provided by two alternatives, rather than the actual level of utility provided by the chosen alternative. The problem is than that an infinity of estimated coefficients result in a given difference, with the consequence that the model is not identifiable.

In order to circumvent this identification issue, the coefficients relative to one alternative are normalised to zero, implying that the concerned alternative serves as reference. As a result, the estimated choice probability correspond to the difference in probabilities relative to the normalised alternative.

Another identification problem arises with *individual-specific* characteristics. Indeed, such variables do not vary with the alternatives in the choice set and do therefore not contribute the difference in utilities provided by two alternatives.For the sake of illustration, suppose an individual that faces a choice

[7] Hence, the probability of the non-chosen alternative does not appear.

set with 3 alternatives, h, i and j, where j serves as reference. Furthermore, assume the only available information relative to this individual is variable x. Then, the difference in representative utility provided by alternatives i and j writes:

$$\begin{aligned} V_{ni} - V_{nj} &= \beta' x_{ni} - \beta' x_{nj} \\ &= 0 \end{aligned}$$

since $x_{ni} = x_{nj}$. Thus, β cannot be identified by the model.

A possible remedy consist in using a dummy coding for each modality of variable x. Suppose x provides the information whether or not individual n is employed or not. Then, the recoding implies that the dummy "employed" takes the value of 1 if individual n is employed and 0 otherwise. Since the dummy "unemployed" is created similarly (1 if n is unemployed, etc.), both dummies are collinear. In order to identify the coefficient β, one dummy variable must be excluded from the model. Similarly to the reference alternative, the excluded dummy variable will serve as reference and the resulting coefficients then yields the impact of the dummy relative to the reference.

2.4 The data

The data stems from the GFK Institute for surveys and spreads from September 2008 to June 2012.[8] During this period, 22072 French mobile phone users have been reached on their cellphone and have been asked to indicate which means for electronic communications they use on a private basis.[9] This present study uses these indications in order to determine the respondent's consumption type. In particular, the respondent is considered as

[8] The 4$^{\text{th}}$ quarter of 2010 and 2011 are unavailable.

[9] Since all respondents have been called on their cellphone, every one has at least a mobile. Consequently, the survey does not include fixed-only users.

- *mobile-only* if she uses only a mobile phone to satisfy her consumption needs,
- *non-bundler* if she uses at least one communications service other than her mobile phone, regardless which operator is providing the additional service(s), but does not have a bundled offer,
- *bundler* if she declares having a bundle from her mobile operator.

Regarding bundlers, it should be noted that the survey does not explicitly ask for the form of the bundle (e.g. whether the respondent has a Triple / Quadruple Play offer or not), but merely whether or not the respondent pays a single invoice for at least two of the services provided by her mobile operator. Hence, less usual bundles appear and are even predominant. For instance, among the 3505 consumers who declared to have a bundle, only 496 declare to have a Quadruple Play offer and only 939 a Triple Play offer. Thus, nearly 60 % of declared bundlers have an unconventional bundle like e.g. traditional fixed telephony and TV.

Moreover, the survey only considers bundles that are *provided by the mobile operator*. This leads to a considerable difference in numbers between the present study and e.g. Special Eurobarometer reports. Indeed, this study is unable to detect users of multiple services that may have a bundle from an operator other than their mobile operator. The only information available about these respondents is that they use multiple services, but it is unknown whether in a bundle or not. They are therefore classified as simple non-bundlers. In contrast, the latest Special Eurobarometer report provides figures of bundlers that are four times higher since they consider all the bundlers *regardless* their provider (Eurobarometer (2014), p. 67).

The pie chart 2.1 shows the distribution of the 22072 respondents following their consumption types, where, for an illustrative purpose only, bundlers are disaggregated into i) Triple Play, ii) Quadruple Play and iii) other forms of

bundle. On this figure, it appears that the large majority (slightly above 81 %) of the respondents use multiple services. Among these, only 15,88 % indicated to have a bundled offer with some 4 people out of 100 have a Triple Play offer, whereas the proportion of Quadruple Play users is slightly above 2 %.

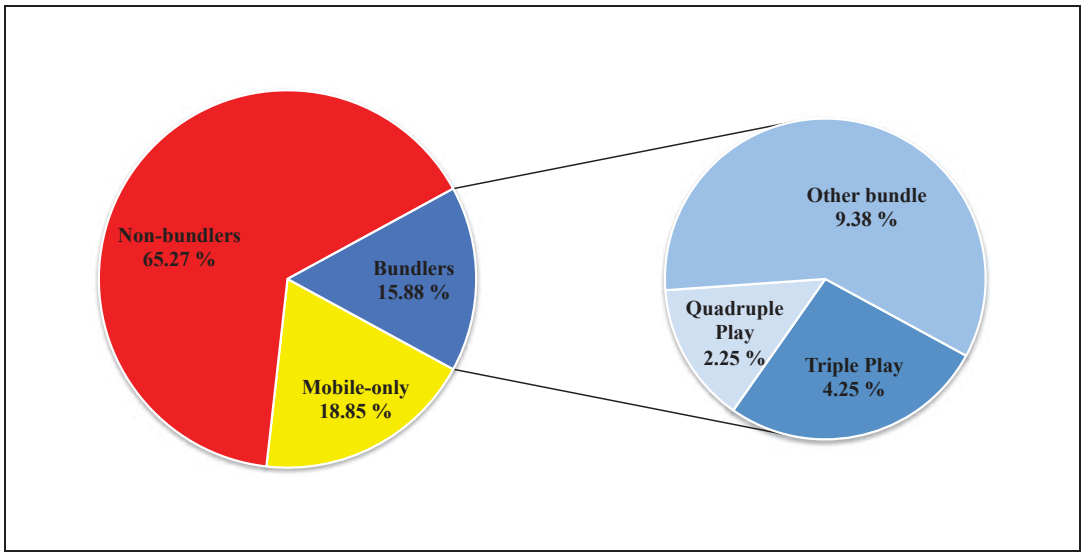


Fig. 2.1 Distribution of the consumption types (Obs: 22072).

Whereas the percentages of Triple Play users and users of other forms of bundles differ from the Eurobarometer reports, the proportions of quadruple play users are very close, as the table 2.1 shows.

Table 2.1 Comparing the proportions of Quadruple Play users: CET vs. Eurobarometer

Year	This study	Eurobarometer†
Nov / Dec 2009	0,7 %	1 %
Feb. / Mar. 2011	2,9 %	2 %
Dec. 2011	2,2 %‡	2 %

† Eurobarometer (2014), p. 70.

‡ January 2012, since Q4 2011 is missing.

For the sake of tractability of the model, all forms of bundle (i.e. Triple Play, Quadruple Play or any other combination) will be aggregated into *bundlers*, as the number of alternative within the choice set would otherwise be too high.

2.4.1 The variables

The analysis relies on two categories of exogenous variables. A first category is alternative-specific and changes with every alternative available, or stated otherwise with every consumption type. In particular, the variable *price* is alternative-specific. A second category is individual-specific and, in contrast to alternative-specific variables, changes from individual to individual. The set of individual specific variables includes *mobile operator, contract, age, occupational status, income, kids, density* and *gender*. The table 2.2 summarises and briefly describes all the variables used in the model.

Table 2.2 Description of the variables

Variable	Category	Description	Min	Max
Type	Mobile-only Multi-service Bundler	Choice alternative	1	3
Price	/	Monthly amount of money in € the respondent declared to pay for all of his services	0	8000
Mobile operator	Orange SFR Bouygues Télécom (BT)	Mobile service provider	1	3
Contract	Prepaid Post-pay	Type of mobile contract	0	1
Category of age	$\leq$ 22 years [23; 30] [31; 40] [41; 50] $\geq$ 51	Respondent's category of age	0	4
Occupational status	Full time employee Part time employee Retired Student Unemployed Housekeeper	Respondent's occupation	0	5
Income	Low income ($\leq$ 1500 €) High income	Whether or not the respondent's income is above 1500 €	0	1
Household composition	No kids With kids	Whether or not kids live in the household	0	1
Area of living	Rural ($\leq$ 107 inhab/km^2) Small city ([108; 1495]) Large city ($>$ 1496)	Density of population of the respondent's area of living	0	2
Gender	Male Female	Respondent's gender	0	1

The variables *Income* and *Area of living* are ad-hoc variables as this information is not provided by the survey. However, the respondent's postal codes are available and thus its place of residence. The postal codes are therefore used as link to i) a database containing the fiscal revenue in the respondent's location and ii) a base providing information about the density of population of her living area. The data for both of these variables are provided by the French statistical office INSEE.[10]

INSEE's data on income provides annual fiscal incomes at town level. Using the postal code of the respondent, her income can be approximated. In this study, the median income at town level is used, which provides more egalitarian measure of income at town level as the average. As the data for 2012 has not yet been available from INSEE at the time of writing this chapter, it has been extrapolated by using a compound average growth rate based on the data from 2008 to 2011. Finally, the data has been divided by 12 in order to have an proxy for the respondent's monthly income.

The data on density of population of the respondent's area of living is a part of the French population census which is undertook every 6 years. The most recent data available is from 2009. The interest of integrating this variable is that the utility of using multiple communication services might be lower in denser areas, such as large cities. Indeed, in the latter areas, activities such as theatre, cinemas or museums are more widely available as in rural areas. Thus, people living in dense area may be less often at home and therefore less inclined to use fixed services on a private basis.

As mentioned above, the variable *price* is alternative-specific, i.e. varies with the consumption type. However, the respondent chooses only one alternative and only one actual price is known per respondent. In order to create the choice sets the respondents will be confronted with, the price for the al-

[10] Both datasets are available freely. The data on income can be found `here` and the data on density of population `here`.

ternatives that have not been chosen has to be approximated. In particular, the price for a non-chosen alternative is set equal to the average price paid by respondents that have chosen that given alternative. For instance, suppose an individual n has chosen to be mobile-only. Thus, the price for the alternative *non-bundler* (resp. *bundler*) is equal to the average amount paid by all the non-bundlers (resp. bundlers) in the sample.Replacing these missing values by an average value, rather than by 0 appears more realistic and economically justifiable, as no consumer would choose an alternative at a strictly positive price over one that is free of charge.

2.4.2 The descriptive statistics

Table 2.3 provides some descriptive statistics of the complete sample and also of the three consumption types.[11]

From this table follows that most respondents are Orange customers ($\approx$ 53 %) and the remaining respondents are evenly distributed among SFR and Bouygues Télécom. This fact is reflected in the subsamples. For instance, 53 % of all the mobile-only consumers and 50 % of all the non-bundlers are Orange customers (the remaining respondents are again split quite evenly among SFR and Bouygues Télécom). Although, the gap widens for bundlers. Indeed, here 2/3 of the respondents declared having a bundle provided by Orange, while slightly above 21 % of the bundlers are SFR customer and slightly more than 12 % of them deal with Bouygues Télécom. Hence, Orange appears to be more attractive to customers that use multiple service in some form of bundle. A detailed profiling of operator is provided in the next section.

Furthermore, it arises from table 2.3 that 17 % of the respondents have less than 23 years, and the other categories account each for a minimum of

[11] Only one category of dichotomic variables (*Contract*, *Income*, *Household composition* and *Gender*) is provided in this table. The averages of the non-shown categories are simply calculated as 1 minus the average of the shown category. E.g., the average of the category "Post-pay" in the complete sample is $1 - 0.4942 = 0.5058$.

Table 2.3 Descriptive statistics of the complete sample and the three consumption types

Variable	Category	Complete Sample		Mobile-only		Non-Bundler		Bundler	
Type	Mobile-only	0.1885	(0.3911)	·	·	·	·	·	·
	Non-bundlers	0.6527	(0.4761)	·	·	·	·	·	·
	Bundlers	0.1588	(0.3655)	·	·	·	·	·	·
Price		43.4223	(57.3322)	36.7887	(39.4385)	40.7845	(56.9449)	62.1375	(71.3787)
Operator	Orange	0.5330	(0.4989)	0.5365	(0.4987)	0.5008	(0.5000)	0.6613	(0.4733)
	SFR	0.2335	(0.4230)	0.2325	(0.4224)	0.2386	(0.4263)	0.2134	(0.4098)
	Bouygues Télécom	0.2335	(0.4231)	0.2310	(0.4215)	0.2606	(0.4390)	0.1252	(0.3310)
Contract	Prepaid	0.4942	(0.5000)	0.6767	(0.4678)	0.4782	(0.4995)	0.3438	(0.4750)
Age	$\leq$ 22 years	0.1687	(0.3745)	0.1675	(0.3735)	0.1718	(0.3643)	0.1575	(0.3643)
	23 - 30 years	0.1974	(0.3980)	0.2332	(0.4229)	0.1892	(0.3910)	0.1883	(0.3910)
	31 - 40 years	0.2138	(0.4100)	0.2228	(0.4162)	0.2124	(0.4065)	0.2088	(0.4065)
	41 - 50 years	0.1964	(0.3973)	0.1873	(0.3902)	0.1929	(0.4152)	0.2214	(0.4152)
	$\geq$ 51 years	0.2238	(0.4168)	0.1892	(0.3917)	0.2337	(0.4170)	0.2240	(0.4170)
Occupational status	Full Time Employee	0.4457	(0.4971)	0.3668	(0.4820)	0.4564	(0.4981)	0.4950	(0.5000)
	Part Time Employee	0.1101	(0.3131)	0.1264	(0.3324)	0.1073	(0.3095)	0.1024	(0.3032)
	Retired	0.1171	(0.3216)	0.0839	(0.2773)	0.1280	(0.3341)	0.1118	(0.3152)
	Student	0.1322	(0.3387)	0.1034	(0.3045)	0.1414	(0.3484)	0.1284	(0.3346)
	Unemployed	0.1303	(0.3367)	0.2308	(0.4214)	0.1085	(0.3110)	0.1010	(0.3014)
	Housekeeper	0.0646	(0.2458)	0.0887	(0.2843)	0.0584	(0.2345)	0.0613	(0.2400)
Income	Low income	0.4875	(0.4999)	0.5363	(0.4987)	0.4831	(0.4997)	0.4476	(0.4973)
Household	No kids	0.4244	(0.4943)	0.5303	(0.4991)	0.3931	(0.4884)	0.4277	(0.4948)
Area of living	Rural	0.3299	(0.4702)	0.3339	(0.4717)	0.3193	(0.4662)	0.3686	(0.4825)
	Dense	0.3300	(0.4702)	0.3103	(0.4627)	0.3310	(0.4706)	0.3492	(0.4768)
	Very dense	0.3402	(0.4738)	0.3558	(0.4788)	0.3498	(0.4769)	0.2822	(0.4501)
Gender	Female	0.5069	(0.5000)	0.4421	(0.4967)	0.5218	(0.4995)	0.5227	(0.4996)
	Obs.	22072		4160		14407		3505	

Average (Standard deviation)

19.6 % of the respondents (i.e. between 23 and 30 years) and a maximum of 22 % (above or equal 51 year). When looking at every consumption type individually, it appears that most mobile-only users are aged between 23 and 30 years. When it comes to multiple services consumption (whether bundled or not), the modal category is "$\geq$ 51 years". However, the proportion of non-bundlers or bundlers belonging to categories "31 - 40 years" or "41 - 50 years" are similarly high. This is especially true for bundlers, where the difference in proportions is less then one percent. However, two different consumption behaviors seem to emerge: mobile-only users are mostly young people (i.e. up to 30 years), whereas respondents above 30 most often use a mobile and at least one fixed communication service.

As for the occupational status, it appears that, in average, 44 % of the respondents are full time employees. The second most represent group are the students with $\approx$ 13 %. Respondents that were unemployed at the time they were surveyed represent also around 13 % of the sample. This proximity between unemployed respondents and student disappears among the mobile-only users. Indeed, there less than half as many students among the mobile-only users as there are unemployed mobile-only users. As for the other consumption types, students occupy the second rank behind the full time employees although followed by retired persons, rather than unemployed. Yet, the phenomenon of mobile-only usage might be considered as budget control measure for respondents with weaker financial resources.

This seems furthermore confirmed by three other facts. Consider first the variable *Income*. Whereas the income for 48 % of the respondent is approximated to be below 1500 € the proportion of mobile-only with a low income is above 53 %. Second, almost 70 % of the mobile-only users declared to have an prepaid card, which allows for a better budgeting as post-pay contracts. Finally, the average amount paid by a mobile-only user is the lowest among

the three consumption types.[12]

As for the household composition, the table shows that ≈ 57 % of the respondents have children at home, while the majority of mobile-only do not (≈ 54 %). The reverse is true for the other consumption types: 60 % of non-bundlers and 57 % of bundlers have kids at home.

The distribution of the respondents over the territory of France is quite balanced, with around 1/3 in each area. Although, bundlers are most often located in rural areas, which somehow confirms the interest of this variable.

Finally, whereas in the complete sample the genders are distributed equally, the table shows mobile-only users are predominantly male respondents, whereas respondents using several services (whether bundled or not) are mostly women.

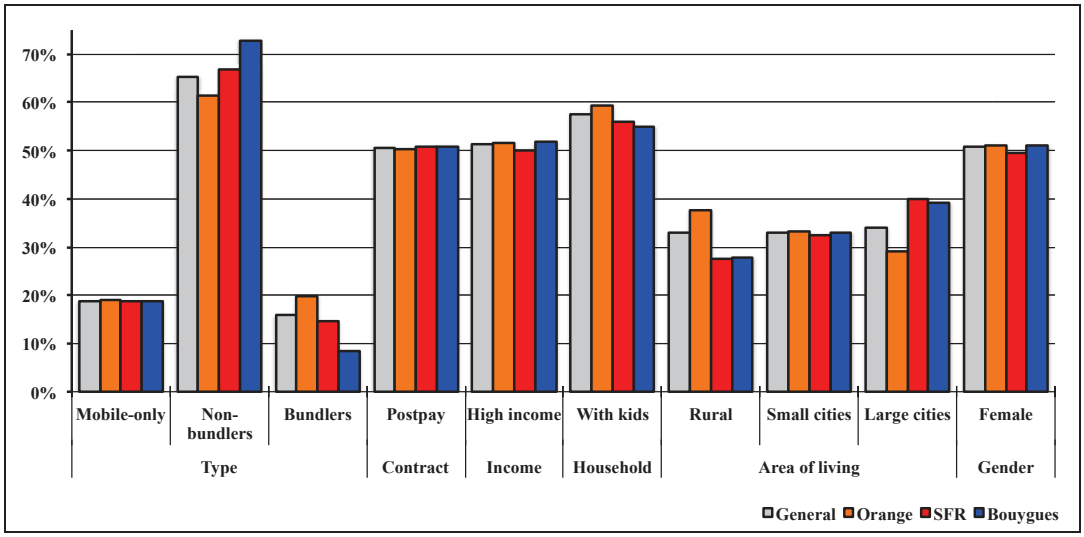
2.4.3 Analysing the profiles of mobile operators

This subsection divides the complete sample into three subsamples based on the variable *operator*. This allows to draw operator-specific profiles and hence to detect whether there are inherent differences of consumption behaviors among the three mobile communications operators present in the survey. The chart 2.2 will help to establish these operator-specific profiles.

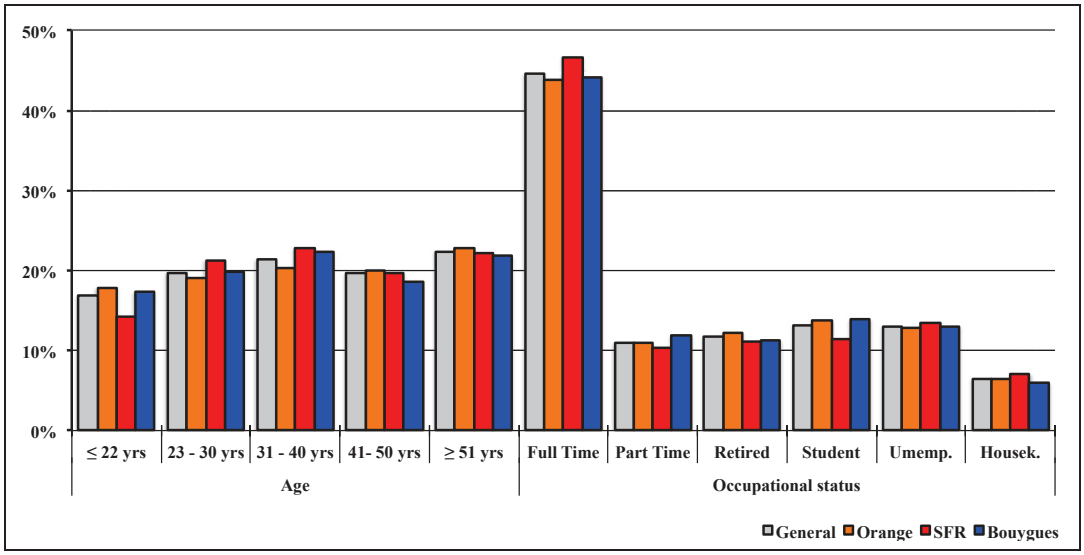
From the chart 2.2 it can be seen that the proportion of mobile-only users is essentially equivalent among all the three operators (≈ 19 %). On the other hand, the proportions of respondents using several services vary considerably among the three operators. For instance, Bouygues Télécom has over 70 % of non-bundlers, a proportion that drops to slightly above 60 % for Orange. SFR is in-between both with approximately 65 %.

As for bundlers, Orange has almost 20 % of bundlers in its interviewed customer base, SFR has ≈ 15 % and Bouygues Télécom around 9 %. These differences are extremely significant from a statistical point of view, as tables

[12] A similar reasoning might apply to housekeeper.



(a) Part I



(b) Part II

Fig. 2.2 Comparing mobile service operators

A.2.1 and A.2.2 in the appendix show.

Some other differences appear on the chart. Consider for instance the area of living. Residents of rural areas seem to prefer to deal with Orange, while this picture changes for dense and very dense areas. The proportions are equivalent in dense areas. In very dense areas, however, SFR serves significantly more customers than Bouygues Télécom as well as Orange. In this area, Bouygues Télécom has also more customers than Orange.[13]

[13] The null hypothesis of the unilateral T-test, that the proportion between Bouygues and

Following these facts, one might be tempted to say that Orange is more attractive for households in less dense areas, which could also be linked to the fact that Orange is the incumbent telephony operator owning a nationwide fixed telecommunications infrastructure. On the hand, denser areas are more profitable, since sunk costs can be spread over a larger potential demand. Thus, newcomers, as opposed to the incumbent, may be more aggressive in these areas in order to build up a sufficiently large source of revenue before expanding in other, less urbanised territories.

In terms of age, it appears that SFR has significantly less young respondents than its competitors. No significant difference exists between the latter. As for the next category (aged between 23 and 30 years), most of the respondents are SFR customers.[14] Another category of age in which Orange has significantly less customers is the category "31 - 40 years". Respondents aged between 41 and 50 years are mainly Orange customers. However, only a small statistically significant difference could be detected between Bouygues and Orange. Finally, the proportions of customers aged above 51 years is similar among all the operators.

As for the household composition, it appears that Orange serves the largest number of households with children. Again, this difference is highly significant.

Finally, some pecuniary elements can be mentioned. Firstly, in terms of monthly amount paid for all of the telecommunications services, Bouygues Télécom seems to offer the most competitive prices (average price for all consumption types: 36.30 €), while Orange customers incur the highest monthly invoices (47.35 €). Moreover, the proportion of respondents having a low income is lower among Orange or Bouygues Télécom customers than among SFR customers, whose average price is 41.58 €.

Orange, resp. SFR and Orange, are equal in the very dense area, is rejected at the 1 ‰ level.

[14] The T-tests confirm that SFR has more customers in this category than Orange or Bouygues Télécom.

To summarise, one might consider Orange as to be oriented towards households with several members, such as households with children. Moreover, Orange appears to be more attractive to households living in less dense areas, as well as people above 41 years.

Bouygues Télécom, the latest entrant among the operators present in the survey, appears as the most aggressive operator, reaching for a younger customer base, mostly without children and living in denser areas. SFR could be positioned in-between Orange and Bouygues Télécom.

This profiling is consistent with the history of the French telecommunications sector. Orange is the French incumbent telecommunications operator which faced first competition from SFR. The latter set up its strategy in order to compete with Orange. After Bouygues Télécom arrived, imposing a competitive threat on both, SFR and Orange. Especially for SFR, this was situation new, as, instead of being the maverick, it had to face competition from one. As for Bouygues Télécom, its strategy was clearly to offer an alternative to French telecommunications users and to offer the most competitive prices.

These profiles allow to detect some first differences in the consumption behaviors among the three operators. Among the users of several services, Orange's customers are more inclined to subscribe to a bundled offer than those dealing with SFR or Bouygues Télécom. In contrast, Bouygues Télécom's users of multiple services are more inclined to consume stand-alone services.[15] Operator-specific regressions may therefore allow to confirm the results obtained in the general regression, or alternatively, confirm the behavioural differences.

[15] Recall that the bundlers do only comprise respondents that have a bundle *from their mobile operator*. This may considerably inflate the number of non-bundlers.

2.5 Estimation results

Before proceeding to the presentation of the results, recall that, due to the identification problem inherent to the multinomial logit model and more specifically individual-specific variables, a reference alternative has to be defined. In this study, the alternative "mobile-only" (MO) will serve as reference. The choice of using MO as reference is motivated by the existence of Fixed-mobile substitution. Trading off the possibility of using multiple services (NB or B) against one of using only one service (MO) will provide useful information about the characteristics of mobile-only consumers. Moreover, the trade-off "B vs. MO" complies with the fact that consumers are looking for simplicity when subscribing to multiple services.

With one reference alternative among three possibilities, two trade-offs appear: "NB vs. MO" and "B vs MO". Therefore, each model, general and operator-specific, comprises these two trade-offs. This feature implies that each category has two coefficients, one for each trade-off. The presentation of the results therefore proceeds as follows. All the variables are discussed in each trade-off. Although, if appropriate, only a general comment is given when, for instance, no significant difference among trade-offs appear.

2.5.1 Results of the general model

Table 2.4 provides the estimated coefficients for the general model. The results seem fairly good with an likelihood-ratio index (LRI) of 0.64. Moreover, the predictability of the general model is quite satisfying. Around 85 % of the observations are correctly predicted by the model.

Price Unsurprisingly, the price coefficient is negative and extremely significant, implying that the more the price increases the less high is the probability

Table 2.4 Estimation results of the general model

Variable	Category	General	
		NB vs Mo	B vs Mo
Price	Price	-0.6891*** (0.0118)	
	Price^2	0.0071*** (0.0001)	
Operator	Orange	0.2718*** (0.0632)	0.0624 (0.0725)
	SFR	.	.
	BT	0.3797*** (0.0735)	-0.4759*** (0.0927)
Contract	Postpay	.	.
	Prepaid	-0.5690*** (0.0547)	-0.8901*** (0.0657)
Age	$\leq$22 years	0.4810*** (0.1054)	-0.1822 (0.1282)
	23 - 30 years	0.5773*** (0.0718)	-0.2366** (0.0882)
	31 - 40 years	.	.
	41 - 50 years	0.5554*** (0.0810)	0.2406* (0.0936)
	$\geq$ 50 years	0.7306*** (0.0986)	0.2564* (0.1147)
Occupational Status	Full Time	.	.
	Part Time	-0.2874** (0.0897)	-0.4129*** (0.1088)
	Retired	0.5026*** (0.1313)	0.2525 (0.1499)
	Student	0.4476*** (0.1193)	0.3698** (0.1414)
	Unemployed	-0.4185*** (0.0830)	-0.7072*** (0.1047)
	Housekeeper	-0.8259*** (0.1136)	-0.6693*** (0.1381)
Area of living	Rural	0.1161 (0.0664)	0.0689 (0.0777)
	Small city	0.1366* (0.0692)	-0.0266 (0.0818)
	Large city	.	.
Household composition	No kids	.	.
	With kids	1.0111*** (0.0557)	0.2238*** (0.0658)
Income	Low income	.	.
	High income	0.3636*** (0.0556)	0.1875** (0.0655)
Gender	Male	.	.
	Female	0.4640*** (0.0582)	0.3024*** (0.0684)
Obs.		22072	
LRI		0.6436	
AIC		17359	
% corr. pred.		84.90	

(Std errors) $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

of choosing any alternative.[16] However, given the very high penetration rates of telecommunications services in France, it seems unreasonable that probability eventually drops to 0 and people simply stop consuming telecommunications services. For this reason, the square of the price variable is introduced into the model.

The estimation results confirm this intuition: the coefficient of the square of price is positive and extremely significant, leading to the conclusion that

[16] The coefficients are said to be *extremely* significant if their p-value is below 0.001, *highly* significant for $p < 0.01$ and significant when $p < 0.05$.

a non-linear price effect exists. The decrease of choice probabilities is thus mitigated by the positive non-linear price effect.

Operator In the trade-off "NB vs. MO", it appears that variable *operator* is extremely significant. Taking SFR as reference, the results show that, compared to SFR's customers, an Orange customer has a higher probability of being non-bundler rather than mobile-only. A similar result is found for consumers dealing with Bouygues Télécom.

However, this finding merely expresses the fact that most consumers prefer having multiple services. It would indeed be misleading to understand this result as depicting the fact that Orange, resp. Bouygues Télécom, consumers prefer *per se* dealing with several operators. A non-bundler may very well have several or all of his services from his mobile operator, but, in contrast to a bundler, does not have a single invoice regrouping at least two services.

The interpretation of this result as preference for several telecommunications services complies with the fact that the majority of the sample actually uses multiple services, since merely about 19 % of the interviewees are mobile-only.

At first sight, a positive coefficient for Orange in the "NB vs. MO" trade-off might appear counter-intuitive. Indeed, panel 2.2a in the descriptive statistics section shows that Orange's proportion of non-bundlers is much lower SFR's. The unilateral T-test in appendix A.2.2 confirms the statistical significance of this difference in proportions. This result may then be due to the high absolute number (rather than proportion) of non-bundlers among both operators' interviewed customer base: SFR counts 3438 non-bundlers, whereas Orange has 7215. The counter-intuitive result may therefore stem from this size effect.

As for the trade-off "B vs. MO", the coefficient for Orange is positive but statistically insignificant. Thus, an Orange customer does not have a signifi-

cantly higher probability of being bundler rather than mobile-only consumer. This is consistent with the fact that Orange's proportions of bundlers and mobile-only are very close: 19 % are mobile-only and 19.7 % are bundlers.[17]

Bouygues' customers do not face the same circumstances. Indeed, the youngest operator in the sample has more than twice as much mobile-only consumers than bundlers. This is reflected by the fact that the estimated coefficient for Bouygues in the "B vs. MO" trade-off (-0.4759) is negative and statistically extremely significant. Hence, the probability of being bundler rather than mobile-only is significantly weaker for a Bouygues customer than for a SFR customer.

Contract The variable *contract* represents the form of mobile subscription the interviewee has. With *postpay* as reference, the estimation shows that subscribers of a prepaid card are less likely use several services. The corresponding coefficient is negative and significant at the .001 level. Moreover, this results holds for both trade-offs. Thus, it can be inferred that prepaid card users are most often mobile-only consumers, rather than bundlers or non-bundlers.

Age The reference category for the variable *age* is "31 - 40 years". As the results show for the "NB vs. MO" trade-off, all coefficients are positive and extremely significant. Hence, the consumption behaviours appear to be equivalent for all the categories of age.

Interesting, however, is the fact that in the trade-off "B vs. MO", younger interviewees are less likely to be bundler whereas people aged above 40 years seem to prefer bundled offers. Potential explanations for this could be as follows. Putting aside the fact that the coefficient for "$\leq$ 22 years" is not statistically significant at the conventional levels (p-value = 0.15), it can be

[17] A T-test for equality of mean does not allow to reject the null hypothesis of equality of a type I risk of 5 %.

assumed that these people still live at their parents' house and that they are not perfectly informed about the modalities relative to the invoice of their parents' offer. The lack of this information causes these people to be classified as non-bundlers, leading to the result that they prefer NB over MO.

Regarding people in the category "23 - 30 years", it is possible that they are leaving or have recently left their parents' house. Thus, their decision to subscribe to a fixed service is more recent than their parents' decision. Moreover, they probably faced a different set of offers, too. Given the rapid change observed in the French telecommunications market in the last years, these people may have faced a much more competitive set of offers, inducing them to choose a different provider as their mobile services provider. As a result and just as people aged 22 years and below, they seemingly prefer choosing NB rather than MO.

In contrast to younger interviewees, people aged 41 and above appear to have a higher probability of being bundler rather than mobile-only than the reference category. These people may face different housing or professional conditions as a younger interviewee and possibly benefit from a more stable financial situation. Their budget constraint might be less restrictive which allows them to profit from several services provided by any operator.[18] The explanation as to why these people prefer a bundle over mobile-only subscription may stem from a quest for simplicity in subscription matters, they may have a longer experience with their mobile operator or may be better informed about their operator's fixed services bundles.

Occupational Status Respondents that are full time employed are used as reference when it comes to analyse the impact of the occupational status on the choice probabilities. First, the results show that the occupational status

[18] The less restrictive budget constraint can also be invoked as explanation for the positive impact on the choice probability incurred by people aged above 40 years in the trade-off "NB vs. MO".

is extremely significant in both trade-offs and exhibits the same sign of coefficients for all available categories. The only exception regarding statistical significance is the category "Retired" with a p-value of 0.09.

Moreover, it appears that, compared to full time employees, people in a situation of part time employment, unemployment or in a position of housekeeper are more likely to be mobile-only rather than non-bundler, as the corresponding negative coefficients imply. This finding is not surprising if these occupational status can be associated to a more fragile financial situation. In such a case, the budget constraint may be too restrictive for allowing the consumption of several telecommunications services and leads to satisfy the telecommunications needs by a sole mobile subscription.

On the other hand, students often enjoy a financial support from their parents, which allows them to scarify a more important part of the budget to telecommunications services. Alternatively, given that fixed services may be used by several members of a household, flat-sharing allows students to share the costs of fixed services among all the community members.

Finally, persons who were retired during the survey period most probably used fixed services before they used any mobile services. Hence, their usage of mobile and fixed services might very well be considered as a form of legacy.

Area of living The ad-hoc variable "area of living" does not impact the choice probabilities of either trade-off. The only exception appears in the trade-off "NB vs. MO", where, compared large cities, people living in small cities have a higher probability of choosing NB over MO. However, the concerned coefficient (*Small city*; 0.1366) is barely significant with a p-value of 0.048. The weak significance, leads to the conclusion that the consumption behavior is little influenced by people's area of living. Thus, the intuition that a wider availability of extra-domestic activities in large cities is not confirmed by the

results.

Household composition The estimation also took account of the household composition by asking whether or not children live under the same roof as the respondent. The reference value of this variable is "No kids". As the results show, the choice probability of being either NB or B (rather than MO) is significantly higher when there children living at home.

Income The ad-hoc variable "Income" appears very significant. Compared to areas characterised by a low income, a positive impact is observed for areas with higher purchasing power, meaning that their probability of choosing NB or B is higher.

The results so far can be synthesised as follows. In absence of any information regarding the individuals' habits of using telecommunications services (i.e. are they heavy data consumers or not? what options do they offers comprise? etc.), the alternative MO appears as a means for budget controlling. As has been discussed above, a person who manifests signs of a weaker financial situations, such as a low income, prepaid card usage or part time employment, resp. unemployment, has a higher probability of being MO rather than B or NB.

In the next section, this synthesis is challenged by conditioning the model on the variable "Operator", in order to check if the characterisation of mobile-only usage varies among the three operators.

2.5.2 Operator-specific estimations

In this subsection, the discussion turns to the operator-specific estimations. The relevant results can be found in the table 2.5 below and allow to check whether the consumption behaviours vary across mobile operators. Since all

the operators offer very similar services, any differences in consumption behavior may be related to horizontal differentiation among service providers. Indeed, if the choice set does not change, an individual that chooses a given operator rather than another must have some preference for the chosen operator. Thus, in the consumer's eyes, mobile operators are not identical, but differentiated.

Globally, the results from the general model hold in the specific regressions: the estimated coefficients have the same sign in the operator-specific model as they do in the general model. Hence, the conclusions from the general model are quite robust and are not influenced by the fact of being customer of either mobile operator.

However, despite the identical signs, some variables show some interesting differences among the providers, namely the variables *price*, *age*, *occupational status* and *area of living*. In the following, these variables and their impacts on choice probabilities are briefly discussed.

Price As can be seen from table 2.5, the estimated price coefficient vary quite considerably. Whereas these coefficient for Orange and SFR are relatively close, it appears that the coefficient for Bouygues is the most important. The marginal impacts of prices on the consumption of telecommunications services are provided in the table 2.6.[19]

[19] The marginal impact of a continuous variable x_{nj} on the choice probability P_{nj} is given by

$$\begin{aligned}\frac{\partial P_{nj}}{\partial x_{nj}} &= \frac{\partial}{\partial x_{nj}}\left(\frac{\exp(V_{nj})}{\sum_i \exp(V_{ni})}\right) \\ &= \beta_j \, P_{nj} \, (1 - P_{nj})\end{aligned}$$

where β_j is the estimated coefficient of x_{nj}. If utility function is non-linear in x_{nj} (e.g. the square of x_{nj} enters the utility function), the above adapts to

$$\frac{\partial P_{nj}}{\partial x_j} = (\beta_j + 2\delta_j x_{nj}) \, P_{nj} \, (1 - P_{nj})$$

where δ_j is the estimated coefficient of the non-linear effect of x_{nj}. The details of the relevant calculus can be found in appendix A.2.3.

Table 2.5 Estimation results of the operator-specific models

Variable	Category	Orange		SFR		Bouygues	
		NB vs Mo	B vs Mo	NB vs Mo	B vs Mo	NB vs Mo	B vs Mo
Price	Price	-0.6897*** (0.0157)		-0.6623*** (0.0235)		-0.7146*** (0.0270)	
	Price^2	0.0071*** (0.0002)		0.0067*** (0.0002)		0.0074*** (0.0003)	
Contract	Postpay	.	.	.	.	.	.
	Prepaid	-0.4188*** (0.0745)	-0.7681*** (0.0859)	-0.5709*** (0.1108)	-0.5838*** (0.1306)	-0.7215*** (0.1127)	-2.0419*** (0.1841)
Age	$\leq$ 22 years	0.3944* (0.1393)	-0.1305 (0.1631)	0.8393*** (0.2258)	-0.4436 (0.2818)	0.7938*** (0.2212)	-0.3896 (0.3041)
	23 - 30 years	0.5131*** (0.0987)	-0.4078*** (0.1203)	0.8094*** (0.1385)	-0.2297 (0.1693)	0.8358*** (0.1425)	-0.0251 (0.1859)
	31 - 40 years	.	.	.	.	.	.
	41 - 50 years	0.5844*** (0.1107)	0.3034* (0.1234)	0.5840*** (0.1572)	-0.0237 (0.1848)	0.7875*** (0.1701)	0.1707 (0.2204)
	$\geq$ 51 years	0.7571*** (0.1357)	0.2811 (0.1529)	0.9346*** (0.1999)	0.4021 (0.2240)	0.8255*** (0.1962)	-0.4375 (0.2917)
Occupational Status	Full Time	.	.	.	.	.	.
	Part Time	-0.3662* (0.1228)	-0.7670*** (0.1494)	-0.0583 (0.1950)	0.1987 (0.2175)	-0.1715 (0.1824)	-0.2946 (0.2515)
	Retired	0.6222*** (0.1802)	0.3654 (0.1982)	0.5736* (0.2721)	0.0709 (0.3057)	0.1977 (0.2764)	0.0802 (0.4098)
	Student	0.5322* (0.1626)	0.2433 (0.1873)	0.3617 (0.2491)	0.4432 (0.2982)	0.4663 (0.2497)	0.5696 (0.3187)
	Unemployed	-0.5012*** (0.1145)	-0.8795*** (0.1392)	-0.2229 (0.1724)	-0.4954*** (0.2129)	-0.2529 (0.1722)	-0.4187 (0.2449)
	Housekeeper	-1.0537*** (0.1550)	-0.8020*** (0.1771)	-0.6981** (0.2283)	-0.7510** (0.2890)	-0.4785 (0.2546)	-0.3469 (0.3715)
Area of living	Rural	0.2227* (0.0885)	0.3071* (0.1005)	0.1927 (0.1373)	-0.0809 (0.1608)	0.2325 (0.1371)	-0.5837** (0.1894)
	Small cities	0.2882*** (0.0968)	0.2103 (0.1112)	0.1262 (0.1338)	-0.1881 (0.1577)	0.1075 (0.1418)	-0.3771 (0.1860)
	Large cities	.	.	.	.	.	.
Household composition	No Kids	.	.	.	.	.	.
	With kids	0.9473*** (0.0760)	0.2461* (0.0870)	1.2045*** (0.1116)	0.1136 (0.1329)	1.1997*** (0.1140)	0.0842 (0.1521)
Income	Low income	.	.	.	.	.	.
	High income	0.4136*** (0.0766)	0.1053 (0.0875)	0.3644** (0.1120)	0.2668* (0.1311)	0.3550** (0.1166)	0.2899 (0.1530)
Gender	Male	.	.	.	.	.	.
	Female	0.5435*** (0.0807)	0.2912** (0.0920)	0.5456*** (0.1193)	0.5167*** (0.1387)	0.3158** (0.1188)	0.0401 (0.1583)
Obs.		11765		5153		5154	
LRI		0.6353		0.6238		0.6945	
AIC		9492		4323		3524	
% corr. pred.		83.87		84.40		87.37	

(Std errors) $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

Table 2.6 Average marginal impacts of prices

General	Orange	SFR	Bouygues Télécom
-0.6355 (0.0660)	-0.6344 (0.0670)	-0.6086 (0.0631)	-0.6656 (0.0648)

(Std. deviation)

This table shows that the marginal impact is largest for Bouygues Télécom and it can therefore be concluded that the latter's customers are more price-sensitive that customers of Orange or SFR.[20]

There is a possible explanation for this, though. At the time the survey was conducted, Bouygues Télécom was the latest entrant and an aggressive prices was a cornerstone of its strategy upon entry. By offering highly competitive prices, Bouygues Télécom achieved to poach customers from Orange and SFR. Consumers that actually have switched may be more sensitive towards price increases and thus may penalise a price increase in a more severe manner than the clientele of Orange or SFR.

Age When looking at the categories of age, an interesting difference of the relative impacts on the choice probabilities appears.[21] The operator-specific estimations reveal that the impact for Orange customers aged below 31 years is much lower than for SFR or Bouygues Télécom customers, whereas the spread between the relative impacts shrinks for persons aged above 40 years. In effect, the average spread of impacts for the category "23 - 30 years" in the trade-off "NB vs. MO" is $1/3[(0.8094-0.5131)+(0.8094-0.8358)+(0.8358-0.5131)] \approx 0.2$ and for the category '41 - 50 years" in the same trade-off is equal to $1/3[(0.5840-0.5844)+(0.7875-0.7939)+(0.7875-0.5844)] \approx 0.1$.[22]

[20] T-test on equality of mean relative to these marginal effects can be found in appendix A.2.3.

[21] Since the estimated coefficients in the trade-off "B vs. MO" are not statistically significant at the conventional levels, the following comments only focus on the trade-off "NB vs. MO".

[22] Similarly, the average spread for the categories "$\leq$ 22 years" and "$\geq$ 51 years" are $1/3[(0.8393-0.3944)+(0.8393-0.7939)+(0.7939-0.3944)] \approx 0.3$ and $1/3[(0.9346-0.7571)+(0.9346-0.8255)+(0.8255-0.7571)] \approx 0.1$ respectively.

This difference might reflects the idea that consumption behaviours of younger and "older" persons are not identical. Given that the average spread is more important for younger people, this finding can be interpreted as a higher sensibility towards the brand image of the mobile operator. As a matter of fact, SFR and Bouygues Télécom are considered to be closer to younger consumers than the historic operator, not least through lower prices. Departing from this, it is possible that the younger individuals have a higher likelihood to deal with several operators or alternatively to choose a single additional service from their mobile operator without choosing a single invoice. As for the latter possibility, assume that younger people most probably fixed broadband as additional stand-alone service. Then, given that dual play offers including mobile services and fixed broadband are very rare, the likelihood that these people are classified as non-bundler can be significant, which may lead to the mentioned result.[23]

This result may, however, stem from a simple interaction of two circumstances in the database. In particular, panel 2.2b and table A.2.2 show that the proportions of individuals aged between 23 and 30 years are (significantly) higher for SFR and Bouygues Télécom, whereas the proportions of people aged 40 and above are equivalent for the three operators. Moreover, SFR and Bouygues Télécom have a significantly higher proportion of non-bundlers in their customer base than Orange. The result regarding the difference in magnitudes of the impacts may therefore reflect this simple interaction.

Occupational status Regarding the occupational status, the estimations show that this variable does not influence the choice probabilities for Bouygues customers. It can therefore be concluded that, ceteris paribus, the consumption behavior of Bouygues' customer is not influenced for all the categories of

[23] Bundles including mobile services appeared in France only in 2011, i.e. at the end of the survey period.

occupational status.

On the other hand, the results relative to Orange customers bear much resemblance to those from the general model and thus the same interpretation can be applied: persons in a presumably weaker financial situation (i.e. *part time employee*, *unemployed* and *housekeepers*) have a lower probability of being non-bundler, respectively bundler, than mobile-only.

As for SFR, the results are somehow in between those of Orange and Bouygues Télécom. Even though all the signs are identical to those from the general model, only two coefficients out of 6 are significant in both trade-offs. The conclusion regarding the occupational status may hold, but surely is weakened.

Area of living Finally, the variable *area of living* reveals an notable difference between Orange and Bouygues Télécom.[24] Whereas this variable is significant in both trade-offs for the Orange-specific results, it appears only significant in the trade-off "B vs. MO" for Bouygues.[25] Moreover, both regressions bear opposing signs for the relevant coefficients: compared to living in large cities, the choice probability of being bundler rather than mobile-only is higher (lower) for Orange (Bouygues) customers living in rural areas or small cities.

One explanation relies on the fact that a large part of Bouygues Télécom's customer base lives in small or large cities rather than rural areas, as panel 2.2a shows. Another possible explanation might rely on the fact that local loop unbundling may come with a decreased quality of connection, leading for instance to low quality IP-TV. This may considerably reduce the attractiveness of Bouygues Télécom's fixed services offers.

[24] The choice probabilities in the SFR-specific model are unaffected by the individual's area of living.

[25] In fact, in the Orange-specific regression, the coefficient for *Small cities* in the trade-off "B vs. MO" has a p-value of 0.058.

2.6 Discussion and conclusion

The aim of this chapter was to shed light on the characteristics of French users of communication services that influence their consumption behavior. In particular, a conditional logit model has been developed in which individuals choose between three alternative consumption possibilities, namely mobile-only consumption, a mobile offer complemented by one or several fixed stand-alone services, or a bundle of services provided by their mobile operator.

The interest of this work is twofold. Firstly, it provided insights on the different consumption types and could be useful for market segmentation. Service providers can rely on such information in order to keep up with the evolution of their customers' needs and choices. Secondly, some of the results showed in this chapter points to the concept of differentiation among services providers present in this study.

With information on the individuals only, this study has shown that the option of mobile-only consumption is a means for budget control. Indeed, individual characteristics that presumably depict a weaker financial situation appear as driving force for choosing this single service alternative. Among these, unemployment, low income or prepaid card usage can be mentioned. As the result showed, persons who entail such characteristics have a lower probability of using several services. This finding can be seen as a general result, as it also holds if the analysis separates the customers from either operator.

In the context of Fixed-Mobile substitution, this result is complementary to the explanations of the emergence of mobile-only consumption as a consequence of technological progress. The increasing performance of mobile communications infrastructures and usage possibilities induced an increasing number of persons who have turned their back to fixed services, since mo-

bile services alone allow them to satisfy their needs. The database used in this study however does not provide information about how the consumers use their services and does therefore not allow to conclude on any influence of technology on their choices. In contrast, by using socio-demographic factors only, this study provides an alternative explanation for this occurrence.

The second major result relates to the different consumer preferences among Orange and Bouygues customers and it relies on two facts. First of all, Bouygues customers are generally less willing to subscribe to a bundle provided by their mobile operator than SFR customers. No significant difference can be provided between Orange and SFR. Second, the difference in consumer preference increases when controlling for the individual's area of living. The model took account of the area of living as possible influence of consumers' choices. While this factor is mostly insignificant in the general regression, it gained in importance when focussing on each operator separately. Notably, Orange customers living in rural areas seem to prefer bundled offers (compared to mobile-only usage), whereas such offers seem less attractive to Bouygues customers.

This finding reminds the concept of differentiation among operators, especially between Orange and Bouygues Télécom, since SFR can be positioned in-between the formerly mentioned.[26] Since any operator is able to provide equivalent offers, the question then is why a consumer prefers a given operator over another? The answer suggested here is that onsumers do not behold service providers as identical, but differentiated, most probably in terms of quality of service or customer care. Moreover, given the restricted definition of bundlers in this study, the result suggests that Orange has an competitive

[26] As a matter of fact, the choice of SFR customers seems unaffected by their area of living. Even though the results for SFR go in the same direction as those for Bouygues, the study does not provide any statistically significant evidence of any impact on the choice probabilities.

advantage in rural areas or small cities compared to its competitors.[27]

The present study suffers from a few drawbacks, though. The most important one consists in the fact that the French market is imperfectly depicted here. As a matter of fact, the question wording of the survey does not allow to distinguish the people that actually use stand-alone services from people that use bundled services from an operator other than their mobile operator. As has been mentioned in section 2.4, this inflates the number of non-bundler and may furthermore bias the estimation results. Therefore, the results relative to non-bundlers and bundlers must be interpreted carefully.

Another drawback may stem from the prices in this study which appear very high, in particular the price for the bundled offers. This may lead to overestimated price coefficients and marginal effects. However, comparing for instance the relative results among operators provides consistent information about the effects on choice probabilities, even though the absolute values have to be considered with care.

Despite these drawbacks, this study gives rise to some possible further research. The most promising alley is probably to introduce information on the usage habits of the individuals alongside with their individual characteristics. This would allow for a more complete analysis of the consumption behaviors.

On a separate note (but yet not less promising), the French telecommunications sector knew an important change upon the entry of the forth mobile service provider Free Mobile in early 2012. The latter's entry implied increased competition among the market players in an unprecedented way. For instance, before its entry, solely high-range offers included unlimited voice calls and data allowance and came at an average price of 80 €. After Free's appearance in the

[27] Since in this study the definition of bundlers is restricted to customers that have a service bundle from their mobile operator, the consumption of a bundle of services implicitly incorporates a notion of satisfaction (for instance with the operator's service quality or policy of customer care) or simplicity to deal with one firm only, rather than benefitting of a price reduction. This becomes even more relevant since, in average, a bundle is the most expensive alternative available in this study.

mobile segment, such offers became much more popular as the price was divided by 4! The incumbent operators had to respond with similarly impressive price decreases, leading ultimately to a further evolution of the consumers' behavior. Free did thus have an important impact on the market and consumers which would be interesting to analyse.

The first and second chapter of this thesis have been dedicated of some aspects on competition between communications services. The next and last chapter will focus on another type of competition, namely, competition between firms, by analysing the interaction between two tools that shape the telecommunications sector: sector-specific regulation and competition law.

Bibliography

Afsa-Essafi C., (2003). Les modèles logit polytomiques non-ordonnés: théorie et applications. Document de travail INSEE Nř 0301. Available here.

ARCEP, (2014). Evolution des prix des services mobiles en France, Résultats pour l'année 2013. Published 28 Mai 2014. Available here.

Cardona M., Schwarz A., Yurtoglu B. B., Zulehner C., (2009). Demand estimation and market definition for broadband internet services, *Journal of Regulatory Economics*, 35(1), 70-95. DOI: 10.1007/s11149-008-9076-x.

CREDOC, (2013). La diffusion des technologies de l'information et de la communication dans la société française. Available here.

DotEcon, (2001). Fixed-Mobile Substitution. A report prepared for BT. Available here.

Eurobarometer, (2014). E-Communications Household Survey Report, Fieldwork: January 2014, March 2014. Available here.

Macher J. T., Mayo J. W., Ukhaneva O., Woroch G., (2012). Demand in a Portfolio-Choice Environment: The Evolution of Telecommunications. Georgetown McDonough School of Business Research Paper No. 2012-19. Available here.

Rodini M., Ward M. R., Woroch G. A., (2003). Going Mobile: Substitutability

between fixed and mobile access, *Telecommunications Policy*, 27(5-6), 457-476. http://dx.doi.org/10.1016/S0308-5961(03)00010-7.

Rosston, G., Savage S., Waldman D., (2010). Household Demand for Broadband Internet Service, Discussion Papers 09-008, Stanford Institute for Economic Policy Research, revised Feb. 2010. Available here.

Savage S., Waldman D., (2005). Broadband Internet access, awareness, and use: Analysis of United States household data. *Telecommunications Policy*, 29(8), 615-633. http://dx.doi.org/10.1016/j.telpol.2005.06.001.

Schejter A. M., Serenko A, Turel O, Mehdi Z., (2010). Policy implications of market segmentation as a determinant of fixed-mobile service substitution: What it means for carriers and policy makers. *Telematics and Informatics*, 22(1), 90-102. http://dx.doi.org/10.1016/j.tele.2009.05.002.

Srinuan P., Srinuan C., Bohlin E., (2012). Fixed and mobile broadband substitution in Sweden,*Telecommunications Policy*, 36(3), 237-251. http://dx.doi.org/10.1016/j.telpol.2011.12.011.

Taylor D. L., (2002). Customer Demand Analysis. in *Handbook of Telelcommunications Economics*, Volume 1, ed. by M. E. Cave *et al.*, 2002, 97-142.

Train K., (2009). Discrete Choice Methods with Simulation, Second Edition, *Cambridge University Press.*

Vogelsang I., (2010). The relationship between mobile and fixed-line communications: A survey, *Information Economics and Policy*, 22(1), 4-17. http://dx.doi.org/10.1016/j.infoecopol.2009.12.002.

Ward M. R., Woroch G. A., (2004). Usage Substitution between mobile telephone and fixed line in the U.S. Available at here.

Ward M. R., Zheng S., (2012). Mobile and fixed substitution for telephone service in China. *Telecommunications Policy*, 36(4), 301-310. http://dx.doi.org/10.1016/j.telpol.2011.12.002.

Appendix Chapter 2

A.2.1 Derivation of Logit choice probability

The model framework exposed the initial steps how a decision maker chooses one alternative from a given and transposed this idea into a mathematically tractable manner. It provided the logit choice probability given by expression (2.4) without describing its derivation. The purpose of this appendix is to explain that derivation. However, the following calculus closely follows those provided by Train (2009) in its chapter 3.

Recall that a decision maker n chooses alternative j over any other alternative if her utility is maximised with j:

$$\begin{aligned} P_{nj} &= Prob(U_{nj} > U_{ni}) \, , \forall i \neq j \, , j = 1, \ldots, J \\ &= Prob(V_{nj} + \varepsilon_{nj} > V_{ni} + \varepsilon_{ni}) \\ &= Prob(\varepsilon_{ni} < \varepsilon_{nj} + V_{nj} - V_{ni}) \end{aligned} \tag{A.2.1}$$

Then, the cumulative choice probability for an individual n for all alternatives $j \neq i$ is the integral of the above, weighted by the density of ε_{nj}. Since ε are iid extreme value with density function $f(\varepsilon)$ and cumulative distribution $F(\varepsilon)$ given by (2.3a) and (2.3b) respectively, the cumulative choice probability yields

$$\begin{aligned} P_{nj} &= \int \prod_{j \neq i} F(\varepsilon_{nj}) f(\varepsilon_{nj}) d\varepsilon_{nj} \\ &= \int_{-\infty}^{+\infty} \prod_{j \neq i} \Big(\exp[-e^{-(\varepsilon_{nj} + V_{nj} - V_{ni})}] \Big) \exp[-\varepsilon_{nj}] \exp[-e^{-\varepsilon_{nj}}] \, d\varepsilon_{nj} \end{aligned} \tag{A.2.2}$$

Regrouping the terms $\exp[-e^{-\varepsilon_{nj}}]$, the last line above becomes:

$$\begin{aligned} P_{nj} &= \int_{-\infty}^{+\infty} \prod_i \left(\exp[-e^{-(\varepsilon_{nj}+V_{nj}-V_{ni})}] \right) \exp[-\varepsilon_{nj}]\, d\varepsilon_{nj} \\ &= \int_{-\infty}^{+\infty} \exp\left[-\sum_i e^{-(\varepsilon_{nj}+V_{nj}-V_{ni})} \right] \exp[-\varepsilon_{nj}]\, d\varepsilon_{nj} \\ &= \int_{-\infty}^{+\infty} \exp\left[-e^{-\varepsilon_{nj}} \sum_i e^{-(V_{nj}-V_{ni})} \right] \exp[-\varepsilon_{nj}]\, d\varepsilon_{nj} \end{aligned} \tag{A.2.3}$$

Following Train (2009), write $\exp[-\varepsilon_{nj}] = t$ so that $-\exp[-\varepsilon_{nj}]\, d\varepsilon_{nj} = dt$. Notice that the limit of t is $+\infty$ if ε_{nj} tends to $-\infty$. Conversely, its limit is equal to 0 if ε_{nj} tends to $+\infty$. Using this changed variable yields

$$\begin{aligned} P_{nj} &= \int_{+\infty}^{0} \exp\left[-t \sum_i e^{-(V_{nj}-V_{ni})} \right] (-dt) \\ &= \int_{0}^{+\infty} \exp\left[-t \sum_i e^{-(V_{nj}-V_{ni})} \right] dt \\ &= \frac{1}{-\sum_i e^{-(V_{nj}-V_{ni})}} \left[\exp[-t \sum_i e^{-(V_{nj}-V_{ni})} \right]_0^{+\infty} \\ &= 0 - \frac{1}{-\sum_i e^{-(V_{nj}-V_{ni})}} \\ &= \frac{1}{e^{-V_{nj}} \sum_i e^{V_{ni}}} \\ &= \frac{e^{V_{nj}}}{\sum_i e^{V_{ni}}} \end{aligned} \tag{A.2.4}$$

A.2.2 Student's T-test for equality of mean

Table A.2.1 Student's T-test for equality of mean

	Bouygues vs. Orange	SFR vs. Orange	SFR vs. Bouygues
Price	-13.4006***	-6.9411***	7.2030***
Mobile-only	-0.4985	-0.3145	0.1563
Non-bundlers	15.0424***	6.7798***	-6.7774***
Bundlers	-20.9255***	-8.4660***	9.5794***
$\leq$ 22 years	-0.7027	-6.1052***	-4.4854***
23 - 30 years	1.0974	3.2889***	1.8832
31 - 40 years	3.0276**	3.5265***	0.4293
41 - 50 years	-2.2275*	-0.5844	1.3818
$\geq$ 51 years	-1.2900	-0.8672	0.3600
Full Time Employee	0.2592	3.3540***	2.6212**
Part Time Employee	1.8131	-0.9730	-2.3764*
Retired	-1.7369	-2.0318*	-0.2466
Student	0.3162	-4.2207***	-3.7912***
Unemployed	0.1383	0.8664	0.6152
Homemaker	-1.2947	1.4450	2.3235*
Prepaid	-0.6158	-0.3952	0.1870
Low Income	-0.2540	1.7095	1.6648
No Kids	5.5449***	4.3329***	-1.0215
Rural	-12.6168***	-12.961***	-0.2798
Dense	-0.3149	-1.0731	-0.6440
Very Dense	12.4405***	13.4579***	0.8742
Female	-0.0024	-1.8494	-1.5661

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

Note: The table reports Student's T-test values for a *bilateral* test of the null hypothesis: Equality of proportions. Alternative hypothesis: Difference in proportions. *Example:* In the first column (Bouygues vs. Orange), the test indicates that the proportions of *bundlers* is significantly (at a 1 ‰ level) different between Bouygues Télécom and Orange

Table A.2.2 Student's T-test for higher mean

	Bouygues vs. Orange	SFR vs. Orange	SFR vs. Bouygues
Price	-13.4006	-6.9411	7.2030***
Mobile-only	-0.4985	-0.3145	0.1563
Non-bundlers	15.0424***	6.7798***	-6.7774
Bundlers	-20.9255	-8.4660	9.5794***
$\leq$ 22 years	-0.7027	-6.1052	-4.4854
23 - 30 years	1.0974	3.2889***	1.8832*
31 - 40 years	3.0276**	3.5265***	0.4293
41 - 50 years	-2.2275	-0.5844	1.3818
$\geq$ 51 years	-1.2922	-0.8672	0.3620
Full Time Employee	0.2592	3.3540***	2.6212**
Part Time Employee	1.8131*	-0.9730	-2.3764
Retired	-1.7369	-2.0318	-0.2466
Student	0.3162	-4.2207	-3.7912
Unemployed	0.1383	0.8664	0.6152
Homemaker	-1.2947	1.4450	2.3235*
Prepaid	-0.6158	-0.3952	0.1870
Low Income	-0.2540	1.7095*	1.6648*
No Kids	5.5449***	4.3329***	-1.0215
Rural	-12.6168	-12.961	-0.2798
Dense	-0.3149	-1.0731	-0.6440
Very Dense	12.4405***	13.4579***	0.8742
Female	-0.0024	-1.8494	-1.5661

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

Note: The table reports Student's T-test values for a *unilateral* test of the null hypothesis: Equality of proportions. Alternative hypothesis: The proportions of the 1st mentioned operator is greater.
Example: In the first column (Bouygues vs. Orange), the test indicates that Bouygues has significantly (at a 1 ‰ level) more *non-bundlers* than Orange.

A.2.3 Derivation of marginal effect of price

This appendix derives the marginal effect of a continuous variable x_{nj} that enters the utility non-linearly. Denote by β_j the coefficient relative to the linear effect of x_{nj}, by δ_j the coefficient relative to its non-linear effect and by γ_{nj} the vector of all other variables in the models (represented by Z_{nj}). The decision maker's representative utility function then writes

$$V_{nj} = \beta_j x_{nj} + \delta_j x_{nj}^2 + \gamma_{nj} Z_{nj}$$

The marginal effect of x_{nj} on the choice probability P_{nj} yields:

$$\begin{aligned}
\frac{\partial P_{nj}}{\partial x_{nj}} &= \frac{\partial\left(\frac{\exp(V_{nj})}{\sum_i \exp(V_{ni})}\right)}{\partial x_{nj}} \\
&= \frac{\left(\frac{\partial V_{nj}}{\partial x_{nj}}\right)\exp(V_{nj})\ \sum_i \exp(V_{ni})}{\sum_i \exp(V_{ni})^2} - \frac{\exp(V_{nj})\left(\frac{\partial V_{nj}}{\partial x_{nj}}\right)\exp(V_{nj})}{\sum_i \exp(V_{ni})^2} \\
&= \left(\frac{\partial V_{nj}}{\partial x_{nj}}\right) \times \left(\frac{\exp(V_{nj})}{\sum_i \exp(V_{ni})} - \frac{\exp(V_{nj})^2}{\sum_i \exp(V_{ni})^2}\right) \\
&= \left(\frac{\partial V_{nj}}{\partial x_{nj}}\right) \times P_{nj}(1 - P_{nj}) \qquad \text{(A.2.5)}
\end{aligned}$$

Thus, given V_{nj} above, $\frac{\partial V_{nj}}{\partial x_{nj}}$ is equal to $\beta_j + 2\delta_j x_{nj}$ and the marginal effect writes:

$$\frac{\partial P_{nj}}{\partial x_{nj}} = (\beta_j + 2\delta_j x_{nj})\, P_{nj}(1 - P_{nj}) \qquad \text{(A.2.6)}$$

A.2.4 Testing the equality of marginal effect of price

Table A.2.3 Student's T-test for equality of mean of marginal effect of price

Test	Bouygues vs. Orange	SFR vs. Orange	SFR vs. Bouygues
Bilateral	28.1038**	-24.0888***	45.2792***
Unilateral	28.1038***	-24.0888	45.2792***

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

Note: The table reports Student's T-test values for a bilateral and unilateral test of the null hypothesis: Equality of average marginal effect.
Alternative hypothesis for the bilateral (unilateral) test: The average marginal effects are not equal (of the 1st mentioned operator is greater).
Example: In the first column (Bouygues vs. Orange), the test indicates that marginal effect of price for Bouygues is significantly higher than Orange.

CHAPTER 3

Combining competition law and sector-specific regulation: the case of margin squeeze[1]

"Ronald [Coase] said he had gotten tired of antitrust because when the prices went up the judges said it was monopoly, when the prices went down they said it was predatory pricing, and when they stayed the same they said it was tacit collusion."

William Landes,
"The Fire of Truth: A Remembrance of Law and Econ at Chicago",
JLE (1981) p. 193.

[1] This chapter relies on a collaboration with Claudia Saavedra, former member of the department of regulatory affairs of Orange.

3.1 Introduction

The last chapter of this thesis focusses on the relation between ex ante sector-specific regulation and ex post competition law enforcement in the case of vertically related markets. Although not pretending to provide a general answer to that question, it aims to shed light on a particular pricing issue that may arise in vertically related market with an upstream monopoly.

The motivation for this study stems form the fact that this relation is of a different kind in the EU than in the US. More specifically, a comparison of jurisprudence on both sides of the Atlantic shows that ex ante market regulation and ex post competition law enforcement are clearly seen as substitutes in the US while forming a complementary set of rules in the EU.

This divergence is illustrated by the case law relative to margin squeeze claims. A margin squeeze is said to occur if, in an industry where a vertically integrated firm sells a bottleneck input to downstream competitors, the spread between the integrated firm's retail price and its wholesale price is insufficient or too narrow such that the activity of equally efficient downstream competitors is unprofitable (Commission (1998), ¶117, Commission (2009), ¶80). Several high profile case in the EU and the US relative to this issue induced the aforementioned divergence.

The competition laws relevant for this analysis are Section 2 of the US Sherman Act and Art. 102 of the Treaty of the Functioning of the EU (*TFEU*).[2]

[2] The amended section 2 of the Sherman Act writes (amendment Pub. L. 108-237, 2004, Source: `Legal` Information Institute):

> "*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, and, on conviction thereof, shall be punished by fine not exceeding $10,000,000 if a corporation, or, if any other person, $350,000, or by imprisonment not exceeding three years, or by both said punishments, in the discretion of the court.*"

Art. 102 of the TFEU yields (Source: `EUR-Lex`):

> "*Any abuse by one or more undertakings of a dominant position within the*

Both laws have the same aim and target the same infringement, namely, impeding competition by abusing a dominant position and thus hamper the proper flow of trade within the internal market.

Both jurisdictions however have different views when competition law meets sector-specific regulation. In particular, US courts are reluctant to intervene in a regulated industry as has been made clear by the *Trinko* and *linkLine* case.[3, 4] As has been mentioned in the introductory section of this thesis, these cases sharply reduced the scope for a margin squeeze claim. Especially when sector-specific regulation is set up. The *Trinko* case ruled that the existence of regulatory framework does not create an antitrust duty to deal. As firms are free to choose their business partners and subsequently the terms and conditions under which they deal with others, they do not have the obligation to offer terms and conditions that please the business partners. Moreover, courts see themselves ill-suited to intervene as market supervisor. This mission is attributed to specific regulatory agencies that have the necessary know-how for regulation and which, when setting up a regulatory framework, consider possible anticompetitive issues.[5]

In the very contrast, European Courts took a different course of action regarding the interplay of sector-specific regulation and competition law. The

> *internal market or in a substantial part of it shall be prohibited as incompatible with the internal market in so far as it may affect trade between Member States. Such abuse may, in particular, consist in:*
>
> *(a) directly or indirectly imposing unfair purchase or selling prices or other unfair trading conditions;*
> *(b) limiting production, markets or technical development to the prejudice of consumers;*
> *(c) applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage;*
> *(d) making the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts.*
>
> "

[3] *Verizon Communications, Inc.* v. *Law Offices of Curtis V. Trinko*, 540 U.S. 398 (2004).
[4] *Pacific Bell* v. *linkLine Communications, Inc.*, 555 U.S. 438 (2009).
[5] *linkLine, supra* note 4

DT case made the first and most important step towards the recognition of a liability doctrine applicable to margin squeeze cases.

A first key element is that the *DT* case specifically recognises a margin squeeze as stand-alone infringement of competition law, differentiating it from i) predatory pricing in the downstream market and ii) refusal to deal in the upstream market (via an excessively high upstream price). This judgment made clear that the most important element in a margin squeeze claim is the "[...]*unfairness of the spread between the downstream and upstream price.*" Moreover, neither price must individually be anticompetitive.[6] Therefore, there appears a strikingly different approach compared to the US, where Judge Roberts in *linkLine* stated that "[if] there is no [antitrust] *duty to deal at the wholesale level and no predatory pricing in the retail level, then a firm is certainly not required to price both of these services in a manner that preserves its rivals' profit margins.*"[7]

A second key element is the recognition of antitrust liability despite the existence of sector-specific regulation:[8]

> "[...]*there can very well be a margin squeeze between regulated wholesale and retail prices.*

. In comparison, Judge Scalia in the *Trinko* case conceived the existence of a regulatory framework as "*an effective steward of the antitrust function*".[9]

A notable decision by the UK's NRA OFCOM occur by mid 2013 though. Here, OFCOM decided not to condemn British Telecom (BT) for alleged margin squeeze. On the basis of a concise analysis of the national market configuration, OFCOM found that BT's pricing might incur a margin squeeze, but without bearing any abusive character (OFCOM, 2013). Indeed, during

[6] Commission's Decision in DT of 21/05/2003 (2003/707/EC), Case T-271/03 *Deutsche Telekom AG* v. *Commission*, 10 April 2008, and Appeal C-280/08 P, 14 October 2010.
[7] *linkLine*, supra 4.
[8] *DT*, Appeal C-280/08 P, ¶11.
[9] *Trinko, supra* 3.

the analysed period, BT's competitors have not incurred negative margins, nor have consumers been harmed via reduced competition. OFCOM therefore made a clear distinction between a technical margin squeeze (i.e. a retail price that does not cover total costs) and a margin squeeze with anti-competitive effects.

Finally, the scope for a margins squeeze as a liability doctrine has been greatly enlarged by the GC's decision in *TeliaSonera*.[10] Not only did the Court made a clear cut between a margin squeeze and refusal to deal, but also ruled that market dominance is sufficient for a margin squeeze to an admissible claim. Thus, even if the downstream competitor could be supplied by another, possibly not integrated, upstream firm, a margin squeeze may be alleged if the accused vertically integrated upstream provider has significant market power.

Given this brief comparative review of the case law between the US and the EU, the question arises whether the US approach or the EU approach is better suited for handling margin squeeze cases. More specifically, in the light of consumer welfare, should ex ante (upstream) market regulation and ex-post competition law enforcement (by banning a margin squeeze) be used as complements (i.e. EU approach) or as substitutes (i.e. US approach)?[11]

A cornerstone for answering this question is the proper understanding of the

[10] Case C-52/09 *Konkurrensverket v. TeliaSonera Sverige AB*, 17 February 2011.

[11] The fact that both jurisdictions aim maximal consumer welfare can be seen from the following statements. For the EU, Art. 5 of the Commission's 2009 guidance of enforcements priorities states that (Commission, 2009)

> "*[I]n applying Article 82 to exclusionary conduct by dominant undertakings, the Commission will focus on those types of conduct that are most harmful to consumers. Consumers benefit from competition through lower prices, better quality and a wider choice of new or improved goods and services. The Commission, therefore, will direct its enforcement to ensuring that markets function properly and that consumers benefit from the efficiency and productivity which result from effective competition between undertakings.*"

For the US, Ginsburg (2008) for instance discusses Judge Bork's analysis of the Sherman Act as

> "[. . .]*contain[ing] no colorable support for application by courts of any value premise or policy other than the maximisation of consumer welfare.*"

economics of margin squeeze. Economic analysis of the impacts on consumer surplus and social welfare when upstream market regulation and competition law are enforced jointly may thus provide evidence on whether the relation is best exploited as one of substitution or complementarity.

This chapter aims to contribute to this issue by proposing the following analysis. Consider a model where a vertically integrated upstream monopolist faces downstream competition from a non-integrated downstream rival. Downstream products are differentiated and the upstream market is under regulatory scrutiny. Both firms may be characterised by different efficiency levels in the downstream market, either because products are of different qualities, firms incur different downstream production costs or any combination of both. The main results of the present analysis can be summarised as follows:

1. in a competitive setting without public intervention, a margin squeeze occurs when the downstream rival is relatively more efficient,
2. without upstream market regulation, enforcing competition law by banning a margin squeeze induces a decrease of the upstream price, increase consumer surplus and social welfare,
3. imposing both upstream market regulation and a margin squeeze ban is likely to induce both downstream prices to increase, yielding a decrease of consumer surplus. The effect on social welfare is ambiguous.

The remainder of this chapter is the following. Section 3.2 present the existing literature. Section 3.3 details the model specifications and section 3.4 analysis the impact of a margin squeeze absent upstream market regulation. In particular, subsection 3.4.1 derives the benchmark equilibrium outcome in an environment and without margin squeeze ban. Subsection 3.4.2 introduces a ban on margin squeeze and describes compares to the benchmark outcome. Section 3.5 introduces regulation in the upstream market and rerun the analysis. Section 3.6 discusses the results and concludes.

3.2 Revue of existing literature

Several academic papers reveal that banning a margin squeeze is likely to induce an increase of downstream prices (Bouckaert and Verboven, 2004; Carlton, 2008; Choné *et al.*, 2010; Sidak, 2008). This effect is called the *price umbrella effect* and has obvious consequences on consumer welfare. The mechanism behind this effect is that the vertically integrated firm's price is subject to an imputation rule that is commonly known as the *equally efficient operator*-test. Implementing this rule is akin to setting the integrated firm's downstream price at least equal to its downstream cost plus the (regulated) upstream price. As a result, the downstream price is higher than in a perfectly competitive environment. Furthermore, if there is no regulatory duty to deal, the vertically integrated firm could choose to cease the production of its own retail product and earn monopoly profits on the upstream market by only selling the upstream good to the downstream firm (Carlton, 2008). Consumers could then be harmed because some diversified products are no longer available.

Briglauer *et al.* (2011) analyse the economics of margin squeeze in the telecommunications sector when retail products are differentiated. Similarly to the result in this chapter, they find that a margin squeeze can arise as the competitive outcome rather than a foreclosure strategy. The difference between their paper and the work here is that in their framework the margin squeeze stems from inter-modal competition. Said otherwise, at a given regulatory strength, an entrant's margins may be squeezed when competition stems from another infrastructure increases.[12]

As stated above, regulatory agencies and competition authorities rely on

[12] The authors speak of an outside option, which represents competition from a substitutable product like mobile telephony services that compete with fixed line telephony services.

the imputation rule when assessing the presence of a margin squeeze. This rule is largely discussed in the academic literature and diverse adaptions are proposed.

Beard, Kaserman and Mayo (2003) provide a critique on the imputation test by depicting several reasons for its lack of bite. For instance, the authors explain that due to an informational asymmetry about the costs of the vertically integrated firm and the difficulty to estimate them accurately, the regulated firm may yet be able to satisfy the imputation rule even though an equally efficient competitor might be excluded. Moreover, the market may be characterized by high switching costs that may induce the competitor to offer high discounts in order to poach the incumbent's customers. Then, using the incumbent's costs as benchmark weakens the effectiveness of the imputation.

Bouckaert and Verboven (2004) stress out that in a fully regulated environment (i.e. upstream and downstream prices are set by the regulator), the pricing scheme of the vertically integrated firm may fail to the standard test, if it does not account of previous regulatory decisions. Therefore, the authors plead for integrating, along with production costs, at least a proportion of the additional costs of supplying the upstream good). Would a margin squeeze be exist, it would merely be an "[...] *artifact of cost-based regulatory system"* and call this occurrence a "*regulatory* [margin] *squeeze*". If the environment is only partially regulated (i.e. only upstream market regulation exists), the authors refer to a "*predatory price squeeze*".[13] In the case of a predatory price squeeze , the standard predatory price test could then easily be adapted by introducing the additional supply costs at upstream level in order to efficiently detect an anticompetitive pricing behavior of the vertically integrated firm.

In a similar vain, Jullien *et al.* (2013) derive an adaption of the standard

[13] Vertical foreclosure may only occur via an excessive upstream price, which in the partially regulated environment is not under the scrutiny of the vertically integrated firm and thus not possible.

margin squeeze test that accounts for vertical integration. In their survey, the authors review the potential of a margin squeeze for being an exclusionary abuse and exploitative abuse. The latter case appears to be an inconsistent theory of harm, because a ban on margin squeeze does merely benefit downstream competitors, may hurt consumers and may raise upstream foreclosure concerns if the upstream level is unregulated. If, however, upstream market regulation exists, competition law enforcement via a ban on margin squeeze may raise exclusionary concerns in the downstream level. Jullien *et al.* (2013) therefore develop an adaption of the standard predatory pricing test. As cost benchmark, the authors consider the opportunity costs of a vertically integrated firm to exclude downstream competitors. This opportunity costs stem from the traditional trade-off a vertically integrated upstream monopolist: more upstream rents by scarifying downstream rents or vice versa. The test proposed by Jullien *et al.* (2013) therefore contains a diversion ratio that allows to measure how many upstream revenue is sacrified by excluding a competitor.

Another adaption of the standard imputation rule is developed by Jaunaux and Lebourges (2013). The main concern of this paper is to derive a test that is in line with the

> "[Commission]'s *dual objective of encouraging NGA investment and maintaining the competitive structure inherited from copper unbundling, while obeying the principle of fair investment risk distribution between access provider and access seekers.*"[14]

As the authors explain, the Commission Recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment includes a test with a two-part cost benchmark, with a variable upstream price (e.g. varying with the volume of access seemed) and some fixed part of the wholesale price. Jau-

[14] NGA = New Generation Access.

naux and Lebourges (2013) show in their analysis that the inclusion of the fixed part is not desirable because NGA investment may be deterred. Moreover, the authors plead for the usage of a second test that takes into account a "*competition migration effect*". This effect arises because of a transitory period where competition migrates from the copper-based network to the NGA network. Thus, the second test takes into account the interdependence between both facilities with the aim to promote investment by all the market players.

Despite all the critics, this chapter uses the standard imputation test (that is, the EEO-test), as it is widely accepted test in the EU-approach.

3.3 The model specifications

The analysis is carried out in an industry with two vertically related markets. In the upstream market, only a vertically integrated firm (I) is active and supplies the bottleneck input for the production downstream that cannot be bypassed. In the downstream market, the integrated firm's downstream unit and a unintegrated competitor (C) compete with differentiated goods.

The production cost of one unit of upstream good, c_u are assumed constant and, without loss of generality, normalised to 0. As supplier of a bottleneck input, the vertically integrated firm (I) has a duty to deal and to provide the input to its competitor. The price of the upstream good is denoted by w and may be regulated with a price cap set either at or above marginal costs. Such imperfect regulation may be due to additional upstream costs of supplying the vital input to the competitor, to informational asymmetries, regulatory capture, or to the need to preserve the long-run investment incentives of the industry. Furthermore, upstream price regulation is assumed exogenous.

The upstream input is assumed to be used in a one-to-one proportion in conjunction with some downstream input. The latters' costs are denoted c_i for firm $i = I, C$.

The demand is given by the following version of the Singh and Vives (1984) model that allows for product differentiation:

$$U = \alpha_I q_I + \alpha_C q_C - \frac{1}{2}[\beta_I q_I^2 + \beta_C q_C^2 + 2\gamma q_I q_C] \tag{3.1}$$

where $\{\alpha_I, \alpha_C\}$ represent consumers' valuations for the products. For simplicity, β_I and β_C are assumed equal to 1. γ is the downstream product differentiation parameter. It measures how much the demand of one firm varies when its rival supplies one further downstream unit. In theory, γ may evolve in $[-1, 1]$, where a negative γ represents complementary goods. If γ is 0, downstream products are independent and finally if γ is positive, the products are substitutes, with perfect substitutability at $\gamma = 1$. This model only considers the case of imperfect substitutes, i.e. $\gamma \in (0, 1)$.

Given prices $\{p_I, p_C\}$, firms face the following demand

$$q_I = \frac{1}{1-\gamma^2}\Big[\alpha_i - p_i - \gamma(\alpha_j - p_i)\Big], \quad i, j = I, C; i \neq j \tag{3.2}$$

To join the works of Singh and Vives (1984) and Zanchettin (2006), α_I and α_C may be interpreted as product quality and equivalently as demand asymmetry. If firms are perceived as providing different levels of quality, then $\alpha_I \neq \alpha_C$. Moreover, the present model allows for downstream cost differentials ($c_I \gtreqless c_C$). Then, as Zanchettin (2006) put it

> [...] *both cost and demand asymmetry reduce to one firm being more efficient than the other in terms of cost per unit of quality supplied.*

To capture this downstream efficiency, an index $\Delta = \frac{\alpha_C - c_C}{\alpha_I - c_I}$ is introduced. If $0 < \Delta < 1$, the integrated firm is relatively more efficient than the competitor, whereas the reverse holds with $\Delta > 1$. Without loss of generality, $\alpha_I - c_I$ is normalised to 1.

The subsequent analysis relies on the following two-stage game:

Stage 1: I sets the price of the upstream price w subject to the regulatory constraint;

Stage 2: Firms simultaneously set retail prices p_I and p_C.

The timing of the game reflects market dynamics where retail prices are more flexible than upstream prices, which are under the regulator's scrutiny. The firms' profit functions are given by the following:

$$\pi_I = (p_I - c_I - w)q_I + (w - c_u)(q_I + q_C) \tag{3.3a}$$

$$\pi_C = (p_C - c_C - w)q_C \tag{3.3b}$$

Expression (3.3a) can also be rewritten as

$$\pi_I = (p_I - c_I - c_u)q_I + (w - c_u)q_C \tag{3.4}$$

, showing that the vertically integrated firm's profit maximisation problem is invariant as to whether its downstream entity considers the upstream price charged to the unintegrated competitor (w) or the upstream production costs (c_u).

Finally, whenever competition law is enforcement via a ban on margin squeeze, the downstream price of the vertically integrated firm must satisfy the *equally efficient competitor*-rule (hereinafter, EEO-rule or EEO-requirement) which is based on the vertically integrated firm's retail costs:

$$p_I \geq c_I + w \tag{3.5}$$

The aim of this rule is to verify that, at downstream price p_I, the vertically integrated firm's downstream unit covers its costs, would it have to buy the

upstream good at the same conditions as the unintegrated competitor. Despite the criticism, this model relies on the EEO-rule (rather than, e.g. the *reasonably efficient competitor* -rule or RJS's *VI-adjusted sacrifice test*) as it provides legal security to the vertically integrated firm. Moreover, it seems natural to apply the EEO-rule, since it has been backed up by the GC in *DT* as well as *Telefònica* and has thus become the standard in the Commission's proceeding in alleging anti-competitive margin squeeze case.

The subsequent analysis seeks to determine the impact the EEO-rule has on the industry outcome, whether regulation is set up or not. Therefore, the analysis is organised as follows. The next section considers an unregulated environment and derives equilibrium without and with a margin squeeze ban (i.e. competition law enforcement). Welfare implications are also discussed. Then, the analysis is rerun with upstream market regulation. This latter analysis will allow to compare the US and EU approach in margin squeeze matters.

3.4 Equilibria in an unregulated environment

The perfect Nash equilibrium is derived by backward induction. Consider first that the integrated firm's price is not subject to the EEO-rule. This is called the "free competition" setting and will be presented next.

3.4.1 "Free competition" - No competition law enforcement

The first step of the backward induction involves price competition in the downstream market at any given upstream price w. Maximising profits given by (3.3a) and (3.3b) leads to the following equilibrium in the second stage of

the game:[15]

$$p_I(w) = c_I + w + \frac{2 - \gamma^2 - \gamma\Delta - w(1-\gamma)(4+\gamma)}{4 - \gamma^2} \tag{3.6a}$$

$$p_C(w) = c_C + w + \frac{(2 - \gamma^2)\Delta - \gamma - 2w(1-\gamma^2)}{4 - \gamma^2} \tag{3.6b}$$

A first thing to notice is the strategic complementarity between the upstream and the downstream prices. Hence, the higher the upstream price, the higher the downstream prices. This is not surprising, as the upstream price is merely a cost factor for downstream entities. Moreover, it can be seen that the competitor's downstream price is more sensitive towards a variation of the upstream price than the vertically integrated firm's is:

$$\frac{\partial p_I(w)}{\partial w} = \frac{3\gamma}{4 - \gamma^2} < \frac{2 + \gamma^2}{4 - \gamma^2} = \frac{\partial p_C^{(}w)}{\partial w} \tag{3.7}$$

Note that, ass long as products are imperfect substitutes, i.e. $\gamma \in (0, 1)$, the impact of a marginal increase in w is strictly positive and smaller than 1.

Next, the fraction in equations (3.6a) and (3.6b) is identified as the price-cost mark-up. This mark-up depends on i) the product differentiation parameter γ, ii) the index Δ and iii) the upstream price w. Whereas at this stage, the impact of a marginal increase in the degree of product differentiation γ is difficult to appreciate, it is easily verified that a marginal increase in the index Δ yields an opposite impact for the integrated firm than for the unintegrated

[15] Different superscripts will be used according to the different scenarios. The superscript * corresponds to "free competition", B correspond to margin squeeze ban as stand-alone policy, R to upstream regulation as stand-alone policy and RB to the combination of a ban and upstream regulation.

downstream competitor:

$$\frac{\partial p_I(w)}{\partial \Delta} = -\frac{\gamma}{4-\gamma^2} < 0, \forall \gamma \in (0,1) \tag{3.8a}$$

$$\frac{\partial p_C(w)}{\partial \Delta} = \frac{2-\gamma^2}{4-\gamma^2} > 0, \forall \gamma \in (0,1) \tag{3.8b}$$

Hence, the more the downstream competitor's efficiency increases (i.e. an increasing Δ), the stronger the competitive pressure exerted on the integrated firm whose downstream price decreases and whose ability to extract rents from final consumers is reduced. On the contrary, the more efficient competitor is able to extract increasing rents from consumers due to its higher efficiency.

The next step in the backward induction concerns the determination of the optimal upstream price w. Substituting equations (3.6a) and (3.6b) into the integrated firm's profit function and maximizing over w yields:

$$w^* = \frac{8\Delta + \gamma^3}{2(8+\gamma^2)} \tag{3.9}$$

Remark from equation (3.9), that the higher the index Δ, the higher the optimal upstream price w^*: $\frac{\partial w^*}{\partial \Delta} = \frac{4}{8+\gamma^2} > 1$. This implies that the integrated firm is extracting higher rents by selling the upstream good to its downstream competitor as the latter is becoming more efficient in the downstream market.

With the optimal upstream price w^* now determined, the final equilibrium outcome is provided in the following lemma:

Lemma 3.1. *In the "free competition" setting without upstream market regulation and no competition law enforcement, the industry outcome is characterized*

by the following equilibria:

$$p_I^* = c_I + \frac{8 - \gamma^2 + 2\gamma\Delta}{2(8+\gamma^2)} \tag{3.10a}$$

$$p_C^* = c_C + \frac{2\Delta(6+\gamma^2) - \gamma(4+\gamma^2)}{2(8+\gamma^2)} \tag{3.10b}$$

$$q_I^* = \frac{8 - \gamma(6\Delta + \gamma + \gamma^3)}{2(1-\gamma)(1+\gamma)(8+\gamma^2)} \tag{3.10c}$$

$$q_C^* = \frac{(2+\gamma^2)(\Delta - \gamma)}{(1-\gamma)(1+\gamma)(8+\gamma^2)} \tag{3.10d}$$

$$\pi_I^* = \frac{4\Big[2 + \Delta(\Delta - 2\gamma)\Big] - \gamma^2(3+\gamma^2)}{4(1-\gamma)(1+\gamma)(8+\gamma^2)} \tag{3.10e}$$

$$\pi_C^* = \frac{(2+\gamma^2)^2(\Delta-\gamma)^2}{(1-\gamma)(1+\gamma)(8+\gamma^2)^2} \tag{3.10f}$$

A first thing to notice from (3.10a) is that the integrated firm's equilibrium downstream price is now increasing with the index Δ. The explanation is as follows. First, recall that the integrated firm's price as a function of w (given in 3.6a) is a decreasing function of Δ (see equation 3.8a) and an increasing function of w (see equation 3.7). Second, the optimal upstream price w^* is also an increasing function of Δ. Hence, the total differential of (3.10a) yields:

$$\begin{aligned} \frac{dp_I^*(w)}{d\Delta} &= \frac{\partial p_I^*(w)}{\partial \Delta} + \frac{\partial p_I^*(w)}{\partial w}\frac{dw^*}{d\Delta} \\ &= -\frac{\gamma}{4-\gamma^2} + \frac{3\gamma w'_\Delta}{4-\gamma^2} \\ &= \frac{\gamma(3w'_\Delta - 1)}{4-\gamma^2} \end{aligned} \tag{3.11}$$

where w'_Δ denotes the first order partial derivative of w^* with respect to Δ. Then, using the fact that $3w'_\Delta$ is always strictly greater than 1 for any degree

of product differentiation, (3.11) is always positive:

$$\begin{aligned}\frac{dp_I^*(w)}{d\Delta} &= \frac{\gamma\left[3\left(\frac{4}{8+\gamma^2}\right)-1\right]}{4-\gamma^2} \\ &= \frac{\gamma}{8+\gamma^2} \\ &> 0 \ ,\forall\gamma\in(0,1)\end{aligned} \tag{3.12}$$

Another explanation is the strategic complementarity between prices already mentioned above. Recall that the upstream price is a cost factor in the downstream segment of the industry. Moreover, the more efficient the competitor, the more rents the integrated firm extracts via the upstream price. Thus, by being a strategic complement to the competitor's downstream price, the integrated firm's downstream price increases as the competitor's costs increase.

Consider next the application of the EEO-rule so as to determine whether the integrated firm's final equilbrium price involves a margin squeeze or not. It then appears that a margin squeeze will always be alleged whenever the competitor is more efficient:

$$\begin{aligned}p_I^* < c_I + w^* &\Leftrightarrow c_I + \frac{8-\gamma^2+2\gamma\Delta}{2(8+\gamma^2)} < c_I + \frac{8\Delta+\gamma^3}{2(8+\gamma)} \\ &\Leftrightarrow \Delta > \frac{8-\gamma^2-\gamma^3}{2(4-\gamma)} = 1 + \frac{\gamma(2-\gamma-\gamma^2)}{2(4-\gamma)} \equiv \tilde{\Delta}\end{aligned} \tag{3.13}$$

Therefore,

Proposition 3.1. *In the "free competition" setting, the vertically integrated firm's efficient pricing scheme would not satisfy the EEO-rule whenever its competitor is more efficient (i.e.* $\Delta \geq 1$*).*

As can be seen from the derivation $\tilde{\Delta}$, the failure of the margin squeeze test is not due to any exclusionary conduct, but merely a by-product of the com-

petitive interaction between both actors. The competitor's higher efficiency induces the integrated firm to seek for recouping lost profits in the downstream market via the upstream price. Although the integrated firm is exploiting its upstream market power, it does not induce its downstream rival's exit. From (3.10f), it can be seen that the competitor earns strictly positive profits for any $\Delta \geq 1$ and any degree of product differentiation.[16]

Before turning to the impacts of competition law enforcement via a ban on margin squeeze, it is of interest to determine the participation constraints of both downstream actors. Indeed, as will be shown below, constraining the integrated firm's downstream price to the fulfill the EEO-requirement induces a contraction of integrated firm's downstream quantity, leading the firm then to leave the downstream market.

In the "free competition" setting, the integrated firm will withdraw from the downstream market whenever its downstream output is 0. This occurs whenever the competitor's efficiency is sufficiently high relative to the integrated firm. Formally,[17]

$$q_I^* \leq 0 \Leftrightarrow \Delta \geq \frac{8 - \gamma^2 - \gamma^4}{6\gamma} \equiv \Delta_I^* \tag{3.14}$$

Fig 3.1 below gives the combinations of (Δ, γ) for which *i*) the competitor is excluded, *ii*) the imputation test is not satisfied and *iii*) the vertically integrated firm's withdraws form the retail market:

The analysis now turns to the outcome when the integrated firm's downstream pricing must meet the EEO-requirement.

[16] Would the competitor be a potential entrant, the presence of sufficiently high fixed costs could deter his entry, even if more efficient.

[17] A similar condition can be found for the competitor: $q_C^* \leq 0$ if and only if $\Delta \leq \gamma$. However, as a margin squeeze only appears when the competitor is more efficient (i.e. $\Delta \geq 1$) an the analysis carried out with $\gamma \in (0, 1)$, the case $\Delta < \gamma$ is not discussed.

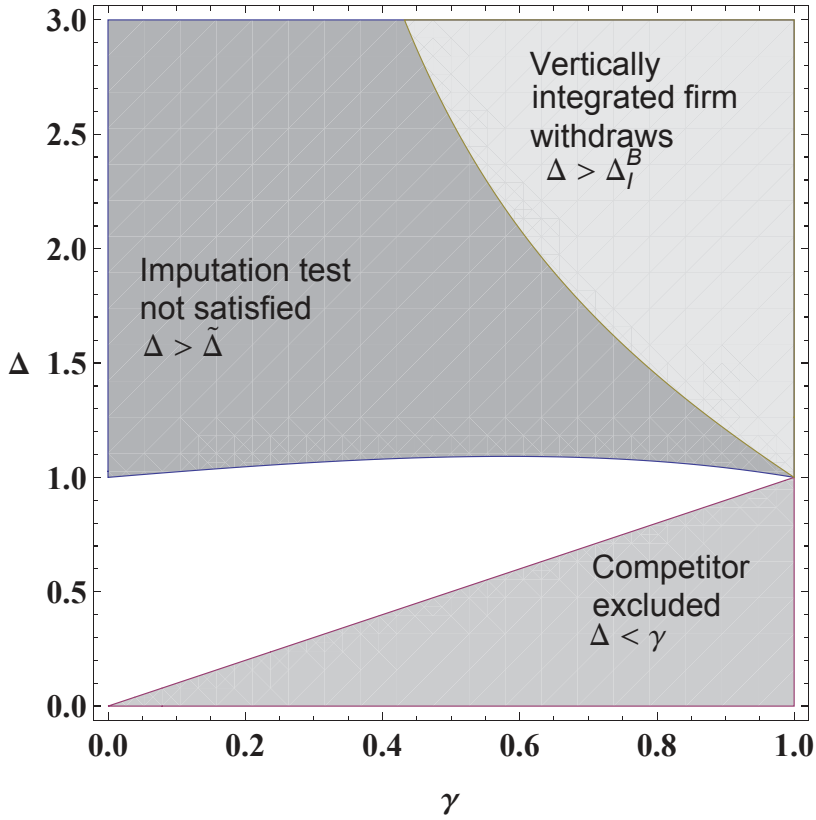


Fig. 3.1 Market outcome (Imputed margin squeeze, firm I's withdrawal and competitor's exclusion) when there is public intervention i.e. no upstream price regulation and no ban on margin squeeze.

3.4.2 Enforcing competition law via a ban on margin squeeze

This section analyses the outcome when competition law obliges the vertically integrated firm to meet the EEO-requirement. The integrated firm's downstream price must comply with the EEO-rule: $p_I \geq c_I + w$.

The vertically integrated firm profit maximisation problem is then as follows:

$$\max_{p_i, w} \pi_I = (p_i - c_i - w)q_i + w\, q_c$$
$$s.t.\ p_I \geq c_I + w \tag{3.15}$$

If the constraint is saturated (i.e. $p_I = c_I + w$), the maximisation problem becomes:

$$\max_w \pi_I = w\, q_c \tag{3.16}$$

For any level of upstream price, profits are maximised with the following equilibrium retail prices and quantities:

$$p_I^B(w) = c_I + w \tag{3.17a}$$

$$p_C^B(w) = c_C + w + \frac{\Delta - \gamma - (1-\gamma)w}{2} \tag{3.17b}$$

Recall from the previous section that whenever the competitor is more efficient (i.e. $\Delta > 1$), the integrated firm's downstream price incurs a margin squeeze, or equivalently a negative margin above costs which are $c_I + w$. Thus, a ban on margin squeeze can only be binding when $\Delta > 1$. It than immediately follows that a ban on margin squeeze requires the integrated firm to set a strictly non-negative mark-up, inducing a competition softening effect. This effect has been acknowledge by several scholars (see Carlton (2008); Choné *et al.* (2010) among others) and is known under the name of *price umbrella*. By an argument of strategic complementarity between downstream prices, it follows that the competitor's downstream price increases as well.

However, as the integrated firm earns profits on upstream market, it may have the incentive to reduce the upstream price so as to boost the competitor's demand for the upstream good, maximising thereby its profits. This is a standard trade-off a vertically integrated firm faces when it competes in the downstream market: increasing the demand for its upstream good that stems from its competitor despite the possible harm incurred by its own downstream entity or being more aggressive in the downstream market despite the possible harm incurred by its upstream entity.

Although, when the integrated firm has to fulfil the EEO-requirement, the second option of this trade-off (that is, fiercer downstream competition) does not emerge. Hence, the only profitable alternative is the reduction of the upstream price. It remains however an open question whether this upstream price reduction is sufficient to outweigh the downstream price increase. In order to determine the balance of these two effect, the optimal upstream price must be determined.

Plugging equations (3.17a) and (3.17b) into the integrated firm's profit function and maximisation over w leads to

$$w^B = \frac{2+\gamma+\Delta}{2(3+\gamma)} \tag{3.18}$$

Comparing the optimal upstream prices in a setting with and without ban shows that the vertically integrated firm sets a lower upstream price and thereby decreases the unintegrated competitor's costs:

$$\mathcal{W}(\Delta) \equiv (w^B - w^*) = \frac{2+\gamma+\Delta}{2(3+\gamma)} - \frac{8\Delta+\gamma^3}{2(8+\gamma^2)} \tag{3.19}$$

$$\tag{3.20}$$

Evaluating the above at $\Delta = \tilde{\Delta}$ shows that the upstream price decrease whenever a ban on margin squeeze is implemented:

$$\begin{aligned} \mathcal{W}(\Delta = \tilde{\Delta}) &= -\frac{\gamma(1-\gamma)(4+\gamma)}{4(4-\gamma)(3+\gamma)} \\ &\leq 0 \ , \ \forall\gamma \in (0,1) \end{aligned} \tag{3.21}$$

Furthermore, because the partial derivative of (3.19) with respect to Δ is positive, a ban does induce a decrease of the upstream input price whenever $\Delta \geq \tilde{\Delta}$. Therefore,

Proposition 3.2. *Competition law enforcement via a ban on margins induces a decreasing rival's costs-effect (henceforth DRC-effect).*

Given w^B, the final market equilibrium under competition law enforcement is characterised by the following lemma:

Lemma 3.2. *Whenever competition law is enforced and thereby the integrated firm required to meet the EEO-rule, the equilibrium industry outcome is as follows:*

$$p_I^B = c_I + \frac{2+\gamma+\Delta}{2(3+\gamma)} \tag{3.22a}$$

$$p_C^B = c_C + \frac{2-\gamma(3+\gamma)+\Delta(3\gamma+7)}{4(3+\gamma)} \tag{3.22b}$$

$$q_I^B = \frac{8+\gamma(1-\gamma)(4+\gamma)-\Big[2+\gamma(5+\gamma)\Big]\Delta}{4(1-\gamma)(1+\gamma)(3+\gamma)} \tag{3.22c}$$

$$q_C^B = \frac{\Delta(5+3\gamma)-\gamma(5-\gamma)-2}{4(3+\gamma)(1-\gamma^2)} \tag{3.22d}$$

$$\pi_I^B = \frac{(2+\gamma+\Delta)^2}{8(1+\gamma)(3+\gamma)} \tag{3.22e}$$

$$\pi_C^B = \frac{\Big[2+\gamma(5+\gamma)-\Delta(5+3\gamma)\Big]^2}{16(3+\gamma)^2(1-\gamma^2)} \tag{3.22f}$$

The impact of a ban on margin squeeze when the upstream market is unregulated can be disclosed by calculating the difference between the equilibria given in lemma 3.2 and 3.1.

Consider first the impacts on the competitor. First of all, the difference between its equilibrium price under a ban on margin squeeze and its price without ban shows that the competitor incurs a stronger DRC-effect than a PU-effect:

$$\mathcal{P}_C(\Delta) \equiv (p_C^B - p_C^*) = \frac{16(1-\Delta)+\gamma^2[2+\gamma(3+\gamma)-(5+\gamma)\Delta]}{4(3+\gamma)\,(8+\gamma^2)} \tag{3.23}$$

$$\tag{3.24}$$

Evaluating $\mathcal{P}_C(\Delta)$ at $\Delta = \tilde{\Delta}$ shows that p_C^B is always lower than p_C^*:

$$\mathcal{P}_C(\Delta = \tilde{\Delta}) \equiv (p_C^B - p_C^*) = -\frac{\gamma(1-\gamma)(1+\gamma)(4+\gamma)}{8(4-\gamma)(3+\gamma)}$$
$$< 0 \ ,\forall\gamma \in (0,1) \quad (3.25)$$

Moreover, a marginal increase of Δ on $\mathcal{P}_C(\Delta)$ is always negative, which leads to the conclusion that the more Δ increases, the more the DRC-effect is amplified compared to the PU-effect.[18]

Second, provided that a firm's quantities depend negatively on its own price, it is immediate to see that the price decrease induced by the ban on margin squeeze generates a higher output for the competitor.

Finally, it is shown that the competitor incurs higher profits whenever competition law is enforced:

$$\Pi_C(\Delta) \equiv \pi_C^B - \pi_C^* = \frac{(8+\gamma^2)^2[2+\gamma(5+\gamma)-\Delta(3\gamma+5)]^2 - 16(3+\gamma)^2(2+\gamma^2)^2(\Delta-\gamma)^2}{16(3+\gamma)^2(1-\gamma^2)(8+\gamma^2)^2} \quad (3.26)$$

At $\Delta = \tilde{\Delta}$, the above yields:

$$\Pi_C(\Delta = \tilde{\Delta}) = \frac{(1-\gamma)^2\gamma(4+\gamma)\{48+\gamma[20+7\gamma(3+\gamma)]\}}{64(4-\gamma)^2(1+\gamma)(3+\gamma)^2}$$
$$> 0 \ , \ \forall\gamma \in (0,1) \quad (3.27)$$

A marginal increase in Δ implies a higher profits whenever Δ is at least 1 and

[18] The marginal increase of Δ on $\mathcal{P}_C(\Delta)$ is equal to:

$$\frac{\partial\mathcal{P}_C(\Delta)}{\partial\Delta} = -\frac{16+(5+\gamma)\gamma^2}{4(3+\gamma)(8+\gamma^2)}$$
$$< 0 \ , \ \forall\gamma \in (0,1)$$

thus always when a ban is implemented.[19]

The impacts on the unintegrated downstream competitor can therefore be summarised as follows:

Proposition 3.3. *Requiring the vertically integrated firm to meet the EEO-rule is beneficial for the competitor, as, ultimately, it earns higher profits.*

The impacts on the vertically integrated firm are less straightforward.

Whether the PU-effect outweighs the DRC-effect or not depends on Δ. By calculating the difference $p_I^B - p_I^*$, a threshold, denoted Δ^{PU} can be derived above which the integrated firm's downstream price is always higher when a ban on margin squeeze is implemented:

$$\begin{aligned}
\mathcal{P}_I \equiv p_I^B - p_I^* > 0 \\
&\Leftrightarrow \frac{8(\Delta-1) - \gamma\Big[6\Delta - \gamma(5+2\gamma-\Delta)\Big]}{2(3+\gamma)\,(8+\gamma^2)} > 0 \qquad (3.29)\\
&\Rightarrow \Delta > \frac{8-\gamma^2(5+\gamma)}{8-\gamma(6-\gamma^2)} \equiv \Delta^{PU} \qquad (3.30)
\end{aligned}$$

This threshold Δ^{PU} is however above $\tilde{\Delta}$, i.e. the threshold for a margin squeeze to arise:

$$\Delta^{PU} \geq \tilde{\Delta} \qquad (3.31)$$

$$\frac{(1-\gamma)\gamma(4+\gamma)(8+\gamma^2)}{2(4-\gamma)[8-\gamma(6+\gamma)]} \geq 0, \forall\gamma \in (0,1). \qquad (3.32)$$

Thus,

[19] The marginal increase of Δ on

$$\begin{aligned}
\frac{\partial\Pi_C(\Delta)}{\partial\Delta} =& \frac{1}{16(3+\gamma)^2(1-\gamma^2)(8+\gamma^2)^2}\Big\{32(3+\gamma)^2(2+\gamma^2)^2(\gamma-\Delta) \\
&- 2(5+3\gamma)(8+\gamma^2)^2[2+\gamma(5+\gamma)-(5+3\gamma)\Delta]\Big\} \\
&> 0\ ,\ \forall\gamma\in(0,1) \qquad (3.28)
\end{aligned}$$

Remark 3.1. *If the competitor is sufficiently more efficient, $\Delta > \Delta^{PU}$, than the equilibrium downstream price of the vertically integrated firm is such that the PU-effect outweighs the DRC-effect, leading to an increase of its downstream price.*

As for the integrated firm's downstream quantities and profits, consider first $\Delta > \Delta^{PU}$. The difference in quantities yields:

$$\mathcal{Q}_I(\Delta) \equiv q_I^B - q_I^* = \frac{16(1+\gamma) - \gamma^2(10 + 2\gamma - 3\gamma^2 - \gamma^3) - \Delta[4(4+\gamma) - \gamma^2(2 - 5\gamma - \gamma^2)]}{4(3+\gamma)(1-\gamma^2)(8+\gamma^2)} \tag{3.33}$$

Evaluated at $\Delta = \Delta^{PU}$, the above yields:

$$\begin{aligned} \mathcal{Q}_I(\Delta = \Delta^{PU}) &= -\frac{\gamma^2(4+\gamma)}{4(1+\gamma)[8-\gamma(6+\gamma)]} \\ &< 0 \ , \forall \gamma \in (0, 0.71) \end{aligned}$$

Since the marginal effect of Δ on $\mathcal{Q}_I(\Delta)$ is strictly negative, it follows that the more efficient the competitor is, the more a ban on margin squeeze induces the integrated firm's output to contract.[20]

Similarly for profits:

$$\begin{aligned} \Pi_I(\Delta) \equiv \pi_I^B - \pi_I^* = &\frac{1}{8}\Bigg\{ \frac{(2+\gamma+\Delta)^2}{(1+\gamma)(3+\gamma)} \\ &+ \frac{2[3\gamma^2 + \gamma^4 + 8\gamma\Delta - 4(2+\Delta^2)]}{8 - \gamma^2(7+\gamma^2)} \Bigg\} \end{aligned} \tag{3.35}$$

[20] The marginal effect of Δ on $\mathcal{Q}_I(\Delta)$ is

$$\frac{\partial \mathcal{Q}_I(\Delta)}{\partial \Delta} = \frac{16 + \gamma\{4 - \gamma[2 - \gamma(5+\gamma)]\}}{4(3+\gamma)(1-\gamma^2)(8+\gamma^2)} < 0 \ , \forall \gamma \in (0,1) \tag{3.34}$$

and

$$\Pi_I(\Delta = \Delta^{PU}) = -\frac{(1-\gamma)\gamma^2(4+\gamma)(4+7\gamma)}{8(1+\gamma)[8-\gamma(6+\gamma)]^2}$$
$$< 0 \ , \forall\gamma \in (0,1) \tag{3.36}$$

Since, the marginal impact of Δ on $\Pi_I(\Delta)$ is negative, the following can be stated:[21]

Proposition 3.4. *Suppose the unintegrated downstream competitor is sufficiently more efficient. A ban on margin squeeze fosters the competitor's profits via the DRC-effect, whereas it harms to vertically integrated firm via the PU-effect.*

In contrast, suppose the unintegrated competitor is only "a bit" more efficient, i.e. $\Delta^{PU} > \Delta > \tilde{\Delta}$. It can be shown that the vertically integrated firm's quantities nor profits necessarily decrease, since the vertically integrated does not incur a price umbrella.

Evaluating $\mathcal{Q}_I(\Delta)$ at $\Delta = \tilde{\Delta}$ shows that the variation in quantities is not always strictly negative:

$$\mathcal{Q}_I(\Delta = \tilde{\Delta}) = \frac{(1-\gamma)\gamma(8+\gamma(6+\gamma))}{8(4-\gamma)(1+\gamma)(3+\gamma)}$$
$$> 0 \ , \forall\gamma \in (0,1) \tag{3.37}$$

[21] The marginal effect of Δ on $\Pi_I(\Delta)$ is

$$\frac{\partial\Pi_I(\Delta)}{\partial\Delta} = \frac{1}{8(1+\gamma)}\Big[\frac{16(\gamma-\Delta}{(1-\gamma)(8+\gamma^2)} + \frac{2(2+\gamma+\Delta)}{3+\gamma}\Big]$$
$$< 0 \ , \forall\Delta < \frac{16(1+\gamma)+(1-\gamma)\gamma^2(2+\gamma)}{16(1+\gamma-\gamma^2(1-\gamma)}$$

Note that, $\frac{16(1+\gamma)+(1-\gamma)\gamma^2(2+\gamma)}{16(1+\gamma-\gamma^2(1-\gamma)} < \tilde{\Delta}$, $\forall\gamma \in (0,1)$.

Therefore, it exists a threshold of Δ that determines the impact on $\mathcal{Q}_I$:

$$\begin{aligned} &\mathcal{Q}_I > 0 \\ &\qquad \Delta \in [\tilde{\Delta}, \frac{16(1+\gamma) - \gamma^2[10 + \gamma(2 - 3\gamma - \gamma^2)]}{4(4+\gamma) - \gamma^2(2 - 5\gamma - \gamma^2)}] \end{aligned} \tag{3.38}$$

Similarly for the integrated firm's profits:

$$\begin{aligned} \Pi_I(\Delta = \tilde{\Delta}) &= \frac{(1-\gamma)^2\gamma^2(4+\gamma)^2}{32(4-\gamma)^2(1+\gamma)(3+\gamma)} \\ &> 0 \ , \forall \gamma \in (0,1) \end{aligned} \tag{3.39}$$

and finally

$$\begin{aligned} &\Pi_I > 0 \\ &\Delta \in \Big[\tilde{\Delta}, \frac{16(1+\gamma) + \gamma^2\,(2 - \gamma - \gamma^2)}{16(1+\gamma) - \gamma^2(1-\gamma)} + \sqrt{2}\sqrt{\frac{(1-\gamma)^2\gamma^2(1+\gamma)(3+\gamma)\,(8+\gamma^2)}{\left(16(1+\gamma) - \gamma^2(1-\gamma)\right)^2}}\Big] \end{aligned} \tag{3.40}$$

Therefore,

Proposition 3.5. *Suppose that the unintegrated downstream competitor is "a bit" more efficient than the vertically integrated firm. Enforcing competition law induces beneficial effect for both the vertically integrated and the unintegrated firm.*

Fig. 3.2 depicts the different combinations of Δ and γ and the associated regions where a price umbrella occurs or the incumbent withdraws from the retail market.

The preceding discussion above has important policy implications. First, enforcing competition law by requiring the vertically integrated firm to meet the EEO-rule benefits the competitor. Moreover, recall that a margin squeeze arises as a by-product of competitive interaction between a vertically integrated

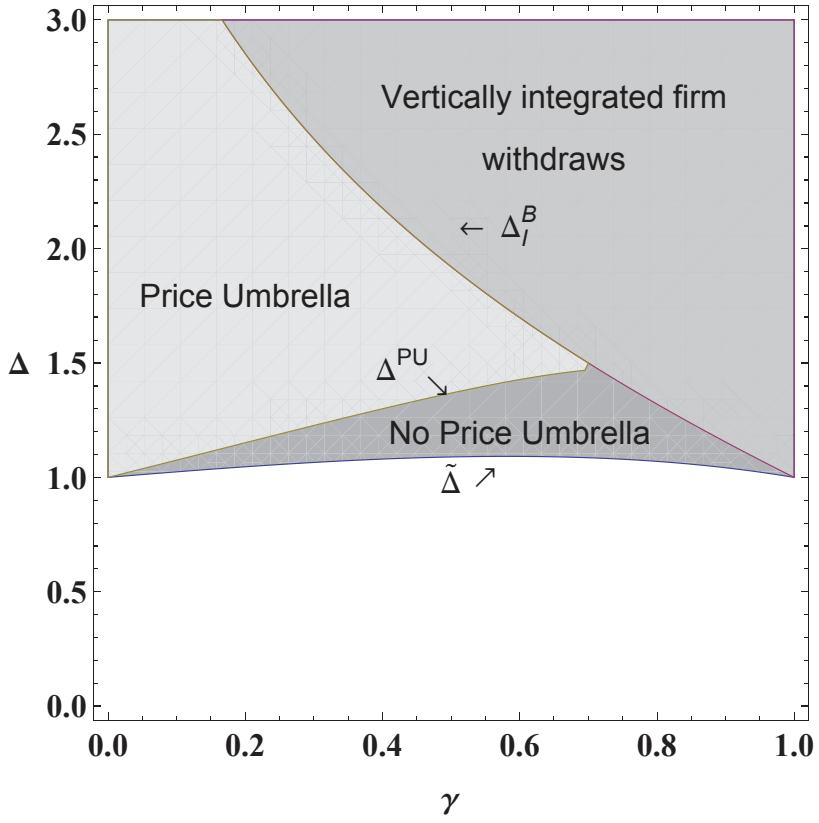


Fig. 3.2 This figure shows the different combinations of Δ and γ for which firm I withdraws and where its price incurs a price umbrella.

firm and a relatively more efficient downstream competitor. The downstream pricing scheme may by exploitative, but despite the exploitation of upstream market power, there is neither exclusionary conduct nor intent to monopolise the downstream market. Competition authorities should therefore be careful when it comes to evaluate possible anti-competitive behavior in vertically related markets so as not to turn down any possible pro-competitive behavior.

This becomes even more essential when the integrated firm's participation constraint is considered. In effect, a ban induces the latter to withdraw from the downstream market for less strong condition than in "free competition" setting. In fact, the downstream output of the vertically integrated firm is

negative whenever:

$$q_I^B < 0 \Leftrightarrow \frac{8+\gamma(1-\gamma)(4+\gamma)}{2+5\gamma(5+\gamma)} \equiv \Delta_I^B \tag{3.41}$$

Then, comparing equations (3.41) and (3.14) yields:

$$\begin{aligned} \Delta_I^B - \Delta_I^* &< 0 \\ \frac{(\gamma-1)(1+\gamma)(2+\gamma)\Big[8-\gamma\Big(8-\gamma(3+\gamma)\Big)\Big]}{6\gamma\Big[2+\gamma(5+\gamma)\Big]} &\leq 0 \ \forall\gamma \in (0,1) \end{aligned} \tag{3.42}$$

The explanation for this result is as follows. Recall from the "free competition" setting, that the more the competitor is efficient compared to the integrated firm, the stronger the competitive pressure exerted and thus the smaller the integrated firm's output.[22] Since a margin squeeze ban may induce a price umbrella on the integrated firm's downstream price and a contraction of the latter's output in the downstream market, the competitive pressure is artificially amplified. The integrated firm is then left with a reduced scope to compete against its rival. Although it should be recalled that the exclusion of a less efficient firm is not a policy problem *per se*, artificially enhancing the competitiveness in such an asymmetric fashion must be outweighed with the possible loss in variety in the consumers' choice.

3.4.3 Welfare analysis

Hitherto, this section has analysed of the impacts of competition law enforcement when upstream market are not regulated. It concludes by presenting the impacts on consumer surplus and social welfare. Social welfare is measured by the sum of consumer surplus and industry profits and, using the utility

[22] To see this, $\frac{\partial q_I^*}{\partial \Delta} = -\frac{3\gamma}{(1-\gamma)(1+\gamma)(8+\gamma^2)}$.

function (3.1), yields:

$$\begin{aligned} W(q_I, q_C) &= U + \pi_I + \pi_C \\ &= q_I + \Delta\, q_C - \frac{1}{2}(q_I + q_C)^2 + (1-\gamma)\, q_I\, q_C \end{aligned} \tag{3.43}$$

Therefore, the following can be stated:

Proposition 3.6. *In an unregulated vertically related industry, where an upstream monopolist competes in the downstream market with an unintegrated firm, a ban on margin squeeze*

i) increases the industry profits,

ii) increases consumer surplus,

iii) increases social welfare

Proof. All proofs are contained in appendix A.3.1.

This is explained as follows. Note first that p_C always decreases when a ban implemented. If p_I decreases, consumer welfare unambiguously must increase since p_C always decreases. Furthermore, the competitor's profits always increase more than the firm I's profits (possibly) decrease, leading thus to increased industry profits.

Consider next the situation with a price umbrella on the integrated firm's downstream price. As is shown in the appendix, the competitor's price decreases more than the integrated firm's price increases and the competitor's quantities increase more than the integrated firm's decrease. Hence, there is more output sold at a lower price (more of the competitor's output q_C^B at the lower price p_C^B). Thus, total consumer surplus increases, even though the remaining consumers of firm I enjoy a lower surplus. As for firms' profits, it can be shown that industry profits increase as well. Finally, with increasing consumer surplus and industry profits, social welfare increases.

The next step of the analysis of the interaction between sector-specific

regulation and competition law involves the introduction of upstream market price regulation. Therefore, the next section reruns the precedent analysis by integrating an exogenous regulator that sets a price cap on the vertically integrated firm's upstream price.

3.5 Equilibria with upstream market regulation

Upstream market regulation is a common characteristic of many utility industries like railways, electricity, water or telecommunications. A common point of these industries is that an essential facility is involved, which prior the liberalisation process during the 1990's belonged to former legal monopolies. Ever since this process was accomplished, the essential infrastructure has been under the scrutiny of a private company. However, the essentiality of these infrastructures, the economic unfeasibility of duplication and the aim to induce a competitive environment in these industries pushed governments to assign NRAs to regulate, among others, the access to the infrastructure.[23] Without such intervention, the public authorities considered the establishment of competition jeopardised, as any downstream competitor that does not own such an infrastructure would be unable to provide a downstream product.

The analysis first considers regulation as stand-alone policy (i.e. without banning a margin squeeze) and then introduces competition law enforcement. Note that regulation as stand-alone policy represents the US way of dealing with margin squeeze case, whereas the joint implementation of sector-specific regulation and competition law enforcement is akin to the EU approach.

[23] the judgement by the European General Court in *TeliaSonera* weakened the characteristic of essentiality of the upstream good. Indeed, essentiality is no longer required at the upstream level of the industry. The sole fact of holding a dominant position suffices for intervention.

3.5.1 Regulation as stand-alone policy

The essential facility is the bottleneck input produced by the vertically integrated firm in the upstream segment of the industry, which, in the remaining analysis, is now regulated. In particular, it is assumed that a NRA exogenously sets a price cap, denoted $\bar{w}$, that the integrated firm is not allowed to exceed.

The most plausible range of $\bar{w}$ is $[0, w^M]$, where $w^M = \frac{\Delta}{2}$ represents the monopoly upstream price, would the integrated firm not be active in the downstream market.[24] The profit-maximising upstream price w^* lies in between these two boundaries and upstream market regulation is said to be constraining whenever $\bar{w}$ is set below w^*. This case will be the only one analysed in what follows, as regulation that does not constrain the integrated firm's upstream pricing behavior is exactly equivalent to the analysis in section 3.4. Therefore, focus is laid on $\bar{w} \in [0, w^*)$.

Exogenous (and constraining) upstream market regulation implies that the first stage of the game (the upstream price setting stage) disappears. Downstream price competition yields the same equilibrium expressions as in section 3.4.1, namely equations (3.6a) and (3.6b):

$$p_I^*(\bar{w}) = c_I + \bar{w} + \frac{2 - \gamma^2 - \gamma\Delta - \bar{w}(1-\gamma)(4+\gamma)}{4 - \gamma^2} \tag{3.44a}$$

$$p_C^*(\bar{w}) = c_C + \bar{w} + \frac{(2 - \gamma^2)\Delta - \gamma - 2\bar{w}(1-\gamma^2)}{4 - \gamma^2} \tag{3.44b}$$

A first thing to notice is the pro-competitive effect of upstream market regulation on both prices. Because the upstream price is still merely a downstream cost factor, a reduction of $\bar{w}$ induces downstream prices to decrease.

When applying the EEO-rule to the integrated firm's price, it should be

[24] If the integrated firm was not active in the downstream market (and thus be a pure upstream monopolist), the competitor would face the following maximisation problem: $\max_{p_C}[(p_C - c_C - w)q_C]$, where $q_C = (\alpha_C - p_C)$. This yields: $p_C(w) = (w + \alpha_C + c_C)/2$. Then, substituting this into q_C, the upstream monopoly maximises $\max_w[w(\alpha_C - c_C - w)/2$, which, given that $\Delta = \alpha_C - c_C$ (recall that $\alpha_I - c_I = 1$) leads to $w^M = \Delta/2$.

recalled that the EEO-rule essentially tests whether the integrated firm's downstream price-cost mark-up is positive would it have to buy the upstream good at the same price charged to its competitor. It then follows that, using equation (3.44a), the integrated firm's downstream price-cost mark-up is

$$m_I^R(\Delta, \bar{w}) = \frac{2 - \gamma^2 - \gamma\Delta - \bar{w}(1-\gamma)(4+\gamma)}{4-\gamma^2} \tag{3.45}$$

. Hence, the EEO-test is equivalent to $m_I^R \gtreqless 0$ and is no longer satisfied whenever:

$$m_I^R < 0 \Leftrightarrow \Delta > \frac{2 - \bar{w}(1-\gamma)(4+\gamma) - \gamma^2}{\gamma} \equiv \tilde{\Delta}^R \tag{3.46}$$

Moreover, due to concavity in w of its profit function, the integrated firm will not undercut a constraining price cap. Rather, it seeks to be as near as possible the profit-maximising level of w. As the upstream price charged to the competitor is now the regulated price cap, it then follows that

$$\tilde{\Delta}^R \in \Big(\tilde{\Delta}, \frac{2-\gamma^2}{\gamma}\Big] \text{ if } \bar{w} \in [0, w^*) \tag{3.47}$$

Note that $\tilde{\Delta} \leq \frac{2-\gamma^2}{\gamma}$, $\forall\gamma \in (0,1)$ and $\bar{w} \geq 0$, with equality at $\bar{w} = 0$. Thus, as represented in Fig 3.3, an *upward* shift of $\tilde{\Delta}^R$ is observed as the price cap becomes tighter.

To understand this upward shift, note that the margin m_I^R is a decreasing function of the upstream price, meaning that a *decrease* of the upstream price (through regulatory intervention) implies an *increase* of the margin.[25] Hence, whenever the competitor's downstream efficiency is such that the integrated firm's downstream price entails a margin squeeze, i.e. a negative downstream price-cost mark-up, a tighter price cap on the upstream price increases the

[25] Indeed, $\frac{\partial m_I^R}{\partial \bar{w}} = -\frac{(1-\gamma)(4+\gamma)}{4-\gamma^2} < 0$.

mark-up and therefore reduces the extent of a margin squeeze. Finally, since the threshold $\tilde{\Delta}^R$ is derived from m_I^R, a similar reasoning regarding the impact of a marginal decrease of $\bar{w}$ applies to $\tilde{\Delta}^R$: the lower the price cap, the higher $\tilde{\Delta}^R$, as represented on figure 3.3.

With this finding, a common characteristic of essential facility regulation applies. Market regulation is set up with the aim to lessen the ability to exploit market power. This is in essence what happens here: by setting a tighter price cap on the upstream price, the NRA narrows the integrated firm's channel for rent extraction on the upstream market.

A commonly known idea of upstream market regulation in a vertically related industry is linked precisely this diminishing of rent extraction: tightly regulating an integrated upstream monopolist may increase its incentive for predatory pricing in the downstream market.[26] The result presented above is somehow at odds with this idea, because the extent of the negative mark-up is closely linked to the regulatory strength: below-cost pricing only appears if the price cap $\bar{w}$ is sufficiently high.

The reason is as follows. First, recall from proposition 3.1, which is applicable at the highest possible price cap (this is, $\bar{w} = w^*$), that a margin squeeze arises whenever the competitor is more efficient. Moreover, the higher efficiency of the competitor exerts a competitive pressure on the integrated firm's downstream price.[27] Secondly, the tighter the price cap, the lower the rents extracted from the competitor. Combining these two effects may thus induce the integrated firm not to undercut its costs by setting a negative margin, as this would only further depress its aggregate profits. Furthermore, as has been mentioned in discussing proposition 3.1, a more efficient competitor will not withdraw from the market, despite facing a margin squeeze. The integrated firm is therefore in the impossibility to use its pricing strategy for any

[26] See for instance Biglaiser and DeGraba (2001) or González (2006).
[27] See equation (3.8a).

exclusionary conduct with sacrificing to much of its revenue.

Turn next to the downstream participation constraint of the integrated firm. Similar to the "free competition" setting, the integrated firm will remain in the downstream market as long as its output is positive:

$$q_I^R(w^R) > 0 \Leftrightarrow \frac{2-\gamma^2-\gamma\Delta-\gamma(1-\gamma^2)w^R}{(1-\gamma^2)(4-\gamma^2)}$$
$$\Rightarrow \Delta < \frac{2-\gamma^2-\gamma(1-\gamma^2)w^R}{\gamma} \equiv \Delta_I^R \tag{3.48}$$

This expression depends negatively on the upstream price, meaning that the tighter the price cap, the more Δ_I^R shifts upwards.[28] Hence, tighter upstream market regulation translates into higher output of the integrated firm. Regulation may therefore have a positive impact because the integrated firm "delays" its decision to withdraw from the retail market.

The effects of constraining regulation on the market outcome can be summarised as follows:

Proposition 3.7. *Constraining regulation i) reduces both downstream prices, ii) reduce the scope for margin squeeze and iii) loosens the downstream participation constraint of the integrated firm.*

Before turning to the introduction of competition law enforcement via a ban on margin squeeze, it is important to determine the relevant parameter space (Δ, γ) for this analysis. More specifically, $\tilde{\Delta}^R$ and Δ_I^R define that space, as they characterise a duopolistic market with a violated EEO-rule. This is of importance, because a ban on margin squeeze is only relevant when there i) actually is a margin squeeze and ii) when both firms are active in the downstream market. Therefore,

Lemma 3.3. *If the upstream market regulation is constraining, a ban on*

[28] This is, $\frac{\Delta_I^R}{\partial_{w^R}} = -(1-\gamma^2) < 0, \forall\gamma \in (0,1)$.

margin squeeze is only binding whenever $\Delta \in [\tilde{\Delta}^R, \Delta_I^R]$ *and for any value of* $\gamma \in (0,1)$.

As the discussion above explained, both thresholds $\tilde{\Delta}^R$ and Δ_I^R shift upwards when the price cap becomes tighter and the upward shift of $\tilde{\Delta}^R$ is stronger:

$$\frac{\partial \tilde{\Delta}^R}{\partial w^R} = -\frac{(1-\gamma)(4+\gamma)}{\gamma} > -(1-\gamma) = \frac{\partial \Delta_I^R}{\partial w^R} \ ,\forall \gamma \in (0,1) \tag{3.49}$$

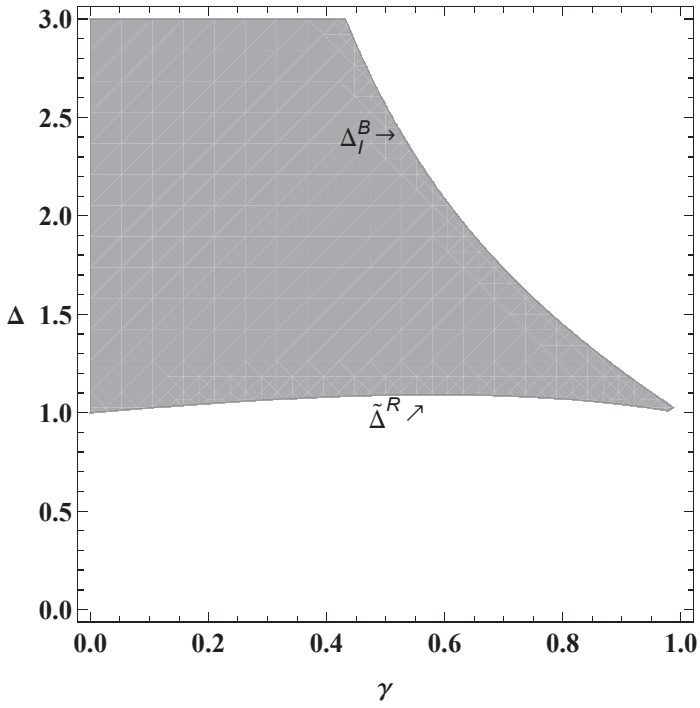
Consequently, the relevant parameter space shrinks as the price cap becomes tighter, as is depicted on Fig. 3.3 below. Finally, it should be noted that at strict cost-oriented regulation with $\bar{w} = 0$, $\tilde{\Delta}^R = \Delta_I^R$, meaning that any scope for a ban on margin squeeze in the present duopolistic setting has vanished.

The analysis turns now to the setting where upstream market regulation is combined with a ban on margin squeeze. This setting is representative for the EU approach. It is applicable to most public utility industries. For instance, whenever an incumbent telecom operator commercialises a new offer based on a price-regulated infrastructure (e.g. the copper network), it has to ensure that alternative operators are able to replicate this new offer based on the incumbent's upstream offer. The next section analyses changes in market outcomes in such a setting.

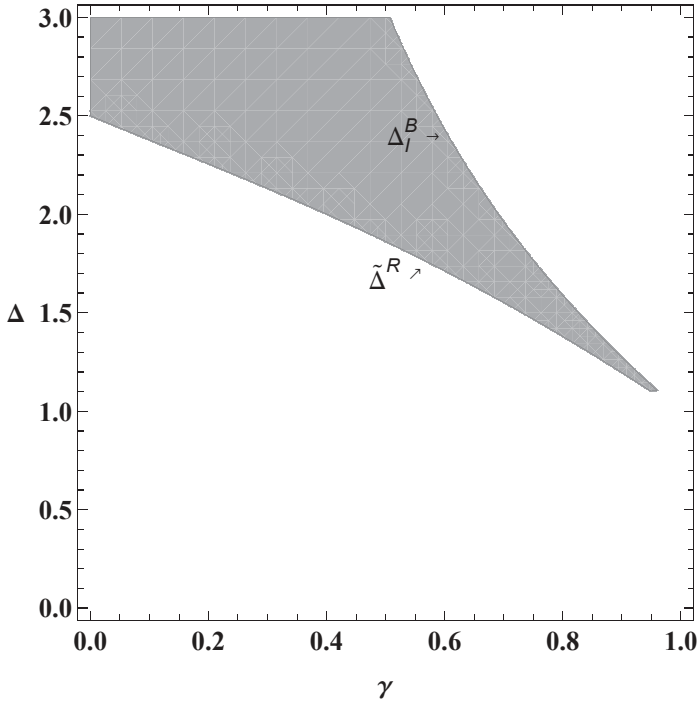
3.5.2 Competition law enforcement

This section considers the combination of upstream market regulation and competition law enforcement.

The equilibrium in the downstream price setting stage is the same as in



(a) $w^R = w^*$



(b) $0 < w^R < w^*$

Fig. 3.3 The shaded areas depicted the combinations of Δ and γ for which both firms are active in the downstream market and the EEO-requirement is not met. Banning a margin squeeze is only a relevant policy in these areas.

section 3.4.2:

$$p_I^{RB}(w) = c_I + \bar{\bar{w}} \tag{3.50a}$$

$$p_C^{RB}(w) = c_C + \bar{\bar{w}} + \frac{\Delta - \gamma - \bar{\bar{w}}(1-\gamma)}{2} \tag{3.50b}$$

Similarly, to the unregulated setting, the vertically integrated firm would ideally charge a smaller upstream price. The DRC-effect would thus still be at play in the regulated setting. However, for regulation to be binding, the price cap must be below the integrated firm's optimal upstream price. Hence, price cap regulation is constraining when $\bar{\bar{w}} \in [0, w^B)$, where $\bar{\bar{w}}$ denotes the exogenous price cap in the present setting.[29]

It is important to recall that the upstream price w^B the integrated firm would ideally set when it has to meet the EEO-rule is lower than w^* from the "free competition" setting (see proposition 3.2). This is important for the assessment of impacts induced by a ban on margin squeeze when the upstream market is regulated. In effect, any price cap above in between w^B but below w^* is constraining in the *regulation-only* setting, but not in the *regulation & ban* setting. Thus, for the sake of consistency, the remaining analysis uses w^B as reference for regulation to be constraining.

As has been the case in the previous subsection 3.5.1, upstream market regulation has a pro-competitive effect on the downstream prices. Although, due to the ban, the integrated firm's downstream price also involves a PU-effect. And, as it turns out, regarding the competitor's price, the domination of the PU-effect over the pro-competitive effect of regulation can longer be excluded. Indeed, calculating the difference between the competitor's prices from the *regulation & ban* setting (equation (3.50b)) and from the *regulation-only* setting (equation (3.44b)), it appears that the PU-effect may dominate whenever the competitor's downstream efficiency index Δ lies within the parameter range stated in lemma 3.3.

To be precise, from the competitor's price difference, it is possible to derive a threshold of Δ such that the price with a ban, p_C^{RB} is higher than p_C^R, i.e the

[29] As in *regulation-only* setting, only constraining regulation is considered, as, otherwise, the analysis would yield exactly the same outcome as in a unregulated environment with a margin squeeze ban.

price without a ban:

$$\begin{aligned} p_C^{RB} - p_C^R > 0 \\ &\Leftrightarrow \frac{\gamma[\gamma(\gamma+\Delta) - 2 + \bar{\bar{w}}(1-\gamma)(4+\gamma)]}{2(4-\gamma^2)} > 0 \\ &\Rightarrow \Delta > \frac{2 - \bar{\bar{w}}(1-\gamma)(4+\gamma) - \gamma^2}{\gamma} = \tilde{\Delta}^R \end{aligned} \tag{3.51}$$

It thus turns out that the competitor's price always increases whenever the EEO-rule would be binding. This stems from the fact that an unregulated upstream price constitutes an optimal balance between upstream demand stimulation and downstream pricing discipline. With an exogenous price cap however, this balance is not sufficiently accounted for. Moreover, an exogenous price cap does not account for the competitor's higher downstream efficiency Δ. To see this, suppose the price cap $\bar{\bar{w}}$ to be a proportion $\varepsilon \in [0, 1)$ of the integrated firm's preferred upstream price, i.e. $\bar{\bar{w}} = \varepsilon w^B = \varepsilon\left(\frac{2+\gamma+\Delta}{2(3+\gamma)}\right)$. ε represents the regulatory strength, where price cap regulation is tighter when ε approaches 0. The unintegrated competitor's downstream prices with ban, p_C^{RB}, and without ban p_C^R would then yield:

$$\begin{aligned} p_C^{RB}(\bar{\bar{w}} = \varepsilon w^B) &= c_C + \varepsilon w^B + \frac{\Delta - \gamma - \varepsilon w^B(1-\gamma)}{2} \\ &= c_C + \varepsilon\Big(\frac{2+\gamma+\Delta}{2(3+\gamma)}\Big) + \frac{\Delta - \gamma - \varepsilon\left(\frac{2+\gamma+\Delta}{2(3+\gamma)}\right)(1-\gamma)}{2} \\ &= c_C + \frac{\Delta[6+\varepsilon+\gamma(2+\varepsilon)] + (1+\gamma)\tau - \Gamma}{4(3+\gamma)} \end{aligned} \tag{3.52}$$

$$\begin{aligned} p_C^{R}(\bar{\bar{w}} = \varepsilon w^B) &= c_C + \varepsilon w^B + \frac{(2-\gamma^2)\Delta - \gamma - 2\varepsilon w^B(1-\gamma^2)}{4-\gamma^2} \\ &= c_C + \varepsilon\Big(\frac{2+\gamma+\Delta}{2(3+\gamma)}\Big) + \frac{(2-\gamma^2)\Delta - \gamma - 2\varepsilon\left(\frac{2+\gamma+\Delta}{2(3+\gamma)}\right)(1-\gamma^2)}{4-\gamma^2} \\ &= c_C + \frac{\Delta[2(3+\gamma)(2-\gamma^2) + (2+\gamma^2)\epsilon] + (2+\gamma^2)\tau - \Gamma}{2(2-\gamma)(2+\gamma)(3+\gamma)} \end{aligned} \tag{3.53}$$

expression where $\tau = (2+\gamma)\varepsilon$ and $\Gamma = 2\gamma(3+\gamma)$. Then, a marginal increase in Δ shows up more important when a ban on margin squeeze is implemented. Indeed, $\forall\gamma \in (0,1)$ and $\forall\varepsilon \in [0,1)$:

$$\begin{aligned}
&\frac{\partial p_C^{RB}(\bar{\bar{w}} = \varepsilon w^B)}{\partial\Delta} - \frac{\partial p_C^{R}(\bar{\bar{w}} = \varepsilon w^B)}{\partial\Delta} > 0 \\
\Leftrightarrow &\frac{6+\varepsilon+\gamma(2+\varepsilon)}{4(3+\gamma)} - \frac{2(3+\gamma)(2-\gamma^2)+(2+\gamma^2)\epsilon}{2(2-\gamma)(2+\gamma)(3+\gamma)} > 0 \\
\Rightarrow &\frac{\gamma[\gamma(3+\gamma)(2-\varepsilon)+4\varepsilon]}{4(2-\gamma)(2+\gamma)(3+\gamma)} > 0
\end{aligned} \tag{3.54}$$

It then follows that, whenever the EEO-requirement is to be fulfilled (i.e. $\Delta \in [\tilde{\Delta}^R, \Delta_I^R]$), the unintegrated competitor's downstream price increases more with its downstream efficiency, because only a proportion equal to ε Δ is incorporated in the regulated upstream price. The PU-effect outweighs the pro-competitive effect and the competitor is able to extract higher rents from consumers.

Both results above also apply to the vertically integrated firm's downstream price. Its price difference increases whenever $\Delta > \tilde{\Delta}$:

$$\begin{aligned}
&p_I^{RB} - p_I^R > 0 \\
\Leftrightarrow &\frac{\gamma\Big(\gamma+\Delta\Big) + \bar{\bar{w}}(1-\gamma)(4+\gamma) - 2}{4-\gamma^2} > 0 \\
\Rightarrow &\Delta > \frac{2 - \bar{\bar{w}}(1-\gamma)(4+\gamma) - \gamma^2}{\gamma} = \tilde{\Delta}^R
\end{aligned} \tag{3.55}$$

And, similarly to the calculations for the competitor, using $\bar{\bar{w}} = \varepsilon w^B$ shows that a ban implies a higher price increase when Δ increases. Plugging $\bar{\bar{w}} = \varepsilon w^B = \varepsilon\Big(\frac{2+\gamma+\Delta}{2(3+\gamma)}\Big)$ into (3.50a) and (3.44a) yields:

$$p_I^{RB}(\bar{\bar{w}} = \varepsilon w^B) = c_I + \varepsilon\frac{(2+\gamma+\Delta)}{2(3+\gamma)} \tag{3.56a}$$

$$p_I^{R}(\bar{\bar{w}} = \varepsilon w^B) = c_I + \frac{2(3+\gamma)(2-\gamma^2) + 3\gamma\tau - \gamma\Delta(2(3+\gamma)-3\varepsilon)}{2(2-\gamma)(2+\gamma)(3+\gamma)} \tag{3.56b}$$

and the difference is equal to

$$p_I^{RB} - p_I^R = \frac{\varepsilon(2+\gamma+\Delta)(1-\gamma)(4+\gamma) - 2(3+\gamma)[2-\gamma(\gamma+\Delta)]}{2(3+\gamma)(4-\gamma^2)} \tag{3.56c}$$

Then, a marginal increase in Δ increases that the difference in prices given by (3.56c):

$$\frac{\partial p_I^{RB}(\bar{\bar{w}} = \varepsilon w^B)}{\partial \Delta} - \frac{\partial p_I^{R}(\bar{\bar{w}} = \varepsilon w^B)}{\partial \Delta} > 0 \tag{3.57}$$

$$\Leftrightarrow \frac{\varepsilon}{2(3+\gamma)} - \Big\{ - \frac{\gamma[2(3+\gamma) - 3\varepsilon]}{2(2-\gamma)(2+\gamma)(3+\gamma)} > 0 \Big\}$$

$$\Rightarrow \frac{\gamma(3+\gamma)(2-\varepsilon) + 4\varepsilon}{2(2-\gamma)(2+\gamma)(3+\gamma)} > 0 \ , \forall \gamma \in (0,1) \text{ and } \forall \varepsilon \in [0,1) \tag{3.58}$$

An important insight becomes thus clear when the unregulated setting is compared to the regulated one: the pro-competitive effect of competition law enforcement absent upstream market regulation disappears. The mere effect of a ban when the upstream market is regulated is to shift the ability to extract rents from the upstream market (absent regulation, the monopolist extracted rents from its competitor) to the downstream market where both firms extract higher rents from consumers.

3.5.3 Welfare analysis

The implications for consumer surplus are evident. With higher prices to pay, consumers are worse off when the EEO-requirement is binding with constraining upstream market regulation.

As for the firms' profits, the relatively more efficient competitor always earns higher revenues, leading to a profit increase. For the integrated firm, the impact goes in the other direction. The latter's profits always decrease. Altogether, the impact on industry profits is less clear-cut. Only when product differentiation is sufficiently strong, the competitor's profit increase may

outweigh the integrated firm's losses.

The impact on social welfare is equally ambiguous. With an ever decreasing consumer surplus, the increase of industry profits must be sufficiently high for social welfare to increase. However, a decrease of social welfare can not be excluded. Moreover, if social welfare increases in the presence of a ban on margin squeeze, it will be to the detriment of consumers.

Therefore,

Proposition 3.8. *Suppose the upstream market is exogenously regulated and* $\Delta \in [\tilde{\Delta}, \Delta_I^R]$. *A ban on margin squeeze*

i) has a downstream competition softening effect via by the price umbrella,

ii) increases the competitor's profits,

iii) decreases the integrated firm's profits,

iv) decrases the industry output,

v) is likely decreases consumer surplus,

vi) has an ambiguous effect on industry profits and social welfare.

Proof. See appendix A.3.2.

Finally, expressions (3.51) and (3.55) showed that the price umbrella occurs whenever a ban on margin squeeze is a potential option, i.e. $\Delta \geq \tilde{\Delta}$. Thus, the same analysis of increasing regulatory strength applies. It has been discussed below lemma 3.3: a tight price cap regulation reduces the parameter space where a margin squeeze occurs. Hence, a tighter price cap also reduces the parameter space for the price umbrella to appear.

From the discussion above arises the question about what good a ban on margin squeeze brings when the upstream market is regulated. Indeed, since the mere effect of a ban is to shift rent extraction from one segment of the industry to the other and its social desirability is challenged, it is questionable whether a ban is actually necessary. Turned otherwise, this becomes "Is

upstream market regulation as stand-alone policy not sufficient?", a question that falls back to the comparison of the EU approach to the US approach. The next section discusses the results above in order to reply to that question.

3.6 Discussion and conclusion

The debate on the complementarity or substitutability of market regulation and competition law is vivid and mainly two opposing views exist. Whereas the US are reluctant towards the application of competition law in a regulated industry, the EU clearly considers that the market risks to function improperly without competition law enforcement.

This chapter considered a duopoly in a vertically related industry in order to assess the economic impacts on the outcome in either view by focussing on the case of margin squeeze. It highlights the strength of regulation as stand-alone policy, which appears to be a means sufficiently strong to annul any margin squeeze threat. Moreover, since tighter regulation reduces the welfare detrimental impact induced by competition law enforcement, a ban on margin squeeze appears unnecessary and not desirable from a social welfare point of view. Indeed, following the analysis, the pro-competitive effect of tighter regulation are passed on to consumers with lower prices to be paid and more output available.

The joint implementation of regulation and margin squeeze ban induces at least one clearly loosing party: the consumers. Now, put into to context of protection of the proper functioning of the market and ultimately consumers, the EU approach is likely to miss its goal.

A margin squeeze may well appear as exploitation of market power, but it also has a pro-competitive side. Due to vertical integration, the upstream monopolist's optimal pricing scheme may lead to a negative margin. However, this exploitative margin squeeze can also be seen as a means to discipline more

efficient downstream competitors without, as is the case in setting analysed here, excluding them. Indeed, strategic complementarity between downstream prices would imply that both prices remain lower, which is undeniably beneficial for consumers.

The conclusion of the present analysis is thus quite clear. The relation between upstream market regulation and competition law enforcement should be considered as one of substitution. Therefore, when market regulation is set up in one level of the industry, authorities should consider to refrain from regulating other levels. This holds for either form of regulation, whether bottleneck access regulation or margin squeeze regulation: absent regulation, ban on margin squeeze induced higher social welfare, whereas it yields an uncertain outcome in a regulated environment.

There are however limits to the analysis presented here. For instance, vertically related industries are often composed of more than two downstream firms. A more competitive setting may be of interest as higher competitive pressure could reduce the possibility to extract higher rents in a regulation & ban setting, which may thus lead to different outcomes. The intuitions are not clear-cut as the results will also depend on several parameters such as downstream efficiency and product differentiation. In order to avoid false positive, a rigorous analysis on that subject is called for.

Furthermore, important questions about investment incentives must be looked into. It is not clear whether regulation & ban favours the upstream investment of unintegrated competitors or not. At first sight, given the increase in the latter's profits, the intuition says it would so. But, anticipating a possible decrease of regulatory strength, provided that upstream market becomes more competitive, may impede such upstream investment. Also, how do the investment incentives of the vertically integrated firm change and how does it react towards possible investment by downstream competitors? These

and other unanswered questions are possible avenues for further research.

Bibliography

Beard T. R., Kaserman D. L., Mayo J. W., (2003). On the impotence of imputation, *Telecommunications Policy*, 27, 585-595.

Biglaiser G., DeGraba P., (2001). Downstream integration by a bottleneck input supplier whose regulated wholesale prices are above costs, *RAND Journal of Economics*, 32(2), 302-315.

Bouckaert J., Verboven F., (2004). Price Squeeze in a Regulatory Environment, *Journal of Regulatory Economics*, 26(3), 321-351. DOI: 10.1007/s11149-004-7554-3.

Briglauer W., Götz G., Schwarz A., (2011b). Margin Squeeze in Fixed-Network Telephony Markets - Competitive or Anticompetitive?, *Review of Network Economics* 10(4). DOI: 10.2202/1446-9022.1257.

Carlton D. W., (2008). Should Price Squeeze be a Recognized Form of Anticompetitive Conduct?, *Journal of Competition Law and Economics*, 4(2), 271-278. DOI:10.1093/joclec/nhn012.

Choné P., Komly B., Meunier V., (2010). Margin Squeeze, entry and "umbrella effect, *Mimeo*.

Economides N., (1998). The incentive for non-price discrimination by an input monopolist, *International Journal of Industrial Economics* 16(3), 271-284. http://dx.doi.org/10.1016/S0167-7187(98)00005-8.

European Commission, (1998). Notice on the Application of the Competition Rules to Access Agreements in the Telecommunications Sector, 98/C: 265/02 (also in Official Journal C 265, 22/08/1998:2-28). Available here.

European Commission, (2009). Communication form the Commission - Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings, C 45/7 (also in Official Journal 2009/C 045/02). Available here.

Ginsburg D. H., (2008). Judge Bork, consumer welfare, and antitrust law, *Harvard Journal of Law and Public Policy*, 31(5), 449-454.

Gonzáles A., (2006). Antitrust and regulation, complements or substitutes? The case of a vertically integrated firm. Avalaible here.

Hastings J. S., Gilbert R. J., (2005). Market power, vertical integration and the wholesale price of gasoline, *Journal of Industrial Economics*, 53(4), 469-492. DOI:10.1111/j.1467-6451.2005.00266.x.

Hay G., McMahon K., (2012). The diverging approach to price squeeze in the US and the EU, *Journal of Competition Law & Economics*, 8(2), 259-296.

Häckner J., (2000). A note on price and quantity competition in differentiated oligopolies, *Journal of Economic Theory*, 93(2), 233-239. http://dx.doi.org/10.1006/jeth.2000.2654.

Jaunaux L., Lebourges M., (2013), Economic Replicability Tests for Next-Generation Access Networks. Available here

Jullien B., Rey P., Saavedra C., (2013). The Economics of Margin Squeeze, IDEI Report. Available here.

OFCOM, (2013). Final Decision of The Office of Communications, CW/988/06/08: Complaint from THUS plc and Gamma Telecom Lim-

ited against BT about alleged margin squeeze in Wholesale Calls pricing, 20/06/2013. Available here.

Salop S. C., Scheffman D. T., (1983). Raising Rivals' Costs. *American Economic Review*, 73(2), 267-271.

Sibley D. S., Weisman D. L., (1998). Raising Rivals' Costs: The entry of an upstream monopolist into downstream markets, *Information Economics and Policy*, 451-470. http://dx.doi.org/10.1016/S0167-6245(98)00012-2.

Sidak G., (2008). Abolishing the Price Squeeze as a Theory of Antitrust Liability, *Journal of Competition Law and Economics*, 4(2), 279-309. Available here.

Singh N., Vives X., (1984). Price and Quantity Competition in a Differentiated Duopoly, *The Rand Journal of Economics*, 15(4), 546-554.

Zanchettin P., (2006). Differentiated Duopoly with Asymmetric Costs, *Journal of Economics and Management Strategy*, 15(4), 999-1015. DOI: 10.1111/j.1530-9134.2006.00125.x.

Appendix Chapter 3

A.3.1 Proofs of proposition 3.6

Variation of industry profits At industry level, total profits increase:

$$\begin{aligned}\Pi^B - \Pi^* =&(\pi_I^B + \pi_C^B) - (\pi_I^* + \pi_C^*)\\ =&\frac{1}{16}\Big\{\frac{(2+\gamma(5+\gamma-3\Delta)-5\Delta)^2}{(3+\gamma)^2(1-\gamma^2)} - \frac{16\,(2+\gamma^2)^2\,(\gamma-\Delta)^2}{(1-\gamma^2)\,(8+\gamma^2)^2}\\ &+\frac{2(2+\gamma+\Delta)^2}{(1+\gamma)(3+\gamma)} + \frac{4\,(3\gamma^2+\gamma^4+8\gamma\Delta-4\,(2+\Delta^2))}{(1-\gamma^2)(8+\gamma^2)}\Big\}\end{aligned} \tag{A.3.1}$$

Evaluating at $\Delta = \tilde{\Delta}$:

$$\begin{aligned}\Pi^B - \Pi^* =& \frac{(1-\gamma)^2\gamma(4+\gamma)\,(48+44\gamma+35\gamma^2+9\gamma^3)}{64(4-\gamma)^2(1+\gamma)(3+\gamma)^2}\\ &> 0\ \forall\gamma\in(0,1)\end{aligned} \tag{A.3.2}$$

Furthermore, a marginal increase in Δ implies higher industry profits with a ban on margin squeeze:

$$\begin{aligned}\frac{\partial[\Pi^B-\Pi^*]}{\partial\Delta} =&\frac{128(1+2\Delta)+\gamma\Big(\gamma\Big\{32-\gamma\Big[64+\gamma\Big(81+\gamma(70+9\gamma)\Big)\Big]\Big\}\Delta-384\Big)}{8(3+\gamma)^2(1-\gamma^2)(8+\gamma^2)^2}\\ &+\frac{\gamma\Big(512\Delta-\gamma\Big\{608-\gamma\Big\{64+\gamma\Big[34+\gamma\Big(111+\gamma(68+11\gamma)\Big)\Big]\Big\}\Big\}\Big)}{8(3+\gamma)^2(1-\gamma^2)(8+\gamma^2)^2}\\ &>0\ \forall\gamma\in(0,1)\text{ and }\Delta>1\end{aligned} \tag{A.3.3}$$

Since industry profits increase even if the vertically integrated firm incur losses, these losses are more than compensated by the increase of the competitor's profits.

Variation of social welfare In the "free competition" setting, the equilibrium level of welfare is obtained by plugging q_I^* and q_C^* into (3.43):

$$W^*(q_I^*, q_C^*) = \frac{1}{8(1-\gamma^2)(8+\gamma^2)^2}\Big\{192 - 13\gamma^4 + \gamma^6 - 4\gamma(64 + 23\gamma^2 + 3\gamma^4)\Delta + 4(4+\gamma^2)(7+2\gamma^2)\Delta^2\Big\} \tag{A.3.4}$$

Similarly, when a ban on margin squeeze is implemented:

$$W^B(q_I^B, q_C^B) = \frac{1}{32(3+\gamma)^2(1-\gamma^2)}\Big\{124 + \gamma\{108 - \gamma[9 + \gamma(26+5\gamma)]\} - \Delta[44 - 2\gamma\left(101 + 60\gamma + 9\gamma^2\right)] + \Delta^2[91 + \gamma(82+19\gamma)]\Big\}$$

The difference between W^B and W^* evaluated at $\Delta = \tilde{\Delta}$ yields:

$$(W^B - W^*) = \frac{(1-\gamma)\gamma(4+\gamma)\Big(336 + \gamma\{140 - \gamma[29 + \gamma(50+13\gamma)]\}\Big)}{128(4-\gamma)^2(1+\gamma)(3+\gamma)^2} \tag{A.3.5}$$

$$> 0 \ \forall\gamma \in (0,1)$$

Furthermore,

$$\frac{\partial[W^B - W^*]}{\partial\Delta} = \frac{1}{32(1-\gamma^2)}\Big(\frac{182\Delta - 44 - 2\gamma[101 + \gamma(60 + 9\gamma - 19\Delta) - 82\Delta]}{(3+\gamma)^2} - \frac{4[8(4+\gamma^2)(7+2\gamma^2)\Delta - 4\gamma(64 + 23\gamma^2 + 3\gamma^4)]}{(8+\gamma^2)^2}\Big) \tag{A.3.6}$$

$$> 0 \ \forall\gamma \in (0,1) \text{ and } \Delta > 1$$

Fig A.3.1 below depicts the different levels of W^*, W^B and the difference

between both.

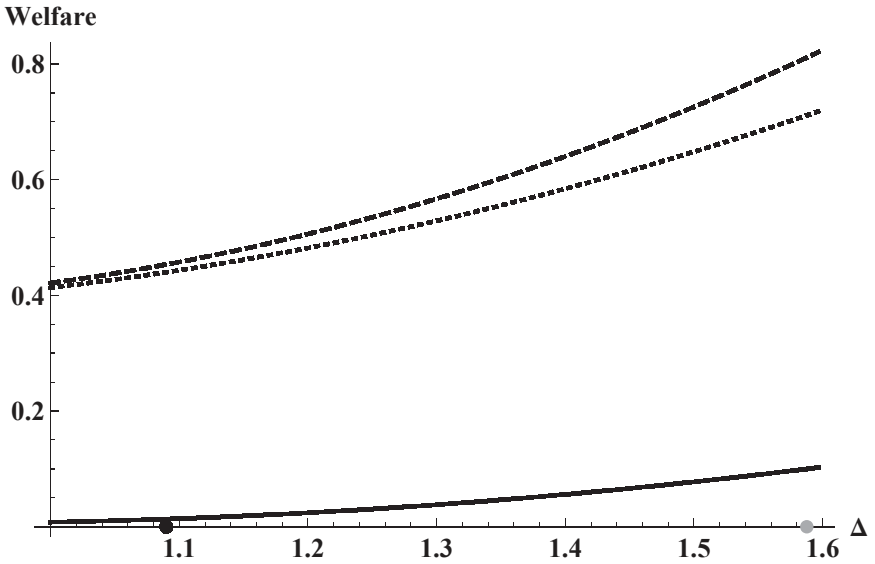


Fig. A.3.1 The level of i) social welfare in the "free competition" setting (the dotted line), ii) with competition law enforcement (the dashed line) and iii) the difference between both. Here, $\gamma = 0.65$. The black point indicates the level of $\tilde{\Delta}$ and the lighter gray point Δ_I^B.

The competitor's price decreases more than the integrated firm's price increases. To see this, it suffices to calculate the difference in variations of prices:

$$(p_C^B - p_C^*) - (p_I^B - p_I^*) = \frac{32 - \gamma^2(8 + \gamma - \gamma^2) - [32 - \gamma(12 - 3\gamma - \gamma^2)]\Delta}{4(3 + \gamma)(8 + \gamma^2)} \tag{A.3.7}$$

Whenever the integrated firm's price entails a price umbrella, i.e. $\Delta > \Delta^{PU}$, the above is negative. Indeed, at $\Delta = \Delta^{PU}$

$$\begin{aligned}(p_C^B - p_C^*) - (p_I^B - p_I^*) &= -\frac{\gamma(1 - \gamma)(4 + \gamma)}{4[8 - \gamma(6 + \gamma)]} \\ &< 0 \ \forall \gamma \in (0, 1)\end{aligned} \tag{A.3.8}$$

Moreover, equation (A.3.7) is a decreasing function of Δ (this is, $\frac{\partial[(p_C^B - p_C^*) - (p_I^B - p_I^*)]}{\partial \Delta} = -\frac{32-\gamma(12-3\gamma-\gamma^2)}{4(3+\gamma)(8+\gamma^2)} < 0, \forall \gamma \in (0,1)$), it follows that the competitor's price decrease outweighs the integrated firm's price increase whenever it is more efficient.

The competitor's quantities increase more than the integrated firm's quantities decrease. Similar calculations for quantities:

$$\mathcal{Q}_C - \mathcal{Q}_I = \frac{\Delta[32 - \gamma(12 - 3\gamma - \gamma^2)] - 32 + \gamma^2(8 + \gamma - \gamma^2)}{4(1-\gamma)(3+\gamma)(8+\gamma^2)} \tag{A.3.9}$$

If a price umbrella is observed, then the above is positive. At $\Delta = \Delta^{PU}$:

$$\mathcal{Q}_C - \mathcal{Q}_I = \frac{\gamma(4+\gamma)}{4[8 - \gamma(6+\gamma)]} > 0 \ \forall \gamma \in (0,1) \tag{A.3.10}$$

And finally, note that equation (A.3.9) is an increasing function of Δ, implying the more efficient the competitor is relative to the integrated firm, the more its output expansion outweighs to integrated firm's output contraction. □

A.3.2 Proof of proposition 3.8

In this appendix, the proof of the proposition 3.8 are provided. Although, recall that comparing the outcome in a setting with upstream market regulation as stand-alone policy to the outcome with joint implementation of upstream regulation and competition law has to rely on a price cap $\bar{\bar{w}}$ such that $\bar{\bar{w}} \in [0, w^B)$. Indeed, a price cap $\bar{\bar{w}} \in (w^B, w^*)$ is only constraining setting with regulation as stand-alone policy, but not in the setting with regulation and competition law enforcement. Therefore, the analysis only considers the case of $\bar{\bar{w}} \in [0, w^B)$. Moreover, let $\bar{\bar{w}} = \varepsilon w^B = \varepsilon\left(\frac{2-\gamma-\Delta}{2(3+\gamma)}\right)$.

In the following, each point of the proposition is proven, except the first (the downstream competition softening effect), which has been explained in

the main text.

If upstream market regulation exists, a ban on margin squeeze increases the unintegrated competitor's profits. First, in a setting with regulation as stand-alone policy and with $\bar{\bar{w}} = \varepsilon w^B$, the competitor's equilibrium prices and quantities are as follows:

$$p_C^R = c_C + \frac{\Delta[2(3+\gamma)(2-\gamma^2) + (2+\gamma^2)\epsilon] + (2+\gamma^2)(2+\gamma)\varepsilon - 2\gamma(3+\gamma)}{2(2-\gamma)(2+\gamma)(3+\gamma)} \tag{A.3.11a}$$

$$q_C^R = frac(3+\gamma)\Big[\Delta(2-\gamma^2) - \gamma\Big] - \varepsilon(1-\gamma^2)(2+\gamma+\Delta)(3+\gamma)(1-\gamma^2)(4-\gamma^2) \tag{A.3.11b}$$

Second, if regulation and a margin squeeze ban are implemented jointly, the above become:

$$p_C^{RB} = c_C + \frac{\Delta[6+\varepsilon+\gamma(2+\varepsilon)] + (1+\gamma)(2+\gamma)\varepsilon - 2\gamma(3+\gamma)}{4(3+\gamma)} \tag{A.3.12a}$$

$$q_C^{RB} = \frac{2(\Delta-\gamma)(3+\gamma) - \varepsilon(1-\gamma)(2+\gamma+\Delta)}{4(1-\gamma^2)(3+\gamma)} \tag{A.3.12b}$$

Next, plugging equation (A.3.11a) and (A.3.11b), respectively (A.3.12a) and (A.3.12b) into the unintegrated competitor's profit function yields:

$$\begin{aligned} \pi_C^R &= (p_C^R - c_C - \varepsilon w^B) q_C^R \\ &= \frac{\Big\{\varepsilon(1-\gamma^2)(2+\gamma+\Delta) + (3+\gamma)\Big[\gamma - \Delta(2-\gamma^2)\Big]\Big\}^2}{(3+\gamma)^2(4-\gamma^2)^2(1-\gamma^2)} \end{aligned} \tag{A.3.13a}$$

$$\begin{aligned} \pi_C^{RB} &= (p_C^{RB} - c_C - \varepsilon w^B) q_C^{RB} \\ &= \frac{\Big[2(3+\gamma)(\Delta-\gamma) - \varepsilon(1-\gamma)(2+\gamma+\Delta)\Big]^2}{16(3+\gamma)^2(1-\gamma^2)} \end{aligned} \tag{A.3.13b}$$

Finally, the difference in profits Π_C yields:

$$\Pi_C = \frac{\left[2(3+\gamma)(\Delta-\gamma)-\zeta\right]^2(4-\gamma^2)^2 - 16\left\{\zeta+(3+\gamma)[\gamma-(2-\gamma^2)\Delta]\right\}^2}{16(3+\gamma)^2(1-\gamma^2)(4-\gamma^2)^2} \tag{A.3.14}$$

where $\zeta = \varepsilon(1-\gamma)(2+\gamma+\Delta)$.

Considered at the boundaries of the relevant parameter space $(\tilde{\Delta}, \Delta_I^R)$, the difference in profits Π_C becomes:

$$\Pi_C(\Delta = \tilde{\Delta}) = 0 \tag{A.3.15a}$$

$$\Pi_C(\Delta = \Delta_I^R) = \frac{(1-\gamma^2)\varepsilon\left\{4(3+\gamma)-\varepsilon[2+\gamma(3+2\gamma)]\right\}}{\gamma[6+\varepsilon+\gamma(2-\gamma\varepsilon)]^2} \tag{A.3.15b}$$

Given $\gamma \in (0,1)$, $4(3+\gamma)$ is always greater than $\varepsilon[2+\gamma(3+2\gamma)]$, regardless the regulatory strength. Hence, at the largest Δ possible that allows a duopolistic setting the competitor is better with a ban on margin squeeze. Moreover, moving from the smallest Δ earns the same profits with or without competition law enforcement. Therefore, the competitor earns higher profits whenever a ban is binding and the upstream market subject to ex ante regulation.

Moreover, the derivative of Π_C with respect to Δ shows up strictly positive for any $\Delta \in (\tilde{\Delta}^R, \Delta_I^R)$:

$$\frac{\partial \Pi_C}{\partial \Delta} = \frac{a\,b + c\,d}{16(3+\gamma)^2(1-\gamma^2)(4-\gamma^2)^2} \tag{A.3.16}$$

with

$$a = 2(4-\gamma^2)^2[6-\varepsilon+\gamma(2+\varepsilon)] \tag{A.3.17}$$

$$b = 2(3+\gamma)(\Delta-\gamma) - \varepsilon(1-\gamma)(2+\gamma+\Delta) \tag{A.3.18}$$

$$c = 32\Big\{6+\gamma\Big[2-\gamma(3+\gamma-\varepsilon)\Big]-\varepsilon\Big\} \tag{A.3.19}$$

$$d = \varepsilon(1-\gamma^2)(2+\gamma+\Delta) + (3+\gamma)\Big[\gamma-\Delta(2-\gamma^2)\Big] \tag{A.3.20}$$

At the $\Delta = \tilde{\Delta}^R$,

$$\begin{aligned} a\,b + c\,d &= f\gamma\Big[2(3+\gamma) - \varepsilon(5+\gamma)\Big] \\ &> 0\ ,\ \forall\gamma \in (0,1) \text{ and } \varepsilon \in (0,1] \end{aligned} \tag{A.3.21}$$

where $f = 8(1+\gamma)(2+\gamma)(3+\gamma)(2-\gamma)(1-\gamma) > 0$, $\forall\gamma \in (0,1)$.

Similarly, at $\Delta = \Delta_I^R$:

$$\begin{aligned} a\,b + c\,d &= \frac{f\Big\{4\gamma(3+\gamma)^2 + 2\varepsilon(3+\gamma)[8-\gamma(2+\gamma)^2] - \varepsilon^2(1-\gamma)\{8+\gamma[9+\gamma(5+\gamma)]\}\Big\}}{2(3+\gamma)+\varepsilon(1-\gamma^2)} \\ &> 0\ ,\ \forall\gamma \in (0,1) \text{ and } \varepsilon \in (0,1] \end{aligned} \tag{A.3.22}$$

Thus, an marginal increase of Δ increases the profits of the unintegrated competitor.

If upstream market regulation exists, a ban on margin squeeze decreases the profits of the vertically integrated firm. In the case of upstream market regulation as stand-alone policy, the equilibrium downstream price and output of the integrated firm are equal to:

$$\begin{aligned} p_I^R &= c_I + \varepsilon w^B + \frac{2-\gamma^2-\gamma\Delta - w^B(1-\gamma)(4+\gamma)}{4-\gamma^2} \\ &= c_I + \frac{2(3+\gamma)[2-\gamma(\Delta+\gamma)] + 3\varepsilon\gamma(2+\Delta+\gamma)}{2(3+\gamma)(4-\gamma^2)} \end{aligned} \tag{A.3.23a}$$

$$\begin{aligned} q_I^R &= \frac{2-\gamma(\gamma+\Delta) - \gamma(1-\gamma^2)\varepsilon w^B}{(1-\gamma^2)(4-\gamma^2)} \\ &= \frac{2(3+\gamma)\Big[2-\gamma(\gamma+\Delta)\Big] - \varepsilon\gamma(1-\gamma^2)(2+\gamma+\Delta)}{2(3+\gamma)(1-\gamma^2)(4-\gamma^2)} \end{aligned} \tag{A.3.23b}$$

On the other hand, when upstream market regulation is set up jointly with a ban on margin squeeze:

$$\begin{aligned} p_I^{RB} &= c_I + \varepsilon w^B \\ &= c_I + \varepsilon \frac{2+\gamma+\Delta}{2(3+\gamma)} \end{aligned} \tag{A.3.24a}$$

$$\begin{aligned} q_I^{RB} &= \frac{2-\gamma(\gamma+\Delta)-\gamma(1-\gamma^2)\varepsilon w^B}{(1-\gamma^2)(4-\gamma^2)} \\ &= \frac{2(3+\gamma)\Big[2-\gamma(\gamma+\Delta)\Big]-\varepsilon\gamma(1-\gamma^2)(2+\gamma+\Delta)}{2(3+\gamma)(1-\gamma^2)(4-\gamma^2)} \end{aligned} \tag{A.3.24b}$$

Plugging (A.3.23a) and (A.3.23b), respectively (A.3.24a) and (A.3.24b), into the vertically integrated firm's profit function yields:

$$\begin{aligned} \pi_I^R &= (p_I^R - c_I - \varepsilon w^B) q_I^R + \varepsilon w^B (q_C^R + q_I^R) \\ &= \frac{a^2(1+\Delta)(3+\gamma)-a(1+\gamma)]}{4(1+\gamma)(3+\gamma)^2(2-\gamma)} + \frac{[a(4+\gamma)(1-\gamma)-b][a\gamma(1-\gamma^2)-b]}{4(2+\gamma)^2(3+\gamma)^2(1-\gamma^2)(2-\gamma)^2} \end{aligned} \tag{A.3.25a}$$

$$\begin{aligned} \pi_I^{RB} &= (p_I^{RB} - c_I - \varepsilon w^B) q_I^{RB} + \varepsilon w^B (q_C^{RB} + q_I^{RB}) \\ &= \frac{\varepsilon(2-\varepsilon)(2+\gamma+\Delta)^2}{8(1+\gamma)(3+\gamma)} \end{aligned} \tag{A.3.25b}$$

with $a = \varepsilon(2+\gamma+\Delta)$ and $b = 2(3+\gamma)[2-\gamma(\gamma+\Delta)]$. The difference between these two expressions yield:

$$\Pi_I = -\frac{[b-a(4+\gamma)(1-\gamma)]\{4(3+\gamma)[2-\gamma(\gamma+\Delta)]-a(1-\gamma)[8+\gamma(6-\gamma^2)]\}}{8(2+\gamma)^2(3+\gamma)^2(1-\gamma^2)(2-\gamma)^2} \tag{A.3.26}$$

At $\tilde{\Delta}^R$, $[b-a(4+\gamma)(1-\gamma)] = 0$ and thus $\Pi_I = 0$.

At Δ_I^R:

$$b - a(4+\gamma)(1-\gamma) = -\frac{4\varepsilon(1+\gamma)(2+\gamma)(3+\gamma)(1-\gamma)(2-\gamma)}{\gamma[2(3+\gamma)+\varepsilon(1-\gamma^2)]}$$

$$4(3+\gamma)[2-\gamma(\gamma+\Delta)] - a(1-\gamma)[8+\gamma(6-\gamma^2)] = - \frac{4\varepsilon(1+\gamma)(3+\gamma)(2+\gamma)^2(1-\gamma)(2-\gamma)}{\gamma[2(3+\gamma)+\varepsilon(1-\gamma^2)]}$$

and thus, the numerator of Π_I is positive. Ultimately,

$$\begin{aligned}\Pi_I &= -\frac{2\varepsilon^2(2+\gamma)(1-\gamma^2)}{\gamma^2[2(3+\gamma)+\varepsilon(1-\gamma^2)]^2} \\ &< 0 \ , \forall\gamma \in (0,1) \text{ and } \varepsilon \in (0,1] \end{aligned} \tag{A.3.27}$$

If upstream market regulation exists, a ban on margin squeeze decreases the industry output. If upstream market regulation is applied as stand-alone policy, the quantities of both firms and industry output ($\mathcal{Q}^R$) are equal to:

$$\begin{aligned} q_I^R &= \frac{2-\gamma(\gamma+\Delta)-\gamma(1-\gamma^2)\varepsilon w^B}{(1-\gamma^2)(4-\gamma^2)} \\ &= \frac{2(3+\gamma)\Big[2-\gamma(\gamma+\Delta)\Big]-\varepsilon\gamma(1-\gamma^2)(2+\gamma+\Delta)}{2(3+\gamma)(1-\gamma^2)(4-\gamma^2)} \end{aligned} \tag{A.3.28a}$$

$$\begin{aligned} q_C^R &= \frac{(2-\gamma^2)\Delta-\gamma-2(1-\gamma^2)\varepsilon w^B}{(1-\gamma^2)(4-\gamma^2)} \\ &= \frac{(3+\gamma)\Big[\Delta(2-\gamma^2)-\gamma\Big]-\varepsilon(1-\gamma^2)(2+\gamma+\Delta)}{(3+\gamma)(1-\gamma^2)(4-\gamma^2)} \end{aligned} \tag{A.3.28b}$$

$$\begin{aligned} \mathcal{Q}^R &= q_I^R + q_C^R \\ &= \frac{2(1+\Delta)(3+\gamma)-\varepsilon[2+\Delta+\gamma(3+\gamma+\Delta)]}{2(2-\gamma)(1+\gamma)(3+\gamma)} \end{aligned} \tag{A.3.28c}$$

On the other hand, if the upstream market is subject to price cap regulation and competition law requires the fulfillment of the EEO-rule, downstream

output is equal to:

$$q_I^{RB} = \frac{\Big[\gamma(1-\Delta)+2-\gamma(1-\gamma)\Big](1-\bar{\bar{w}})}{2(1-\gamma^2)}$$
$$= \frac{2(3+\gamma)\Big[2-\gamma(\gamma+\Delta)\Big]-\varepsilon(1-\gamma)(2+\gamma)(2+\gamma+\Delta)}{4(3+\gamma)(1-\gamma^2)} \quad \text{(A.3.29a)}$$

$$q_C^{RB} = \frac{\Delta-\gamma-(1-\gamma)\bar{\bar{w}}}{2(1-\gamma^2)}$$
$$= \frac{2(\Delta-\gamma)(3+\gamma)-\varepsilon(1-\gamma)(2+\gamma+\Delta)}{4(1-\gamma^2)(3+\gamma)} \quad \text{(A.3.29b)}$$

$$\mathcal{Q}^{RB} = q_I^{RB} + q_C^{RB}$$
$$= \frac{(2-\varepsilon)(2+\gamma+\Delta)}{4(1+\gamma)} \quad \text{(A.3.29c)}$$

The difference in industry outputs in both regimes then yields:

$$\mathcal{Q}^{RB} - \mathcal{Q}^{R} = \frac{2(3\gamma)[2-\gamma(\gamma+\Delta)]-\varepsilon(1-\gamma)(4+\gamma)(2+\gamma+\Delta)}{4(1+\gamma)(3+\gamma)(2-\gamma)} \quad \text{(A.3.30)}$$

At the boundaries of the relevant parameter space $(\tilde{\Delta}^R, \Delta_I^R)$, the above becomes:

$$\mathcal{Q}^{RB} - \mathcal{Q}^{R}(\Delta = \tilde{\Delta}^R) = 0 \quad \text{(A.3.31a)}$$

$$\mathcal{Q}^{RB} - \mathcal{Q}^{R}(\Delta = \Delta_I^R) = -\frac{\varepsilon[2-\gamma(1+\gamma)]}{\gamma[\varepsilon(1-\gamma^2)+2(3+\gamma)]} \quad \text{(A.3.31b)}$$

(A.3.31c)

Furthermore, within the relevant parameter space $(\tilde{\Delta}, \Delta_I^R)$, the above decreases with Δ:

$$\frac{\partial}{\partial\Delta}(\mathcal{Q}^{RB} - \mathcal{Q}^{R}) = -\frac{(2-\varepsilon)\gamma(3-\gamma)+4\varepsilon}{4(1+\gamma)(3+\gamma)(2-\gamma)}$$
$$< 0 \ , \forall\gamma \in (0,1) \text{ and } \varepsilon \in [0,1). \quad \text{(A.3.32)}$$

Thus, even if the difference in industry output between both regimes shrinks as Δ increases, it is always negative.

If upstream market regulation exists, a ban on margin squeeze has an ambiguous effect on industry profits. The difference in total industry profits is given by:

$$\begin{aligned}\Pi_{Industry} =& \pi_I^{RB} + \pi_C^{RB} - (\pi_I^R + \pi_C^R) \\ =& \frac{1}{16(2+\gamma)^2(3+\gamma)^2(1-\gamma^2)(2-\gamma)^2}\Big\{[b-a(4+\gamma)(1-\gamma)] \\ & \Big\{-2(3+\gamma)[8-\gamma(10+\gamma^4)] + \varepsilon\Big[32+\gamma\Big(28+\gamma(3+\gamma)(10-3\gamma)\Big)\Big] \\ & - \Delta\Big[2\gamma(3+\gamma)(4-3\gamma^2) - \varepsilon\Big[16+\gamma\Big(4\gamma(16+\gamma(7-3\gamma))\Big)\Big]\Big\}\Big\}\end{aligned} \tag{A.3.33}$$

Then, $\forall \Delta \in (\tilde{\Delta}^R, \Delta_I^R)$:

$$\Pi_{Industry} \begin{cases} > 0 \begin{cases} \gamma \in (0, \frac{1}{2}) \begin{cases} \varepsilon \in (0, \frac{4\gamma(3+\gamma)}{4+\gamma[4+\gamma(3+2\gamma)]}) \text{ and } \Delta \in (\tilde{\Delta}^R, \Delta_I^R) \\ \varepsilon \in (\frac{4\gamma(3+\gamma)}{4+\gamma[4+\gamma(3+2\gamma)]}, 1) \text{ and } \Delta \in (\tilde{\Delta}^R, \hat{\Delta}) \end{cases} \\ \gamma \in (\frac{1}{2}, 1) \text{ and } \varepsilon \in (0,1) \text{ and } \Delta \in (\tilde{\Delta}^R, \Delta_I^R) \end{cases} \\ < 0 \quad \gamma \in (0, \frac{1}{2}) \text{ and } \varepsilon \in (\frac{4\gamma(3+\gamma)}{4+\gamma[4+\gamma(3+2\gamma)]}, 1) \text{ and } \Delta \in (\tilde{\Delta}^R, \Delta_I^R) \end{cases} \tag{A.3.34}$$

where $\hat{\Delta} = \frac{\varepsilon(1-\gamma)(2+\gamma)[16+\gamma(2+\gamma)(10-3\gamma)]-2(3+\gamma[8-\gamma^2(10-\gamma^2)]}{2\gamma(3+\gamma)(4-3\gamma^2)-\varepsilon\Big[16+\gamma[4-\gamma\Big(16+\gamma(7-3\gamma)\Big)]\Big]}$.

If upstream market regulation exists, a ban on margin squeeze has an ambiguous effect on social welfare. Plugging equilibrium quantities (A.3.23b) and (A.3.11b), respectively (A.3.24b) and (A.3.12b) in expression

(A.3.23b) and (3.43) yields:

$$W^R = \frac{1}{8(2+\gamma)^2(3+\gamma)^2(1-\gamma^2)(2-\gamma)^2}\Big\{ a(1-\gamma^2)\Big\{4(3+\gamma)[\gamma^3-\Delta(4-3\gamma^2)] - \varepsilon\Big[\gamma\Big(4+5\gamma(2+\gamma)\Big)+\Delta(4+5\gamma^2)+8\Big)\Big]\Big\} - 4(3+\gamma)^2\{2\gamma\Delta(8-3\gamma^2)-(1+\Delta^2)[12-\gamma^2(9-2\gamma^2)]\}\Big\} \quad \text{(A.3.35a)}$$

$$W^{RB} = \frac{4(3+\gamma)^2[4-\gamma^2+3\Delta(\Delta-2\gamma)] - a(1-\gamma)\Big[4(3+\gamma)(\Delta-\gamma)+a(5+3\gamma)}{32(3+\gamma)^2(1-\gamma^2)\Big]} \quad \text{(A.3.35b)}$$

where $a = \varepsilon(2+\gamma+\Delta)$.

The difference in social welfare between both regimes yields:

$$W^{RB}-W^R = -\frac{1}{32(3+\gamma)^2(1-\gamma^2)(4-\gamma^2)^2}\Big\{ [b-a(1-\gamma)(4+\gamma)]\Big(2(3+\gamma)\Big[8-\gamma\Big[12\Delta+\gamma(2-\gamma(\gamma+5\Delta))\Big]\Big]\Big) + a\Big[16+\gamma\Big[4-\gamma(16+\gamma(7-3\gamma))\Big]\Big]\Big\} \quad \text{(A.3.36)}$$

At the boundaries, the above yields

$$W^{RB}-W^R \begin{cases} = 0 \text{ if } \Delta = \tilde{\Delta}^R \\ = -\frac{(1-\gamma)\varepsilon\left[4\gamma(3+\gamma)-\varepsilon[4+\gamma(6+\gamma(5+2\gamma))]\right]}{2\gamma^2[2(3+\gamma)+\varepsilon(1-\gamma^2)]^2} \text{ if } \Delta = \Delta_I^R \end{cases} \quad \text{(A.3.37)}$$

Finally, if $\Delta = \Delta_I^R$, the difference $W^{RB}-W^R$ becomes, $\forall\gamma \in (0,1)$:

$$W^{RB}-W^R \begin{cases} \leq 0 \text{ if } \varepsilon \in (0, \frac{4\gamma(3+\gamma)}{4+\gamma[6+\gamma(5+2\gamma)]}] \\ > 0 \text{ if } \varepsilon \in [\frac{4\gamma(3+\gamma)}{4+\gamma[6+\gamma(5+2\gamma)]}, 1) \end{cases} \quad \text{(A.3.38)}$$

If upstream market regulation exists, a ban on margin squeeze has an ambiguous effect on consumer welfare. The difference in consumer

surplus between both regime can be derived from $CS = W - \Pi_{Industry}$ using expressions A.3.36 and A.3.33:

$$\begin{aligned}\mathcal{CS} =& \frac{1}{32(3+\gamma)^2\,(1-\gamma^2)\,(4-\gamma^2)^2}\Bigg\{ \\ & 4(3+\gamma)^2\Big[3(8+\gamma^4)-\gamma(4+\gamma^2)\Delta-22\gamma^2\Big]\Big[2-\gamma(\gamma+\Delta)\Big]-a(1-\gamma) \\ & \Big\{\Big[12\gamma^6-128\varepsilon-\gamma\Big\{128-\gamma\varepsilon\Big[88+\gamma[148+(2-\gamma)\gamma(17+3\gamma)]\Big]\Big\} \\ & -\varepsilon\Delta(1-\gamma)(4+\gamma)[16+\gamma(2+\gamma)(10-3\gamma)]\Big] \\ & +4\Big[192+\gamma\Big[160-48\Delta-\gamma\Big[112+52\Delta+\gamma \\ & \Big[24(5+\Delta)+\gamma\Big(12+\Delta-\gamma(13+\Delta)\Big)\Big]\Big]\Big]\Big]\Big\}\Bigg\} \end{aligned} \tag{A.3.39}$$

At the boundaries, the above yields

$$\mathcal{CS}\begin{cases} = 0 \text{ if } \Delta = \tilde{\Delta}^R \\ = \frac{(1-\gamma)(1+\gamma)\varepsilon\Big\{\varepsilon\Big[4+\gamma(2+\gamma+2\gamma^2)\Big]-4\gamma(3+\gamma)\Big\}}{2\gamma^2[2(3+\gamma)+\varepsilon(1-\gamma^2)\Big]^2} \text{ if } \Delta = \Delta_I^R \end{cases} \tag{A.3.40}$$

Finally, if $\Delta = \Delta_I^R$, the difference $\mathcal{CS}$ becomes:

$$W^{RB} - W^R \begin{cases} \leq 0 \text{ if } \gamma \in (0,1) \text{ and } \varepsilon \in [0, \frac{4\gamma(3+\gamma)}{4+\gamma(2+\gamma+2\gamma^2)}] \\ > 0 \text{ if } \gamma \in (0,\omega) \text{ and } \varepsilon \in (\frac{4\gamma(3+\gamma)}{4+\gamma(2+\gamma+2\gamma^2)}, 1] \end{cases} \tag{A.3.41}$$

where ω is the root of $4 - 10\varepsilon - 3\varepsilon^3 + 2\varepsilon^3$.

General conclusion

The ICT industry is one of the most dynamic in our present economic environment. It is not surprising that it became a cornerstone of today's strategy regarding the further development of the society, as these dynamics have provided (and will continue to provide) considerable efficiency and productivity gains to the complete society.

However, this industry is composed of a high number of actors. And, the higher the number of actors involved in a process, the more complicated the process becomes. Unfortunately, the telecommunications industry is no exception to this rule. It is therefore of crucial importance to understand the strategic behavior of all the members of the underlying value chain and the consequences implied by their actions.

With the objective to contribute to the comprehension of this ecosystem, the three brief essays in this thesis focussed in particular on the telecommunications sector. The past 20 years have brought around substantial changes to this sector, ranging from technological innovations, increasing competition, to changes of the behavior of services providers, consumers as well as national regulatory agencies. Which one has influenced the other resembles to the chicken-and-egg problem. Fact is that the changes occurred and their consequences have to be understood.

The first two chapters of this thesis place emphasis on the evolving behavior of consumers and service providers. While an ongoing Fixed-Mobile substitution is observed on the demand side, a trend towards Fixed-Mobile bundling

is observed on the supply side. This opposition gives rise to the question of whether bundling substitutable services is an adequate response and what it means for the telecommunications sector. A theoretical framework is therefore developed in the first chapter that aims to provide relevant insights. By placing the differential between consumers' valuations for fixed and mobile services in the centre of the analysis, it is shown that bundling is profitable as long as consumers appreciate fixed services sufficiently in comparison to mobile services. In contrast the existing literature, a prisoners' dilemma situation does not necessarily emerge, nor does consumer surplus decrease. Although, since bundled sales come with a reduced price, this price competition may lead to a decrease of the market value and thus potential revenue streams for firms, putting in question investment incentives or agreements.

The French market may be used to illustrate this result. With the appearance of a fourth multi-market operator, a fierce price competition has been triggered in early 2012. Highly aggressive mobile offers have emerge along with very competitive Fixed-Mobile bundles. The low-cost era in the French market has thus started. The consequence in the short run is obvious: consumers benefit from low prices and well stuffed plans. On the other hand, though, it also triggered a consolidation process, as two of the three established operators got into financial difficulties.[30] Whether this consolidation process is to be welcomed be from a social welfare perspective remains yet an open question. However, the market actors' revenues have suffered considerable retractions in the first year and investments dropped by up to 30 % in the following year.[31] Anyway, operators have concluded agreements to cover France with a nationwide high-speed Internet network by the early 2020's and these potential negative effects of this increased competition remain yet to be proven in the mid or long term.

[30] See here for information on SFR's and Bouygues Télécom's workforce reorganisation.
[31] See here for ARCEP's observatory on electronic communications.

The changes on the demand side are also the centroid of the second chapter. Unlike the precedent one, this chapter treats the subject empirically. In particular, it studies the impact of socio-demographic factors on the consumption behavior of French communication service users, shedding thus a different light on Fixed-Mobile substitution.

Using a large sample of French data for the period 2008 - 2012, the study allows to confirm a result already established for the US or the UK, namely that mobile-only consumption is predominantly due to a stronger budget constraint of the concerned consumers. Several studies from the beginning of the 2000's on FMS in the US derived that low income households are more likely to use only mobile services. However, these studies also highlighted that this "new" type of consumption is predominantly embodied by market newcomers, rather than people who actually cancel a fixed line subscription. Despite the fact that the data used here does not allow to conclude on this topic, it allows to conclude on French multi-market operators' differentiation. As a matter of fact, it reveals that the incumbent operator has a competitive advantage in rural areas and small cities, whereas in large cities, where competition is most intense, its competitors do not lack of aggressiveness.

Even though the results are in line with former studies, their robustness might be debatable. First of all, the data has been collected at the time of the worst economic crisis since the Black Thursday in 1929, nor does it not include any information about the consumers' habits to use their services. Notwithstanding the (high) probability that technological evolution has a significant impact on the emergence of mobile-only consumption, it amounts to speculation to include it as a component of the explanation of the results from this chapter. It would therefore be of interest to repeat the analysis using data from economically better times and with the missing data. Second, as mentioned above, the market entry of the fourth mobile operator in the French market

has created much agitation, implying another impact on consumers' behavior. Future data will tell more about that impact.

Competition between services and firms as considered in the first two chapters has been achieved, among other things, by the political will of liberalising the telecommunications sector. In particular, the access regulation of the nation-wide copper network, under the scrutiny of a former legal monopoly, became the core mission of national regulatory agencies. As time went by and service-based competition in the fixed market took off, several claims of discriminatory pricing, namely margin squeeze, arose with the ultimate consequence that the telecommunications industry became subject to some form of wholesale and downstream price regulation.

The question of whether the joint implementation of these regulatory tools, respectively judicial tools is wise or not is the focus of the third and last chapter. Here, a theoretical framework is used in order to analyse the interaction between upstream market access regulation and downstream market non-discrimination obligations, and particularly a ban on margin squeeze. In a context of differentiated retail products, the analysis reveals that the combining both tools is likely to lead to a decrease of social welfare, as final prices increase and output decreases. A sufficient condition for this to arise is a higher downstream efficiency of the unintegrated competitor.

The results from the last chapter can be put in perspective in the following way. The ultimate goal of the European Commission is to enhance social welfare and in order to achieve this, the Commissions relies on the perfect competition ideology. Enhancing the competitive process is thus one of the main drivers of European competition policy. Within this framework, the Commission considers a margin squeeze as an independent doctrine of anticompetitive behavior by dominant firms and has therefore increased its surveillance of pricing strategies, in particular by complementing access price regulation with

competition law enforcement.

Unlike the US approach towards margin squeeze case, which prefers substitutability between both tools, the European approach is likely to miss the objective of increased welfare. The debate on the best way to handle this issue remains vivid, as the most recent EU judgement in these matters once again confirmed the case of margin squeeze as a reliability doctrine.[32] The newly invested Commission did not yet made any statement on the topic at hand, but it will be interesting to see whether a change (and thus possibly a convergence in that matter) between the US and the EU will occur or not.

The fact that the ICT industry has become a top priority of political authorities shows its importance for our society. But, the underlying complex features borne by his industry bears have to be well understood in order to reap its full benefits. This thesis is merely a little drop on this glowing stone and much remains yet to be done.

[32] Memo of the European Commission dated from 10/07/2014 on the judgment by the EU Court of Justice (case C-295/12 P). To be found here.

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VU et PERMIS D'IMPRIMER

A Montpellier, le

Le Président de l'Université de Montpellier

Philippe Augé

DOCTORAT DE L'UNIVERSITE DE MONTPELLIER

FACULTE D'ECONOMIE

TITRE: Essais en économies des télécommunications: concurrence entre services et entre firmes

RESUME

Le secteur des télécommunications est devenu très important pour notre société, car, non seulement permet-il de mettre en relation des personnes se trouvant à des bouts opposés dans le monde, mais il contribue également à la croissance de notre productivité. Afin de bénéficier au maximum de ce secteur, il est indispensable de bien comprendre son fonctionnement. Le but de cette thèse est justement de contribuer à sa meilleure compréhension. Elle vise en particulier des questions relatives à son environnement concurrentiel. Un premier volet se concentre sur la concurrence entre les services de télécommunication: les services fixes et mobiles. En effet, des évolutions contradictoires sont observées depuis quelque temps. D'abord, le nombre de consommateurs qui n'utilisent que leur mobile pour satisfaire leurs besoins en télécommunications ne cesse d'augmenter. Ensuite, le nombre de souscription d'offres groupées, regroupant des services fixes et mobiles, connaît également une hausse importante. Se pose alors la question, traitée dans le premier chapitre, concernant la rentabilité de cette pratique pour les opérateurs de télécommunications, ainsi que l'impact sur le bien-être social lié à cette stratégie. Un modèle théorique, intégrant à la fois la différenciation horizontale, la substitution fixe-mobile et les préférences hétérogènes des consommateurs, permet de conclure que les opérateurs risquent de subir des pertes de profits, alors que les consommateurs profitent de cette pratique. Par ailleurs, le gain des consommateurs est plus grand que la réduction de profits des opérateurs, de façon à ce que le welfare social augmente. La substitution fixe-mobile est également au cœur du deuxième chapitre qui cherche à déterminer les caractéristiques sociodémographiques d'environ 20.000 utilisateurs français expliquant le mieux leur choix en matière de souscription soit à une offre mobile en tant que service unique, soit à une offre groupée ou encore à plusieurs services séparément. Le résultat principal est que les utilisateurs «mobile-only» semblent avoir une contrainte de budget plus serrée que les utilisateurs «multi-services». Par ailleurs, l'étude fait apparaître un avantage pour l'opérateur historique quand il s'agit de souscrire une offre groupée. Le deuxième volet de cette thèse traite de la concurrence entre entreprises. En particulier, le troisième et dernier chapitre propose d'analyser l'impact de l'interaction entre la réglementation sectorielle (notamment la régulation de prix) et le droit de la concurrence (notamment, l'interdiction de la pratique dite de «ciseau tarifaire») sur l'équilibre dans une industrie de réseau. Le débat sur ce sujet a engendré des points de vue diamétralement opposés, spécialement entre les USA et l'Europe: alors que ces deux outils sont considérés comme substituts outre-Atlantique, ils sont des compléments dans la conception européenne. La question est donc évidente: laquelle de ces deux doctrines a le moins d'impact sur l'efficacité du marché? Une analyse théorique permet de montrer que le prix de détail pratiqué par une firme verticalement intégrée, propriétaire du réseau physique et qui, contre paiement d'une «charge d'accès», laisse son concurrent accéder à son réseau, peut ne pas respecter le droit de la concurrence sans qu'il y ait une intention anticoncurrentielle. Par ailleurs, l'application du droit de la concurrence en combinaison avec la réglementation des prix (notamment, la charge d'accès) mène à une inefficacité du marché représentée par une hausse des prix de détails, néfaste non-seulement pour le consommateur, mais aussi pour le welfare social. Cette thèse conclut en rappelant l'importance d'une compréhension approfondie du fonctionnement du secteur des télécommunications. Parce que les évolutions reconnues dans ce secteur ne sont pas anodines, des analyses théoriques et empiriques sont nécessaires afin que chacun puisse bénéficier des apports de ce secteur.

MOTS-CLES: Télécommunications, concurrence, réglementation sectoriel

TITRE: Essais in economics of telecommunications: competition between services and between firms

ABSTRACT

The telecommunications sector has becomes very important for today's society, as it allows people at either end of the world to communicate, as well as it contributes to the growth of our productivity. In order to fully benefit from this sector, a deep understanding of its functioning is indispensable. The aim of this thesis is to contribute to its better comprehension by focusing in particular on questions relative to the competition in this sector. This thesis concentrates first on the competition between fixed and mobile telecommunications services. Indeed, contradictory evolutions are observed. First, the number of consumers relying only on their mobile so as to satisfy their need in telecommunications increases steadily. Second, the number of subscriptions of bundled offers, regrouping fixed and mobile services, has also increased in an impressive manner. The question, treated in the first chapter, is thus to know whether the practice of bundling is profitable for telecommunications operators, as well as the impacts on social welfare induced by this strategy. A theoretical model, integrating horizontal differentiation, Fixed-Mobile substitution and heterogeneous consumer preferences, allows to conclude that operators are likely to lose profits when bundling their services, whereas consumers are clear winners. Furthermore, the increase of consumer surplus more than compensates the firms' profit losses, such that social welfare increases. Fixed-Mobile substitution is also at the core of the second chapter. Its aim is to determine the socio-demographic characteristics of about 20.000 French users that explain best the users' choice of subscribing either to only a mobile offer, to a bundled offer or to several services separately. The main result is that "mobile-only" consumers seem to have a stronger budget constraint than "multi-service" users. Moreover, the study provides evidence for an "incumbency advantage" when it comes to subscribing to a bundled offer. The thesis then turns to competition between firms. More specifically, the third and last chapter offers an analysis of the impact on the equilibrium in a network industry induced by the interaction of sector regulation (notably, price regulation) and competition law (notably, the prohibition of the so-called "margin squeeze"). The debate on this subject has induced two widely opposed points of view, in particular between the US and Europe: whereas the US considers both tools to be substitutes, they are used as complements in Europe. The underlying question is thus evident: which doctrine has the least impact on the market efficiency? A theoretical analysis allows first to show that the retail price set by a vertically integrated firm, that owns the physical network and grants its downstream competitor access to it against the payment of an "access charge", may not comply with competition law without any anticompetitive intention. Moreover, applying competition law in combination with sector regulation (notably, regulation the level of the access charge) leads to market inefficiency, characterized by an increase of retail prices, which is detrimental to consumer surplus and social welfare. The thesis concludes by reminding the importance of a deep understanding of the functioning of the telecommunications sector. Since the evolutions in this sector are not harmless, many theoretical and empirical analyses are need, so that every one can profit from the contribution of this sector.

KEYWORDS: Telecommunications, competition, sector-specific regulation

DISCIPLINE : Sciences Economiques (Section 05)

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THÈSE

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Présentée par **Marc Petulowa**

Essais en économie des télécommunications: concurrence entre services and entre firmes

(Résumé français)

Sous la direction d'Edmond Baranes

Soutenue le 27 février 2015 devant le jury composé de

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Introduction générale

Imaginez le monde de nos jours sans technologies d'information et de communications (TIC). Les sociétés n'utiliseraient ni Internet, ni smartphone ou ordinateur. Les gens ne communiqueraient pas par les moyens simples que sont les courriers électroniques et ne participeraient pas à des vidéoconférences.

Toutefois, l'impact des TIC sur la vie des gens devient très clair si on regarde la réalité. Considérés comme une technologie polyvalente, les TIC deviennent un pilier pour le développement économique de nos sociétés.

D'un point de vue économique, un large éventail d'études apporte la preuve empirique: 37 % de la croissance du produit intérieur brut générée aux Etats-Unis entre 2005 et 2010 sont attribués aux TIC. Ce chiffre s'élève à 32 % pour l'Allemagne et 26 % pour la France (Arlandis *et al.*, 2011). Par ailleurs, la consommation et l'usage des TIC n'affectent pas que la croissance, mais engendrent également d'importants effets d'entraînement et de réseau. Par exemple, en apprenant à utiliser les TIC de manière efficace, la productivité globale des facteurs a augmenté de 1,3 points de pourcentage aux Etats-Unis et de 0,7 en Union Européenne pendant la période 1997-2005 (Welsum *et al.*, 2012). Comme le montre Maliranta *et al.* (2010), la forte productivité du travail en Finlande a induit une destruction créative bénéfique et un usage des ressources plus efficace.

Le secteur des télécommunications suit de près la manufacture d'appareils électroniques et constitue la deuxième composante de l'industrie TIC la plus importante. Ce secteur représente environ 37 % du PIB généré par les TIC

en Europe et presque 20 % des emplois dans les TIC (ce qui représente à peu près 1 million d'emplois).[1]

A côté de la volonté de libérer les potentiels des TIC et du secteur des télécommunications (cf. le Digital Agenda de l'Union Européenne de 2000 et la proposition de la Commission Européenne *Connected Continent* de 2013), les décideurs publics ont fait, et continuent de faire, appel à la réglementation sectorielle. D'après eux, l'introduction d'un environnement compétitif est capable de libérer ces potentiels et donc de bénéficier à toute la société. Comme les anciens monopoles légaux n'ont pas d'incitation privée à encourager la concurrence, les décideurs publics ont misé sur la réglementation pour atteindre leurs objectifs.

Il est bien connu que la duplication d'un réseau d'envergure nationale, qui est basé sur la même technologie que le réseau déjà existant, n'est pas une option viable économiquement à cause de coûts irrécupérables très élevés. Ces coûts peuvent constituer des barrières à l'entrée insurmontables pour de nouveaux entrants et ont, entre autres, été le point de départ du concept de l'échelle d'investissement, concept élaboré par Cave (2006a). D'après cette idée, pour que l'industrie toute entière soit concurrentielle, la concurrence doit être encouragée par étapes. Le marché final constitue alors la première étape, où les nouveaux entrants peuvent proposer leurs propres offres de services de télécommunications en passant par le réseau de l'opérateur historique. L'accès au réseau de ce dernier est alors soumis à la réglementation sectorielle. Une fois cette étape achevée et donc la concurrence établie sur le marché final, elle est supposée monter l'échelle et entamer la deuxième étape qui consiste à créer une concurrence entre infrastructures. Ce sont donc les investissements réalisés par les concurrents de l'opérateur historique qui constituent la clé pour l'achèvement de cette deuxième étape.

[1] Source: `Eurostat`'s Statistics Explained. Des chiffres similaires peuvent être trouvés pour les Etats-Unis, qui sont fournis par le *US Bureau of Economic Analysis* (`BEA`).

Alors que la concurrence entre services est devenue réalité en Europe, l'émergence récente de plans nationaux de subventions publiques pour aider le déploiement de nouvelles infrastructures indique que le mécanisme derrière le concept de Cave ne fonctionne pas parfaitement. La concurrence entre infrastructures ou réseaux dans le segment des communications fixes n'est pas encore achevée et il paraît que les seules forces concurrentielles sont insuffisantes pour y arriver. Certains articles académiques se sont donc penchés sur la pertinence du concept de Cave pour atteindre l'objectif du mise en place de nouveaux réseaux. Les résultats sont divergents: alors que certains auteurs considèrent que la concurrence entre services est nécessaire pour arriver à la concurrence entre infrastructures (Oldale and Padilla, 2004), d'autres remettent en question sa simple existence (Bacache *et al.*, 2013).

Une première application de la réglementation sectorielle est donc la régulation des charges d'accès au réseau fixe de l'opérateur historique. Toutefois, le marché des communications mobiles fait lui aussi l'objet d'interventions réglementaires, même si bien plus tard que sa contrepartie fixe. En particulier, les terminaisons d'appels, essentiellement sous le contrôle de l'opérateur de réseau and donc monopolistiques, ne furent pas régulées pendant un certain temps, parce qu'on croyait la concurrence sur ce marché suffisamment forte afin de discipliner les opérateurs et donc d'induire une baisse des terminaisons d'appels. Or, un effet dit «du matelas d'eau »(*waterbed effect*) a empêché cette baisse attendue. Suivant cet effet les prix finaux des communications augmentent si les terminaisons d'appels sont baissées, parce que les opérateurs de réseaux cherchent à maintenir leur niveau de profits. Cependant, la baisse des terminaisons d'appels a été achevée grâce à la réglementation, qui orientent les prix vers les coûts, mais également grâce à l'évolution des habitudes d'appels et plus spécifiquement, l'augmentation du nombre d'appels «mobiles vers mobiles». Finalement, tout comme au niveau national, les instances ré-

glementaires cherchent également à réduire les coûts d'itinérance, c.-à-d. les coûts d'un appel émis depuis l'étranger.

Le Digital Agenda et la proposition *Connected Continent* montrent toutefois que la réglementation sectorielle ne se consacre plus quasi exclusivement au développement de la concurrence afin d'atteindre des niveaux de prix bas. En effet, les instances réglementaires et législatives sont appelées à s'occuper de manière plus intense d'autres sujets, comme p. ex. la promotion d'un marché unique des communications, l'émergence d'opérateurs de services mobiles pan-européens ou encore la protection de l'*Open Internet*.

Concernant le marché unique des communications, un grand nombre de défis sont à maîtriser, parmi lesquels on trouve la création d'un cadre harmonisé relatif à l'allocation du spectre, une tarification unique et la consolidation pan-européenne.

A ce jour, les 28 pays membres ont tous leurs propres règles et designs d'enchères, souvent très complexes, pour attribuer les fréquences radioélectriques, un élément essentiel pour les communications mobiles. Cette complexité et cette multitude de règles engendrent des coûts de transactions considérables et *in fine* des dépenses très élevées pour les opérateurs mobiles. Avec un cadre unique et harmonisé, les opérateurs mobiles peuvent avoir plus de facilités pour entreprendre à l'extérieur de leur marché national.

Toutefois, si le nombre d'opérateurs mobiles est pris comme indicateur, le marché des communications mobiles européen apparaît très fragmenté. En effet, le marché des communications mobiles est caractérisé par un indice de concentration de Herfindahl-Hirschmann qui varie entre 2500 pour la Pologne et 4400 pour Malte, alors qu'il est de ± 2300 pour tout le territoire des Etats-Unis (GSMA, 2013b). La capacité d'investissement nécessaire à une éventuelle consolidation en Europe risque de ne pas être au rendez-vous, ce qui remet en question le succès quant à l'émergence d'un opérateur pan-européen.

Finalement, une tarification unique à travers toute l'Union Européenne risque d'être tout aussi problématique, car il s'agit ici d'aligner les prix pratiqués p.ex. en Roumanie (coût moyen d'un appel national: 2.2 €cents) et ceux pratiqués p.ex. en France (coût moyen: 12.7 €cents).[2]

Le cœur du problème par rapport à la protection de l'Open Internet est le concept de la neutralité du net, introduit par Wu (2003). L'idée derrière ce concept est la non-discrimination des données qui transitent à travers Internet. Plus précisément, un opérateur de réseau ne doit pas avoir le droit de discriminer les contenus échangés sur son réseau, même si ces contenus nécessitent beaucoup de ressources, c.-à-d. de la bande passante. Comme ces ressources sont essentiellement les câbles déployés et payés par l'opérateur de réseau, ce dernier se voit habiliter de pouvoir monétiser l'utilisation de ses «tuyaux ». En outre, l'évolution irrévocable des prix finaux vers des forfaits, forfaits qui connaissent par ailleurs des baisses considérables, a conduit l'opérateur de réseau à se tourner vers les fournisseurs d'applications et de contenu pour trouver de nouvelles sources de revenus.[3] Les opérateurs de réseaux et les fournisseurs d'applications et de contenu sont évidemment en désaccord, car aucun camp ne veut être le seul à contribuer à l'expansion du réseau et de chaque côté on invoque des arguments relatifs à l'investissement et l'innovation des incitations.[4]

[2] Cf. le communiqué de `presse` de la Commission du 6 août 2013 relatif au prix moyen d'un appel dans les pays membres de l'Union.

[3] La littérature sur les marchés bi-face a montré qu'une plateforme (ici, les réseaux) préfèrent fixer des prix plus bas pour le côté le mieux valorisé, qui est ensuite subventionné par des prix plus élevés sur l'autre côté (Armstrong, 2006; Rochet and Tirole, 2006). Les consommateurs finaux sont souvent considérés comme étant le côté le mieux valorisé, puisqu'ils procurent des revenus publicitaires aux fournisseurs de contenus. Il apparaît donc cohérent que les opérateurs de réseaux se tournent vers les fournisseurs de contenus pour trouver de nouvelles sources de revenus.

[4] Beaucoup d'articles académiques sont également dédiés à ce débat. L'idée ici est de décrire les incitations à innover et investir des opérateurs de réseaux ainsi que des fournisseurs d'applications et de contenu. P.ex. Wu (2003) écrit que l'innovation au niveau des applications et contenus est plus importante que celle au niveau de réseau et le conduit à la conclusion de la supériorité en terme de bien-être social d'un régime de net neutralité. A l'inverse, Yoo (2010) est de l'avis qu'un régime discriminatoire engendre plus de bien-être social, car l'allocation de la bande passante (qui est une ressource rare) au plus efficace est

Le débat sur la neutralité du net pose également des problèmes d'un point de vue juridique. Par exemple, dans sa proposition sur le *Connected Continent*, la Commission a défini des *services spécialisés*, c.-à-d. des services pouvant bénéficier d'un traitement prioritaire. La définition sous-jacente invoque une meilleure qualité de service pour ces services spécialisés, sans définir un seuil pourtant, laissant ainsi beaucoup d'espace à l'interprétation. De nombreuses discussions sont donc encore à venir.

Aux États-Unis, le problème ne réside pas dans la définition de services pouvant bénéficier d'un traitement de faveur, mais dans la question de savoir qui a le pouvoir de décider sur l'application ou non d'un régime de net neutralité. En effet, la Federal Communication Commission (FCC) a publié en 2010 une ordonnance visant à interdire toute inégalité de traitement par le fournisseur d'accès Internet.[5] Cependant, cette ordonnance a été annulée par la Cour d'appel américaine, faisant valoir que la FCC a choisi de ne pas classer le broadband comme un service de télécommunications, mais comme *Information services*.[6] Or, suivant le Telecommunications Act de 1996, le pouvoir de la FCC est limité aux seuls services de télécommunications.[7] Les *Information services* ne sont donc pas sous le contrôle du régulateur fédéral américain. Une réflexion sur le reclassement du broadband, pour qu'il tombe sous le mandat de la FCC, est maintenant en cours, mais aussi et bien plus généralement, sur la mission de la FCC dans l'ère d'Internet.

Comme indiqué ci-dessus, beaucoup de discussions restent encore à venir,

tout simplement «*l'évolution naturelle d'un réseau qui cherche à satisfaire une demande de la part du consommateur qui est en augmentation constante*»(Yoo, 2010) (traduit par Marc Petulowa). D'autres auteurs concluent également qu'un régime discriminatoire est mieux en terme de bien-être social, car augmentant la diversification des contenus et applications ainsi que des variétés de qualité de service, alors qu'un régime de net neutralité risque d'exclure les applications nécessitant une qualité moindre (Hermalin and Katz, 2007) ou favorisant l'investissement en réseau et donc la réduction de la congestion (Bourreau *et al.*, 2014).

[5] L'ordonnance «Open Internet Order »peut être trouvée `ici`.

[6] Cf. un article de `Reuter's` relatif à cette décision.

[7] Le Telecommunications Act de 1996 est une loi qui régit le secteur de télécommunications aux Etats-Unis. Par ailleurs, elle définit les missions et leur étendue de la FCC.

comme beaucoup de questions importantes sont encore sans réponse. Toutefois, le secteur des télécommunications s'est vu attribuer un rôle important pour notre société. Il est donc crucial d'analyser et de comprendre les spécificités économiques sous-jacentes de ce secteur. L'objectif de cette thèse est ainsi de contribuer à ces connaissance en se focalisant sur deux sujets majeurs qui peuvent être classés dans le domaine de la concurrence dans le secteur des télécommunications.

Concurrence entre services

Les deux premiers chapitres de cette thèse portent sur la concurrence entre les services de communication fixes et mobiles. Cette concurrence est apparue lorsque un nombre croissant de services de communications fixes sont également devenus disponibles sur les réseaux mobiles.

L'émergence de la substitution fixe-mobile

Du côté de la demande, la concurrence entre services a commencé au niveau des services vocaux. Comme les services de télécommunications mobiles sont des biens d'expérience et en raison de prix et de facteurs hors-prix (p.ex. une qualité de service moins bonne, la couverture du réseau géographique ou simplement la maniabilité des téléphones mobiles disponibles à ce moment), le taux de souscription aux offres mobiles était faible.[8] Avec l'amélioration de la couverture du réseau et la qualité de service, la substitution fixe-mobile (SFM) a eu lieu et a commencé avec la substitution de la souscription d'une deuxième ligne de téléphonie fixe par la souscription d'un forfait mobile. Puis, la SFM en matière de services vocaux a continué à se développer. Mais cette expansion a également été favorisée par les progrès technologiques. Le market-

[8] Au début des années 1990, le poids d'un téléphone mobile variait entre 250 gr. et 500 gr.

ing et stratégie de prix comme appels on-net (c.-à-d. un appel émis et placé sur le même réseau) ou comme c'est souvent le cas de nos jours, les appels illimités, quel que soit le réseau de terminaison, sont également des facteurs expliquant l'émergence de la SFM. Plus récemment, les opérateurs mobiles ont aussi introduit des offres d'appels illimités de mobile vers les réseaux fixes. Par conséquent, les appels nationaux, qu'ils soient terminés sur un réseau mobile ou fixe, sont de plus en plus émis depuis un réseau mobile. D'après la Commission, le trafic vocal sur les réseaux mobiles a dépassé le trafic vocal sur les réseaux fixe en 2008 - 2009.

Le nombre de services disponibles à la fois sur l'infrastructure fixe et l'infrastructure mobile n'a cessé de croître, entre autres, grâce à l'évolution technologique. En 40 ans, quatre technologies, respectivement évolutions technologiques, ont été développées et commercialisées avec succès. Mais l'évolution la plus impressionnante a eu lieu au cours des 15 dernières années avec l'émergence de GSM, UMTS et enfin LTE.[9]

Evolution technologique et communications mobiles

Cette évolution technologique n'a pas affecté que les services vocaux, mais a également permis de proposer des services nouveaux et innovants, avec le haut débit mobile comme produit phare. Le haut débit mobile a bénéficié de l'évolution technologique en ce que les vitesses de connexion et de transmission ont constamment augmenté. La dernière technologie, LTE permettra aux utilisateurs mobiles de surfer sur le Web à des vitesses de téléchargement théoriques proches des100 Mbps.[10] De tels débits de données sont suffisants

[9] GSM: *Global System for Mobile Communications*, est arrivé au début des années 1990 et est à la base des technologie plus efficaces GPRS (*General Packet Radio Service*), introduit vers 2001 et EDGE (*Enhanced Data rates for GSM Evolution*), introduite vers 2004.
UMTS: *Universal Mobile Telecommunications System*, avec l'extension HSPA (*High Speed Packet Access*), introduite en 2010.
LTE: *Long Term Evolution*.

[10] Cependant, de telles vitesses de téléchargement sont sujettes à de nombreux facteurs, comme p. ex. le terminal utilisé, les fréquences utilisées par les opérateurs mobiles pour le

pour permettre, entre autres, l'IP-TV sur les tablettes ou smartphones ou encore visioconférence mobile.

La technologie permettant le broadband mobile la plus répandue à ce jour est la HSPA (communément appelé 3G+), qui couvre pratiquement 100 % de la population de l'Europe (Commission (2013), p. 73). Néanmoins, le taux de pénétration de l'Europe est, en moyenne, relativement faible par rapport à d'autres parties dans le monde. A titre d'exemple et compte tenu de tous les terminaux mobiles (smartphones, tablettes et ordinateurs portables), 54 % des Européens ont souscrit à un forfait haut débit mobile à la fin de 2012 (*idem*, p. 74), alors que, le taux de pénétration de la Corée du Sud se rapproche de 110 % (GSMA (2013a), p. 30). [11] Cependant l'image est très divergente en Europe: les pays nordiques annoncent un taux de pénétration de broadband mobile de près ou au-dessus de 100 % (Danemark: 98 %, Suède: 106 %, Finlande: 107 %) et 18 des 27 Etats membres de l'UE ont des taux de pénétration en dessous de la moyenne de l'UE (Commission (2013), p . 74).

Souscription mobile croissante et tarification évolutive

Avec l'augmentation du taux de souscriptions mobiles, les opérateurs de réseaux ont profité d'économies d'échelle, ce qui a conduit à une diminution du coût moyen des services et donc des prix des abonnements mobiles. Mais les économies d'échelle n'étaient pas le seul facteur de la baisse des prix des communications mobiles. L'intensification de la concurrence joue également un rôle majeur. Par exemple, en janvier 2012, Free Mobile est entré dans le marché des communications mobiles français comme quatrième opérateur de réseau

déploiement LTE, le type d'antenne installé, le nombre de consommateurs connectés à une cellule donnée, etc.

[11] GSMA (*GSM* Association) est une association qui représente les intérêts de plus de 1000 opérateurs de télécommunications mobiles qui utilisent les normes GSM et visant à élaborer et à promouvoir des normes inter-réseaux, telles que par exemple l'utilisation de cartes SIM.

mobile.[12] Free Mobile a été lancé avec une politique de prix agressive et a déclenché l'ère du *low cost* dans le secteur des télécommunications français. A titre d'exemple, la facture mensuelle moyenne pour les services mobiles peut être mentionnée: la facture moyenne était approximativement de 23 € avant l'entrée sur le marché de Free et, d'après l'ARCEP, environ de 18 € à la fin de Septembre 2013 (Arcep, 2014b). Une autre raison expliquant la baisse des forfaits mobiles est l'intervention réglementaire qui a induit une diminution considérable des terminaisons d'appels mobiles.[13]

Les évolutions technologiques mentionnées avant ont également été accompagnées d'une évolution de la tarification des forfaits. Ainsi, avec l'introduction de la technologie GPRS, la tarification est désormais basée sur la consommation effective et non plus sur la connexion. Autrement dit, avant GPRS, le consommateur devait payer pour le temps qu'il a été connecté comme il occupait une "ligne" pleine pendant son temps de connexion. Ceci est due à la technique dite de *commutation de circuits*. Avec le GPRS, le réseau évolué vers la technique dite *commutation de paquets* qui permet le partage de la ligne entre plusieurs utilisateurs connectés. Les frais à payer par l'utilisateur dans une infrastructure à commutation de paquets sont donc basés sur le volume de données (les paquets) effectivement envoyé ou reçu, et donc sur la base de la consommation effective.

Il convient toutefois de noter que l'évolution des réseaux de communication ne constitue pas le seul facteur responsable de l'évolution de l'écosystème des

[12] Si les opérateurs de réseaux mobiles virtuels sont ajoutés, le marché français métropolitain compte pas moins de 47 opérateurs (tous marchés confondus, résidentiel et professionnel). Même si la plupart des MVNO sont spécialisés dans un segment de marché donné (p. ex. les personnes âgées, les étrangers, etc.), ils représentaient au total 11,6 % du marché français en juin 2014 (Arcep, 2014a).

[13] Les terminaisons d'appels mobiles peuvent être défini comme la charge qu'un opérateur $\mathcal{A}$ doit payer un opérateur $\mathcal{B}$ pour que ce dernier achemine (termine) l'appel émis depuis le réseau du premier. En s'appuyant sur les chiffres fournis par BEREC (Body of European Regulators of Electronic Communications), GSMA indique une diminution annuelle allant jusqu'à 18 % des terminaisons d'appels mobiles pendant la période 2006-2012 (GSMA (2013a), p 36.).

communications. Afin de bénéficier pleinement des avantages offerts par les réseaux améliorés, les consommateurs doivent s'équiper de terminaux compatibles. L'industrie des appareils mobiles tels que les smartphones et les tablettes a réagi à ces nouvelles possibilités offertes par les réseaux mobiles en développant des terminaux qui sont loins d'être de simples téléphones. Cette nouvelle génération de terminaux offre des possibilités d'usage similaires aux ordinateurs de bureau grâce à l'augmentation de la convivialité (p. ex. des icônes d'illustration) ou de l'efficacité technique (p. ex. des processeurs plus efficaces, des écrans avec une résolution plus élevée). L'utilisateur rencontre ainsi une meilleure qualité de service lorsqu'il regarde un film sur sa tablette ou smartphone. En outre, les fournisseurs de contenu tels que les réseaux sociaux, la vidéo ou la musique en streaming ont développé des applications qui permettent aux utilisateurs de consommer ces contenus sur n'importe quel terminal, ce qui augmente l'utilité de souscrire à une offre mobile des consommateurs.

Consommation de data croissante

Parallèlement au taux de pénétration mobile croissant, le taux de pénétration des terminaux mobiles est également en forte augmentation. Ces terminaux sont supposés contribuer à l'augmentation du trafic de données mobiles. Cisco fournit un rapport et les prévisions de trafic de données mobiles. Ce rapport indique qu'en 2012, le traffic de data mobile a augmenté de 70 % et que 885 pétaoctets par mois ont été échangés sur les réseaux mobiles, ce qui correspond à «*18 fois la taille de l'ensemble du traffic Internet en 2000*»(Cisco (2014), p. 1).[14] De plus, Cisco estime que le trafic de données mobiles croîtra à un taux de 66 % par an sur la période 2012 - 2017 (*idem*, p. 3). Cette croissance du trafic sera soutenue par i) la poursuite du déploiement du réseau LTE («*En 2012, [...] une connexion 4G a généré en moyenne 19 fois plus de trafic que*

[14] Traduit par Marc Petulowa. 1 pétaoctet (Pb) = 1000 téraoctet (To) = 1 000 gigaoctets (Go) . Pour illustrer, un film de 2 heures en HD nécessite environ 4 Gb

les connexions autre que 4G»(*idem*, p. 2)) et ii) l'importance croissante de la pénétration des smartphones (environ 68 % du trafic mobile mondial sera généré par les smartphones (*idem*, p. 7)).

Bien que le haut débit mobile va continuer à gagner en importance, il ne représentera qu'une fraction du trafic Internet mondial. Comme Cisco (2013b) le rapporte, le trafic de data mobile ne représente que 2 % du trafic IP mondial en 2012 et environ 9 % en 2017. L'essentiel du trafic Internet sera ainsi généré par le haut débit fixe, qui présente les avantages indéniables i) d'offrir des vitesses de connexion plus élevés que le haut débit mobile et ii) des volumes de données illimités.[15] Ce dernier avantage, toutefois, est dû à la rareté du spectre radioélectrique mis à disposition aux opérateurs mobiles afin de fournir leurs services mobiles, ce qui réduit leur possibilité d'offrir des volumes de data mobiles élevés.

Evolution technologique et communications fixes

Comme les réseaux mobiles, les réseaux fixes ont été améliorés également. Le réseau cuivre traditionnel, qui, au début ne permettait que des services vocaux analogiques et l'accès Internet à bande étroite, a fait l'objet d'une évolution constante. La paire de cuivre a bénéficié de la numérisation et les informations envoyées sur un réseau fixe sont désormais converties en données en s'appuyant sur le protocole IP (*Internet Protocol*). Ceci a permis un usage plus efficace de la bande passante, qui est accompagné d'une gamme élargie de service avec notamment *Voix sur IP* (VoIP), *TVIP* avec les *séances de rattrapage* et la *VsD* et finalement l'Internet haut débit.[16] Avec la mise à niveau vers le réseau de

[15] Dans son rapport de 2012, un seul des opérateurs interrogés avait plafonné le volume de données inclus dans ses offres fixes (OECD (2012), p. 22).

[16] *Video sur Demande* (VsD) est un service qui permet aux consommateurs de regarder n'importe quelle émission télé à n'importe quel moment qu'ils souhaitent, à condition que le contenu soit compris dans le catalogue VoD de l'opérateur. Une *séance de rattrapage* (*Catch-up TV* en anglais) est définie comme la possibilité de revoir une émission télé très peu de temps après sa première diffusion et ce pendant quelques jours seulement.

fibre optique, le réseau fixe sera en mesure d'offrir des vitesses de connexion jusqu'à 1 Gbps en liaison descendante et 10 Mbps pour la liaison montante.

Compte tenu du déploiement des dernières technologies fixes et mobiles, il apparaît que les deux infrastructures convergentes. Cette convergence vers *tout IP* implique que la relation entre les services fixes et mobiles change. Comme indiqué avant, les services vocaux sont soumis à une substitution croissante entre fixe et mobile: au début de 2011, environ 27 % des Européens ont déclaré utiliser exclusivement des services de téléphonie mobiles contre 21 % au tournant de 2005/2006 (Eurobarometer, 2006, 2011). En ce qui concerne les États-Unis, un sondage réalisé par le NHIS révèle que près de 45 % des ménages américains étaient «*mobile-only*» au premier semestre de 2013, contre approximativement 6 % fin 2005, début 2006 (Blumberg & Luke, 2007, 2014).

Toutefois, la relation entre haut débit fixe et haut débit mobile est moins nette. En fait, elle peut aller dans les deux sens.

Substitution fixe-mobile en matière de broadband

Évaluer cette relation sur le côté de la demande est délicate étant donné l'hétérogénéité des besoins des consommateurs. Certains consommateurs sont en mesure de satisfaire leurs besoins de consommation en utilisant uniquement une offre mobile. Selon une comparaison internationale faite en 2012 par le régulateur britannique OFCOM, plus d'un quart des ménages italiens ont seulement le haut débit mobile à la maison (OFCOM (2013), p. 213). [17] Aussi, un ménage australien sur cinq indique utiliser exclusivement le haut débit mobile pour se connecter à Internet. A l'inverse, certains consommateurs sont de grands consommateurs d'Internet et sont abonnés à la fois à une offre haut débit fixe et mobile afin de profiter de plus de volume de données.

La seule preuve de SFM en matière de haut débit, qui par ailleurs a été

[17] *Office of Communications.*

approuvée par une autorité nationale, est fournie par le marché autrichien. Au cours de sa révision des marchés pertinents en 2009, l'autorité nationale de régulation autrichienne, TKK, a considéré le haut débit mobile comme étant «[...]*un substitut suffisamment proche pour les connexions DSL et câble* [, d'où la décision] *de les inclure* [toutes les connexions] *dans le même marché de détail*»(Berec, 2011).[18] Face à ce constat, TKK a décidé de retirer les contraintes réglementaires ex ante sur l'accès haut débit sur le marché de gros pour les offres destinées aux particuliers.

SFM et le côté offre

Vu du côté de l'offre, les réseaux mobiles et fixes sont très probablement des compléments, à cause de la capacité limitée des réseaux mobiles. N'utiliser que les réseaux mobiles pour transiter le trafic de données mondial apparaît comme une solution insoutenable. Comme la demande des consommateurs dans le trafic de données est en augmentation constante, les opérateurs de télécommunications ont besoins de leurs réseaux fixes pour décharger au moins une partie des données passant par les réseaux mobiles afin d'assurer un niveau donné de qualité de service.[19]

Évidemment, les consommateurs ne pourraient pas bénéficier des évolutions technologiques décrites ci-dessus si les opérateurs de télécommunications n'avaient pas investi dans les infrastructures. Le déploiement de telles infrastructures de réseau nécessite des coûts d'investissement énormes.[20]

[18] *Telekom - Control-Kommission*

[19] Détourner le trafic de données mobiles est possible grâce au *Wi-Fi Offload*, par lequel les consommateurs se connectent, via le Wi-Fi, avec leur terminal mobile à un réseau broadband fixe. Dans certains pays, les opérateurs offrent à leurs abonnés haut débit fixe la possibilité «d'ouvrir» leur accès broadband fixe, créant ainsi un réseau Wi-Fi communautaire. Un autre moyen de déchargement de trafic est *Femtocell*, qui peut être défini comme une extension du réseau broadband fixe. Via une "station de base miniature" connectée à l'accès fixe, les opérateurs peuvent augmenter ou améliorer le signal du réseau mobile. Les données échangées sont, toutefois, transitées par le réseau fixe.

[20] En France, les coûts total d'investissement pour le déploiement d'un réseau de fibre optique à l'échelle nationale sont estimés autour de 20-30 milliards €. Les coûts de mise à niveau du réseau mobile vers LTE sont délicats à estimer, dépendant de l'équipement

Des coûts d'investissement élevés et une concurrence féroce sur les marchés de services ont poussé les opérateurs à adopter des stratégies permettant i) d'attirer de nouveaux consommateurs, respectivement pour réduire la volonté des consommateurs existants de changer d'opérateur et ii) d'encourager l'adoption de nouvelles infrastructures. Ce dernier point est particulièrement important si l'on tient compte des consommateurs *mobile-only* et les coûts d'investissement importants dans les infrastructures de réseaux fixes. En outre, ceci devient d'autant plus important qu'aucuns services innovants (le service dit *killer services*) ont été développés. L'objectif d'un tel service est de créer un besoin chez le consommateur et donc une incitation pour ce dernier de souscrire à une nouvelle offre.[21]

Les ventes liées comme innovation marketing

Une stratégie adoptée est la vente liée de plusieurs services. Dans le secteur des télécommunications, le regroupement de services en une seule offre existe sous des formes diverses. Dans le segment mobile, presque toute offre peut être considérée comme une offre groupée incluant une quantité donnée de minutes pour appeler, de SMS et un certain volume de data limité. Pareil pour le marché fixe, où presque chaque opérateur offre une gamme complète d'offres groupées de services avec deux des trois ou les trois services possibles (téléphonie fixe, haut débit fixe et TV). Les offres dual-play, c.-à-d. un ensemble de services de deux sur trois, sont les plus populaires en Europe avec environ 25 %, suivies par des offres triple-play (16 %, Eurobarometer (2013), p. 26).

La dernière évolution dans la pratique des ventes liées est la combinaison de

déjà installé dans les stations de base par chaque opérateur de réseau mobile. Toutefois, des consultants de Polyconseil estiment cette mise à niveau à environ 2 milliards € pour les opérateurs Orange, SFR et Bouygues et à environ 1 milliard pour le participant Free Mobile. Outre les coûts de cette mise à niveau de l'infrastructure, les licences nécessaires devaient être acquises, pour lesquels les quatre opérateurs ont payés 3,5 milliards €. Le rapport de Polyconseil est consultable `ici`.

[21] A titre d'exemple, ces killer services dans les communications mobiles sont le service voix pour la 2G et le haut débit mobile pour la 3G.

services fixes et mobiles en une seule offre. Au niveau européen, ces offres n'ont pas encore été souscrites (env. 4%), mais de nombreuses divergences existent entre les États membres de l'UE. Dans certains pays, des offres quadruple-play ne semblent pas attirer l'intérêt d'une grande partie des consommateurs. Un rapport Analysys Mason de 2013 prévoit des taux d'abonnement quadruple-play d'environ 10 % en Allemagne, en Pologne ou au Royaume-Uni. [22] A l'inverse, ces offres quadruple-play reçoivent beaucoup d'attention de la part des consommateurs dans d'autres pays. En Espagne, par exemple, la commercialisation de l'offre quadruple-play *Fusiòn* de Telefònica a incité 21 % des ménages espagnols de souscrire à cette offre en 2012 (et son taux d'adoption est estimé à doubler en 2017).[23] Les ménages français semblent également être friands des offres quadruple-play, puisque le taux de souscription est estimé à 42 % en 2012 avec un taux prévu de 75 % en 2017.[24]

Pour les consommateurs, ces offres groupées présentent de multiples avantages. Outre le fait de plus de simplicité, de transparence et un nombre réduit de factures, ils les paient également moins chères, puisqu'elles sont proposées avec un rabais. Pour les entreprises par contre, les effets de cette pratique ne sont pas toujours clairs. Le succès à court terme de *Fusiòn* de chez Telefònica, ainsi que des offres quadruple-play en France est visible. En particulier, Telefònica a réussi à récupérer toutes ses pertes en terme de clients des années 2011/2012 en seulement quelques mois après le lancement de *Fusiòn*.[25] En ce qui concerne le marché français, environ 3 ans après le lancement de son offre quadruple play, Orange prétend qu'approximativement un tiers de sa base client fixe ont souscrit à une offre quadruple-play. Il est par ailleurs estimé que

[22] Le rapport d'Analysis Mason peut être trouvé ici.
[23] *idem.*
[24] *idem.*
[25] En 2011/2012, l'opérateur historique espagnol a abandonné le système de subventions de terminaux, suite à quoi plus de 1 million de consommateurs ont quitté Telefònica pour s'abonner auprès d'un des concurrents. Voir, par exemple here.

près de la moitié de la base de clients de Free a souscrit à son offre groupée.[26]

Toutefois, la pratique des ventes liées peut avoir un inconvénient important. Plus précisément, le haut débit mobile a été le service à valeur ajoutée pour les opérateurs lorsque les forfaits mobiles avec accès 3G ont été commercialisés. Désormais, ce service à valeur ajoutée fait partie d'une concurrence féroce pour les parts de marché et l'augmentation de la fidélité des consommateurs. Comme les consommateurs sont rationnels dans le sens où ils choisissent l'offre la moins chère qui convient le mieux à leurs besoins, la vente liée avec son rabais associé risque de diminuer la valeur de marché des services haut débit. Mais, comme tous les opérateurs introduisent des offres groupées, il faut se poser la question quant à la rentabilité de ces stratégies de tarification.

Chapitre 1: Substitution Fixe-Mobile et ventes liées

Le premier chapitre de cette thèse traite de cette question et analyse les impacts potentiels de la pratique des ventes liées dans le secteur des télécommunications en tenant compte de la présence de la SFM. En particulier, via une modélisation micro-économique, l'analyse porte sur l'impact d'introduire un rabais sur la demande des consommateurs pour l'offre groupée fixe-mobile, la demande pour le fixe et mobile en tant que services isolés et la demande de *mobile-only*. Les effets sur les profits des opérateurs ainsi que le bien-être social sont également analysés.

Cette analyse considère deux entreprises multi-marché et montre que, en cas de symétrie, la pratique des ventes liées est une situation semblable au dilemme du prisonnier: à l'équilibre, aucune entreprise ne veut, mais toutes les deux doivent offrir un rabais, à cause de l'incitation individuelle à en proposer et donc attirer plus de clients.[27] Les profits des entreprises diminuent, même

[26] Source: La Tribune.

[27] Les entreprises sont supposées symétriques lorsque les consommateurs ont un même prix de réserves pour les services fixes quel que soit l'entreprise qui offre le service.

si la part des consommateurs qui s'abonnent à deux services augmente (c.-à-d. que le nombre de consommateurs *mobile-only* diminue lors de l'introduction des offre groupées). Mais, avec le rabais qui agit comme un outil concurrentiel, les opérateurs attirent plus de consommateurs vers leur offre groupée. Comme le prix ce cette dernière est inférieur à la somme des prix des services isolés, les bénéfices sont réduits. Pour les consommateurs, cette réduction de prix est parfaitement bénéfique. Par ailleurs, l'augmentation du surplus du consommateur est telle que les pertes de bénéfices des opérateurs sont plus que compensées, de sorte que, *in fin*, le bien-être social augmente.

Si, par contre, une entreprise est en mesure de fournir un service fixe de plus grande valeur (c.à-d. si les entreprises ne sont pas symétriques), l'analyse montre que cette entreprise s'accapare de profits plus importants en offrant un rabais, alors que cette stratégie est une stratégie dite de *Maximin* pour le concurrent: en proposant également des offres groupées malgré son désavantage compétitif, il minimise ses pertes. Néanmoins, l'entreprise qui propose le service fixe le mieux valorisé par le consommateur n'a aucun intérêt à provoquer une saturation complète du marché fixe et induire la totalité des consommateurs *mobile-only* à s'abonner à un service fixe. En effet, la présence de ce type de consommateur implique que le marché des services fixes ne soit pas entièrement couvert. Si c'était le cas et le marché fixe entièrement couvert, la pratique des ventes liées ne serait pas une stratégie rentable puisqu'à l'équilibre, les opérateurs n'offriront pas de rabais. En outre, si les deux services étaient parfaitement substituables, la stratégie en question ne serait pas rentable non-plus. Cela montre que le bundling est rentable pour au moins une entreprise, à condition que les services fixes et mobiles ne soient ni trop complémentaires, ni trop substituables. Finalement, comme pour le cas symétrique, le surplus du consommateur et de bien-être sociale augmente.

Chapitre 2: Caractéristiques socio-démographiques et services de télécommunications

La substitution fixe-mobile est également au cœur du deuxième chapitre de cette thèse. Le chapitre 2 tente d'évaluer de manière empirique les effets des variables socio-démographiques sur la demande des services de télécommunications en France.

En utilisant des données issues d'une enquête de satisfaction avec l'opérateur mobile des consommateur, un modèle logit multinomial est développé. Ce travail vise à identifier les caractéristiques qui influencent la probabilité d'un consommateur à être *mobile-only*, de souscrire à une offre groupée ou souscrire à plusieurs services isolés. Les premiers résultats confirment les conclusions de la littérature existante: moins le consommateur dispose de ressources financières, et plus forte est la probabilité qu'il est *mobile-only*, ce qui suggère l'existence d'une contrainte budgétaire forte pour ce type de consommateur. Un autre résultat suggère un avantage compétitif de l'opérateur historique (et plus particulièrement dans les zones rurales) dans le sens où les consommateurs d'Orange sont moins susceptibles d'être *mobile-only* que les clients des autres acteurs du marché.

L'interaction entre réglementation sectorielle et droit de la concurrence: le cas du ciseau tarifaire

Les chapitres 1 et 2 portent sur la concurrence entre les services, qui peut également être considérée comme la concurrence inter-plateforme ou une concurrence basée sur les infrastructures. Mais, au début du processus de libéralisation à la fin des années 1990, la concurrence a eu lieu sur l'infrastructure fixe, puisque les réseaux mobiles n'ont pas encore été suffisamment déployés pour exercer une pression concurrentielle sur les réseaux fixes à cette époque. Ainsi,

la concurrence intra-plateforme est la première forme notable de concurrence dans le secteur des télécommunications. La réglementation sectorielle a sa part dans cet événement.

En plus des contraintes réglementaires, les acteurs du secteur des télécommunications doivent également se conformer au droit de la concurrence. Cependant, l'interaction entre la réglementation et du droit de la concurrence peut avoir des répercussions importantes sur l'industrie. Le chapitre trois vise à analyser cette interaction et ses impacts en considérant spécifiquement la réglementation du ciseau tarifaire.

Le secteur des télécommunications est fortement influencé par la réglementation sectorielle. L'objectif de la réglementation sectorielle est de créer et de promouvoir un environnement concurrentiel en utilisant différents outils tels que l'obligation d'accès et la réglementation des prix. Même si ces outils pourraient concerner les deux secteurs mobiles et fixes, ce chapitre se concentrera sur l'intervention réglementaire dans le secteur fixe.

La réglementation du secteur a été mise en place lorsque le processus de libéralisation du secteur des télécommunications a été lancé.[28] Avant ce processus, les réseaux fixes étaient sous le contrôle d'un monopole légal ou privé, parce qu'il était plus rationnel d'un point de vue économique que ce réseau soit déployé par une seule entreprise, plutôt que par plusieurs entreprises concurrentes. Avec l'introduction de la concurrence dans les marchés des télécommunications fixes, la préoccupation principale des autorités était de créer

[28] Plusieurs autorités sont impliquées dans le processus de libéralisation. Premièrement, la Commission en poursuivant son objectif de créer un marché intérieur unique au niveau européen. Elle fixe des objectifs à atteindre et fournit un cadre réglementaire et les remèdes à d'éventuelles défaillances de marché. Voir par exemple l'avis de la Commission sur l'application des règles de concurrence aux accords d'accès dans le secteur des télécommunications (Commission (1998) (dénommé dans ce qui suit *la communication relative à l'application des règles de concurrence*). Deuxièmement, au niveau national, les autorités nationales de la concurrence (ci-après *ANC*) surveillent l'application de la législation européenne et nationale en matière de concurrence et le bon fonctionnement du processus concurrentiel. Enfin, également au niveau national, les autorités nationales de réglementation (ci-après *ANR*) ont pour mission spécifique la mise en place d'un cadre réglementaire national en accord avec les prescriptions de la Commission.

le meilleur environnement concurrentiel dans le marché en aval, compte tenu du fait que l'infrastructure de réseau fut héritée par l'ancien monopole légal. Ce dernier est ainsi devenu monopole contrôlant une infrastructure essentielle. Cette configuration, un monopole en amont qui est verticalement intégré et est en concurrence sur le marché en aval avec des concurrents qui doivent s'appuyer sur le réseau de l'entreprise intégrée, a soulevé (et soulève encore) des préoccupations d'abus de position dominante par l'entreprise intégrée.

De ce fait, une intervention réglementaire a été mise en place.

Quelques outils réglementaires

Un premier pas vers la concurrence en aval effective a été fait en introduisant l'obligation de garantir l'accès au réseau imposée à l'entreprise verticalement intégrée. Plus précisément, l'opérateur historique a été obligé de dégrouper la boucle locale, c.-à-d. d'accorder l'accès à la partie du réseau qui relie le consommateur au répartiteur principal.[29] Le dégroupage peut être compris comme la location des lignes qui relient les clients au reste du réseau à un prix dénommé «charge d'accès».

Toutefois, le dégroupage n'a pas suffi pour éviter d'éventuels abus de position dominante par le biais de charges d'accès *excessives*. Considéré comme une entrave au bon fonctionnement du jeu concurrentiel, ce comportement est interdit par le droit de la concurrence, et ce qu'il soit européen ou national.[30] En outre, les ANR s'appuient sur une réglementation *ex ante* des charges d'accès.[31] Pour que ce dernier outil soit efficace, l'entreprise verti-

[29] Le répartiteur principal est un équipement qui recueille tous les fils qui relient les clients à l'opérateur de télécommunications et qui établit l'interconnexion entre deux parties communicantes.

[30] Voir notamment le Traité sur le fonctionnement de l'Union européenne, Art.102 (2008). Le *Sherman Act* de 1890, et notamment la §2, est la loi équivalente aux États-Unis.

[31] Plusieurs méthodes de régulation des prix existent. Les plus courantes sont le *Rate of Return* (ci-après, *RoR*) et le *price cap* (*PC*). Alors que la première vise à établir un niveau de prix tel que les investisseurs gagnent un taux de rendement fixe sur le capital qu'ils ont investi, la dernière établit un niveau de prix maximum qui ne peut être dépassé. Le RoR a été abandonné au profit du PC, parce le RoR peut inciter l'entreprise réglementée être inefficace

calement intégrée est soumise à une autre obligation: la séparation comptable (Commission, 2005). Selon cette obligation, l'entreprise concernée est obligée de fournir les renseignements sur ses coûts liés à l'exploitation de son réseau (coûts de déploiement et de maintenance, la dépréciation des actifs, etc.) à son ANR. Cet échange devrait permettre aux ANR de déterminer de manière transparente les éléments de coûts pertinents à être couverts par la charge d'accès. Aussi, cette obligation est censée fournir des informations précises afin de

> «[...]*permettre de vérifier qu'il n'y a eu aucune discrimination indue entre les services fournis de façon interne et ceux fournis à l'extérieur*[...]» (Commission (2005), Art. 5, p. 266/67).[32]

Au-delà de la réglementation des prix en amont, la relation entre les prix en amont et en aval préoccupe également. Comme indiqué ci-dessus, la fourniture du service en amont doit être exempte de toute discrimination entre le bras en aval de l'opérateur historique et son rival en aval. Les autorités sont donc

en terme de coûts (faible incitation à réduire les coûts et une forte incitation à surinvestir, et donc plus de revenus nécessaires pour récupérer les investissements, ce qui *in fine* fait grimper les prix). Même si le PC a des inconvénients tels que l'asymétrie d'information entre l'autorité de réglementation et de l'entreprise réglementée ou l'incitation à réduire les coûts par la réduction de la qualité, il est largement adopté. Une troisième approche de réglementation des prix est la *règle du partage des profits* (PP). Il définit un intervalle de RoR et le partage des profits se fait de manière suivante: à chaque fois que le taux de rendement effectivement réalisé au cours d'un exercice comptable se trouve à l'intérieur de cet intervalle, l'entreprise peut garder tous ses bénéfices et, lorsque le taux de rendement effectif dépasse l'intervalle, les gains sont partagés avec les consommateurs, p. ex. par le biais d'une baisse, resp. augmentation des prix.

[32] La séparation comptable est une pratique très répandue en Europe. En dehors du vieux continent, les entités en amont et en aval des opérateurs historiques opèrent souvent sous des formes de séparation verticale plus strictes. Par exemple, au Royaume-Uni en 2005, la proposition de l'opérateur historique britannique British Telecom (BT) pour une séparation verticale plus stricte fut approuvée par l'OFCOM, l' ARN (et ACN) britannique. Depuis, certaines activités de gros sont gérées par une unité distincte de BT, où les gestionnaires ont *des incitations locales*, ce qui veut dire qu'ils cherchent à maximiser les bénéfices de leur unité plutôt que les profits de l'ensemble du groupe (Cave, 2006b). D'autres exemples de séparation verticale plus stricte sont le cas de l'opérateur historique australien Telstra (avec une approche similaire à celle de l'OFCOM) ou aux Etats-Unis avec une séparation structurelle stricte des opérations de télécommunications. Toutefois, en 2006, les États-Unis ont entamé une réflexion pour revenir sur l'approche de la séparation structurelle (OECD, 2006).

vigilantes en ce qui concerne l'écart entre les prix en amont de l'opérateur historique (i.e. la charge d'accès) et son prix en aval. En particulier, elles veillent à empêcher tout comportement anticoncurrentiel de la part de l'opérateur historique qui pourrait apparaître si l'écart mentionné ci-dessus était trop étroit. De ce fait, l'écart serait trop étroit pour qu'une entreprise non intégrée et active sur le marché en aval soit viable économiquement. Un tel écart trop étroit entre les prix en amont et en aval définit généralement un ciseau tarifaire.

Le débat sur le ciseau tarifaire

Une table ronde organisée par l'OCDE sur le sujet du ciseau tarifaire fournit une définition du ciseau tarifaire généralement acceptée:

> *Un ciseau tarifaire ne peut émerger que lorsque a) une firme active sur le marché en amont produit un input pour lequel il n'existe pas de substituts suffisamment comparables, (b) la firme active sur le marché en amont vend son input à un ou plusieurs firmes sur le marché en aval et (c) la firme active sur le marché en amont est en concurrence directe avec ces firmes sur le marché en aval.*[33]
> (OECD (2009c), p. 7)

Un débat vif est en cours sur la reconnaissance du ciseau tarifaire comme infraction indépendante au droit de la concurrence ou bien s'il vaut mieux traiter des cas de ciseau tarifaire comme une théorie du préjudice existante (i.e. prix prédateurs ou refus de vente). Ce débat oppose deux positions radicalement différentes prises par les États-Unis et l'UE.

La position américaine: le jugement *Trinko*

Une première caractéristique essentielle de l'approche américaine relative au ciseau tarifaire, est que les tribunaux américains considèrent la réglementation

[33] Traduit par Marc Petulowa.

sectorielle et le droit de la concurrence comme des substituts. Par ailleurs, la réglementation, quand elle existe, prime sur le droit de la concurrence. Le jugement historique dans l'affaire Trinko est parfaitement clair sur ce point.[34]

En 2004, l'opérateur historique du New York, Verizon, a été accusé d'avoir fourni à ses concurrents en aval un produit de gros (l'accès au réseau, dont le prix a été régulé) de moindre qualité, empêchant ainsi ses concurrents à rivaliser efficacement dans le marché en aval. Par ailleurs, l'entreprise accusée avait l'obligation réglementaire de fournir l'accès à ses concurrents non intégrés. La partie plaignante a invoqué une violation à la fois du cadre réglementaire mis en place par la Federal Communications Commission (FCC) et le droit de la concurrence, et notamment l'article 2 du Sherman Act.

Dans ce cas, la Cour Suprême des États-Unis a enquêté pour savoir si les obligations réglementaires de faire du commerce (i.e. *regulatory duty to deal*) induisent des obligations légales de faire du commerce (i.e. *antitrust duty to deal*).[35] La Cour a jugé que l'obligation réglementaire, sous la forme d'obligation d'accès imposée au monopole en amont verticalement intégré, n'est ni équivalent, ni induit-elle une obligation légale de commercer. En outre, dans son avis, la Cour s'est montrée réticente quant à l'application du droit de la concurrence en présence de la réglementation sectorielle:

> «[la réglementation sectorielle est *élaborée de manière à dissuader et de remédier à tout préjudice anticoncurrentiel.*»(Trinko, p. 12,

[34] *Verizon Communications, Inc.* v. *Law Offices of Curtis V. Trinko*, 540 U.S. 398 (2004), (ci-après *Trinko*).

[35] Suivant une déclaration des États-Unis au cours de la table ronde de l'OCDE sur le ciseau tarifaire, il existe, depuis le jugement Trinko, une différence doctrinale entre une obligation réglementaire et légale de faire du commerce. En effet, d'après le jugement, l'obligation réglementaire s'applique si le concurrent est déjà établi sur le marché en aval. Une différence institutionnelle est que le régulateur est mieux placé pour imposer des obligations de faire du commerce, compte tenu de leur proximité avec le secteur en question et une meilleure capacité d'équilibrage entre les effets à court terme sur la concurrence et les effets dynamiques à long terme tels que les investissements (OECD (2009c), p. 294). Enfin, le délégué des États-Unis à la table ronde de l'OCDE a déclaré que, même si une obligation légale existe, une plainte pour ciseau tarifaire devra être déposée en tant que plainte pour prix prédateurs (OECD (2009c), p. 251.

traduit par Marc Petulowa).

Elle estime que les autorités spécifiques et dédiées à la régulation sont plus appropriées et capables de gouverner l'environnement concurrentiel que les lois générales relatives à la concurrence et souligne plusieurs inconvénients éventuels liés à l'application simultanée. Ainsi, la Cour craignait p. ex. que l'imposition d'une obligation légale de faire du commerce pourrait induire le monopoleur en amont, ainsi que le concurrent en aval, à renoncer à la réalisation d'investissements pouvant renforcer la concurrence. En outre, imposer à deux ou plusieurs parties de négocier peut engendrer de la collusion, induisant donc une concurrence réduite au détriment du bien-être des consommateurs.

Le jugement *linkLine*

La réticence des États-Unis à accepter le ciseau tarifaire comme une infraction indépendante est illustrée par le jugement dans l'affaire linkLine.[36] En 2009, l'opérateur historique de la Californie AT&T fut accusé de compresser les marges de ses concurrents et de leur refuser l'accès à l'infrastructure essentielle de l'AT&T (son réseau DSL), alors qu'il y avait eu une obligation réglementaire de fournir l'accès. La Cour Suprême a estimé, en se basant sur le jugement Trinko, qu'AT&T n'avait aucune obligation légale de faire du commerce et n'a donc pas d'obligation d'offrir des conditions de vente qui «*préserve*[nt] *les marges de ses concurrents*».[37]

Par ailleurs, la Cour estime qu'une plainte pour ciseau tarifaire devrait être introduite sous la forme d'une plainte pour prix prédateurs. La Cour Suprême a invoqué l'argument de «*préoccupations institutionnelles*» pour ne pas reconnaître un effet de ciseaux comme une violation indépendante du droit de la concurrence lorsque la réglementation sectorielle est mis en place (linkLine, p. 4). Elle se voit mal adaptée pour surveiller en permanence les prix en

[36] *Pacific Bell* v. *linkLine Communications, Inc.*, 555 U.S. 438 (2009), (ci-après *linkLine*).
[37] linkLine, p. 3.

amont et les prix en aval, ainsi que l'écart entre les deux, puisque cette tâche reviendrait à agir comme un organisme de réglementation, ce qui est en dehors des missions d'un tribunal.

La position européenne

L'approche de l'UE est en opposition frappante. Tout d'abord, même si la recommandation de la Commission sur la séparation comptable confère une tâche équivalente à la réglementation sectorielle que les États-Unis - à savoir «[...]*identifier les comportements anticoncurrentiels potentiels,* [...]»(Commission (2005), Art. (6), 266/64) - la communication relative à l'application des règles de concurrence définit clairement les deux outils comme étant complémentaires:

> «*La Commission estime que les règles de concurrence et la réglementation sectorielle forment un ensemble cohérent de mesures propres à assurer un environnement de marché libéralisé et concurrentiel dans le secteur des télécommunications de l'Union européenne.*» (Commission (1998), Art. (149), 265/23).

Cette complémentarité a, par la suite, été soutenue par la jurisprudence européenne relative au ciseau tarifaire. Les décisions juridiques les plus importantes et explicatives concernant le ciseau tarifaire ont été prises dans des cas impliquant une entreprise active dans le secteur des télécommunications.

Le jugement *Deutsche Telekom*

Dans le cas de Deutsche Telekom (ci-après DT), la Commission a estimé que le système de tarification de l'opérateur en position dominante n'a laissé qu'une marge insuffisante à ses concurrents, qui, par la suite, se sont retrouvés dans l'impossibilité de couvrir des coûts spécifiques à leurs produits de détail (coûts

encourus sur le marché en aval afin fournir le service de détail ou produit final).[38]

Le Tribunal de première instance, soutenu par la suite par la Cour Générale (désormais *CG*), a approuvé la décision de la Commission selon laquelle un ciseau tarifaire constitue une violation indépendante de droit de la concurrence en soulignant que

> «[...]*le caractère abusif du comportement de la requérante est lié au caractère non équitable de l'écart entre ses prix [de gros] pour les [services intermédiaires d'accès à la boucle locale] et ses prix de détail [pour les services d'accès aux abonnés], qui revêt la forme [d'une compression des marges].*[39]

Cela implique que la Commission n'est pas tenue de prouver que ni le prix en amont, ni le prix en aval sont éventuellement illégaux, mais le caractère inéquitable de l'écart entre ces deux éléments de prix constitue par lui-même une violation de l'art. 102 du TFUE. Cette décision fut réaffirmée dans les jugements *Telefónica* et *TeliaSonera*.

La Commission a fondé son analyse sur le *critère du concurrent aussi efficace* (ci-après *CAE*). Le but de ce test est de vérifier si le prix en aval de l'opérateur historique permet de couvrir ses propres coûts spécifiques liés aux produits de détail pertinents lorsque le prix d'accès facturé à ses concurrents avait été imputé à son propre bras opérationnel en aval. Les tribunaux ont confirmé la légalité de ce critère, car il fournit la sécurité juridique que tous les paramètres de coûts sont connus par l'opérateur historique.[40]

Un autre élément important tiré de l'arrêt DT est que la réglementation sectorielle ne prévoit pas l'immunité face au droit de la concurrence. La Com-

[38] *Deutsche Telekom AG* v. Commission, affaire T- 271/03 et appel C-280/08 P, du 14 Octobre 2010.
[39] Appel C-280/08 P, 14 October 2010, recital 142. Ecriture d'origine.
[40] Appel C-280/08 P, 14 October 2010, ¶201 et ¶202.

mission et le CG soulignent que l'environnement réglementaire était basé sur le principe de plafonnement des prix, ce qui laisse au défendeur une marge de manœvre suffisante pour ajuster son prix de détail et ainsi mettre fin à la compression des marges.[41] Comme indiqué plus haut, la régulation des prix suivant un price cap établit un niveau maximal du prix à ne pas dépasser. Comme le prix de DT n'était pas fixé au niveau maximum, DT avait les moyens d'augmenter son prix et donc d'éviter un ciseau tarifaire. De par son inactivité à cet égard, DT a commis l'infraction qui se traduit par un comportement anticoncurrentiel. Ce point du jugement DT souligne également la vision de la Commission de la complémentarité entre les interventions réglementaires et le droit de la concurrence .

Le jugement Telefónica

Dans l'affaire Telefónica, la Commission a adopté une méthodologie de calcul plus sophistiquée.[42] L'opérateur historique espagnol, verticalement intégré, fut accusé de ciseau tarifaire envers ses clients en amont avec lesquels il était en concurrence dans le marché en aval. Afin de démontrer la présence d'une compression des marges, la Commission a utilisé, outre le calcul *année-sur-année*, la méthode *actualisation des flux de trésorerie* (ci-après *DCF*, issu de l'expression anglaise *discounted cash-flow*) afin de vérifier la rentabilité à long terme de l'entreprise accusée. Malgré les inconvénients possibles liés à cette méthode (p. ex. faux positif en raison de flux de trésorerie futurs importants qui l'emportent sur les pertes initiales (¶333 de la décision de la Commission dans Telefónica)), la CG a rejeté l'appel de Telefónica contre l'utilisation de DCF. La Cours a considéré que la Commission avait raison d'appliquer la méthode DCF, vu que les deux méthodes ont déjà demontré la présence d'un

[41] *idem*, ¶11.

[42] *Telefónica & Telefónica de España* v. *Commission*, affaires T-336/07 et T-398/07, 2007, et *Telefónica & Telefónica de España* v. *Commission*, affaire C-295/12 P.

ciseau tarifaire.

Dans son appel, Telefónica a affirmé que des investissements en amont ont induit des charges d'accès élevées, alors qu'en même temps, le marché en aval a fait l'objet d'une concurrence intense entre les offres convergentes. A cette concurrence intense furent associées des pratiques de rabais importants, d'où donc des prix de vente très bas sur le marché de détail. Contrairement au juge Scalia dans Trinko, le CG ne reconnaissait pas d'obstacles quant aux incitations d'investir si le droit de la concurrence était appliqué dans un environnement réglementé. Au contraire, la CG était d'accord avec la Commission sur le fait que l'obligation réglementaire de faire du commerce imposée Telefónica à

> «[. . .]*result*[ait] *d'un équilibrage par les autorités publiques des incitations de Telefónica et de ses concurrents à investir et à innover.*»

Davantage d'explications ont été apportées par l'affaire *TeliaSonera*.[43] Dans cette affaire, l'opérateur historique suédois fut accusé par la ANC suédoise d'abus de position dominante. Avant de prononcer son jugement, la Cour suédoise a adressé à la Cour de justice européenne une série de questions par rapport à l'interprétation correcte de l'Art. 102 du TFUE.

Le jugement *TeliaSonera*

Dans TeliaSonera, le GC a souligné que le caractère *essentiel*, ou *indispensable*, de l'accès au réseau n'est pas une condition nécessaire à l'existence d'un ciseau tarifaire. Elle a jugé que, compte tenu de la position dominante sur le marché en amont de l'entreprise verticalement intégrée, l'accès amont n'a pas besoin d'être indispensable pour que des effets anticoncurrentiels émergent via un ciseau tarifaire. En particulier, si l'input en amont est essentiel pour la concurrence en aval, alors des *effets anticoncurrentiels sont probables*, alors que si l'input n'est pas indispensable, des *effets anticoncurrentiels potentiels*

[43] *Konkurrensverket* v. *TeliaSonera Sverige AB*. affaire C-52/09, 2011.

peuvent exister et doivent être prouvés.[44] Il résulte de la décision TeliaSonera que le champ d'application du ciseau tarifaire en tant que théorie du préjudice est fortement élargi.

US vs. UE: deux vues opposées quant à la reconnaissance du ciseau tarifaire comme abus indépendant

La discussion ci-dessus des jurisprudences américaine et européenne montre qu'il existe deux points de vue diamétralement opposés: faut-il oui ou non reconnaître le ciseau tarifaire comme théorie du préjudice dans un environnement réglementé. Aux États-Unis, il ne faut clairement pas. Pour l'UE, la réponse est oui et les décisions récentes ont même desserré les conditions de son application. Chaque position peut avoir ses mérites, mais il faut bien comprendre les impacts qu'ont l'application conjointe du droit de la concurrence et les restrictions réglementaires, puisque chaque outil affecte le comportement stratégique des entreprises concernées.

Chapitre 3: Interaction entre réglementation sectorielle et droit de la concurrence

Ce dernier chapitre de cette thèse analyse, d'un point de vue théorique, les impacts potentiels que peuvent avoir l'application conjointe du droit de la concurrence et la réglementation sectorielle.

Dans un modèle micro-économique, considérant un duopole avec des produits différenciés, une entreprise intégrée verticalement est supposée vendre un produit de gros à un rival aval non intégré. Une asymétrie de la demande émanante du consommateur est introduite par le biais de différences de qualité entre les produits finaux et/ou de différence d'efficacité sur le marché en aval entre l'entreprise intégrée et son concurrent. En outre, la modélisation permet

[44] Cf. *supra* 43, ¶. 69 - 72.

de comparer le point de vue des États-Unis à la vision de l'UE en comparant différents scénarios. Le premier scénario est celui de l'environnement concurrentiel, c.-à-d. sans aucune régulation en amont, ni interdiction de ciseau tarifaire. Dans un second scénario, l'interdiction du ciseau tarifaire est introduite en faisant appel au critère du concurrent aussi efficace (CAE), ce qui signifie que l'écart entre le prix final et la charge d'accès de l'entreprise intégrée doit permettre la couverture des coûts spécifiques au produit final. Les scénarios trois et quatre refont l'analyse des scénarios un et deux, mais en introduisant la réglementation du marché en amont.

L'analyse montre que, lorsque la régulation du marché en amont est absente, le prix en aval de l'opérateur historique ne satisfait pas le critère du concurrent aussi efficace dès lors que l'entreprise non-intégrée est relativement plus efficace (c.-à-d. si elle est plus efficace en terme de coûts en aval, si elle offre une meilleure qualité ou toute combinaison possible de ces deux possibilités). Cependant, dans ce cas, le concurrent en aval ne subit pas de pertes et n'est donc pas exclu du marché. Ce résultat montre que l'efficacité du critère du concurrent aussi efficace est fortement dépendante des conditions de marché auxquelles les deux entreprises font face sur le marché en aval.

La comparaison du premier scénario au second révèle que la seule application du droit de la concurrence, en interdisant la compression des marges, peut avoir un effet positif sur le bien-être social.[45] En effet, comme le prix de l'entreprise intégrée doit satisfaire le critère CAE, sa seule variable restant à sa disposition pour optimiser ses profits est le prix en amont. L'entreprise intégrée maximise alors ses profits globaux en baissant le prix en amont, ce qui, à son tour, affecte de manière positive le prix fixé par le rival dans le marché en aval: le prix final de ce dernier diminue et sa demande augmente. D'autre part, le prix final de l'opérateur historique subit une hausse, ce qui

[45] Il convient de rappeler que le marché en amont n'est pas régulé dans les deux premiers scénarios.

pénalise alors ses consommateurs. Cependant, l'analyse du bien-être social montre que l'augmentation des profits de la firme non-intégrée l'emporte sur la baisse des profits de l'entreprise intégrée. Par ailleurs, comme plus de consommateurs bénéficient du prix réduit du rival, le surplus du consommateur augmente. Finalement, en l'absence de réglementation du marché en amont, une interdiction du ciseau tarifaire a un effet bénéfique sur le bien-être social.

En revanche, l'analyse en présence de la régulation du marché en amont montre des résultats opposés. Tout d'abord, lorsque le droit de la concurrence est appliqué, l'effet baissier sur le prix en amont disparaît et les deux prix finaux augmentent. Les consommateurs ne bénéficient plus de l'excédent d'efficacité du concurrent par rapport à la firme intégrée. En raison de la hausse des prix, les profits de l'industrie augmentent, alors que les consommateurs s'en sortent moins bien. L'impact sur le bien-être social est toutefois ambigu.

Enfin, comme une interdiction augmente le fardeau imposé à l'entreprise réglementée, celle-ci peut manifester moins d'initiatives dans le marché en aval. En effet, à un certain niveau d'inefficacité (par rapport à son concurrent), elle peut préférer de se retirer du marché en aval et de se concentrer sur la fourniture du produit de gros à son rival, qui, lui, sera la seule entreprise sur le marché en aval.[46]

L'analyse de ce chapitre suggère que la façon dont agit la Commission face au ciseau tarifaire risque de compromettre l'achèvement de son objectif de promotion de la concurrence et de protection des consommateurs. Les tribunaux américains semblent avoir eu la bonne intuition en matière de ciseau tarifaire en tant qu'infraction indépendante.

[46] Comme un tel comportement n'a pas encore été observé dans le monde réel, le retrait de l'opérateur historique doit être relativisé. Il est, cependant, concevable que l'entreprise intégrée puisse quitter certains segments de marché, tout en restant active dans d'autres.

Bibliography

ARCEP (2014a). Observatoire des marchés des communications électroniques (services mobiles). 2ème trimestre 2014. Available here.

ARCEP (2014b). Observatoire des marchés des communications électroniques en France Q2 2014 - Observatoire des investissements et de l'emploi. 2ème trimestre 2014 - Résultats définitifs. Available here.

Arlandis A., Ciriani S., Koleda G. (2011). L'économie numérique et la croissance, poids, impact et enjeux d'un secteur stratégique, Document de travail Nř 24. Available here. Accessed last: 19/11/2014.

Armstrong M., (2006). Competition in two-sided markets, *RAND Journal of Economics*, 37(3), 668-691.

Berec (2011). Berec Report on impact of Fixed-Mobile Substitution in Market Definition, 8 December 2011, available here.

Blumberg S. J., Luke J. V. (2007). Wireless substitution: Early release of estimates based on data from the National Health Interview Survey, July - December 2006. National Center for Health Statistics, May 2007., available here

Blumberg S. J., Luke J. V. (2014). Wireless substitution: Early release of estimates from the National Health Interview Survey, January - June 2014. National Center for Health Statistics, December 2014, available here.

Bacache M., Bourreau M., Germain G., (2013). Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Fixed Broadband Industry. *Review of Industrial Organization*, 44(2), 179-209.

Bourreau M., Kourandi F., Valletti T., (2014). Net Neutrality with Competing Internet Platforms, CEIS Research Paper 307, Tor Vergata University, CEIS, revised 14 Feb 2014.

Cave M. (2006), Encouraging infrastructure competition via the ladder of investment. *Telecommunications Policy*, 30(3-4), 223-237.

Cave M. (2006), Six Degrees of Separation: Operational Separation as a Remedy in European Telecommunications Regulation, MPRA Paper No. 3572, posted 14/06/2007, available here.

Cisco (2014), Visual Networking Index: Global Mobile Data Traffic Forecast Update 2013 - 2018, February 4, 2014, available here.

Cisco (2013b), Visual Networking Index: Forecast and Methodology 2012 - 2017, May 29, 2013, available here.

European Commission (1998), Notice on the Application of the Competition Rules to Access Agreements in the Telecommunications Sector, (98/C), OJ C 265, 22/08/1998:2-28.

European Commission (2005), Recommendation on accounting separation and cost accounting systems under the regulatory framework for electronic communications, (2005/698/EC), OJ L 266, 11/10/2005:64-69.

European Commission (2013), Commission Staff Working Document Digital Agenda Scoreboard SWD (2013) 217 final.

Dogan P., Bourreau M., Manant M, (2009). A Critical Review of the "Ladder of

Investment" Approach. Scholarly Articles 4777447, Harvard Kennedy School of Government. Available here.

Eurobarometer (2006), E-Communicatins Household Survey Report, Fieldwork: December 2005 - January 2006, July 2006.

Eurobarometer (2011), E-Communicatins Household Survey Report, Fieldwork: December 2011, June 2012,

Eurobarometer (2013), E-Communicatins Household Survey Report, Fieldwork: February-March 2011, July 2011, available here.

GSM Association (2013a), Mobile Economy Europe 2013, available here.

GSM Association (2013b), Mobile Wireless Performance in the EU & the US, May 2013, available here.

Hermalin B. E., Katz M. L., (2007). The economics of product-line restrictions with an application to the network neutrality debate, *Information Economics and Policy*, 19(2), 215-248.

Jullien, B., Rey, P., Saavedra, C. (2013), The Economics of Margin Squeeze, IDEI Report, available here.

Maliranta M., Rouvinen P., Ylä-Anttila P., (2010), Finland's Path to the Global Productivity Frontier through Creative Destruction, *International Productivity Monitor*, Centre for the Study of Living Standards, 20, Fall, 68-84. Available here.

OECD (2006), Report on experiences with structural separation, 07/06/2006, available here.

OECD (2009a), Information Economy Product Definitions Based On The Central Product Classification (Version 2), available here.

OECD (2009b), Mobile Broadband: Pricing and Services, available here.

OECD (2009c), Policy Roundtables Margin Squeeze, 2009, DAF/COMP(2009)36, available here.

OECD (2011), Broadband Bundling: Trends and Policy Implications, OECD Digital Economy Papers, No. 175, OECD Publishing, available here.

OECD (2012), Fixed and Mobile Networks: Substitution, Complementarity and Convergence, OECD Digital Economy Papers, No. 206, OECD Publishing, available here.

OFCOM (2013), International Communications Market Report, Research Document, 12 December 2013, available here.

Oldale, A., Padilla, J. (2004). From state monopoly to the “investment ladder": Competition policy and the NRF. *in* The Pros and Cons of Antitrust in Deregulated Markets, Swedish Competition Authority.

Rochet J.-C., Tirole J., (2006). Two-sided markets: a progress report, *RAND Journal of Economics*, 37(3), 645-667.

RTR (2009), Abgrenzung des Marktes für breitbandigen Zugang auf Vorleistungsebene.

Welsum D., Overmeer W., Van Ark B., (2012). Unlocking the ICT growth potential in Europe: Enabling people and businesses. A study prepared for the European Commission DG Communications Networks, Content & Technology. Available here. Accessed last: 19/11/2014.

Wu T., (2003). Network Neutrality, Broadband Discrimination, *Journal on Telecommunications and High-Technology Law*, 2, 141-176.

Yoo C., (2010). Network Neutrality or Internet Innovation? Regulation, 33(1), 22-29. Available on SSRN.

CHAPITRE 1

Substitution fixe-mobile et offres groupées fixe-mobile

La substitution fixe-mobile correspond au fait que les services fixes, notamment les appels, sont de plus en plus substitués par les services mobiles. Ce phénomène est apparu avec la convergence en performance des technologies sous-jacentes. Ainsi, la technologie 3G sur les réseaux mobiles permet des usages similaires à ceux possibles avec la technologie ADSL sur les réseaux fixes.[1] Avec le déploiement de la 4G LTE, les frontières entre possibilités d'usage sur les réseaux mobiles et les réseaux fixes utilisant l'ADSL s'effaceront encore plus. Pour autant que la fibre optique n'est pas encore suffisamment établie comme technologie sur les réseaux fixes, la substitution fixe-mobile continuera à prendre de l'ampleur.

Par ailleurs, la concurrence entre les opérateurs multi-marchés, i.e. les opérateurs actifs à la fois dans le marché des communications fixes et communications mobiles, a connu une intensification considérable. A titre d'exemple, avec l'apparition de Free Mobile sur le marché mobile français, un quatrième opérateur multi-marchés a signé son entrée. Le lancement de Free Mobile fut accompagné d'une guerre des prix entre les quatre acteurs, comme le démontre une étude de l'ARCEP. En effet, avec l'entrée de Free, la facture moyenne pour

[1] La technologie ADSL, basée sur la paire de cuivre, est aujourd'hui la technologie la plus répandue en Europe.

des services mobiles a diminué de 5 € ce qui représente une baisse d'environ 20 % (Arcep, 2014).

Parallèlement à cette concurrence intense, les opérateurs multi-marchés ont lancé des offres convergentes, c.-à-d. des offres groupées intégrant les services fixes (Internet haut débit, TVIP, VoIP) et un forfait mobile. Ces offres *quadruple-play* connaissent un succès remarquable: en Espagne, p. ex. 21 % des ménages ont souscrit à une telle offre vers la fin de l'année 2012 et en France ce chiffre s'élève à environ 40 % pour la même époque. Un élément clé de ces offres est le rabais que l'opérateur octroie à ses consommateurs lorsque ces derniers souscrivent à une offre groupée. Le prix de l'offre groupée est donc inférieur à la somme des prix des offres isolées.

Or, compte tenu de la substitution fixe-mobile qui se manifeste de plus en plus et compte tenu de l'intensification de la concurrence, il faut se poser la question si la pratique des ventes liées est une stratégie adéquate aux phénomènes observés. Quels sont les impacts de cette pratique sur i) les profits des opérateurs, ii) les demandes pour les services mobiles et fixes en tant que ventes isolées ou vente groupées?

L'objectif de ce chapitre est de fournir des éléments de réponses pertinents en se basant sur un modèle micro-économique. Ce modèle considère un duopole à la Hotelling avec deux opérateurs multi-marchés, qui détiennent chacun ses propres infrastructures fixes et mobiles.[2] Au centre de l'analyse se trouvent les prix de réserve des consommateurs pour les deux services. L'écart entre ces prix de réserve est utilisé comme mesure de la substituabilité entre le service fixe et mobile: plus les prix de réserve sont proches, plus les services sont substituts.[3] Par ailleurs, le modèle pose l'hypothèse que le consommateur

[2] Cette hypothèse est certes simplificatrice, mais elle permet de se focaliser uniquement sur les effets induits par la pratique des ventes liées, sans devoir gérer d'éventuelles perturbations liées à l'intégration verticale d'un opérateur historique et les problèmes réglementaires liés à l'accès au réseau de ce dernier.

[3] Toutefois, il est supposé que les prix de réserve pour les services fixes sont strictement supérieurs aux prix de réserve pour les services mobiles. Sinon, les produits seraient des sub-

choisit d'abord son offre mobile et puis, s'il anticipe une utilité nette positive, il souscrit à une offre de services fixes. S'il souscrit à ces deux offres, il a le choix entre l'achat d'une offre groupée (et donc de profiter du rabais) et l'achat de deux offres isolées. Si, à l'inverse, le consommateur n'anticipe pas d'utilité positive liée au fait d'avoir simultanément une offre fixe et mobile, il restera *mobile-only*. Ainsi, l'existence de consommateurs *mobile-only* sous-entend que le marché fixe n'est pas complètement couvert.

Finalement, alors que les prix de réserve pour les offres mobiles sont supposés égaux pour les deux opérateurs, les services fixes peuvent être valorisés différemment par les consommateurs. Ceci peut représenter des situations de concurrence entre deux infrastructures fixes, comme p. ex. la fibre vs. l'ADSL. Si les prix de réserve diffèrent, l'environnement est dit asymétrique.

Les résultats dans le cas symétrique, révèle l'émergence d'un dilemme du prisonnier: à l'équilibre, les opérateurs proposent des offres groupées, même s'ils préfèreraient ne pas le faire. Or, chacun est incité de le faire de manière unilatérale, d'où l'émergence du dilemme du prisonnier. Ceci n'est pourtant pas un résultat nouveau, car il a été identifié à plusieurs reprises par la littérature existante.[4]

Si, par contre, les opérateurs évoluent dans un environnement asymétrique, il n'y a pas émergence du dilemme du prisonnier. En effet, l'opérateur, dont le service est mieux valorisé, peut augmenter ses profits en octroyant un rabais aux clients qui souscrivent à une offre groupée. L'analyse montre la puissance du rabais comme outil concurrentiel: vu que les consommateurs choisissent en premier leur offre mobile et ensuite une éventuelle offre fixe, le rabais permet d'augmenter la part de marché dans le marché mobile et donc d'augmenter la demande potentielle pour l'offre groupée.[5]

stituts parfaits, ce qui ne correspond à la réalité, compte tenu de caractéristiques des services (fixe=volume data illimité et mobilité réduite; mobile=volume data limité et ubiquité).

[4] Cf. Matutes and Régibeau (1992) ou Thanassoulis (2007), entre autres.

[5] Le résultat que le dilemme de prisonniers n'apparaît pas dans le cas d'un environnement

Pour le concurrent, il s'avère que la pratique de ventes liées s'apparente à une stratégie de Maximin, car, en proposant lui-aussi un rabais pour une offre groupée, il s'en sort mieux que de laisser l'autre opérateur proposer des offres groupées tout seul.

A noter également que, grâce au rabais, la demande pour le *mobile-only* (c.-à-d. les consommateurs qui ne souscrivent pas du tout à une offre fixe) diminue, ce qui implique une couverture plus importante du marché fixe. En analysant les incitations de proposer un rabais dans le cas d'un marché fixe complètement couvert, il apparaît que cette pratique n'est pas rentable pour l'opérateur proposant le service fixe le mieux valorisé. La pratique des ventes liées n'est par conséquent rentable uniquement lorsque le marché fixe n'est pas entièrement couvert, ou de manière équivalente, lorsque les services fixes et mobiles ne sont ni trop substituables (auquel cas, aucun consommateur ne choisirait une offre fixe), ni trop complémentaires (auquel cas, le marché serait trop couvert et la stratégie des offres groupées non-rentable).

Finalement, en ce qui concerne le bien-être social, les résultats montrent que le consommateur est toujours gagnant lorsqu'il se voit proposer un prix réduit pour les deux services, et ce tant dans un environnement symétrique que dans un environnement asymétrique. A l'inverse, les profits de l'industrie (c.-à-d. la somme des profits des deux opérateurs) diminue dans le cas symétrique, alors qu'il ne varie pas dans l'autre cas. Ce dernier résultat est dû au fait que l'opérateur proposant le service le mieux valorisé gagne ce que perd son concurrent. Somme toute faite, le bien-être social augmente toujours, car la baisse des profits de l'industrie est plus que compensée par l'accroissement du surplus du consommateur.

En guise de conclusion, il est à noter que l'analyse du chapitre 1 montre que

asymétrique n'a pas encore été énoncé dans la littérature. Au contraire, Thanassoulis (2007), qui utilise un cadre similaire, estime que la pratique de la vente liée engendre ce dilemme même en cas d'asymétrie.

la rentabilité de la pratique des offres groupées est intimement liée au degré de substituabilité entre les services. Par ailleurs, contrairement à la littérature existante, le dilemme du prisonnier n'apparaît pas nécessairement. Finalement, il reste à noter que la baisse des profits de l'industrie peut soulever des problèmes de collusion entre les opérateurs, bien que dans un cas asymétrique, cette question ne se posera vraisemblablement pas.

La substitution fixe-mobile sera également au cœur du prochain chapitre. Cependant, le chapitre deux proposera une analyse empirique, et plus particulièrement, une analyse des facteurs qui influencent les choix de consommation de services de communications des Français.

Bibliography

ARCEP (2014). Observatoire des marchés des communications électroniques (services mobiles). 2e trimestre 2014.

Matutes C., Régibeau P., (1992). Compatibility and bundling of complementary goods in a duopoly. *Journal Of Industrial Economics*, 40(1), 37-54.

Thanassoulis J., (2007). Competitive Mixed Bundling and Consumer Surplus, *Journal Of Economics & Management Strategy*, 16(2), 437-467. DOI: 10.1111/j.1530-9134.2007.00145.x.

CHAPITRE 2

Caractéristiques socio-démographiques et services de télécommunications

Comme le premier chapitre, le deuxième est consacré à la substitution fixe-mobile. Toutefois, le sujet sera maintenant traité de manière empirique.

Le but de ce chapitre est de dresser des profils de consommateur en se basant sur les caractéristiques socio-démographiques d'environ 22000 utilisateurs français de services de communications. Plus spécifiquement, ce travail cherche à déterminer les facteurs qui influencent les choix des consommateurs. Par ailleurs, il soulève la question de savoir si l'impact des facteurs ainsi déterminés varie d'un opérateur à l'autre.

Le point de départ pour cette analyse est le constat de l'évolution impressionnante que connaît le marché des communications en France depuis quelques années. Par exemple, la commercialisation par Bouygues Télécom de la première offre quadruple-play en 2009 peut être vue comme une innovation tarifaire. En offrant un avantage en prix allant jusqu'à 16 €, le troisième opérateur français a créé une vraie incitation pour les consommateurs de changer de comportement de consommation, en passant d'une série de services isolés à une offre groupée. En outre, l'entrée sur le marché de Free Mobile, avec une politique tarifaire très agressive, a marqué le début de l'ère du *low cost* dans le secteur des télécommunications français. Ainsi, les prix ont baissé d'environ 20

% et l'abondance en services vocaux et messages, combinée à des volumes de data très généreux, est devenue la norme sur le marché. En guise de réponse, les opérateurs établis ont également mis sur le marché des offres mobiles très compétitives, mais ils ont aussi accéléré le déploiement de nouvelles technologies telles que la 4G LTE ou la fibre optique. Toutefois, cette accélération des investissements en vue d'échapper à la concurrence n'a pas arrêté le trend du *low cost*.

Il apparaît donc que le marché est en mouvement constant, ce qui implique alors un changement de comportement de la part des consommateurs. Comme il a été indiqué auparavant, un nombre croissant de consommateurs substituent leurs services fixes par des services mobiles, alors que le nombre de souscriptions à des offres convergentes est lui également en hausse. Reconnaître ces changements est indispensable pour chaque opérateur afin de ne pas perdre de vue les intérêts et les besoins du côté de la demande de services.

La motivation de ce travail est donc de contribuer à la compréhension de ces changements en se concentrant sur les caractéristiques socio-démographiques des consommateurs. Afin d'atteindre cet objectif, un modèle logit conditionnel est développé qui met en relation les caractéristiques des individus et de leurs offres souscrites avec leurs choix i) d'être *mobile-only*, ii) compléter leurs services mobiles par un ou plusieurs services fixes isolés ou iii) de souscrire à une offre groupée d'au moins deux services chez l'opérateur mobile. Les données sont issues d'une enquête de satisfaction avec l'opérateur mobile menée auprès d'environ 22000 utilisateurs français pendant la période 2008-2012. Les variables intégrées dans le modèle sont les suivantes: prix, opérateur mobile, contrat (pré-payé ou post-pay), l'âge, catégorie socio-professionnelle (CSP), revenu, composition du ménage, lieu de résidence et le sexe.[1]

Il est vraisemblable que les évolutions technologiques en matière de ter-

[1] A noter que Free n'est pas compris dans la base de données.

minaux et de possibilités d'usage affectent aussi les choix énumérés avant. Toutefois, comme ces informations n'ont pas été collectées lors du sondage, cette étude ne peut pas se prononcer sur un éventuel impact lié à ces variables.

La base de données est constituée d'à peu près 20 % de *mobile-only*, 15 % de personnes ayant une offre groupées (ci-après *bundlers*) et environ 65 % de personnes ayant plusieurs services sans que ces services ne soient regroupés en une seule offre (ci-après *non-bundlers*). Alors que la proportion des *mobile-only* correspond à ce qu'ont observé d'autres études pour le marché français, les deux autres proportions méritent quelques explications. En effet, la proportion de *bundlers* est très faible pour le marché français et, inversement, la proportion des *non-bundlers* très élevée. Ceci s'explique par le fait que le sondage ne demandait que si la personne a une offre groupée «chez l'opérateur mobile». De ce fait, les personnes ayant une offre groupée chez un autre opérateur ne sont pas identifiables et sont alors classées parmi les *non-bundlers*.

Le résultat principal de l'estimation du modèle général (i.e. sans spécification par opérateur) est que les consommateurs de type *mobile-only* peuvent être décrits comme ayant une contrainte budgétaire plus forte que les autres types de consommation.[2] En effet, les résultats montrent que les variables pouvant laisser penser à une fragilité financière ont un effet significatif et négatif sur la probabilité de souscrire à une offre groupée ou à plusieurs services. Il s'agit notamment des variables *pré-payé*, *travail à temps partiel*, *H/F au foyer* ou encore *faible revenu*.[3]

A noter que le résultat décrit avant a été trouvé pour d'autres pays également. Ainsi Schejter *et al.* (2010) l'a trouvé dans son analyse concernant les Etats-Unis. Il est également mentionné dans un rapport DotEcon (2001) pour le Royaume-Uni. Pour la France, le rapport du CREDOC (2013) peut égale-

[2] Le pseudo-R^2 est 0.64 et le pourcentage de prédictions correctes s'élève à ± 85%, ce qui indique un bon pouvoir explicatif du modèle.

[3] Ces variables sont toutes significatives au seuil 1 ‰.

ment être cité. Toutefois, ces deux derniers rapports fournissent des statistiques descriptives plutôt qu'une estimation des influences des différentes variables, telle que proposée dans ce travail.

Les estimations par opérateurs confirment le résultat principal du modèle général. De ce fait, les consommateurs *mobile-only* peuvent être décrits de manière identique pour tous les opérateurs.

Par ailleurs, ces estimations font apparaître un avantage compétitif pour l'opérateur historique. En effet, les clients Orange qui résident dans des zones rurales ou des petites villes ($\leq$ 1500 habitants/km^2) sont plus enclins de souscrire à plusieurs services (groupés ou non) que les clients SFR ou Bouygues. Toutefois, dans les grandes villes, où la concurrence est plus intense, car une demande potentielle plus élevée, cet avantage est plus faible.

Ce travail a pu identifier des éléments relatifs aux types de consommateur. Premièrement, les personnes qui utilisent exclusivement leurs services mobiles peuvent être caractérisées par une contrainte budgétaire plus stricte que les personnes utilisant plusieurs services. Ceci paraît être un résultat robuste, car il est confirmé par les régressions spécifiques aux opérateurs. Deuxièmement, les consommateurs de plusieurs services de communications qui résident en-dehors des grandes villes semblent préférer l'opérateur historique. Ce résultat peut être vu comme une indication sur la différentiation entre les trois opérateurs présents dans la base de données. Finalement, cette différentiation entre les opérateurs semble conférer un avantage compétitif à l'opérateur historique, du moins dans les zones rurales ou moyennement dense.

Reste à noter que cette étude a ses limites. Tout d'abord, parce qu'elle ne dispose pas de données relatives à l'habitude d'usage des consommateurs. Les profils dressés dans ce chapitre ne sont donc que partiels. Ensuite, la période pendant laquelle les données ont été collectées correspond à une des pires crises économiques depuis le jeudi noir en 1929. Beaucoup de ménages

ont dû procéder à des coupes budgétaires, qui ont aussi affectées les dépenses consacrées aux télécommunications. Les résultats dans ce chapitres risquent donc de ne pas être généralisables.

Les chapitres un et deux de cette thèse se sont donc concentrés majoritairement sur la concurrence entre les services de communications. Le prochain et dernier chapitre sera consacré à la concurrence entre les entreprises en se focalisant sur l'interaction de deux outils qui façonnent le secteur des télécommunications. Il s'agit ici de la réglementation sectorielle et du droit de la concurrence.

Bibliography

CREDOC, (2013). La diffusion des technologies de l'information et de la communication dans la société française. http://www.credoc.fr/pdf/Rapp/R297.pdf.

DotEcon, (2001). Fixed-Mobile Substitution. A report prepared for BT. http://www.dotecon.com/assets/images/fmsub3.pdf.

Schejter A. M., Serenko A, Turel O, Mehdi Z., (2010). Policy implications of market segmentation as a determinant of fixed-mobile service substitution: What it means for carriers and policy makers. *Telematics and Informatics*, 22(1), 90-102. http://dx.doi.org/10.1016/j.tele.2009.05.002.

CHAPITRE 3

Chapitre 3: L'interaction entre réglementation sectorielle et droit de la concurrence: le cas du ciseau tarifaire

Contrairement aux deux chapitres précédents, ce troisième et dernier chapitre se consacre à la concurrence entre les firmes. Plus spécifiquement, il analyse les effets de l'interaction entre la réglementation sectorielle et le droit de la concurrence sur les comportements stratégiques des entreprises. Le travail dans ce chapitre se concentre sur l'interdiction de ciseau tarifaire dans un environnement réglementé.

Le cadre d'analyse est celui d'une industrie verticalement intégrée avec un monopole sur le marché en amont. Ce monopole produit un input essentiel pour la production d'un bien final. Par ailleurs, le monopoleur en amont est verticalement intégré et est en concurrence sur le marché de détail avec son client en amont. Ainsi, un ciseau tarifaire peut apparaître lorsque l'écart entre le prix en amont et le prix de détail pratiqué par la firme verticalement intégrée est insuffisant pour couvrir les coûts spécifiques au produit de détail, de façon à ce que l'activité d'un concurrent au moins aussi efficace que la firme verticalement intégrée n'est pas rentable.

La réglementation sectorielle et le droit de la concurrence sont omniprésents dans le secteur des télécommunications et le façonnent de manière importante.

Surtout en Europe, où ces deux outils sont considérés comme des compléments et s'appliquent ainsi de manière conjointe (Commission (1998), ¶149). Ceci est en opposition diamétrale par rapport à la vision américaine sur ce sujet, car plusieurs jugements juridiques aux Etats-Unis ont clairement identifié la réglementation sectorielle et le droit de la concurrence comme étant des substituts, avec une primauté de la réglementation lorsque celle-ci existe.[1] Un autre point de divergence entre les Etats-Unis et l'Union Européenne est que l'UE reconnaît explicitement le ciseau tarifaire comme un abus indépendant, c.-à-d. différent des prix prédateurs ou le refus de vente.[2] A l'inverse, les Etats-Unis considèrent qu'une plainte pour ciseau tarifaire doit être déclinée soit en plainte pour prix prédateurs, soit en plainte pour refus de vente.[3]

Il s'agit ici d'un débat vif qui occupe un bon nombre d'académiques. Cependant, ces académiques ont un point commun. En effet, nombreux sont les papiers qui critiquent notamment le critère du *concurrence aussi efficace* (CAE), un test utilisé par la Commission Européenne pour détecter la présence d'un ciseau tarifaire. Ce test impose, en quelque sorte, un prix-plancher à la firme verticalement intégrée de façon à éviter que la marge entre le prix de détail et le prix en amont est suffisante pour couvrir les coûts encourus sur le marché de détail. D'après plusieurs études théoriques, imposer un tel plancher induit une hausse des prix de détail, ce qui est évidemment néfaste pour le consommateur (Carlton (2008) ou Choné *et al.* (2010), entre autres).

Le travail mené dans ce chapitre s'inscrit dans la lignée de ces papiers, mais en considérant un marché de détail avec des bien différenciés. Par ailleurs, le modèle micro-économique développé ici propose la possibilité d'une différence d'efficacité en terme de coûts encourus sur le marché de détail entre les deux entreprises. Finalement, il considère 4 scénarios. Le premier est celui de la

[1] *Verizon Communications, Inc.* v. *Law Offices of Curtis V. Trinko*, 540 U.S. 398 (2004)
[2] Le dernier jugement confirmant le ciseau comme abus indépendant: *Telefónica & Telefónica de España* v. *Commission*, affaire C-295/12 P.
[3] *Pacific Bell* v. *linkLine Communications, Inc.*, 555 U.S. 438 (2009).

«libre» concurrence (c.-a-d. sans réglementation du marché en amont, ni interdiction de ciseau tarifaire), tandis que le deuxième introduit le droit de la concurrence par le biais de l'interdiction du ciseau tarifaire. Dans ce deuxième scénario, le prix de détail de la firme verticalement intégrée doit satisfaire le critère CAE. Les scénarios trois et quatre refont cet exercice en intégrant la réglementation sur le marché en amont.

L'analyse montre tout d'abord qu'un ciseau tarifaire apparaît dès lors que le concurrent est plus efficace que la firme verticalement intégrée. Cependant, le ciseau tarifaire apparaît sans qu'il y ait un comportement anticoncurrentiel de la part de la firme verticalement intégrée, c.-à-d. sans que celle-ci cherche à évincer son concurrent. Ceci montre alors la fragilité du critère CAE, car le résultat est très dépendant de l'environnement dans lequel évoluent les firmes.

Ensuite, imposer la satisfaction du CAE a pour effet i) d'augmenter le prix de détail de la firme verticalement intégrée, ii) de baisser le prix en amont et iii) de baisser le prix de détail du concurrent. En tant qu'obligation unique (dans le sens où il n'y a pas de contraintes réglementaires sur le marché en amont), le critère CAE a donc un effet bénéfique qui est celui de la baisse du prix en amont. Cette baisse est le résultat de la balance optimale, recherchée par la firme verticalement intégrée, entre la stimulation de la demande pour le bien en amont et la compétitivité-prix sur le marché de détail, compte tenu de la contrainte qui lui est imposée. Par ailleurs, le surplus du consommateur augmente, ainsi que le bien-être social.

Par contre, lorsque le marché en amont est réglementé par le biais d'un prix plafond, une interdiction de ciseau tarifaire fait que les deux prix de détail augmentent. Contrairement à un environnement sans réglementation, l'imposition d'un prix régulé sur le marché en amont combiné avec un prix «régulé» sur le marché de détail enlève toute possibilité de tenir compte de l'efficacité supérieure du concurrent (relative à la firme intégrée). En effet,

un prix plafond contraignant ne peut être qu'une proportion du prix optimale que pratiquerait la firme intégrée en cas d'absence de réglementation. De ce fait, seulement une proportion de l'efficacité du concurrent est pris en compte par la réglementation. En ce qui concerne le bien-être social, les résultats sont toutefois ambigus, car ils dépendent à la fois du degré de différentiation, de l'efficacité du concurrent et du niveau du prix régulé sur le marché en amont.

Ce chapitre met donc en évidence la complexité de l'interaction entre la réglementation sectorielle et le droit de la concurrence. Les bénéfices en terme de bien-être social que pourrait procurer l'application conjointe de ces deux outils sont très difficiles à cerner. L'approche américaine dans la matière semble être meilleure que celle de l'UE.

Bibliography

Carlton D. W., (2008). Should Price Squeeze be a Recognized Form of Anticompetitive Conduct?, *Journal of Competition Law and Economics*, 4(2), 271-278. DOI:10.1093/joclec/nhn012.

Choné P., Komly B., Meunier V., (2010). Margin Squeeze, entry and "umbrella effect, *Mimeo*.

European Commission, (1998). Notice on the Application of the Competition Rules to Access Agreements in the Telecommunications Sector, 98/C: 265/02 (also in Official Journal C 265, 22/08/1998:2-28). Available here.

Conclusion générale

Le secteur des TIC est l'un des plus dynamiques dans notre environnement économique actuel. Il n'est guère étonnant qu'il soit considéré comme une pierre angulaire de la stratégie de poursuite de développement de notre société, puisque ces dynamiques ont fourni (et continueront à fournir) des gains d'efficacité et de productivité considérables à la société complète.

Cependant, ce secteur est composé d'un grand nombre d'acteurs. Et, plus le nombre d'acteurs impliqués dans un processus est élevé, plus compliqué le processus devient. Malheureusement, l'industrie des télécommunications n'est pas une exception à cette règle. Il est donc d'une importance cruciale de bien comprendre les comportements stratégiques de tous les membres de la chaîne de valeur sous-jacente et les conséquences impliquées par leurs actions.

Avec l'objectif de contribuer à la compréhension de cet écosystème, les trois essais, qui constituent cette thèse, ont porté plus particulièrement sur le secteur des télécommunications. Les 20 dernières années ont été marquées par des changements importants relatifs à ce secteur, allant des innovations technologiques jusqu'aux changements de comportement des prestataires de services, des consommateurs ainsi que des organismes de réglementation nationaux. Savoir qui a influencé qui revient au problème de la poule et de l'oeuf. Le fait est que les changements sont survenus et leurs conséquences doivent être comprises.

Les deux premiers chapitres de cette thèse ont mis l'accent sur le comportement des consommateurs et l'évolution des prestataires de services. Alors

qu'une substitution fixe-mobile soutenue est observée du côté de la demande, une tendance vers les ventes liées, c.-à-d. des offres regroupant des services fixes et mobiles, est observée du côté de l'offre. Cette opposition donne lieu à la question de savoir si la pratique de regrouper des services substituables est une réponse adéquate aux phénomènes observés et ce que cela signifie pour le secteur des télécommunications. Un cadre théorique a donc été développé dans le premier chapitre, qui vise à fournir des indications pertinentes. En plaçant le différentiel entre les prix de réserve des consommateurs pour les services fixes et mobiles au centre de l'analyse, il est démontré que la pratique des ventes liées est rentable tant que les consommateurs valorisent les services fixes suffisamment forts par rapport aux services mobiles. A l'inverse des résultats dans la littérature existante, la situation de dilemme du prisonnier n'émerge pas nécessairement, ni ne baisse le surplus du consommateur. Néanmoins, puisque les offres groupées sont vendues à un prix réduit, cette guerre de prix peut conduire à une diminution de la valeur de marché et donc des flux de revenus pour les entreprises, remettant en question les incitations ou des accords d'investissement.

Le marché français peut être utilisé à des fins d'illustration de ce résultat. Avec l'apparition d'un quatrième opérateur multi-marchés, une guerre des prix féroce a été déclenchée au début de l'année 2012. Des offres mobiles très agressives ont émergé ainsi que des offres groupées fixe-mobile très compétitives. L'ère du *low cost* sur le marché français a donc commencé. La conséquence à court terme est évidente: les consommateurs bénéficient de prix bas et de forfaits très généreux. D'un autre côté par contre, cette concurrence intense a également déclenché un processus de consolidation de marché, une consolidation qui est rendue visible à travers le fait que deux des trois opérateurs établis ont vécu (et vivent toujours) des difficultés financières.[4] Que ce processus de

[4] Cf. `ici` pour des informations relative à la réorganisation des effectifs chez SFR et chez Bouygues Télécom.

consolidation soit à saluer d'un point de vue bien-être social reste encore une question ouverte. Cependant, les revenus des acteurs du marché ont souffert des rétractions considérables dans la première année suivant l'apparition de Free et les investissements ont chuté de presque 30 % l'année suivante.[5] Quoi qu'il en soit, les opérateurs ont conclu des accords pour couvrir la France avec un réseau Internet à très haute débit à l'échelle nationale vers le début de 2020 et ces éventuels effets négatifs dus à cette concurrence intense restent encore à vérifier dans le moyen ou long terme.

Les changements du côté de la demande sont également au cœur du deuxième chapitre. Contrairement au précédent, ce chapitre traite le sujet de manière empirique. En particulier, il étudie l'impact des facteurs socio-démographiques sur le comportement de consommation des utilisateurs français des services de communications.

En utilisant un large échantillon de données françaises pour la période 2008 - 2012, l'étude permet de confirmer un résultat déjà établi pour les États-Unis ou le Royaume-Uni, à savoir que le type de consommateur *mobile-only* est principalement dû à une contrainte budgétaire forte des consommateurs concernés. Plusieurs études depuis le début des années 2000 aux États-Unis montrent que les ménages à faible revenu sont plus susceptibles d'utiliser exclusivement des services mobiles.[6] Les données utilisées ici permettent de conclure sur la différenciation des opérateurs français. En effet, l'étude révèle que l'opérateur historique a un avantage concurrentiel dans les zones rurales et les petites villes, alors que dans les grandes villes, où la concurrence est plus intense, cet avantage semble réduit.

Même si les résultats sont en ligne avec des études antérieures, leur robustesse est peut-être discutable. Tout d'abord, les données ont été recueillies

[5] Cf. `ici` pour l'observatoire sur les communications électroniques de l'ARCEP.

[6] Cependant, ces études ont également souligné que ce nouveau type de consommateur est principalement incarné par les nouveaux arrivants sur le marché plutôt que par des gens qui ont effectivement annulé leur abonnement de communications fixes.

au moment de la pire crise économique depuis jeudi noir en 1929, et elles n'incluent pas des informations sur les habitudes d'usage des consommateurs. Malgré la (forte) probabilité que l'évolution technologique a un impact significatif sur l'émergence du type de consommation *mobile-only*, ce serait de la pure spéculation de l'inclure comme une composante de l'explication des résultats de ce chapitre. Par ailleurs, il serait intéressant de répéter l'analyse en utilisant des données issues de temps meilleurs d'un point de vue économique ainsi qu'avec les données manquantes sur l'usage. Deuxièmement, comme indiqué ci-dessus, l'entrée sur le marché du quatrième l'opérateur mobile a fortement agité le marché, ce qui implique d'autres impacts sur le comportement des consommateurs. Des données futures sauront en dire plus sur cet impact.

La concurrence entre services et entreprises, telle que considérée dans les deux premiers chapitres, fut atteinte, entre autres, par la volonté politique de libéraliser le secteur des télécommunications. En particulier, la réglementation de l'accès du réseau de cuivre à l'échelle nationale, le plus souvent sous le contrôle d'un monopole, est devenue une des missions principales des autorités nationales de réglementation. Au fur et à mesure que la concurrence basée sur les services dans le marché du fixe a décollé, plusieurs plaintes pour discrimination tarifaire, et plus particulièrement pour compression des marges, ont surgi avec la conséquence ultime que le secteur des télécommunications est devenu l'objet d'une certaine forme de réglementation des prix en amont et des prix en aval.

La question de savoir si la mise en œuvre conjointe des outils réglementaires et des outils juridiques est sage ou non fait l'objet du troisième et dernier chapitre. Ici, un cadre théorique est utilisé afin d'analyser l'interaction entre la régulation du marché en amont et des obligations de non-discrimination sur le marché aval. L'analyse se focalise en particulier sur l'interdiction de ciseau tarifaire. Dans un contexte de produits de détail différenciés, l'analyse révèle que

la combinaison des deux outils est susceptible de conduire à une diminution du bien-être social, que les prix finaux augmentent et que les quantités produites diminuent. Une condition suffisante pour cet événement est une efficacité plus élevée du concurrent non intégré.

Les résultats du dernier chapitre peuvent être mis en perspective de la façon suivante. Le but ultime de la Commission Européenne est d'améliorer le bien-être social en s'appuyant, entre autres, sur l'unification des marchés nationaux et une concurrence intense. Améliorer le processus concurrentiel est donc l'un des principaux moteurs de la politique européenne en matière de concurrence. Dans ce cadre, la Commission considère que le ciseau tarifaire est une théorie indépendante des théories du préjudice déjà existantes, telles que les prix prédateurs ou le refus de vente. Elle a donc augmenté sa surveillance des stratégies de tarification des entreprises en position dominante sur un marché, notamment en complétant la réglementation des prix d'accès avec l'application du droit de la concurrence.

Contrairement à l'approche américaine, qui préfère considérer ces deux outils comme substituts, l'approche européenne est susceptible de manquer l'objectif de promotion du bien-être social. Le débat sur la meilleure façon de traiter cette question reste vif, puisque l'arrêt le plus récent de la Cour de Justice de l'UE en matière de ciseau tarifaire a réaffirmé l'indépendance de cet abus.[7] La nouvelle Commission européenne, investie à la fin de l'année 2014, n'a pas encore fait de déclaration sur le sujet en question, mais il sera intéressant de voir si un changement de vision a eu lieu, et donc si une convergence de traitement du sujet entre les USA et l'UE aura lieu ou non.

Le fait que l'industrie des TIC est devenue une priorité des autorités politiques montre son importance pour notre société. Mais, les caractéristiques complexes sous-jacentes doivent être maîtriser pour tirer pleinement avantage

[7] Mémo de la Commission européenne en date du 10/07/2014 sur l'arrêt de la Cour européenne de justice dans affaire C- 295/12 P. Cf. ici.

de cette industrie. Dans l'optique de contribuer à la compréhension de cette industrie, cette thèse n'est néanmoins qu'une petite goutte dans cet océan immense et il reste encore beaucoup à faire.

VU et PERMIS D'IMPRIMER

A Montpellier, le

Le Président de l'Université de Montpellier

Philippe Augé

DOCTORAT DE L'UNIVERSITE DE MONTPELLIER

FACULTE D'ECONOMIE

TITRE: Essais en économies des télécommunications: concurrence entre services et entre firmes

RESUME

Le secteur des télécommunications est devenu très important pour notre société, car, non seulement permet-il de mettre en relation des personnes se trouvant à des bouts opposés dans le monde, mais il contribue également à la croissance de notre productivité. Afin de bénéficier au maximum de ce secteur, il est indispensable de bien comprendre son fonctionnement. Le but de cette thèse est justement de contribuer à sa meilleure compréhension. Elle vise en particulier des questions relatives à son environnement concurrentiel. Un premier volet se concentre sur la concurrence entre les services de télécommunication: les services fixes et mobiles. En effet, des évolutions contradictoires sont observées depuis quelque temps. D'abord, le nombre de consommateurs qui n'utilisent que leur mobile pour satisfaire leurs besoins en télécommunications ne cesse d'augmenter. Ensuite, le nombre de souscription d'offres groupées, regroupant des services fixes et mobiles, connaît également une hausse importante. Se pose alors la question, traitée dans le premier chapitre, concernant la rentabilité de cette pratique pour les opérateurs de télécommunications, ainsi que l'impact sur le bien-être social lié à cette stratégie. Un modèle théorique, intégrant à la fois la différenciation horizontale, la substitution fixe-mobile et les préférences hétérogènes des consommateurs, permet de conclure que les opérateurs risquent de subir des pertes de profits, alors que les consommateurs profitent de cette pratique. Par ailleurs, le gain des consommateurs est plus grand que la réduction de profits des opérateurs, de façon à ce que le welfare social augmente. La substitution fixe-mobile est également au cœur du deuxième chapitre qui cherche à déterminer les caractéristiques sociodémographiques d'environ 20.000 utilisateurs français expliquant le mieux leur choix en matière de souscription soit à une offre mobile en tant que service unique, soit à une offre groupée ou encore à plusieurs services séparément. Le résultat principal est que les utilisateurs «mobile-only» semblent avoir une contrainte de budget plus serrée que les utilisateurs «multi-services». Par ailleurs, l'étude fait apparaître un avantage pour l'opérateur historique quand il s'agit de souscrire une offre groupée. Le deuxième volet de cette thèse traite de la concurrence entre entreprises. En particulier, le troisième et dernier chapitre propose d'analyser l'impact de l'interaction entre la réglementation sectorielle (notamment la régulation de prix) et le droit de la concurrence (notamment, l'interdiction de la pratique dite de «ciseau tarifaire») sur l'équilibre dans une industrie de réseau. Le débat sur ce sujet a engendré des points de vue diamétralement opposés, spécialement entre les USA et l'Europe: alors que ces deux outils sont considérés comme substituts outre-Atlantique, ils sont des compléments dans la conception européenne. La question est donc évidente: laquelle de ces deux doctrines a le moins d'impact sur l'efficacité du marché? Une analyse théorique permet de montrer que le prix de détail pratiqué par une firme verticalement intégrée, propriétaire du réseau physique et qui, contre paiement d'une «charge d'accès», laisse son concurrent accéder à son réseau, peut ne pas respecter le droit de la concurrence sans qu'il y ait une intention anticoncurrentielle. Par ailleurs, l'application du droit de la concurrence en combinaison avec la réglementation des prix (notamment, la charge d'accès) mène à une inefficacité du marché représentée par une hausse des prix de détails, néfaste non-seulement pour le consommateur, mais aussi pour le welfare social. Cette thèse conclut en rappelant l'importance d'une compréhension approfondie du fonctionnement du secteur des télécommunications. Parce que les évolutions reconnues dans ce secteur ne sont pas anodines, des analyses théoriques et empiriques sont nécessaires afin que chacun puisse bénéficier des apports de ce secteur.

MOTS-CLES: Télécommunications, concurrence, réglementation sectoriel

TITRE: Essais in economics of telecommunications: competition between services and between firms

ABSTRACT

The telecommunications sector has becomes very important for today's society, as it allows people at either end of the world to communicate, as well as it contributes to the growth of our productivity. In order to fully benefit from this sector, a deep understanding of its functioning is indispensable. The aim of this thesis is to contribute to its better comprehension by focusing in particular on questions relative to the competition in this sector. This thesis concentrates first on the competition between fixed and mobile telecommunications services. Indeed, contradictory evolutions are observed. First, the number of consumers relying only on their mobile so as to satisfy their need in telecommunications increases steadily. Second, the number of subscriptions of bundled offers, regrouping fixed and mobile services, has also increased in an impressive manner. The question, treated in the first chapter, is thus to know whether the practice of bundling is profitable for telecommunications operators, as well as the impacts on social welfare induced by this strategy. A theoretical model, integrating horizontal differentiation, Fixed-Mobile substitution and heterogeneous consumer preferences, allows to conclude that operators are likely to lose profits when bundling their services, whereas consumers are clear winners. Furthermore, the increase of consumer surplus more than compensates the firms' profit losses, such that social welfare increases. Fixed-Mobile substitution is also at the core of the second chapter. Its aim is to determine the socio-demographic characteristics of about 20.000 French users that explain best the users' choice of subscribing either to only a mobile offer, to a bundled offer or to several services separately. The main result is that "mobile-only" consumers seem to have a stronger budget constraint than "multi-service" users. Moreover, the study provides evidence for an "incumbency advantage" when it comes to subscribing to a bundled offer. The thesis then turns to competition between firms. More specifically, the third and last chapter offers an analysis of the impact on the equilibrium in a network industry induced by the interaction of sector regulation (notably, price regulation) and competition law (notably, the prohibition of the so-called "margin squeeze"). The debate on this subject has induced two widely opposed points of view, in particular between the US and Europe: whereas the US considers both tools to be substitutes, they are used as complements in Europe. The underlying question is thus evident: which doctrine has the least impact on the market efficiency? A theoretical analysis allows first to show that the retail price set by a vertically integrated firm, that owns the physical network and grants its downstream competitor access to it against the payment of an "access charge", may not comply with competition law without any anticompetitive intention. Moreover, applying competition law in combination with sector regulation (notably, regulation the level of the access charge) leads to market inefficiency, characterized by an increase of retail prices, which is detrimental to consumer surplus and social welfare. The thesis concludes by reminding the importance of a deep understanding of the functioning of the telecommunications sector. Since the evolutions in this sector are not harmless, many theoretical and empirical analyses are need, so that every one can profit from the contribution of this sector.

KEYWORDS: Telecommunications, competition, sector-specific regulation

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