

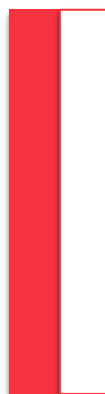
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The Effectiveness of Strategic Response to Market Commoditization: A Case Study Over the Portuguese Telecommunication Sector

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THE EFFECTIVENESS OF STRATEGIC RESPONSE TO MARKET
COMMODITIZATION: A CASE STUDY OVER THE PORTUGUESE
TELECOMMUNICATION SECTOR

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Abstract

Commoditization has gained increased importance in the study of industry dynamics as a process that erodes competitive differentiation and leads to diminished value creation. Nevertheless, as it challenges business actors to react and impose barriers to the process, it also pushes companies to focus on innovation as a counteraction. This study sheds light on an analytical question somewhat overlooked in the last years, by addressing the effectiveness of companies' strategic response to market commoditization in the Portuguese telecommunication sector. The research questions investigate the effects that some commoditization variables have on the average revenue per user in the segment, comparing the respective impacts between common standardized bundles of services and packages offering innovative components.

Through a hedonic pricing approach, panel data econometric methods, namely pooled OLS and fixed effects, were employed. As suggested by economic theory, this dissertation shows that decisive factors of a commoditized market lose their representation when faced with differentiated value propositions. The investigation demonstrates that the number of quarters since the launch of a service does not dictate a decrease in revenues, but rather supports better financial results for enhanced bundles. Moreover, for this type of packages, a higher level of pricing spread was found to be correlated with higher incomes. These results set the ground for additional investigation across industries, as it demystifies commoditization as an irreversible outcome.

JEL Codes: C23, C51, D43, L13, L25, L96, O30

Keywords: Commoditization process; Commoditization paradox; Differentiative strategy; Telecommunication sector; Hedonic pricing approach, Average revenue per user

Resumo

A comoditização ganhou cada vez mais importância no estudo da dinâmica da indústria como um processo que corrói a diferenciação competitiva e leva à diminuição da criação de valor. No entanto, ao desafiar as organizações a reagir e a impor barreiras ao processo, também leva as empresas a apostar na inovação como contrapartida. Este estudo pretende colmatar uma lacuna negligenciada nos últimos anos, ao abordar a eficácia da resposta estratégica das empresas à comoditização do mercado no setor das telecomunicações português. As questões de pesquisa envolvem os efeitos que algumas variáveis de comoditização incitam na receita média por utilizador, comparando os respetivos impactos entre pacotes de serviços padronizados comuns e pacotes com componentes inovadores.

Por meio de uma abordagem hedônica de preços, foram empregues métodos econométricos de dados em painel, nomeadamente *Pooled OLS* e *fixed effects*. Como sugere a teoria económica, esta dissertação demonstra que os fatores decisores de um mercado comoditizado perdem a sua representatividade quando confrontados com propostas de valor diferenciadas. A investigação demonstra que o número de trimestres desde o lançamento de um serviço não dita uma diminuição das receitas, mas sim suporta melhores resultados financeiros para pacotes enriquecidos melhorados. Além disso, para este tipo de pacotes, um maior nível de *spread* de preços está correlacionado com maiores rendimentos. Estes resultados estabelecem bases para investigações adicionais em outros setores, pois desmistificam a comoditização como um resultado irreversível.

Códigos JEL: C23; C51; D43; L13; L25; L96; O30

Palavras-chave: Processo de comoditização; Paradoxo da comoditização; Estratégia de diferenciação; Setor das telecomunicações; Abordagem hedônica de preços; Receita média por utilizador

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List of Acronyms

2P		Double-Play
3P		Triple-Play
4P		Quadruple-Play
5P		Quintuple-Play
FB		Fixed Broadband
FEM		Fixed-Effects Model
FTS		Fixed Telephone Service
MB		Mobile Broadband
MTS		Mobile Telephone Service
OLS		Ordinary Least Squares Model
OTT		Over-the-Top Operators
PTO		Public Telecommunications Operator
STV		Subscription Television

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1. Introduction

“Commoditization is increasing in every category. Once novel features are now table stakes” (Laja, 2021)

This work aims to measure the effectiveness of companies' strategic response to market commoditization. As the digital transformation emerges across industries, the advantages are undeniable. It enables firms to revolutionize processes, streamline operations and improve security (Øverby & Audestad, 2018). However, at a price. As market reach increased vastly, so did the customer's available options and expectations. With so much choice and information accessible, any client can opt to buy a good or service from a wide range of suppliers, with little to differentiate one company from another (Coe, 2021). In the Amazon and AliExpress age, customers have access to the same deals faster than ever before.

It is a world of possibilities, there is a multitude of things to choose. In that sense, everything from services to goods, operations to marketing, customer service, and experience, can end up being seen as identical (Beveridge, 2018). This is the so-called commoditization process.

Therefore, it is not unexpected that firms struggle to present a value proposition that is sufficiently different. For many, this means that the cheapest will survive, as price becomes the primary criterion for making decisions. Others will try to impose barriers on the process, even if it may only be a temporary solution. LCD flat panel displays, fitness trackers, or cloud storage apps, are all examples of goods that presented innovative features some years ago and ended up losing their uniqueness, becoming part of daily life.

The conventional belief viewed commoditization as an inevitable process (Rangan & Bowman, 1992) and increasingly difficult (Bharadwaj et al., 2009) for companies to deal with. As it eroded competitive differentiation, firms' financial situations would deteriorate over time, confirming the fate of market stagnation.

As a result, several corporations attempted to divest mature or commodity-type industries throughout the 1980s to reinvest their resources in something more promising (Rangan & Bowman, 1992). During the 1990s the discussion also turned to the impact companies could have in detaining the process, as Porter (1980) introduced, launching differentiated proposals.

Most authors agree that commoditization is occurring in most markets, with noteworthy exception (Schrage, 2007), presenting a challenge for decision-makers across industries. Leaders in 61% of the companies inquired for a 2014 report realized they have not taken

adequate action to escape the commodity set-up, and the majority of them, acknowledged there was a big gap between recognizing commoditization and reacting appropriately (Berger, 2014).

Despite this recognition, the literature offers no comprehensive construct (Reimann et al., 2010) that is able to capture the effectiveness of the strategic response to commoditization challenges. On one side, the introduction of innovative offers is capable of attracting more revenue, however, if the product becomes the market standard, the overall level of commoditization increases. This view encapsulates a paradox.

Based on this motivation, a cluster of cases from a specific industry allows hypotheses to be tested regarding the level of efficacy of firm strategic response to restrict this evolution.

In the Portuguese context, the telecommunication sector (or telco) fulfils all the requirements. With increasing technological advancements, an escalating number of business models are entering the market, challenging telco's core business. While the total consumer spending on overall services is expected to increase, the consumption of traditional offers is likely to decline (Kalem et al., 2020). In such a context, the conventional proposals are threatened by the possibility of a decline in revenues.

Notwithstanding, reformulating business strategies, and resorting to the usage of bundling approaches, has demonstrated to be effective in maintaining positive outcomes for each operator. The objective here proposed is to understand to what extent the level of differentiative offers in a bundle, ultimately results in an increase of a key metric in the industry – the average revenue per user (ARPU).

The research questions are established as follows:

- Is the time since the launch of a bundle progressively less significant for enriched bundles, as they present more differentiated offers?
- To what extent is a lower level of price proximity in the industry responsible for lower revenues for operators?
- Does the positive influence of market concentration become gradually lower for bundles with additional innovative complements?

Panel data econometric regressions over different datasets of bundle types allow the evaluation of the effects that such variables have on ARPU. Resorting to a hedonic pricing approach, an analysis on the evolution of these constituents can be performed. The temporal data collected is related to the period between 2015 and 2021.

From the academic standpoint, developing this model to test such hypotheses would provide supported conjectures on the strategic response to commoditization and raise the possibility for further developments on the most efficient reaction mechanisms. It is also expected that the study is capable of deliver significant managerial contributions as well.

Regarding the limitations the research scope is only restricted to a specific industry, and to Portuguese context. Nevertheless, it is assumed that the results here found can be used as possible guidelines for similar situations.

This study will be divided into 5 chapters. After the introduction, a literature review (chapter 2) follows, introducing the main concepts on the topic: the commoditization process on one end of the spectrum, versus innovation and differentiation on the other end. The discussion then moves to the rationale behind the process, its drivers, and barriers. The empirical study requests a selection of a specific group of research, examined in chapter 3. Concerning the methodology of the present study, it is presented in chapter 4, followed by the research findings and its discussion. Chapter 5 concludes the study, presenting its managerial findings, limitations, and suggestions for future research.

2. Literature Review

This literature review is divided into two main chapters. As commoditization captures a wide range of economic concepts, those will be briefly addressed (2.1.1), moving the discussion to the process itself (2.1.2), on one side of the spectrum, versus innovation and differentiation (2.1.3).

Once the two topics have been introduced in their fundamental objectives, differences, and perspectives, it becomes relevant to understand the rationale leading the process. Since numerous factors “push” markets and companies towards commoditization, those drivers are worth assessing (2.2.1). On the other hand, several barriers can be imposed to decelerate this impetus (2.2.2). If classic literature present innovation and commoditization as two opposites, more recently some authors also acknowledge the mutual positive influence, creating a paradox (2.1.3).

2.1 Major Themes and Concepts on the Literature

2.1.1 Commodities - A Historical Perspective

In economics, a good can be referred to as a commodity when it is easily interchanged with other goods or assets of the same type, an attribute called fungibility (Marshall, 1890). They are often used as raw materials to manufacture other goods and services, from agricultural products to energy, to gold or petrol.

The term is far from new, as its use can be traced down to the 15th century. Nonetheless, its application in early macroeconomic perspectives was achieved by contributions from authors such as Adam Smith, Karl Marx, or Friedrich Engels.

“The value of any commodity (...) to exchange it for other commodities, is equal to the quantity of labour which it enables him to purchase or command.” - (Smith, 1776, p. 47)

“The wealth of societies in which the capitalist mode of production prevails appears as an ‘immense collection of commodities’” - (Marx & Engels, 1867, p. 3)

Since the days farmers lugged stacks of corn into the local market, the commodities market has changed dramatically. From a financial perspective, commodity futures markets arose in response to a demand for standardized contracts to trade agricultural products in the 1800s (Beck, 1994). For instance, if a farmer decided to sell his products in those markets, he would

determine a price for a specific date in the future and would not be affected if the prices declined until then.

Today, commodities are another class of assets in the same way as bonds and stocks. These future and option contracts can be exchanged around the world, enabling producers to offload risk to other participants in the financial markets (Roache, 2008).

Besides the macroeconomic discussion of the topic, more recent approaches also turned their attention to the importance of commoditization as a consequence of competitive environments. It is commonly regarded as a symptom of mature markets, in which the products offered are less or even undifferentiated (Kotler, 2002; Turner, 2009).

In fact, the term can capture a wide broad of economic concepts. Nevertheless, this micro-industry rationale, in which commoditization is both the result of competition and a booster of the rivalry itself, is the approach this work will further refer to.

2.1.2 Commoditization Process

Commoditization is the process by which any good becomes indistinguishable from the standpoint of a consumer (Zysman, 2014). It typically refers to products, although services can also be commoditized (Kushida, 2015). As competing goods start appearing the same to users, it becomes difficult to discern them, even if produced by different companies, with price being the remaining differentiator factor.

Anderson et al., (2018, p. 2) go further, and argue that “commoditization of a market occurs when the importance of product attributes that can distinguish a product disappear. Hence, [it] is the opposite of differentiation”.

Traditional literature considered the process as the end result of the competitive forces in the market, rather than as practice itself (Seshadri, 2011). Nevertheless, recent studies also include the role of other companies’ strategies in the course of product development.

The conventional belief was that commoditization is inevitable (Rangan & Bowman, 1992) and increasingly difficult (Bharadwaj et al., 2009) for companies to deal with. Most studies focused on the product life cycle to base their findings and expectations (see Bharadwaj et al., 2009; Seshadri, 2011). In the authors’ view, after the development and growth stages of any product or service, they would eventually face the maturity phase and declining process. During maturity, market saturation is evident, and sales grow on a par with the market population, with competitors trying to hold brand preference (Levitt, 1965). As this pressure

takes place, consumers eventually can make no distinction between each product, leading firms to compete over prices.

In the most radical view, companies ultimately decrease prices until profits became null – an extension of the Bertrand duopoly model (Cannan & Edgeworth, 1925). As a result, throughout the 1980s, many corporations attempted to divest their mature or commodity-type businesses to reinvest their resources in something more promising (Rangan & Bowman, 1992).

As commoditization erodes competitive differentiation, firms' financial situations deteriorate over time (Matthyssens & Vandenbempt, 2008) accepting the fate of market maturity stagnation. Matthyssens & Vandenbempt (2008) outline three major characteristics of such markets, (i) higher product homogeneity, (ii) customers gaining a better understanding of the product, and (iii) producers starting to imitate each other. Building on those findings, Reimann et al., (2010) add other three determinants: (iv) increased customers' price sensitivity, (v) reduced switching costs, and (vi) higher industry stability.

As a matter of fact, most authors agree that several markets experience the pressures of commoditization (for instance Bettis & Hitt, 1995; Olson & Sharma, 2008; Rangan & Bowman, 1992). Nevertheless, more recently, the idea of dealing with commoditized markets has also been studied. Rangan & Bowman (1992) challenged the traditional principle that product commoditization is unavoidable and accompanied by deteriorating profits. They start by presenting the combination of “product-market commoditization” (Rangan & Bowman, 1992, p. 217) instead of just focusing on products and services. In their view, it is not only the product that becomes standardized but also the market itself. However, their base study is focused only on trying to beat the commodity “magnet”, as they describe, formulating strategies to escape those markets.

Adding to these beliefs, Manno (2000) argues that the process acts as a Darwinian selection pressure, "choosing" certain types of goods and services that prosper over others. This force of evolution favours certain qualities in products and operate simultaneously on the individual product level, and in the economic system as a whole, affecting sectors like agriculture, computing, environmental protection, and so forth (Manno, 2000).

Until the beginning of the century, the literature widely accepted the fate of commoditization, with more or less positivity towards the topic. Greenstein (2004) consider that, in general, low margins are the norm in the world, and every now and then a company manages to break

away. It is uncommon, although it is possible. In the author's opinion, whether it occurs early in the history of the product category, or later, is merely a minor detail. Reimann et al. (2010) agree with this view and building on it, even acknowledge its importance in market competition.

Recent studies started to turn their attention to the commoditization process itself. Instead of an undeniable future, the process, its barriers and drivers also became relevant. Holmes and Ryan (2008) present real cases where companies were able to "survive" the commoditized market, by either accepting the condition and dealing with it or beating commoditization through innovation. Different strategies were approached, from Ryanair moving toward a low-cost provider, to Walmart improving their supply chain, or Starbucks improving the coffee experience into a brand.

A noteworthy distinction should also be pointed out. Schrange (2007) discuss the myth of commoditization. In his view, goods were not turning into commodities, according to history. Unlike researchers until now, the author discusses how the market advancements cannot be seen as commoditization, using the toasters example. Their invention came around 1900, however, a simple study shows their continual evolution until today, continuously making great money, and better toasts.

The challenging competitive landscape and each firm's strategy became an important factor in research. For instance, Bharadwaj et al. (2009) discuss how standardization and commoditization are potential buyer solutions, arguing that practices that adjust prices aim for faster standardization. Kushida (2015) also faces the process through this point of view. When entrants come into new industries, they pose a threat to incumbents by "radically accelerating the competitive logic of commoditization, which disrupts existing firms and business models" (Kushida, 2015, p. 50).

Accordingly, Christensen (2016) claims that commodities are only created in a market when recurrent changes in competition play themselves out. In other words, just when more than one product satisfies the market needs on each attribute of performance. Goffin et al. (2021) also study factors that counter commoditization, concluding that companies are susceptible from the moment they do not have distinguishing products or technologies, nor do they provide unique value.

As new waves of commoditization struck different markets dramatically, many of them much earlier than expected, the discussion turned to the impacts of differentiation and innovation.

If on one hand goods were being perceived as fungible much faster, companies were also able to recreate themselves and emerge with differentiated proposals that added value to those products.

As Kushida (2015) points out, since commoditization is likely to continue to spread in new domains such as transportation, telecommunications, energy, computer, healthcare, and others, it is worth understanding this trajectory, perhaps by looking at the opposite view.

2.1.3 Differentiation and Innovation

Circling back to Anderson et al. (2018)'s view, commoditization can be understood as the opposite of differentiation. This type of strategy is used to attract and retain customers by providing them with one-of-a-kind products or services, to gain competitive advantage (Porter, 1985).

The three strategic orientations of cost leadership, differentiation, and focus, according to Porter (1980), provide the fundamentally distinct possibilities for a company aiming to develop a competitive lead.

Cost leadership is focused on outperforming competitors through efficiency instead of product quality, typically at the expense of excellence. Companies that adopt this technique are better positioned to withstand pricing pressures imposed by market forces (Porter, 1980). Differentiated firms, on the other hand, strive to create a genuine or perceived difference, building a customer base that considers the provider's product or service as superior (Green et al., 1993; Porter, 1980).

Finally, the focus approach is based on narrowing the firm's market goals by geography, consumer group, or product line. By using this concentration, companies can satisfy specific customer needs either through superior service, or cost leadership (Porter, 1980).

Besanko et al. (2017) take into consideration several factors that make firms able to create more value, thus more profit, using a differentiating strategy. When consumers are willing to pay a significant price premium due to a relatively steep indifference curve, or firms are selling experience goods, a company can distinguish its product by including extra features that may be able to fetch a larger price premium. Moreover, once scale or learning economies are significant and firms already exploit them, opportunities to achieve cost advantage are limited.

Green et al. (1993) consider that differentiation should be present in a variety of areas, including product quality, service, and delivery. In their view, cost considerations become secondary given the lower price sensitivity, and greater margins emerge due to brand loyalty benefits.

"Stuck-in-the-middle" firms, according to Porter (1980), are those that fail to adopt a single generic strategy. Due to their inability to attract high volume consumers associated with low pricing, or low volume/high margin customers associated with a differentiation strategy, such businesses are condemned to low market share and profitability.

Some may argue that no company is created with the intention of blending in, raising the question for marketers and entrepreneurs on how to stand out from the crowd. From straightforward differentiators such as enhanced customer service, competitive pricing, extended range of products, brand identification, serving specific geographic markets, advertising, and reputation (Green et al., 1993) to innovations that can revolutionize the market, numerous strategies can be pursued.

Approaches resembling new product development, modernization in the manufacturing process, or employment of new technologies are linked with the innovation conception. Schumpeter (1943) consider the entrepreneurs' role is to reform or revolutionize the production pattern by utilizing an invention or, more broadly, an untested technological possibility for producing a new commodity or an old one in a new way, by establishing a new source of materials or a new outlet for products, reorganizing an industry.

Freeman and Soete (1997) included in the method of industrial innovation the technical, design, production, management, and commercial processes that go into marketing a new (or improved) product, or the first commercial usage of a new, or enhanced, method or equipment.

Rothwell and Gardiner (1985) also state that innovation does not rely solely upon the commercialization of a major advance, or radical innovation, but also includes the application of even minor shifts in technological knowledge known as incremental innovations. Tidd and Bessant (2018) discuss the different types of innovation, using the "4 P's of Innovation" model, further summarized in table 2.1.

Table 2.1: 4 P's of innovation model definitions (Adapted from Tidd & Bessant, 2018)

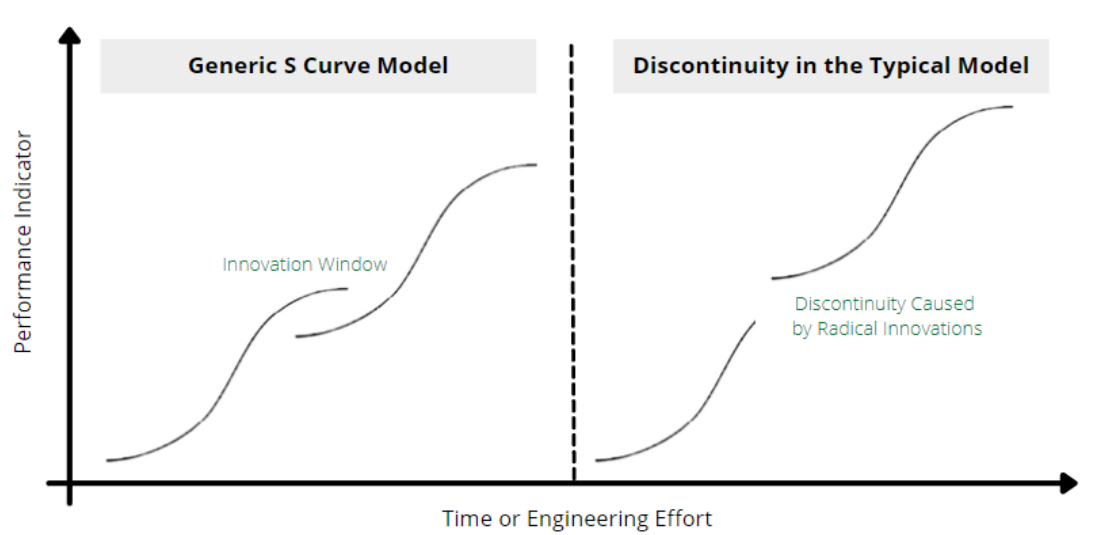
Concepts	Definition
Product Innovation (Tidd & Bessant, 2018; OECD, 2018)	These are innovations incorporated into the organization's outputs and are defined as the introduction or improvement of a product or service. It does not necessarily account for a new product in the market, just regarding the company's previous offers. Vertical innovation improves the quality of existing products, whilst horizontal, the creation of original products.
Process Innovation (DGEEC, 2018; Tidd & Bessant, 2018)	Centred on a new or improved business process in one or more functions of the company, that differ significantly from the processes used until then. They resemble different categories such as methods to produce goods and deliver services, logistics, information processing and distribution, management practices, and so forth. Generally, they are driven by efficiency gains.
Position Innovation (Tidd & Bessant, 2018)	Based on the repositioning of the original offering, they change the context in which the products or services are introduced. The product remains the same however, the target, the story told, or the consumer's perception is changed.
Paradigm Innovation (Freeman & Soete, 1997; Tidd & Bessant, 2018)	Represent the shift of the underlying mental models that frame the organization's procedures. For instance, by engaging in sustainable goals, firms may redefine themselves and their offerings to respond to social concerns.

The diffusion of technological advancements, measured by the year of adoption and the market penetration of determined technology, is characterised by an S-shaped curve (Meade & Islam, 2006).

Simultaneously, the relationship between technological development work and results also takes the shape of an S-curve (see Foster, 1986; Ichikohji, 2019; Schilling, 2009).

At first, technology improves slowly as it is not understood in its potential and there is a lack of confidence in future adoption. With increasing knowledge, the performance rises abruptly, towards its potential through incremental innovations. Finally, when the technology reaches the natural limits, performance is only able to improve marginally (Schilling, 2009). In this final stage, there is a window of innovation where other technologies are entering the adoption stage, starting a new curve toward a higher limit of performance. When disruptive innovations take place, the first cycle may not even be finished as the technological breakthrough suddenly changes the market landscape.

Figure 2.1: S-Curve Model and the influence of radical innovation.



Source: Own elaboration, based on Schilling, 2020.

Different types of innovation occur as time and engineering efforts advance. When no further technological advancements are expected, the new product is technologically standardized (Giachetti & Dagnino, 2015; Ichikohji, 2019). Nevertheless, different types of innovations will take place. Abertnathy & Utterback (1978, 1975) point out that product innovation turn into process innovation once a dominant design appears, while Koski & Kretschmer (2007) acknowledge the influence of vertical and horizontal innovation in product attributes.

Additionally, while firms prioritize technology innovation in the early phases of a product's market, they move their priority to design innovation as time goes on (Akiike & Yoshioka-Kobayashi, 2017).

As discussed, market conditions ultimately affect innovation. Increasing interconnected global markets, higher competition, and the reduction in product life cycles are just a few examples of challenges with particular relevance nowadays. Companies assess existing technologies from different viewpoints and build technologies that highlight their diversity (Adner & Snow, 2010; Ichikohji, 2019).

Ultimately two alternative outcomes emerge: either the price-lowering effect brought by market commoditization, or the price-increasing impact offered by differentiation generated by innovation.

2.2 The Mechanisms of Commoditization

Whilst early approaches understood commoditization as an irremediable destiny, in the last decades general literature considers not only that it is possible to thrive in these markets, while also agreeing that differentiating strategies can hold the process.

Therefore, the rationale behind the slower or faster development becomes relevant. These mechanisms are influenced by drivers as well as barriers, which is worth an analysis.

2.2.1 Commoditization Drivers

Porter (1980) define five key forces shaping the competitive landscape of industries: supplier power, the bargaining power of customers, competitive rivalry among existing players, the threat of substitution, and the risk of new entrants. When all of those play a significant role, the fierce competition is characterised by numerous actors with parallel size and power, low switching costs, high fixed costs, slow growth, and high exit barriers.

Commoditized markets present similar indicators. The availability of product substitutes, customers' unwillingness to pay a price premium for additional features, as well as general pressure on prices and margins tend to signal these markets (Shapiro, 1987).

Amongst the literature, numerous authors approached the pushing forces of the process, or the commodity “magnet” (see Rangan & Bowman, 1992; Turner, 2009), remarking how there are influences towards such results. Rangan & Bowman (1992), based on Shapiro et al., (1987), proposed a visual model to understand such progress.

The model (Figure 2.2) uses a two-dimensional matrix, with one axis denoting price and the other reflecting the service offered by such product. The cross diagonal reflects a power axis: in quadrant A, the manufacturer is more powerful (differentiated), whereas, in quadrant D,

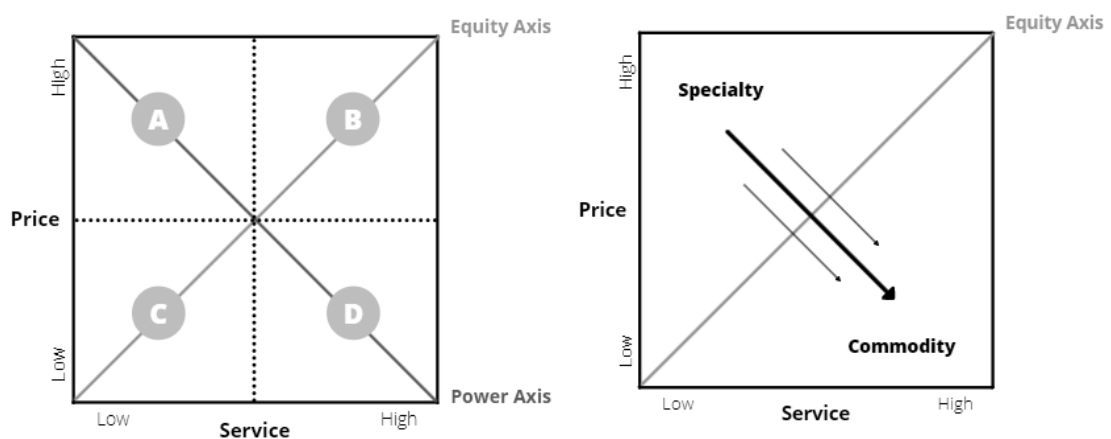
the customer possesses other alternatives. Strategy B would differentiate through augmented services, while C provides a low-cost approach. Nevertheless, strategy A would largely benefit any company, providing higher value.

The axis of equity, which runs from the bottom left to the higher right, is where a corporation charges the price reflecting the value of the service it delivers. Quadrant C embodies a basic product without much-added value, where the customer pays a cheap price for the service. Alternatively, scenario B depicts a product with extensive value-added services that include a price premium.

For each point above the equity line, consumers perceive superior value in comparison to the competition and the company can extract a price premium due to its differentiation. Situation D, for instance, indicates that a company would be giving away all of its services, possibly to maintain market share in a highly competitive market.

Depicted each scenario, Rangan & Bowman (1992, p. 218) state: “strategy D is rarely consciously adopted by any firm. The customer and competitive environment drag a firm reluctantly down to that quadrant”, eventually transforming differentiated products – specialties – into simple commodities (Figure 2.2).

Figure 2.2: Commoditization magnet.



Source: Based on Rangan & Bowman (1992) perspective.

Over the years, different triggers have been pointed out for the phenomenon. Matthyssens and Vandenbempt (2008) infer product life cycles are getting shorter and shorter in today's

turbulent and rapidly changing industries. In their view, margin pressure is increasing as a result of intensified worldwide competition and more informed purchasers.

Those findings were based on Shapiro's (2002) studies. The author derives two main drivers: the introduction of a market-wide standard design or technology, and an improvement in transparency in pricing and product features.

In the author's view, when markets mature, companies end up converging on a standard technology, ending up with similar substitute offers. For instance, Qualcomm presented a disruptive product in 2002 with System on a Chip (SoC), gaining control over the mobile semiconductor market, until eventually, every competitor merged into the same offer after understanding its superior advantages (Hagel et al., 2015).

On the other hand, customers are more inclined to switch from one product to another since they can compare them at ease. Seshadri (2011) also focuses on these learning curves as a primary reason for commoditization. While defining the study model, the author describes how buyers in every industry "will strive to extract cost reductions from learning" (p. 45).

Simultaneously, as the adoption of new technology occurs, market transparency also increases competitors' imitation (Matthyssens & Vandenbempt, 2008). In doing so, they reduce the lifespan of any effort to differentiate or gain a cost advantage. One remarkable example of such transparency is related to the introduction of online marketplaces in the automobile insurance or airline industry, which resulted in an increasing commoditization pressure (Hagel et al., 2015).

Several authors base their research on these factors, and their respective consequences. For instance, Coe (2021) concludes that, in general terms, intense cost-based competition tends to lead to business approaches that "prioritize efficiency and simplicity, calculability and predictability, tight control and repetition, and incremental innovation" (p. 293). Nevertheless, there is no comprehensive framework in the literature that covers the numerous facets of commoditization.

Reimann et al. (2010) were the last ones to attempt to fill this gap. The authors proposed a multi-dimensional construct to point the drivers of the process, focusing on four different variables: product homogeneity, price sensitivity, switching costs, and industry stability (Figure 2.3).

- High *product homogeneity* can be translated as consumers seeing products as fungible (Marshall, 1890). Commodity-like products, such as wood or metal are practically equal offers

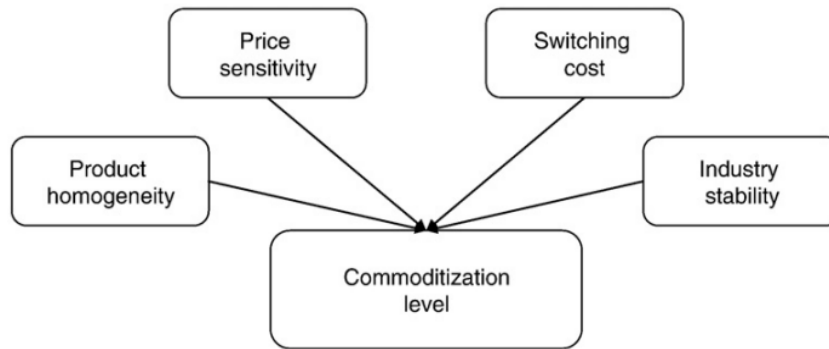
between competitors. Nevertheless, the spectrum before reaching this state gives the opportunity to companies to differentiate their offers. If they fail to do so, this driver will lead to a faster process. While studying the commoditization of high-tech industries, Shih (2018) refers three main explanations for similarity: (1) flagrant intellectual property (IP) copy, (2) governments forcing corporations to disclose technology in exchange for business rights, and (3) typical knowledge spillovers as employees shift from multinationals to local businesses.

- Burnham et al. (2003) state several considerations defining *switching costs*. Economic risk, valuation, learning, setup, benefit loss, monetary loss, personal relationship loss, and brand relationship loss are all expenses that must be considered. When companies fail to impose a differentiated offer that retains consumers, lower switching costs, characteristic of such markets, speed the progress.

- As switching costs fall, customers get a better understanding of product qualities and a stronger focus on pricing, giving them more bargaining power. Such as Shapiro (1987) described, in commoditized industries, high *price sensitivity* arises from purchasers seeking the best price for a standard product, assuming that products of roughly equal quality and features, would continue to be available. Alajoutsijärvi et al. (2001) demonstrate how price fluctuations in fact tend to happen in commoditized environments. Further research (see Davenport, 2005; Heil & Helsén, 2001) also discuss the negative influence of price-wars in the process. Since those industries are more likely to experience price wars, price proximity also results in increased commoditization. Firms likely start to cut prices to attract customers entering a downward spiral.

- Finally, *industry stability* is once again a signal of commoditization, as well as a driver itself. In mature markets, horizontal mergers are frequently used to increase economies of scale and scope as organic growth is no longer possible (Pelham, 1997). A steady market demand, stable competitive structure, and slight changes in the consumer base give room for the other forces to act. It is also noteworthy to point out Reimann et al. (2010)'s questioner responses since two opposite types of answers were obtained regarding industry stability. While interviewing managers from industries previously pointed out as highly commoditized, some acknowledge the stability of such markets. However, others refer to the industry as a constantly changing landscape. These answers suggest how the climate in commoditized industries may vary, pointing to the importance of the static versus dynamic situation.

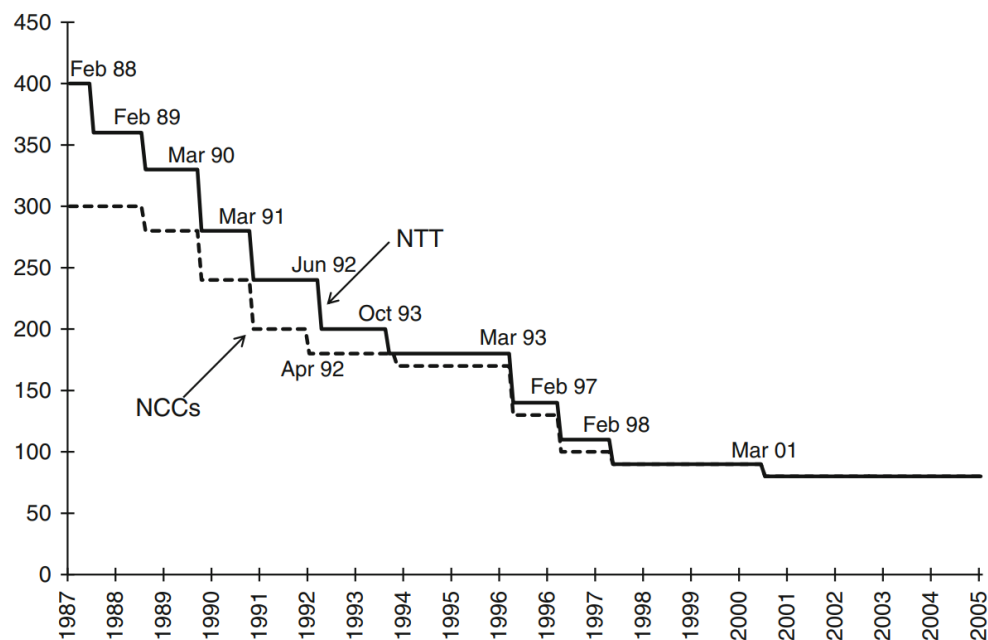
Figure 2.3: Commoditization level as multi-dimensional construct



Source: Reimann et al. (2010)

Kushida (2015) present one of the few analytical measurements on the phenomenon, in the telecommunication sector, in Japan. By comparing pricing proximity between the two main telecommunication companies: Nippon Telegraph and Telephone (NTT) and National Communication Commission (NCC) (Figure 2.4)

Figure 2.4: Japan's price-proximity development (yen per 3 min call)



Source: Kushida, 2015

As it is clearly presented, not only the price decrease is evident for the same good, as the price proximity between offers is scarce, with decreases happening almost at the same periods, to meet the competitor offer. Nevertheless, many differentiation strategies were put

into practice since then. The digital age brought challenges for each market, while on the other hand presenting further ways to create appealing products and perhaps deviate from such outlooks.

2.2.2 Imposing Barriers on Commoditization

Rangan & Bowman (1992)'s studies showcase how companies can, at least partially, influence consumers' behaviour to beat commoditization. By altering the price/ service offered marketing mix, firms are able to differentiate themselves. As one of the first studies on the field, such strategies might be seen as generic, while suggestive at the same time, offering a straightforward approach to the alternatives available.

During the path of technological development Kampas (2003) discusses how the source of consumer value transfers from product innovation to business innovation, and how the center of power shifts from vendors to customers. Product functioning and standards are apparent, and product styling, packaging, and branding, in addition to price, the convenience of use, safety, and reliability become major marketing tactics.

More recently, Ulaga & Eggert, (2006) demonstrate that product and pricing are not that significant differentiators. Service assistance and human engagement, as well as access to know-how to a lesser extent, have emerged as key differentiators in commercial relationships. All these differences lead firms to approach new strategic responses.

Firms are ultimately problem-solving entities that strive to establish, maintain, and manage a superior competitive position that is dependent on the firm, its resources, and the status of the environment (Zeithaml et al., 1988). According to the contingency-based approach to strategy formulation, there is no optimum plan, or any single strategy is most effective in all circumstances (Harrigan, 1983). Companies strive to combine variables they can control such as products and differentiation, with those they generally cannot.

While some studies argue that in commoditized marketplaces, only operational excellence counts (Pelham, 1997), more recently product- and customer-centered strategies have been understood as essential for success. Nevertheless, generalizable empirical evidence is still missing.

Quelch (2007) propose a three points approach to these challenges: innovation, bundling, and segmentation. As debated, a new or enhanced product to fit consumer expectations is

likely to provide more value, as well as force competitors to act. If these services are offered in combination with determining auxiliary services, such as after-sales, buyers may be more willing to pay a price premium for the bundle. Finally, the author suggest that large markets can be divided into segments, and firms should be focused on delivering application expertise to customers who are less price-sensitive and still value the product.

Regarding the introduction of innovations, Lieberman and Montgomery (1988) also debate the first-mover advantages for firms. By surpassing the competition, even for a short period, this created differentiation establishes leadership, captures market share, and lets the firm collect the early price premium. As time goes by, companies conform to another else's concept of value.

Reimann et al. (2010) conduct interviews with managers across industries, aiming to find connections between marketing strategies and commoditization levels. The authors find out that driving performance in lower commodity contexts requires a strategy that is balanced across operational excellence, customer intimacy, and product leadership. As commoditization increases, however, a stronger competitive focus on customer intimacy appears to have the most impact on success.

Even in recent research, these results stand. Coe (2021) propose three different strategies¹ to address these challenges:

1. The maintenance of close relations with consumers, as debated, to secure product leadership and operational excellence.
2. Consolidation, even if it might seem counterintuitive. Industry stagnation represents a driver for commoditization, nevertheless, the organizational efficiencies created can benefit firms, even if increasing the overall market standardization.
3. Outsourcing and offshoring of non-core activities, refocusing on differentiative operations the firm can perform better.

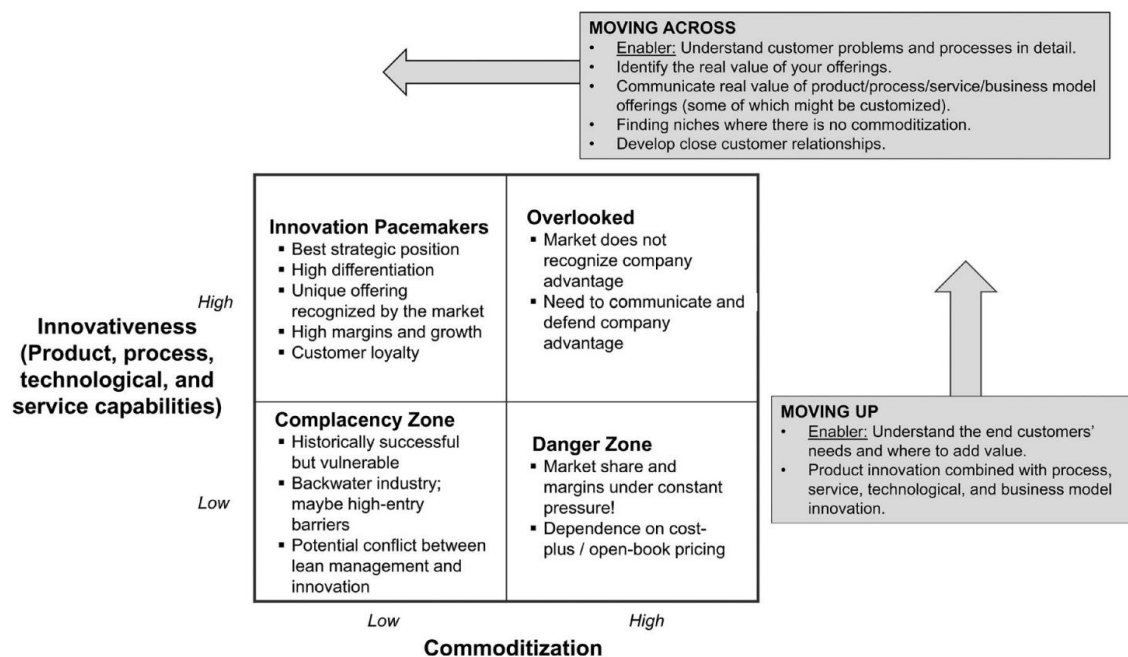
Ichikohji (2019) tries to understand to which extent commoditization is favouring innovation, at least in the specific context of digital cameras. The results are in fact interesting. It looks at how product prices went from being in a decreasing trend to an upward. Price increases were sparked by two strategies in the low-priced segment: the

¹ These strategies resulted from Coe, (2021) research regarding the third-party logistics industry. The author proposes four different strategies, three applicable to multiple industries, and one specifically designed for the logistics industry.

withdrawal of companies that had previously engaged in price rivalry, and a shift in focus to high-quality items. Moreover, the prices in the high-quality group increased slightly. The author concludes that companies were always investing in an extremely high-end product, with constant differentiation, with comparable costs, and clients were available to pay a price premium for such characteristics.

As it became apparent in the literature, commoditization can be suppressed by innovation. Goffin et al. (2021) make a set of interviews in European business-to-business (B2B) companies, concluding that most of them were vulnerable to commoditization, lacking differentiated products or technology. Confronted with such results, the authors develop one of the most recent frameworks regarding commoditization and innovation (Fig. 2.5).

Figure 2.5: Commoditization- Innovativeness Matrix



Source: Goffin et al. (2021)

As debated, the objective of companies in high commoditization and low innovativeness is to increase innovation. The authors agree that can be achieved by understanding consumers and focusing on product, service, technological and business model innovation.

Moreover, in zones of high commoditization, as well as increased originality in value propositions, the authors suggest a move towards niches or segmented customer needs. The goal is to find a unique offering capable of establishing customer loyalty.

2.2.3 The Commoditization Paradox

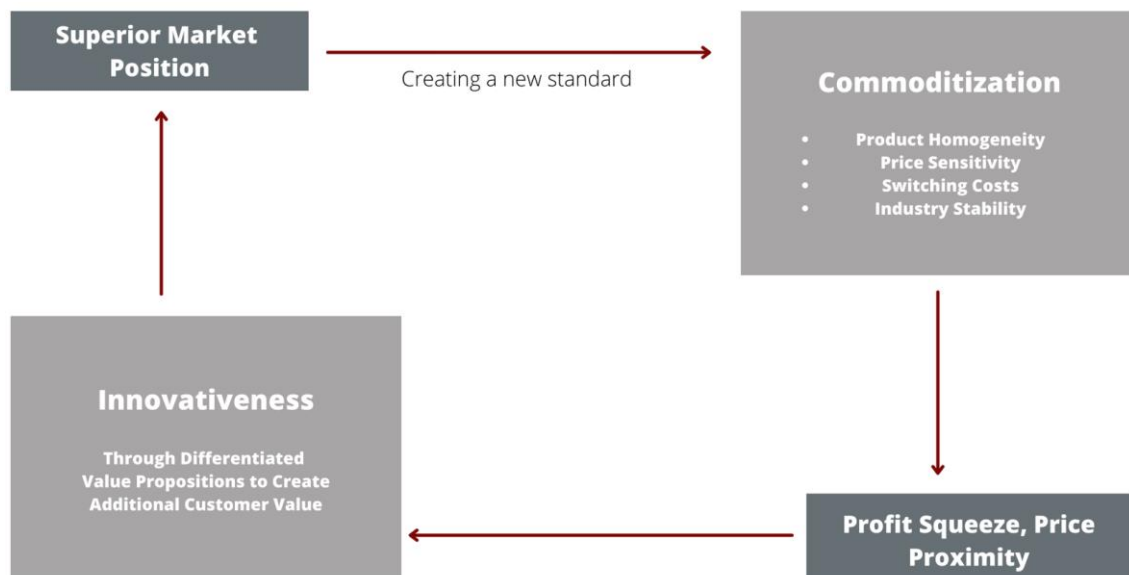
Despite the advances regarding commoditization and innovation, Ichikohji (2019) considers that the relationship between the two factors remains inadequate.

On one side, commoditization is an important factor in market evolution, imposed by different drivers that eventually erode competitive differentiation of products, while fostering a response from companies. In this sense, literature faces commoditization as a pre-condition for innovation (Seshadri, 2011).

On the other, innovation is both a solution for the progress and a driver of further standardization. Innovation adds complexity. At the same time, this complexity turns products not so up to date, as even simpler from the consumer standpoint, increasing industry commoditization.

This leads to the central paradox of commodity markets (Fig. 2.6): to avoid commoditization, firms must invest in something unique. However, if it was simple to ensure, everyone would do it, making the "something extraordinary", commonplace. If the product turns into the standard, then it no longer is effective in preventing commoditization.

Figure 2.6: Commoditization Paradox



Source: Own elaboration, based on Matthyssens and Vandenbempt (2008)

It is definitely interesting to develop research over different sets of industries to understand the extent of this relation, but data and time constraints make such approach impracticable.

3. Empirical Study – Sector Specification

Empirical research is based on direct observation and measurement of phenomena by the researcher, and the collected data can then be compared to a theory or hypotheses (Tranfield & Starkey, 1998). To investigate the correlation amongst the commoditization paradox, and perform a measurable study, a specific cluster of cases had to be selected.

For the argument in question, the chosen industry should have been affected by commoditization, measurable metrics had to be available to assess the phenomena, and to some extent, companies on the market should rely on differentiation strategies to face the situation. On the customer side, innovations that have being easily perceived were also an imposition. Simultaneously, price changes should be measurable, preferably for short periods of time.

By selecting a specific sector, and understanding the strategic response of intervenient parties, the process can formulate some solutions on whether companies can create an effective response towards industry commoditization, perhaps applicable to other industries. Having this background of prerequisites in mind, the Portuguese telecommunication sector fulfilled all the requirements. By acting mostly as an oligopoly of only four enterprises, measurements could perhaps be effectively obtained.

Over this chapter a general overview in the global sector is presented (3.1), followed by the Portuguese configuration of services, regulator, and operators (3.2). Finally, the specific economic characteristics of the market are also debated (3.3).

3.1 The Telecommunication Sector

The telecommunication sector comprehends companies that enable communication on a global scale, being that by phone or internet, cables or airwaves, wires, or wirelessly (EC-RRC, 2021). These companies own infrastructure, therefore can be either telephone operators, cable companies, satellites, or internet service providers. In fact, nowadays what the industry presents is a set of companies capable to bundle all these services.

Not that long ago, the sector consisted of highly regulated regional operators, being understood as a natural monopoly (Chakravartty, 2001). This notion was based on the existence of economies of scale in all the relevant steps in the market production, related to

high initial fixed costs (Chakravartty, 2001). Therefore, a dilemma between the productive efficiency and efficiency of resource allocation was created, and only the presence of a single producer, public or private would be required to reach maximum productivity. (Baumol & Bradford, 1970).

In fact, in the European Union, until the establishment of the 1987 Green Paper, the sector was conducted by a monopolist company in each country that provided the infrastructure and services. The so-called “Public Telecommunications Operator” (PTO). The government of each country either detained major equity in these PTOs or detained them completely (European Commission, 1987). As private companies were not able to access the market, regulations were not required, simply recommendations.

Over time, as technology developments appeared and the demand for telecommunications increased, additional measures led to the liberalization of the sector. The 1994 Green Paper and directives such as the 90/387/ECC and 90/388/ECC aimed the creation of an internal market for telecommunications services by implementing open network provision (European Economic Community, 1990; Ungerer, 2013). The initial modifications made the service provision competition reliant on access to monopolized infrastructures. After 1998, most PTOs were privatized and turned into vertically integrated enterprises, providing both services and infrastructure in competition (Li & Xu, 2004).

Over the last two decades, these services became an integral part of consumers' lives. In a market characterised by constant technological evolution, new capabilities and services were critically required to respond to customers increasing demand for innovation. These advancements called for companies to keep up with the progression not only regarding the services provided, as well as the infrastructure available.

Nowadays, the industry comprehends four different layers: infrastructure (antennas, gears), telco services (configuration and platforms that allow the services to run), service (end-user support), and finally over-the-top applications (that come on top of all the investments that telco operators do – OTTs) (Tselentis et al., 2009).

Regarding the infrastructure, it is characterised by expensive R&D and implementation costs, and above all, indivisibilities. Even for small countries, it is highly costly to invest in the initial infrastructure. Nevertheless, distinctly from other sectors, the telco infrastructure requires modifications and improvements. For instance currently the divestment of the third-generation communications (3G) and funding of the fifth-generation (5G). On the opposite

side, the marginal cost of supplying an additional unit of the service to a new customer is almost zero (Laffont & Tirole, 2001).

Even though, the “commodity trap” (Zysman, 2014) presents itself. If telecoms choose prices rather than quantities then the competitive outcome would occur with price being equal to marginal cost, the Bertrand equilibrium (Cannan & Edgeworth, 1925). There may be the desire for each company to decrease prices, therefore increasing the customer surplus. However, the response would be an overall price decrease and eventually face the outcome of the model.

Especially in smaller countries, the operator's strategy is to face infrastructure as a commodity in the sector. For many years telco operators had seen the masts and towers that house their radios and antennas as vital strategic assets in competitive advantage. Nevertheless, the European market has followed the trend of US companies, that largely divested these types of towers years ago (Walko, 2021). By spinning them off to new entities that partially take control or even buy these assets, operators can focus on other areas of the business.

In small markets, the differences in the quality of products between competitors are not significant, so plenty of synergies can be shared between competitors. By selling these fixed assets, all the parties are able to reduce operating costs and improve coverage in other areas. This restructuring and consolidation trend enabled operators to focus on their core business - services. Having this in mind it is not peculiar to find partnerships or joint ventures between competitors in regard to these fixed assets.

Focusing on services and embracing a customer-centricity model was equivalent to embracing new model propositions in the industry. Historically, operators have developed a horizontal performance on the market. Nowadays, a vertical integration of a wide range of products, bringing competition to different battlefields, has been the way to respond to customer needs.

Telcos offer services that penetrate and connect different aspects of people's lives by providing individual, tech-based services, tailor-made to meet the requirements of their B2B and B2C customers (Deloitte, 2017). Their opportunities to develop are now based on efficiency, cutting costs of serving and selling, growth, and transformation.

As digitalization spreads throughout the telecommunications industry, incumbent telcos find themselves in the midst of a paradox. These companies are providers of their digital services, while also supporting the basic infrastructure for new business models to proliferate. The

growing demand for the service offer is evident. Nevertheless, consumers' behaviour toward the traditional offers is shifting.

With increasing technological advancements, an escalating number of business models are entering the market, challenging telco's core business. While the total consumer spending on the overall services is expected to increase (Kalem et al., 2020), the consumption of traditional offers is likely to decline. Adding to the traditional competition between operators, new over-the-top providers, such as Apple, Meta, Amazon, Google, and Microsoft are being able to cannibalize clients. For instance, with iMessage, Facebook, and Instagram message structures replacing telco's traditional voice calls and short message systems.

Despite the adaptations traditional operators present, the discussion over commoditization in the telecommunication sector is not new. The industry is highly based on innovation and differentiation of the ecosystem, even converging products from other partners' products through their extensive distribution networks. Among convergence, on the other side, commoditization is also shaping telco's strategic planning.

The global industry is becoming increasingly commoditized as a result of new market entrants, saturated markets, booming data demand, ongoing consolidation and price wars (Gröne, 2018). In response, companies must formulate a focused strategy that allows them to take advantage of the current situation.

"Commoditization can be avoided; convergence can be exploited" (Gröne, 2018)

3.2 Portuguese Configuration – Services, Regulator and Operators

In order to understand the evolution of the industry, its efforts toward innovation, and the development of commoditization, it is also relevant to understand how the Portuguese telecom sector is constituted.

A national regulator, ANACOM, is responsible for assuring the transparency of the market, as well as the compliance of each operator towards national and EU regulations.

On the supply side, the market is constituted by four main operators that represent more than 99% of current subscribers (SABI, 2021): MEO, NOS, NOWO, and Vodafone.

In what concerns the services offered, there are six types of basic offers (single play): Subscription Television (STV), Fixed Telephone Service (FTS), Fixed Broadband (FB), Mobile Telephone Service (MTS), Mobile Telephone Service with Mobile Data (MTS with

mobile data) and Mobile Broadband (MB). Multiplay constitutes different bundles of these services.

Double Play (2P) packages usually are just composed by telephone offers and television, but the regulator always accounts for different combinations (FB+ STV, FB+ FTS, or STV + FTS). Triple Play (3P) normally include FB+ STV + FTS. Quadruple play services can include FB+ STV + FTS + MTS or FB+ STV + FTS + MTS with Mobile Data, and Quintuple Play FB+ STV + FTS + MTS with Mobile Data + MB.

3.2.1 ANACOM – The Regulator of Portuguese Telecommunications

The inspection, supervision, regulation, and sanctions on the Portuguese communications sector are assured by ANACOM (Autoridade Nacional de Comunicações). It is the Portuguese national regulatory authority (NRA) for communications, also inheriting the assignments, powers, and responsibilities of the Emergency Communications Planning Committee of EU law and national legislation (ANACOM, 2015).

The entity constitutes a legal individual with administrative, financial, and managerial autonomy and its own assets, not being subject to government direction or supervision in its exercise (ANACOM, 2015).

The Portuguese telecommunication decree is presented in law no. 5/2004, revised sixteen times, being the most recent modification the DL no. 49/2020, from August 2020. Article 5 presents the objectives of the legislation: (i) Promote competition in the provision of electronic communications networks and services, resources, and related services; (ii) Contribute to the development of the European Union's internal market; and (iii) Defend the interests of citizens (Law No. 5 on Electronic Communications, 2004).

Multiple responsibilities are granted to ANACOM to regulate telco operators. Amongst the most relevant for the topic in question, article 3 gives authority to regulate consumer loyalty programs, and the consequent lock-in of clients. Article 47 adjusts the obligation to provide information to subscribers, linked to article 67 which legislates the obligation of transparency. Article 60 concerns the relative market power, giving power to the regulator regarding barriers against new entrants. To protect consumers, measures such as non-compliance, administrative offenses and fines, pecuniary and compulsory sanctions are regulated by articles 110, 113, and 116, respectively (Law No. 5 on Electronic Communications, 2004).

Regarding the obligation of transparency and publication of results, ANACOM complies by performing multiple studies throughout the year. Reports such as the evolution of telecommunications prices (published monthly), “NET.Mede” (quarterly), Regulation, supervision, and other activities report (annual), and the final report of the telecommunications sector, published annually, ensure this transparency.

These reports focus on multiple data, for instance, the evolution of the average cost per subscription over time, the developments in the main offers (average number of services, number of television channels, theoretical download internet speed), the revenue of each operator, the ARPU, and so on, relevant for the present study.

3.2.2 MEO

Focusing on the operators, PT Communications, S.A., known as Portugal Telecom, was founded in 1992, derived from CTI[†] (Correios de Portugal) operations. After the merger between PT, TLP (Telefones de Lisboa e Porto), TDP (Teledifusora de Portugal) and the integration of CN (Comunicações nacionais, SGPS), the company enters in the XXI century as Portugal Telecom, SGPS, S.A. (Machado, 2017).

In 2007, the company creates a spin-off, PT Multimédia (later rebranded as ZON Multimédia). After this separation, PT Comunicações forms MEO, that began using copper wires after separating from PT Multimédia, which had been using coaxial cables (Altice Portugal, 2021). By 2014, Telecomunicações Móveis Nacionais (TMN), the first and largest mobile network operator, was integrated into the brand forming MEO Serviços de Comunicações e Multimédia S.A. (Machado, 2017).

Among the multiple contributions to the innovation of the sector, some are worth a remark. In 2013 takes place the launch of M4O, the first convergent quadruple-play service, which includes TV, Internet, phone, and mobile. In 2014, the service is complemented by offering a new bundle including mobile internet, the M5O.

On July 2nd, 2015, PT Portugal became an integral subsidiary of the Altice Group, having the European Commission imposed the divestment of Altice in Cabovisão and Oni Telecom in Portugal. In 2018 PT becomes Altice Portugal, maintaining its trademarks MEO, Altice Empresas, SAPO, MOCHE, and UZO (Altice Portugal, 2021).

3.2.3 NOS

ZON was the first pay-TV company in Portugal, with the brand name TV Cabo. The service was launched with 30 channels. ZON Multimedia appeared as an independent brand in 2008, following the separation of TV Cabo from the incumbent operator PT Comunicações. That same year, the company launched the ZON box, a pioneering piece of equipment in the country (NOS, 2022).

Owner of the holding Zon Lusomundo, the company becomes the first, and only, to include advantages of access to its cinemas in the telecommunications bundles it offers.

By 2012 the company negotiates with Optimus – Comunicações, S.A. its acquisition and consequent merger of the two companies. Since 2013, Optimus was responsible for the launch of WoW, an internet fix offer with voice, as well as WTF, a product for the younger demographics that offers unlimited use of communication apps such as WhatsApp, Viber, Skype, Facebook Messenger, iMessage, and Facetime, combined with abundant data traffic.

In 2014 NOS Comunicações, S.A., is founded, from the merger. Accordingly, ZON TV Cabo Madeirense and ZON TV Cabo Açoreana change their denomination to NOS Madeira – Comunicações, S.A., and NOS Açores – Comunicações, S.A. (NOS, 2022).

3.2.4 Vodafone

In 1992 the mobile operator Telecel - Comunicações Pessoais, S.A., was born. For many years the company presented the most relevant competitor of TMN's mobile offers. In 2000 the service Yorn is created, again to answer the younger audience's demand, being in that same year the first operator licensed to offer third-generation networks (3G) (Vodafone, 2021).

Telecel was one of the first operators to join the British operator Vodafone. The company reformulated its name, changing to Telecel Vodafone in January 2001 and finally Vodafone from 22nd October on (Vodafone, 2021).

Since 2010 with the implementation of optical-fibre offers the company was able to quickly expand, especially in triple bundle offers where they kept presenting a low-cost approach compared to the other operators.

In 2017, Vodafone Portugal signed an agreement with NOS to share optical fibre networks and mobile infrastructure, allowing both companies to reach 4,4 million homes and being

able to offer gigabit-per-second internet speeds. This deal was later on reinforced, in 2020.

In 2017, in association with the Netflix launch in the country, the company was also the first operator to associate its services with a streaming service supply in their offers.

3.2.5 NOWO

In 1993, Cabovisão – TV por Cabo S.A., was born as a Portuguese telecommunication operator. In 2006 the company is acquired by the Canadian company Cocego, and later re-acquired by Altice in 2011. To allow Altice to continue the deal to acquire PT, the EU imposed the disinvestment in Oni Telecom as well as Cabovisão, bought by the private equity fund Apax France (Brito, 2015).

NOWO Communications S.A., appeared in September 2016 as a rebranding of Cabovisão. Their national mobile service is obtained by a mobile virtual network operator (MVNO) agreement with MEO.

Apax France also detains Oni Telecom, which addresses the business market. The company and Oni were purchased by the Spanish telecoms group MásMóvil Iberocom in September 2019 (Jornal de Negócios, 2019).

3.3 Economic Characteristics of the Established Market

As previously introduced, the telecommunication sector encompasses very specific market characteristics that must be discussed prior to performing any methodology.

Taking a step back over the literature review, Reimann et al., (2010) characterised commoditization as a multi-dimensional construct of four factors: (i) switching-costs, (ii) product homogeneity (iii) price sensitivity, and (iv) industry stability. All these factors can be acknowledged in the Portuguese context as difficulties for each intervenient party.

Right from the implementation of the service, the sunk costs and indivisibilities present on the market were already pointed out for the overall industry. Adding to these initial losses, the fixed cost of enabling a consumer to access the network in Portugal is estimated at around 350€². To prevent, especially the aforementioned fixed costs, to be worthless, companies develop loyalty programs to retain consumers. As these programs are regulated by ANACOM, there is an imposed maximum limit of 24 months. During this period each client

² Based on the offers present on each operator's official website for non-loyalty programs offers

is responsible to pay a certain amount to reimburse the operator if there is the desire to abandon the company early on. In order to attract consumers to such programs, many deals include special bargains, for instance, free installation fees, free subscriptions to certain services, and so forth. Nevertheless, when this period is over each client has almost null switching costs to move to another operator.

Once the loyalty program is over, there is the opportunity to observe the prices practiced in the market and consumers can demonstrate their price sensitivity. In fact, in most cases, each operator practices very similar prices, with close variations³. Nevertheless, as Vodafone, and now NOWO attempted, offering a low-cost approach while entering the market, presents developments in the customer base, even if for short periods. This migrations to lower-priced offers demonstrate how the industry is influenced by price sensitivity.

Regarding product homogeneity, two different views can take place. As many authors point out, telco operators are offering the same services to most clients. Nevertheless, each company is able to differentiate its offers. In fact, in Portugal, the four firms have the capacity to offer very similar products⁴. However, their value proposition is also strongly based on the differentiative strategies that each offer takes. The aim of the present research is exactly understanding how effective this strategy is.

Finally, and taking the debate over industry stability, ANACOM estimated that at the end of 2021, 89,1 in every 100 families were already subscribers of a certain telecommunication bundle of services (ANACOM, 2021). With such figures, it becomes clear how the market for new clients is scarce. The efforts remain around moving consumers across bundles including more services.

However, the competition might remain in concentrating consumers over bundles including more services, and therefore revenues.

All these factors were responsible for the wave of commoditization over the industry, threatening to turn telcos into companies just capable of generating enough revenue to cover expenses. Naturally, it is not the current outlook of the sector in Portugal, leading the discussion to the solutions and advantages proposed by operators over time.

The fact that the established market is composed by the same companies over the years may

³ Since June 2020 ANACOM publishes a monthly report over the evolution in the telecommunication prices, where this conclusion can be derived for multiple months.

⁴ It then makes sense that operators are even sharing their fixed assets through joint ventures.

possibly be one of the first benefits for operators. MEO and NOS remain market leaders possibly due to the strategic advantages connected with brand seniority. As Kraemer (2008) suggest, there are five strategic advantages of this antiquity: an installed base of consumers, expertise in the market, technological know-how, existing relationships with other companies, and finally a better psychological adherence (as many clients are psychologically connected to a brand). These advantages allow companies to impose entry barriers in a market where the investment costs already prevented many entrants from even attempting to compete with incumbents.

Besides the scale economies, incumbent telcos have been more recently reliant on synergies created through relationships with other sectors. While initially the offers were based on the four or five basic services, nowadays companies are investing in approaches from a variety of services to attract consumers. Just to mention offers still present on the market (for July 2022): free subscription of streaming services, family-friendly features to share mobile data, unlimited calls, SMS or mobile data, special price discriminated offers for younger audiences, free event tickets, home security alarm systems, subscriptions of premium channels, animal care, health insurance, senior follow-up, and delivery network subscriptions. All these plans have one characteristic in common – being either included, or having their price increasingly reduced, as the number of services included on the offer increases, as Quelch (2007) debated.

Multiple authors turned their research over bundling as a revenue driver. Companies can attract new customers by offering bundles, as these consumers would not have bought every single product of the bundle if sold separately (OECD, 2015). Accordingly, bundles also contribute to the retention of clients. Bundling can be used as a method of raising market prices by adding new services to existing bundles to justify price increases, and consequently lead to revenue growth. This strategy is also able to capture greater market share by connecting more members of the household.

Nalebuff (2003) divided the reasons to bundle into two different categories: efficiency and strategic reasons. For efficiency reasons the two main drivers are cost synergy and cost reduction, and the effect as a price discrimination tool (since bundles reduce customer heterogeneity). Regarding strategic reasoning, bundling contributes to increase entry barriers, mitigate competition, and enhance competitive advantage.

Having this background in mind it is not challenging to understand why bundles offering more services are also the tool behind an increasing amount of differentiative strategies.

4. Methodology, Estimation, and Findings

Following the sector specification, an empirical methodology design is required to shed light on the subject at hand. An econometric model can be employed in the case by applying statistical methods to quantitative data, and effectively test the hypotheses.

This dissertation intends to analyse the relationship between innovation and commoditization in the telecommunication sector, while considering other determinants of the market environment. By obtaining such results, the theoretical background in the Portuguese industry can be enriched, and strategic implications can be obtained.

In the following chapters, the background model analysis is performed (4.1), the final hypotheses are defined (4.2), the estimation results are assessed (4.4), and discussed (4.5).

4.1 Hedonic Pricing Approach in Telco Bundles

As previously mentioned, comparing prices among bundles of telecommunication products is complex, as each operator's offer tends to change along different dimensions. Simultaneously each consumer is able to create specific plans with extra services, within the same package, to fit their own demand, making the task even more intricate.

The hedonic pricing analysis can separate price changes from other qualities of the good or market differences, on a like-for-like comparison of values across time and products (Lyons & Savage, 2013). The premise of the model is that price is both determined by the internal characteristics of the goods as well as the external factors of the market affecting it. Thus, the model can be applied to analyse bundle telecommunication prices.

This method has been widely used to compare the prices of products whose quality varies over time or across product spaces (Ofcom, 2018). Besides the communication sector, as in mobile communications (see Dewenter et al., 2004; Forenbacher et al., 2016), other types of goods can also be analysed by hedonic pricing approaches. The automotive industry was considered by Brenkers & Verboven (2005) or Berry et al. (2004), for instance.

Lancaster (1971) proposes a consumption theory stating that are the good's characteristics or attributes what consumers ultimate desire, rather than the goods themselves. Adding this approach to hedonic pricing models, multiple research projects focused on the premise that the total prices of a telecommunication bundle can be derived from the sum of the willingness to pay of each consumer for each one of the services/ attributes in the bundle.

Products with enhanced or expanded qualities have higher prices, *ceteris paribus*. In other words, a bundle's combination of characteristics can be valued by observing how the price individuals are willing to pay changes, as the characteristics change.

The hedonic pricing approach is a kind of regression where a function of quality features explains the price of the product or service. Such a model requires that the composite product in question can be divided between its components, and respectively how the market values them. The typical hedonic relationship for an offering is (Lyons & Savage, 2013; Varoutas et al., 2008):

$$P_{it} = f(X_{it}, \beta) + u_{it}$$

P_{it} is the observed price of the product i at time t , where $i = 1, \dots, n$ and $t = 1, \dots, T$. X_{it} is a vector of qualities of the product i at time t , and u_{it} is a vector of disturbance terms. (Lyons & Savage, 2013)

Albeit according to Varoutas et al. (2008) only a limited number of studies applied hedonic approaches in the communication sector, more recently, several authors turned their attention towards the specific settings that affected telecommunications pricing.

Varoutas et al. (2008) use evidence from Greece to construct a model for telecommunication price evolution based on circuit length and the transmission rate per second. At the time, leased communication lines were still recent to the country and the authors were able to prove the positive effects brought to the overall product demand.

Wallsten and Riso (2010) focus on bundle components and analyse a dataset across 25 thousand different plans spanning between 2007 and 2009 in thirty countries. The variables in assessment are, for instance, download speed, the data usage limit, contract length, fixed and mobile phone lines, taxes, and technology type. The research is mostly based on broadband prices and data limits. The authors conclude that those constraints did not always lead to increasing prices, and can present more benefits than unlimited plans.

Both Crocioni & Correa (2011) and Lyons & Savage (2013) design hedonic approaches to broadband services. In the first case, by comparing the industry in Ireland and the Netherlands, the authors attempt to determine which operators possess more pricing power. In this case, the methodology is based on breaking down bundle prices into components such as the technology used (cable, satellite, and so forth), upload and download speed, fixed and dynamic internet protocols, and web data size range. In the second example, by

comparing prices and subscriber base, the researchers try to determine how much Irish customers are willing to pay for faster broadband service. Their findings suggest that such prices likely decrease to very low levels mainly due to technological progress.

Pines and Fanfalone (2015) were the first researchers to consider the effect of triple-play and quadruple-play bundles in the market, more specifically in the United States, United Kingdom, and France. Moreover, they included a second-part study to account for the operators' financial performance. The authors constructed twelve different regressions using different sets of independent variables: (i) technology (download speed, data limit, satellite, fibre), (ii) contract term, (iii) dummy variables for operator and country, (iv) fixed telephony variables (unlimited national and international calls), (v) TV indicators (number of channels, sports, and movie channels), (vi) mobile phone indicators and finally (vii) bundle indicators (using the variables 2-play, 3-play, and 4-play). The differentiator factor in the study was the analysis of over three hundred offers, taking into account the effects of each characteristic in different types of bundles. Nonetheless, as the database included data from different countries with different positionings toward n-play bundles, the conclusions taken simply regarded broad aspects of the market development.

Lastly, the work of Calzada and Santos (2016) is worth mentioning as the most recent research. Conducted in 37 countries, once more the mobile network is the main objective of the study. They conclude that plans including an access fee, a usage allowance, and a penalty system if the usage is exceeded, correlate with lower prices, depending on the penalty used. The paper also focuses on how market structure and entry regulation affect prices.

Table 4.1 aims to capture the main considerations in each of the models, depicting both the year of examination as well as the countries in question. Overall, most studies targeted data across multiple countries and tried to illustrate how prices are affected by the characteristics of the offer. Lately, authors attempted to understand how the market regulation and type of offer influence overall price. Nonetheless, it becomes complex to design conclusions that are valid for the different countries in each study.

Table 4.1: Outline of hedonic pricing methodology in the literature (Own elaboration)

Authors	Year	Hedonic Model	Countries
Varoutas et al.	2008	$\ln(\text{Price}) = \beta_0 + \beta_1 \text{Distance} + \beta_2 \text{MB}$	Greece
Wallsten and Riso	2010	$\text{Price}_{it} = f(\text{DownloadSpeed}_{it}, \text{BitCap}_{it}, \text{Tax}_{it}, \text{ContractLenght}_{it}, \text{VideoBundle}_{it}, \text{TechnologyType}_{it}, \varphi_{it}, \gamma_{it})$	30 Countries
Crocioni & Correa	2011	$\text{Price}_{it} = f(\text{DSL}, \text{Satellite}, \text{ADSL2+}, \text{Cable}, \text{Download Speed}, \text{Upload Speed}, \text{WebSize}, \text{FixedIP}, \text{DynamicIP}, \text{NoTelephony}, \text{Company}_i, \text{UploadSpeed}_{it}, \text{Contention Ratio}_{it})$ (*Divided into two regressions)	Ireland Netherlands
Lyons & Savage	2013	$\text{Price}_{it} = f(\text{DownloadSpeed}_{it}, \text{UploadSpeed}_{it}, \text{ContentionRatio}_{it}, \text{EmailUnlimited}_{it}, \text{Access}_{it}, \text{ContractTime}_{it}, \text{MinimumContractTime}_{it}, \text{OnlineBilling}_{it}, \text{LimitedDataTransfer}_{it}, \varphi_{it}, \gamma_{it})$	Ireland
Pines and Fanfalone	2015	$\text{LogPrice} = f(\text{DownloadSpeed}, \text{LimitedData}, \text{Cable}, \text{Satellite}, \text{Fibre}, \text{ContractTerm}, \text{Operator}, \text{Country}, \text{FixedPhone}, \text{FixedBroadband}, \text{TV}, \text{Mobile}, \text{2-Play}, \text{3-Play}, \text{4-Play}, \text{NationalCalls}, \text{InternationalCalls}, \text{WeekendCalls}, \text{TvChannels}, \text{SportsChannels}, \text{SportsQuality}, \text{PremiumTV}, \text{DVR}, \text{BasicMobile}, \text{AdvancedMobile}, \varphi_{it}, \gamma_{it})$	UK US France
Calzada and Santos	2016	$\text{Price}_{moit} = f(\text{LimitedData}^{**moit}, \text{Penalty}_{moit}, \text{Volume}_{moit}, \text{Volume}^2_{moit}, \text{Speed}_{moit}, \text{Technology}_{moit}, \text{LimitedVoice}_{moit}, \text{MinVoice}_{moit}, \text{Smartphone}_{moit}, \text{Historical}_{moit}, \text{NPlans}_{moit}, \text{Country}_{moit}, \text{Year}_{moit}, \varphi_{it}, \gamma_{it})$ (**Where m is the plan offered by the operator, o is the operator, i is the country, and t is the year)	37 Countries

4.1.1 Modelling for Market Variables

As discussed, the hedonic pricing methodology decomposes bundle prices among the internal characteristics of the goods as well as the external factors in the industry. The models addressed previously, and the conclusions driven, mostly focused on the internal factors of a bundle and their respective effects on price. Other approaches tried to find inferences that connected with the market configuration.

Boylaud & Nicoletti (2000) mainly focused on the market environment effect on overall performance, yet again using data from multiple countries. The model portrayed:

$$Y_{ist} = c + \alpha_{is}f_i + Z_s\beta_s + M_s\gamma_s + R_s\delta_s + \varepsilon_{ist}$$

Where Y represents a performance measure in a specific country i , sector s , and period t . The model also accounts for country-specific effects f , exogenous economic characteristics Z , market indicators M , and regulatory factors R . At the time, the conclusions were mostly focused on the effects of deregulation and respective impacts on financial performance.

Shew (1994) propose that each customer already consumes the “ideal” bundle for his patterns of demand, therefore letting the market developments more evident. McCloughan & Lyons (2006) construct a model based on Shew’s price:

$$P^* = f(S, M, R, Q)$$

Following the same approach, the price is therefore influenced by service quality (S), market environment (M), regulatory factors (R), and quantities supplied (Q). This kind of method already set out to suggest factors that connect with the discussion over commoditization in telecommunications.

Following the same approach, two other studies were developed as such. Park and Jayakar (2015) focus on the number of companies established in the market ($ncomp$), the number of mobile standards ($nstd$), a dummy variable to represent competition ($compet$), GDP per capita, education variance ($educ$), and mobile teledensity. Unfortunately, in their approach, most results lacked statistical significance. Most recently Genakos et al., (2017) analyse the impact of market structure and operator characteristics on returns. In contrast to McCloughan & Lyons’ (2006) findings, their analysis indicate that market structure and operator-specific variables had no significant influence on average revenue. In this case, the model is specified as such:

$$\ln P_{uoc} = \alpha_{uoc} + \alpha_t + \beta_1 Mkt_Str_{ct} + \beta_2 Char_{uoc} + \epsilon_{uoc}$$

The dependent variable in question is the logarithm of retail prices, paid by a consumer with determined usage profile u , subscribing to operator o , in country c , in quarter t . Along with controls for time trends and country-specific characteristics, the main variable in the study, Mkt_Str_{ct} , is an indicator of market structure that uses two alternatives: the number of operators as well as the Herfindahl-Hirschman Index (HHI⁵) to account for the industry concentration.

Taking into account the previously addressed literature review (chapter 2), these two results seem to not support the theoretical background, raising, even more, the interest in the effects of market structure on telecommunication services. One possible explanation for the results might be the beneath consideration of different N-bundle types specificities, as Pines and Fanfalone (2015) research suggested.

4.2 Structural Model and Hypotheses

Distinctly from the hedonic approaches focused on bundle characteristics, the objective of this dissertation is to obtain conclusions regarding commoditization on telecommunication sector, and connect it to competitors' behaviour, as well as consumer relation with prices.

Instead of understanding how each bundle quality influences the price, the goal is to comprehend how the market influences the operators' actions, and how the innovative response of each offer correlates with financial performance.

Throughout the literature, different approaches to innovation measurements have been discussed. For instance, Kemp (2009) suggest four different types of innovation indicators, based on environmental modernization:

1. Input measures: R&D expenditures, R&D personnel, and innovation expenditures;
2. Intermediate output measures: number of patents and scientific publications;
3. Direct output measures: number of innovation descriptions, data on sales, etc;
4. Measures of indirect impact derived from aggregate data: changes in resource efficiency and productivity using decomposition analysis.

The challenge with the telecommunication sector remains on how to effectively obtain the innovative differences perceived by consumers.

⁵ The measurement will be further discussed while defining the analytical model structure.

As previously discussed, one common factor in the Portuguese industry is linked to the type of bundle each operator offers. For instance, if double play offers remain as simple direct offers of two services, quadruple and quintuple plays have been the target of multiple differentiative strategies. To recall, family-friendly features to share mobile data, unlimited calls or SMS, cinema tickets, the inclusion of streaming services, and so forth, are some of the examples debated.

Having this differentiation between n-type bundles in mind, and Kemp's (2009) proposal, different types of bundles can be perceived and interpreted as separate industries as a measure of indirect impact on innovation. The approach is not brand-new, as Pines and Fanfalone (2015) have already studied the role of triple and quadruple-play bundles in three different countries. Their research, however, focused on a rather limited dataset. The authors analysed 300 offers in France, the United Kingdom, and the United States constructing the investigation in offers present on the market in a specific month of the year. The model used was then enriched with dummy-variables for each type of offer.

Since the objective is to focus on market evolution, a different type of approach to n-play bundles evolution was necessary. Therefore, the interpretation of each bundle as a specific industry sub-set. On the other hand, the specific variable in question also requires further analysis.

In fact, most studies use prices as the dependent variable of each model. Nevertheless, this methodology does not assess the problematic of collecting data from many different types of non-linear complements in each operator's offer. In other approaches, the problem was then partially addressed by focusing on the characteristics of each basket of services, yet again taking the discussion away from market advancements.

McCloughan & Lyons (2006) defend that measures based on prices, unlike basket-based approaches, tend to include a broader set of elements and reduce difficulties while modelling. The authors base their approach on average revenue per user (ARPU) as a proxy of price. As the authors state, ARPU has been overlooked in academic literature despite standing as one of the most examined indicators in the industry. This statistic is typically calculated at the company level as follows:

$$ARPU = \frac{\text{Total Revenues per Month}}{\text{Number of Active Users}}$$

Likewise, Park & Jayakar (2015) and Genakos et al. (2018) examined the influence of market structure and bundle qualities on the ARPU indicator. Therefore, based on the three studies approach, having the n-play sub-industry as a proxy for innovation, and ARPU as a proxy for price, may yield conclusions on market commoditization, and operators' response, in the Portuguese telecommunication industry.

Recalling, Shew's Price was based on:

$$P^* = f(S, M, R, Q)$$

Therefore, the average revenue of company i during quarter t , can be derived as a function:

$$ARPU_{it} = g(S_{it}, M_{it}, R_{it}, Q_{it})$$

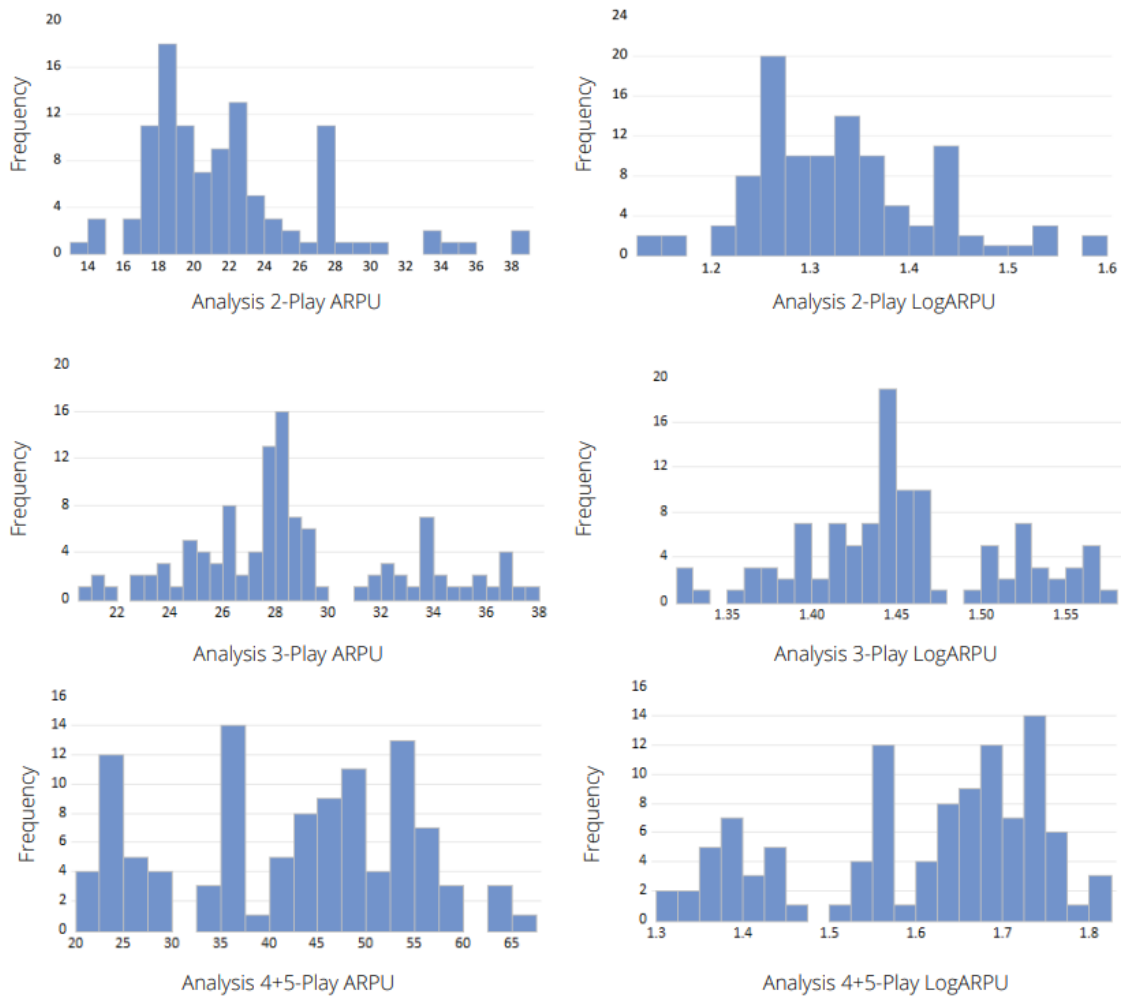
- In McCloughan & Lyons original model S contained service quality factors such as congestion level, reputation, and network coverage. In the present case, the approach means to measure innovation, therefore decomposing the industry in n-play segments to assess service quality and differentiation.
- M represents the market environment. The disadvantage of studying the Portuguese industry is that factors such as population density, GDP, or personal incomes turn out to be less relevant. Other determinants of competition can therefore complement the analysis. Having a sub-industry division, and the number of subscribers in each n-play bundle enables the calculation of the Herfindahl–Hirschman Index (HHI) of concentration. As Genakos et al., (2018) suggest, this proxy represents the better proxy for the overall level of market competition. Adding to the HHI, and focusing on the state of commoditization per sub-industry, a variable concerning the number of trimesters since the launch of each bundle may also be pertinent to the analysis.
- In the original proposal, R denotes factors related to regulatory concerns⁶. One possible disadvantage of concentrating the study on the Portuguese practice is that the model ends up not being able to capture regulatory discrepancies. As discussed, the regulator sets changes over the same period. Therefore, each bundle is affected in the same way.
- At last, Q illustrates the quantity of services each operator provides. McCloughan & Lyons (2006) suggest different approaches such as number of users served, number of minutes

⁶ These included requirements for mobile number portability, national roaming and wholesale network access services

per call, or data usage. For the case, the number of subscribers of each operator i in quarter t represents a fitted measurement.

As the vector functions influencing the proxy of price are defined it also becomes relevant to address the type of hedonic model to carry out. Among the literature in the sector, most authors use log-linear and log-log forms. In the case of ARPU for each industry, the log form facilitates the reduction of skewness, as figure 4.1 bellow illustrates.

Fig. 4.1: Histogram analysis of ARPU and LogARPU variables in each n-play sub-industry.



Source: Own elaboration, EViews Software v.12

Regarding other independent variables, both the log-log and log-linear forms were tested, to propose the better suited econometric model. Collecting the variables for each vector already discussed, and taking the natural logarithm of the average revenue per user of company i in quarter t (LogARPU_{it}) as the dependent variable, the following model is estimated:

$$\begin{aligned} \text{LogARPU}_{it} = & \beta_0 + \beta_1 \text{HHI}_t + \beta_2 \text{TimeLaunch}_{it} + \beta_3 \text{LogSUBS}_{it} + \beta_4 \text{ARPUSpread}_t \\ & + \beta_5 \text{Penetration}_t + \beta_6 Q2_{it} + \beta_7 Q3_{it} + \beta_8 Q4_{it} + u_i + e_{it} \end{aligned}$$

Where

- *HHI* represents the Herfindahl–Hirschman Index of the specific n-play industry. This measure represents the concentration of the industry and was calculated for each quarter by adding the squared values of the market share of each company in each trimester. The greater the concentration of a market, the closer it is to a monopoly (and the lower its competition)
- *TimeLaunch* embodies the number of trimesters since the launch of the bundle in the Portuguese market by company *i*.
- *LogSubs* denotes the natural logarithm of the number of subscribers of each company, in each quarter.
- *ArpuSpread* measures the difference between the maximum and minimum ARPU values in each trimester. As it has been discussed, ARPU represented a proxy of prices, therefore this measurement tries to capture the significance of price proximity in each market.
- *Penetration* represents the penetration rate of each bundle type.
- *Q1-Q4* are quarterly dummy variables designed to capture any seasonal variations. *Q1* is selected as the base, and therefore omitted in each regression.

In conjunction with the econometric model, the final hypotheses based on different variables and the theoretical background on commoditization evolution can be defined.

Regarding the time of launch of each bundle, the premise is based on how differentiation is able to impact the commoditization progression, represented by the additional offers present on enhanced bundles, and possibly revert it.

H1: *There is consecutively less effect of the time of launch for enriched bundles, as they present more differentiative offers.*

H1.1: The time of launch has a negative effect on lower composition bundles, and positive effect on improved bundles, accounting for advantages from differentiation.

As ARPU acts as a proxy of price, its spread, representative of price proximity and possible price wars, infers the respective effects in different types of bundles. Following Heil & Helsen (2001), the downward spiral of commoditization is prevented by a higher level of price distances in enhanced offers, representative of different value propositions from clients' standpoint.

H2: *The spread of the average revenues in the market positively affects the overall revenue of companies.*

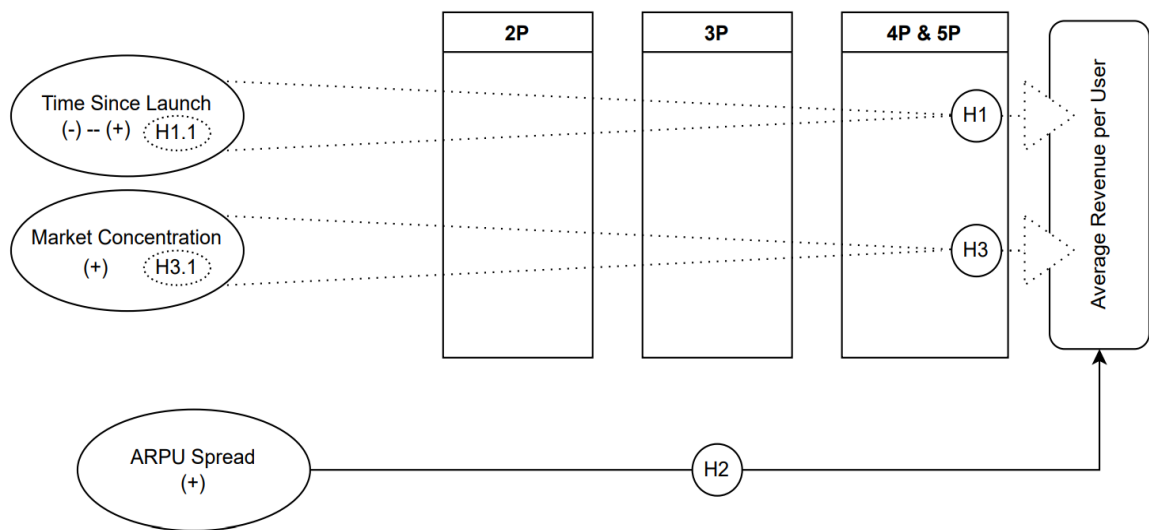
Finally, the positive effects of market concentration are expected to be less expressive for developed bundles. As Coe (2021) suggest, mergers and acquisitions remain as one of the few possible options to definitively avoid commoditization. In these cases, companies rely on increased revenues that result from diminished consumer surplus. The background for this main theory is that for offers with higher innovative factors, the revenue is less dependent on market dominance.

H3: *The level of market concentration, has consecutively fewer positive effects as the n-play bundles augment.*

H3.1: *The level of market concentration, represented by HHI, is positively correlated with average revenue in each company.*

Following the hypotheses proposed, the structural model can be presented as in figure 4.2:

Fig. 4.2: Structural model (Own elaboration)



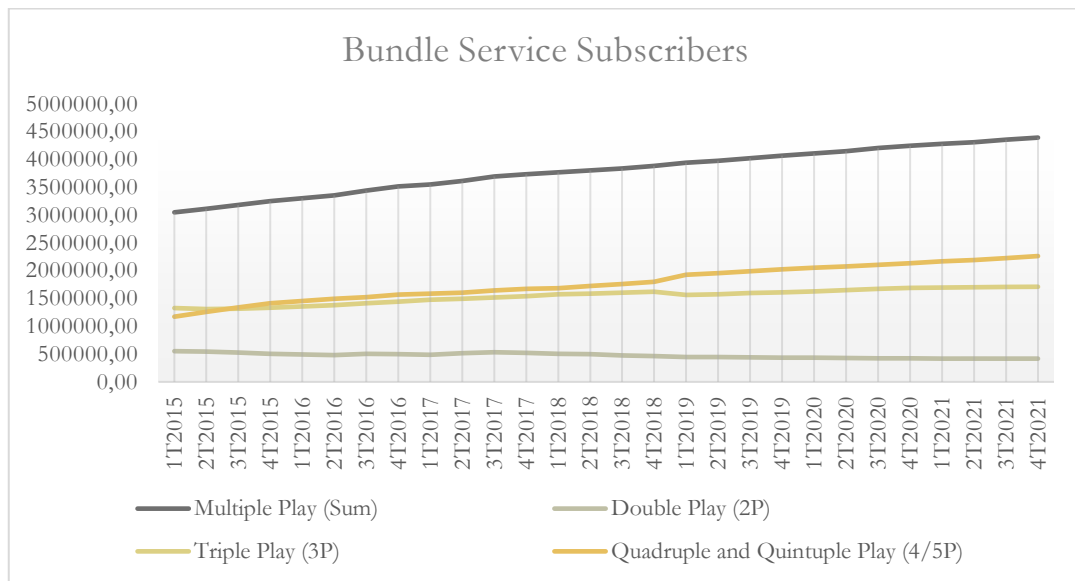
4.3 Data Collection

Time and capacity limitations can explain the dataset's relatively small size. Albeit most studies recur to databases from large organizations, for instance, OECD, IMF, or Merrill Lynch, focusing on data from a single country impedes this macro-approach. Most data have been collected from ANACOM publications, as statistics from each company are either not publicly available or raise questions about their accuracy.

Moreover, regarding the time span in analysis, nearly all information with quarterly frequency was available only since 2015. Nevertheless, as other approaches showcased, this 6-year period seems to be appropriate to reach correct conclusions (see Calzada and Santos (2016); Pines and Fanfalone (2015)).

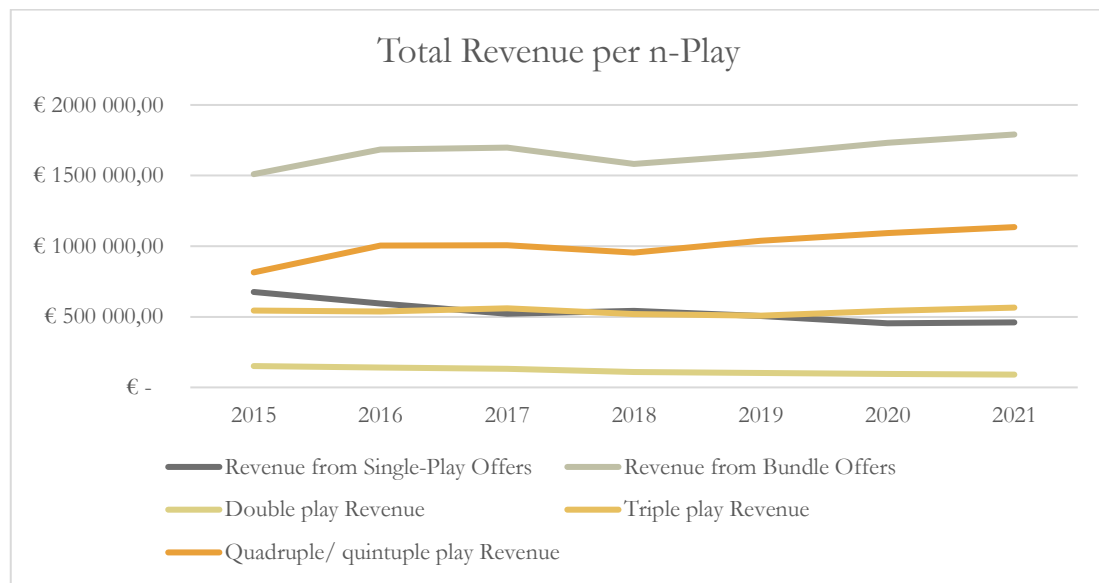
The overall subscriber distribution in the Portuguese experience, between multi-play offers is depicted in the following figure.

Figure 4.3: Multi-play subscribers breakdown (ANACOM)



As it is evident, the bundle demand is still increasing in recent years, especially in regard to triple, quadruple, and quintuple plays. Double play offers are, however, showing a decline, as more and more customers are opting for more services included in their consumption basket. These results are closely correlated with the penetration rate per bundle (Figure 4.4 in Appendix 1) as well as the total revenue of each package in the industry. The figure below portrays the correlation between the revenue of each bundle in each year, and likewise, the revenue of single-play offers as a term of comparison.

Figure 4.5: Revenue of each type of offer in the industry in thousands of euros (ANACOM)

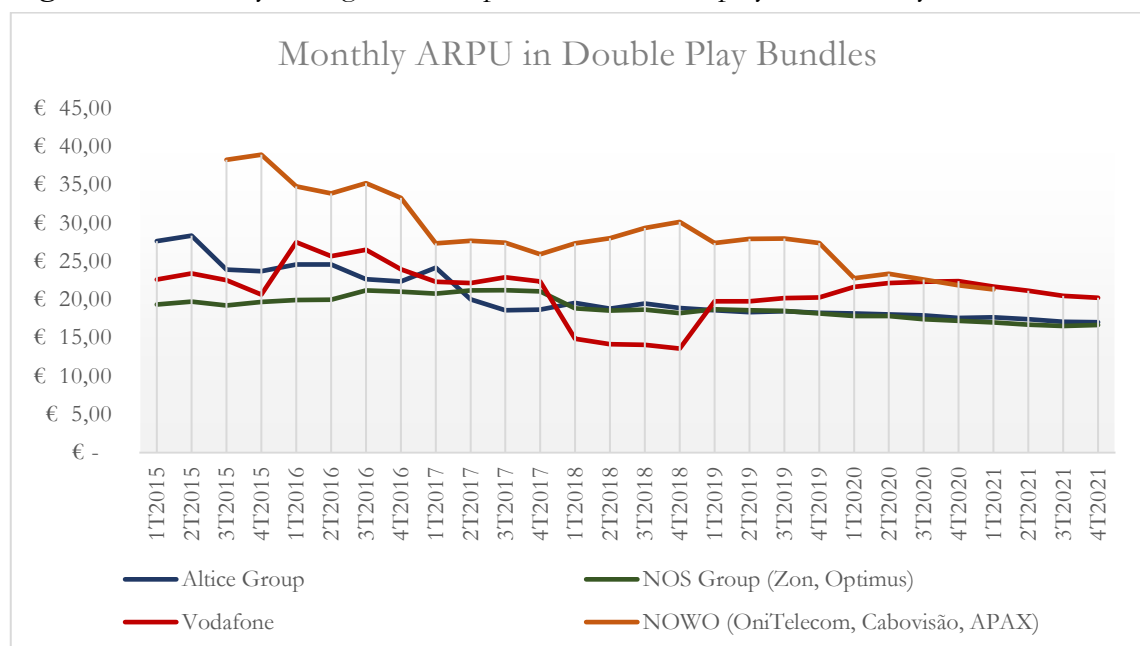


Further from the analysis of the overall industry, the objective of the data collection remained associated with the developments of each company, in each sub-industry.

4.3.1 The Double-Play Industry Outlook

As the theoretical background suggests, the average revenue per user is both decreasing and converging among the four main operators, as figure 4.6 illustrates.

Figure 4.6: Monthly average revenue per user in double-play sub-industry, in euros.



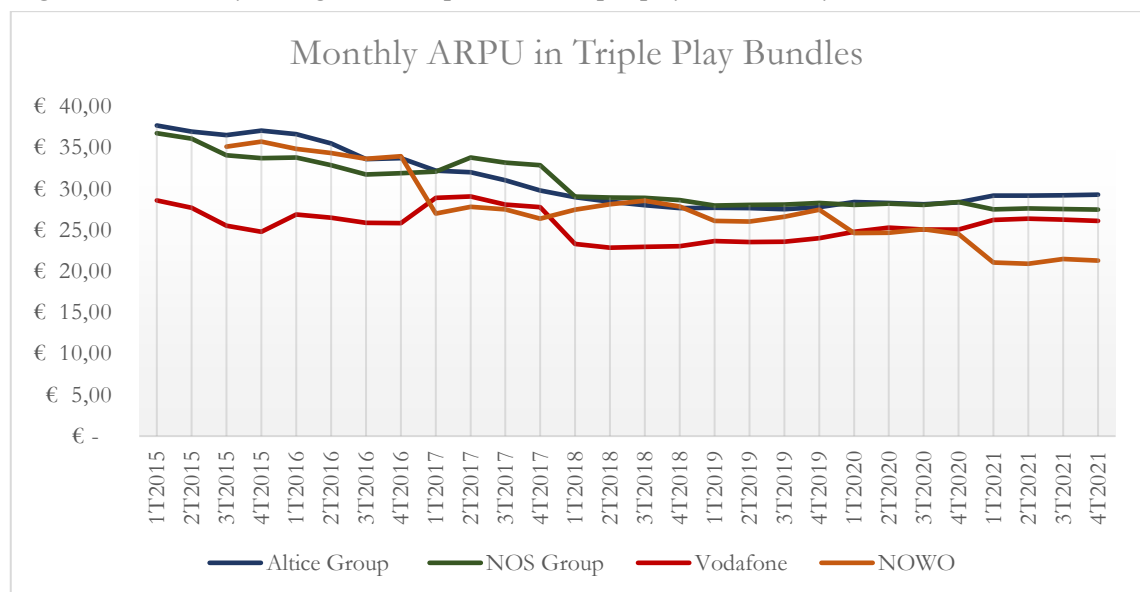
Source: ANACOM, Own calculations

These results are based on ANACOM's publication in what concerns the revenue share of each operator in this bundle, as well as the subscriber share, both showcased in figures 4.7 and 4.8, respectively, in Appendix 1.

4.3.2 The Triple-Play Industry Panorama

As the lower HHI denotes, the triple play industry is less concentrated. Therefore, also the average revenue per user seems to be affected in similar ways for the four enterprises on the market. As it was previously pointed out the triple play industry presents very similar offers between operators, as the monthly ARPU values presented in the following picture (Fig. 4.9) seem to suggest. Once again, these were based on ANACOM publications and calculated from the values of subscriber share, both showcased in figure 4.10 and 4.11, respectively, in Appendix 1.

Figure 4.9: Monthly average revenue per user in triple-play sub-industry, in Euros.



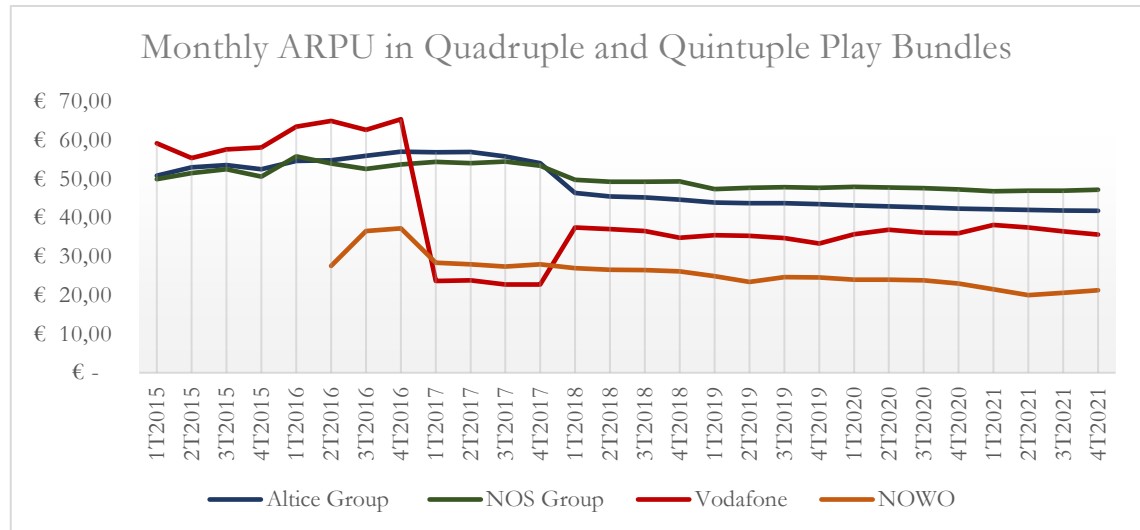
(ANACOM, Own calculations)

4.3.3 The Quad and Quintuple-Play Angle

On the opposite side, the average revenue for quadruple and quintuple play bundles has been fairly stable (as in comparison to the remaining two n-plays). Different from the previous analysis, the level of convergence between companies also displays results apart from the ones expected. These results (Fig. 4.12) are based on ANACOM's publication in what

concerns the revenue share of each operator in this bundle, as well as the subscriber share, both showcased in figures 4.13 and 4.14, respectively, in Appendix 1.

Figure 4.12: Monthly average revenue per user in quadruple & quintuple-play sub-industry, in euros.



(ANACOM, Own calculations)

4.4 Estimation Results

Having a cross-sectional time-series database, with average revenue per user, per company, per quarter, panel data econometric regressions were the evident option to analyse data and test the hypotheses.

The Pooled Ordinary-Least-Squares model employs OLS methodology over panel datasets, being the simplest regression for such data. This model ignores the component α_i of the error term, therefore the heterogeneity between companies (Verbeek, 2021). If there is no endogeneity, the estimators are consistent, but not efficient, due to the presence of autocorrelation between the errors (Verbeek, 2021). Before deciding over which model to employ, the Durbin-Watson test was performed, pointing to negative autocorrelation in all regressions, therefore an additional estimation was surely relevant.

Using Pooled OLS with fixed effects eliminates the problem of endogeneity, accounting for unobserved attributes inherent to each organization, especially those which are time-invariant (Verbeek, 2021). As both models present advantages regarding the data in question, the decision was to analyse both types of regressions.

The methodology employed is based on performing both model analysis for each n-play bundle, to reach conclusions over the evolution of each different variable.⁷

For the double-play industry, the analysis is presented below.

Table 4.2: Descriptive statistical variable information on the double-play regression

Variable	Description	N	Mean	Median	Std. dev.	Min	Max
LogARPU	Logarithm of average revenue per user	107	1.331	1.322	0.091	1.133	1.590
HHI	Herfindahl-Hirschman Index	107	3238.697	3231.530	215.465	3001.780	4090.260
TimeLaunch	Quarters since launch of 2P bundle	107	42.149	42.000	7.871	28.000	57.000
LogSubs	Logarithm of Subscribers	107	4.999	5.131	0.317	4.223	5.420
ARPUSpread	Difference between the maximum and minimum ARPU	107	9.933	8.846	4.567	3.587	19.244
Penetration	2P Penetration Rate	107	4.584	4.600	0.396	4.000	5.300

Preliminary to the regression analysis, correlations were calculated for all variables in the analysis, and reported in the following table. In general, correlations were not high among the independent variables except between *LogSubs* and *Penetration* as both present means of analysing the number of customer developments.

Table 4.3: Correlations (n=107) in double-play dataset

	LogARPU	HHI	TimeLaunch	LogSubs	ARPUSpread	Penetration
LogARPU	1.0000					
HHI	-0.0801	1.0000				
TimeLaunch	-0.4565	-0.1071	1.0000			
LogSubs	-0.5363	0.1081	-0.1619	1.0000		
ARPUSpread	0.2907	-0.2440	0.5255	-0.6705	1.0000	
Penetration	0.3544	0.2026	-0.4454	-0.8923	0.5255	1.0000

⁷ Every regression is based on unbalanced panel-data due to measurements for NOWO operator. The company divested from double play offers in recent periods. At the same time some revenues had to be disregarded as Altice was the precious owner of Cabovisão, and there was the risk that such results were mixed with MEO revenues, now owned by Altice.

Table 4.4: Panel data regression for the double-play sub-industry, with Pooled OLS and fixed-effects model (Own elaboration, Eviews v.12 software)

Dependent variable = LogARPU	Panel Least Squares		Fixed Effects OLS	
	Coefficient [Std. Err.]	<i>t-stat</i>	Coefficient [Std. Err.]	<i>t-stat</i>
Constant	3.266 [.266]	12.295***	1.197 [.315]	6.283***
HHI	0.000 [.000]	-1.529***	0.000 [.000]	-0.713
TimeLaunch	-0.012 [.002]	-6.008***	-0.011 [.002]	-6.562***
LogSubs	-0.182 [.019]	-10.179***	0.069 [.048]	1.402
ARPUSpread	-0.005 [.011]	-2.766***	-0.005 [.001]	-3.035***
Penetration	-0.072 [.033]	-2.128**	-0.093 [.0289]	-3.227***
Q2	0.007 [.016]	0.487	0.006 [.048]	0.462
Q3	0.027 [.017]	1.631	0.026 [.048]	1.868
Q4	0.022 [.017]	1.313	0.019 [.048]	1.403
Sample	4 companies		4 companies	
Periods	28		28	
Observations	107		107	
R-Squared	0.63		0.75	
F-Test	21.286***		26.557***	

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

The model with pooled OLS is estimated as:

$$\begin{aligned} \text{LogARPU}_{it} = & 3.266 + 0.00 \text{HHI}_t - 0.012 \text{TimeLaunch}_{it} - 0.182 \text{LogSubs}_{it} \\ & - 0.005 \text{ARPUSpread}_t - 0.072 \text{Penetration}_t + 0.007 \text{Q2}_{it} \\ & + 0.027 \text{Q3}_{it} + 0.022 \text{Q4}_{it} + u_i + e_{it} \end{aligned}$$

With fixed effects, the model is presented as such:

$$\begin{aligned} \text{LogARPU}_{it} = & 1.197 + 0.00 \text{HHI}_t - 0.011 \text{TimeLaunch}_{it} + 0.069 \text{LogSubs}_{it} \\ & - 0.005 \text{ARPUSpread}_t - 0.093 \text{Penetration}_t + 0.006 \text{Q2}_{it} \\ & + 0.026 \text{Q3}_{it} + 0.019 \text{Q4}_{it} + u_i + e_{it} \end{aligned}$$

To focus on the results with higher statistical significance, the estimations show that for 2P:

- An additional unit of the concentration index represents very low effects on ARPU, as expected for an index varying between 0 and 10000.
- An increase of time in one quarter results in an approximate reduction of ARPU by 1.1%/1.2%.
- The increase in one unit of ARPU spread is as well correlated with a decrease of ARPU by 0.5%.
- Both models also correlate an increase of one unit in the penetration rate with a decline of average revenues of 7,2% for Pooled OLS and 9.3% for FEM.

Regarding the triple-play sub-industry, the same methodology was employed.

Table 4.5: Descriptive statistical variable information on the triple-play regression

Variable	Description	N	Mean	Median	Std. dev.	Min	Max
LogARPU	Logarithm of average revenue per user	110	1.454	1.448	0.059	1.320	1.576
HHI	Herfindahl-Hirschman Index	110	3122.287	3076.840	162.700	2984.640	3774.750
TimeLaunch	Quarters since launch of 3P bundle	110	44.209	44.000	8.115	29.000	59.000
LogSubs	Logarithm of Subscribers	110	6.187	6.198	0.037	6.117	6.233
ARPUSpread	Difference between the maximum and minimum ARPU	110	6.638	5.985	2.358	3.056	12.288
Penetration	3P Penetration Rate	110	14.962	15.300	1.269	12.600	16.500

For the second regression correlations were calculated once more and reported in the following table (4.6):

Table 4.6: Correlations (n=110) in triple-play dataset

	LogARPU	HHI	TimeLaunch	LogSubs	ARPUSpread	Penetration
LogARPU	1.0000					
HHI	0.0990	1.0000				
TimeLaunch	-0.5999	-0.0665	1.0000			
LogSubs	-0.6503	-0.1100	0.9547	1.0000		
ARPUSpread	0.4493	0.0878	-0.5418	-0.6544	1.0000	
Penetration	-0.6503	-0.1025	0.9551	0.9995	-0.6475	1.0000

In this case, correlation among multiple variables is elevated. For instance, LogSubs and Penetration are highly correlated, predicting how these variables are weak to present consistent and efficient β_{OLS} estimators. Such levels of correlation result in a model incapable of effectively measuring the level of the impact of each variable, nevertheless, might present guidelines over the type of effect that such variables present.

The results are presented in the following table (4.7):

Table 4.7: Panel data regression for the triple-play sub-industry, with Pooled OLS and fixed-effects model (own elaboration, evIEWS v.12 software)

Dependent variable = LogARPU	Panel Least Squares		Fixed Effects OLS	
	Coefficient [Std. Err.]	<i>t-stat</i>	Coefficient [Std. Err.]	<i>t-stat</i>
Constant	2.114 [23.010]	0.091	-3.079 [15.752]	-0.195
HHI	0.000 [.000]	0.415	0.000 [.000]	0.631
TimeLaunch	0.002 [.002]	0.806	-0.001 [.001]	-0.800
LogSubs	-0.030 [3.991]	-0.008	0.841 [2.731]	0.308
ARPUSpread	0.000 [.002]	0.051	0.002 [.002]	0.844

Penetration	-0.039 [.114]	-0.341	-0.045 [.078]	-0.574
Q2	0.001 [.013]	0.080	0.002 [.008]	0.189
Q3	0.003 [.013]	0.280	0.004 [.009]	0.500
Q4	0.007 [.013]	0.567	0.007 [.009]	0.791
Sample	4 companies		4 companies	
Periods	28		28	
Observations	110		110	
R-Squared	0.43		0.74	
F-Test	9.56***		25.81***	
Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.				

As forecasted, the lack of statistical significance is predominant for the second regression. Taking these results, no definite causal effects can be numbered, taking the discussion over the last regression, for the quadruple and quintuple play industry.⁸

Table 4.8: Descriptive statistical variable information on the quad & quintuple-play regression

Variable	Description	N	Mean	Median	Std. dev.	Min	Max
LogARPU	Logarithm of average revenue per user	107	1.604	1.640	0.138	1.301	1.815
HHI	Herfindahl-Hirschman Index in 4&5P Market	107	3981.189	3941.190	243.334	3684.570	4643.780
TimeLaunch	Quarters since launch of 4P bundle	107	20.794	21.000	8.120	6.000	36.000
LogSubs	Logarithm of Subscribers	107	5.454	5.719	0.512	3.777	5.976
ARPUSpread	Difference between the maximum and minimum ARPU	107	23.667	23.918	7.854	3.941	37.353
Penetration	4+5P Penetration Rate	107	17.471	17.100	2.919	11.300	21.900

Correlations were calculated for all variables in the analysis prior to the regression analysis and are shown in the table below. In general, correlations between independent variables were low, except for correlations with *Penetration*.

⁸ ANACOM publications consider 4P and 5P together for their analysis since 2015, as they did before 2015 merging 3P and 4P, mostly likely due to the low penetration level new bundles present in their initial years in the market.

Table 4.9: Correlations (N=107) in quadruple and quintuple-play dataset

	LogARPU	HHI	TimeLaunch	LogSubs	ARPUSpread	Penetration
LogARPU	1.0000					
HHI	0.4634	1.0000				
TimeLaunch	-0.1541	-0.8585	1.0000			
LogSubs	0.6707	-0.0776	0.3725	1.0000		
ARPUSpread	-0.2796	-0.5023	0.2489	-0.1041	1.0000	
Penetration	-0.4223	-0.955	0.9149	0.1021	0.3543	1.0000

Table 4.10: Panel data regression for the quad and quintuple-play sub-industry, with Pooled OLS and fixed-effects model (Own elaboration, Eviews v.12 software)

Dependent variable = LogARPU	Panel Least Squares		Fixed Effects OLS	
	Coefficient [Std. Err.]	<i>t-stat</i>	Coefficient [Std. Err.]	<i>t-stat</i>
Constant	-1.112 [.715]	-1.555	0.006 [.872]	0.007
HHI	0.004 [.002]	3.381***	0.003 [.000]	2.346**
TimeLaunch	0.005 [.003]	1.857*	-0.011 [.007]	-1.592
LogSubs	0.170 [.019]	8.681***	-0.008 [.072]	-0.110
ARPUSpread	0.002 [.001]	1.751*	0.000 [.001]	0.504
Penetration	-0.006 [.013]	-0.460	0.040 [.022]	1.833**
Q2	0.000 [.019]	0.019	0.006 [.048]	0.462
Q3	0.016 [.019]	0.882	0.026 [.048]	1.868

Q4	0.020 [.019]	1.050	0.019 [.048]	1.403
Sample	4 companies		4 companies	
Periods	28		28	
Observations	107		107	
R-Squared	0.73		0.78	
F-Test	34.430***		30.340***	
Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.				

The model with pooled OLS is estimated as:

$$\begin{aligned} \text{LogARPU}_{it} = & -1.112 + 0.004 \text{HHI}_t + 0.005 \text{TimeLaunch}_{it} + 0.170 \text{LogSubs}_{it} \\ & + 0.002 \text{ARPUSpread}_t - 0.006 \text{Penetration}_t + 0.000 \text{Q2}_{it} \\ & + 0.016 \text{Q3}_{it} + 0.020 \text{Q4}_{it} + u_i + e_{it} \end{aligned}$$

With fixed effects, the model is presented as such:

$$\begin{aligned} \text{LogARPU}_{it} = & 0.006 + 0.003 \text{HHI}_t - 0.011 \text{TimeLaunch}_{it} - 0.008 \text{LogSubs}_{it} \\ & + 0.000 \text{ARPUSpread}_t + 0.040 \text{Penetration}_t + 0.006 \text{Q2}_{it} \\ & + 0.026 \text{Q3}_{it} + 0.019 \text{Q4}_{it} + u_i + e_{it} \end{aligned}$$

Regarding the results with higher statistical significance, the estimations show that for 4&5P:

- An additional unit of the concentration index represents an additional increase between 0.4 and 0.5% in ARPU
- The pooled OLS model estimate that an increase of time in one quarter results in an approximated expansion of ARPU by 0.5%.
- An increase in one unit of ARPU spread is as well correlated with a raise of ARPU by 0.2%.
- Finally, contrarily to the 2P estimation, the fixed effects model suggests an increase in ARPU by 4% if the rate of penetration for 4P and 5P increases in one unit.

4.5 Results Discussion

The beginning of the discussion of results must be marked by the level of significance observed in each regression. The level of the adjustment of the model allows conclusions to be inferred as it attests to the higher or lower level of validity and reliability of each coefficient.

In regards to the goodness of fit of the model for each n-play bundle, the results seem fitted to the type of hedonic pricing approach taking place. The R-squared represents the explanatory power each of the models exhibits. For the Panel OLS approach, the results were 0.63, 0.43, and 0.73 for the double, triple, and quad-quintuple regressions, respectively. Regarding the fixed-effects model, these same measures of R^2 resulted in the values: 0.75, 0.74, and 0.78. While these results might seem rather low, similar research has inferred conclusions with similar, or lower, explanatory capacity. Pines and Fanfalone (2015) obtained results ranging from 0.50-0.78. Yet, Park and Jayakar (2015) considered a model with $R^2 = 0.25$ as being acceptable. Taking these considerations, the coefficient of determination suggests that the models have satisfactory explanatory power.

Regarding the overall significance of the model, F-statistics were presented. This analysis attests to the predictive power of all the independent variables together, indicating the low likelihood of all the coefficients being equal to zero. As the p-value attests to the significance of all the models, there seems to be sufficient reasoning to believe in the goodness of fit.

Nevertheless, focusing on the individual significance of the variables in the model, evident obstacles show up. Especially for the triple-play regression, as the correlation level previously forecasted, none of the variables present enough significance level (even for a level of confidence of 90%). Taking this outcome, it becomes debatable to effectively consider such results to test the hypotheses.

As the methodology here proposed considers the inputs of three different regressions, conclusions might still be extracted, considering the limitations here implied (e.g. disregarding the triple play results) further debated in the next chapter. Table 4.11 summarizes the main results of the regressions.

Table 4.11: Outline of the Main Regression Results (Own elaboration)

	Panel Least Squares			Fixed Effects OLS		
	2P	3P	4&5P	2P	3P	4&5P
HHI (H3)	0.000 (***)	0.000	0.004 (***)	0.000 (***)	0.000	0.003 (**)
TimeLaunch (H1)	-0.012 (***)	0.002	0.005 (*)	-0.011 (***)	-0.001	-0.011
ARPUspread (H2)	-0.005 (***)	0.000	0.002 (*)	-0.005 (***)	0.002	0.000

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Considering each of the hypotheses proposed:

- **H1:** There is consecutively less effect of the time of launch for enriched bundles, as they present more differentiative offers.

The results from pooled OLS method hold statistical significance and suggest that for double play bundles, an increase in the time of launch of the bundle in one unit (therefore one more quarter) leads to a likely decrease in the average revenue per user in 1.1% to 1.2%. On the opposite side of the spectrum, for 4 and 5-P, the increase of a quarter unit is expected to result in an improvement of ARPU of 0.5%. These results are in accordance with the hypothesis and support the conclusions of Crocioni & Correa (2011), regarding the likely decrease of prices for lower-composition bundles. H1 is therefore confirmed.

- **H1.1:** The time of launch has a negative effect on lower composition bundles, and positive effect on improved bundles, accounting for advantages from differentiation.

As the previous analysis already forecasted, H1.1. is also confirmed by the results, of course taking into account the limitations represented for the lack of significance for triple-play⁹.

⁹ Despite the impossibility to use such results, only for the completion of the debate, if the triple play regression results were considered, H1.1 would hold as the coefficients are progressively lower.

The result is able to demonstrate how the seniority of a package is less relevant when there are enough differentiative offers added to the value proposition.

- **H2:** The spread of the average revenues in the market positively affects the overall revenue of companies.

Regarding the second hypothesis, the results suggest that an increase of one unit in the difference of average revenues per user of the better performing company and the one with worst outcomes results in a decrease of 0.5% of ARPU for 2P, and an increase of 0.2% for 4 and 5P. This outcome does not allow the hypothesis to be totally confirmed. One possible explanation for the failure of this hypothesis might be the underestimation that ARPU spread gets of price proximity.

Nonetheless, the partial outcome of an increase in revenues for enhanced bundles might suggest that this spread is the result of differentiative offerings that end up generating additional revenues, by avoiding price wars.

- **H3:** The level of market concentration has consecutively fewer positive effects as the n-play bundles augment.

As the theoretical setting established, an increase in HHI represents an industry closer to a monopoly, in standard conditions, correlated with increased revenues that result from the reduction of consumer surplus.

The background for this main theory, is that for offers with higher innovative factors, the revenue is less dependent on market dominance. As the n-play augments, even for industries dominated by few operators, more differentiated proposals would result in a less expressive contribution from the level of market concentration, unable to confront innovative proposals.

Nevertheless, the results suggest that an increase of one unit in the HHI would result in a very low increase in ARPU for 2P (as expected, since just one unit increase over an index ranging between 0-10000 must result in a low impact), and a 0.3-0.4% increase for 4 and 5P. The hypothesis is therefore rejected.

- **H3.1:** The level of market concentration, represented by HHI, is positively correlated with average revenue in each company.

Finally, H3.1 aims to capture the initial theoretical background of the previous hypothesis. The result confirms the positive effect of market concentration, as Coe (2021) established in the commoditization-innovativeness matrix (Figure 2.5, p. 19).

One possible explanation for the low coefficient over the 2P model might be how even market dominance is incapable of reverting a highly commoditized market. This cannot of course be confirmed by the present model.

Table 4.12 summarizes the results of the established hypotheses, and set the tone for the next chapter, where the implications of the model in business theory will be further analysed.

Table 4.12: Hypothesis acceptance (Own elaboration)

H1: There is consecutively less effect of the time of launch for enriched bundles, as they present more differentiative offers.	Confirmed
H1.1: The time of launch has a negative effect on lower composition bundles, and positive effect on improved bundles, accounting for advantages from differentiation.	Confirmed
H2: The spread of the average revenues in the market positively affects the overall revenue of companies.	Partially Confirmed
H3: The level of market concentration, has consecutively fewer positive effects as the n-play bundles augment.	Rejected
H3.1: The level of market concentration, represented by HHI, is positively correlated with average revenue in each company.	Confirmed

5. Conclusion

The following chapter presents the general conclusions, answering the research questions introduced earlier in the study, as well as implications for theory and management, limitations, and suggestions for further research on the topic.

5.1 General Conclusions and Implications

This paper contributes to academic research on commoditization and bundling while also developing useful implications to drive telco operators on revenue management strategies.

As debated throughout the literature review (chapter 2), there has been a lack of a constructive model capable of correlating innovation and commoditization in the study of industry dynamics. As a result, a commoditization paradox takes place. On one hand, the introduction of differentiating offers establishes a new value proposition, capable of detaining commoditization. On the other, the implementation of a new product as the market standard contributes to the increase of the overall commoditization. The question remained whether firms could in fact detain the process, or if it represented a market fate.

In chapter 3 a sector was selected, having in mind all the background needed to perform a measurable study. The Portuguese telecommunication industry, while limiting the research, was at the same time fitted, and characterised by important metrics capable of performing such investigation.

Across chapter 4 a model capable of answering the research questions was constructed. Using the average revenue per user as a proxy of prices in the industry, and the number of services in a bundle as a proxy for innovation strategies, the results are as follows:

- The time since the launch of a bundle is not only progressively less significant for enriched bundles, as it even presents a positive effect for such models. While the study revealed that double-play service are negatively affected by 1.2%, the result for quadruple and quintuple play bundles is an increase of 0.5% on average revenue per user.
- While not fully attesting the hypothesis, the methodology also concluded that a higher level of price proximity is responsible for an increase of 0.2% in outcomes for enriched bundles.
- Finally, there was not sufficient evidence to infer the effects of the market concentration taking into account different industry sub-sets.

The ARPU drivers' analysis conducted in this dissertation conclusively attest to the differences in comparing a standardized bundle against an enriched offering. These findings can be translated into managerial implications as guidelines for which types of offers should operators focus and invest on. The inclusion of family-friendly options, special offers, limited subscriptions, and so forth, results in higher positive returns on revenue. Regarding the evolution of commoditization, the findings suggest that the continued inclusion of these innovations is effectively capable of responding to the threat.

Against what the initial literature might have forecasted, Portuguese telco operators stand in a favourable position, as the outcome of the measures debated suggests. Hopefully, these results are capable of enriching strategic decisioning, not limited to the telecommunication sector, but rather to a set of industries suffering similar pressures.

5.2 Limitations and Future Research Suggestions

This dissertation aimed to present a conceptual framework able to discuss hypotheses over strategic adaptations to market commoditization. The empirical findings discussed are inherent to a set of limitations intrinsic to the research question and the methodology adopted.

First and foremost, the cluster of cases. The literature review presented focused on several aspects of different industries, nonetheless, a group had to be selected to perform an empirical investigation. The most obvious limitation of the present research remains exactly how it might not apply to other sectors or countries. The approach here taken might therefore be used as a possible method for further research on the topic in other sets of industries.

Regarding the methodology taken, ARPU being used as a proxy for prices unquestionably limits the accuracy of results, as it presents an imperfect compromise. In the exact same view, using n-play subsets of the industry also merely intends to mimic the effects of innovation on the sector. As a future direction, a compilation of prices practiced over time, as well as the constituent offers will surely construct responses with many further possibilities for discussion and hypotheses implementation. In fact, this approach was the initial concept for the research, however, data publication limitations, as well as time constraints, turned such approach impractical. ANACOM started a set of publications on price evolution in June 2020, which may possibly be a fitted dataset for the same research when there is a long

enough period of time to allow such developments, perhaps longer than the approach here taken.

Over the hypotheses proposed, the fact that triple-play regression outcomes were statistically insignificant also contributed to a lower level of confidence confirming the theory. As it is commonplace in econometric methodology, the fact that each regression presented on average an explanatory power of 75%, despite being higher than similar research, also opens the possibility that other relevant variables were not considered.

The results of this dissertation have triggered additional investigation hypotheses regarding industry commoditization, which may aid future research to be built upon these findings. At the same time, hopefully, the questions approached can increase the interest over the topic in academia and generate valuable results for decision-makers across industries.

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Appendix 1 – Additional Data Collection

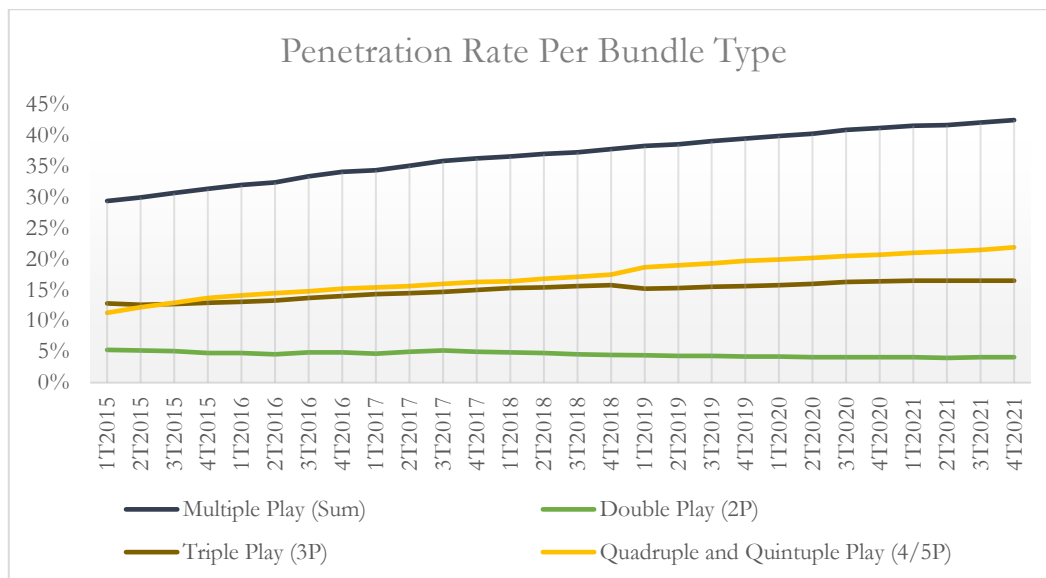


Figure 4.4: Penetration rate per n-bundle, 2015-2021 (ANACOM)

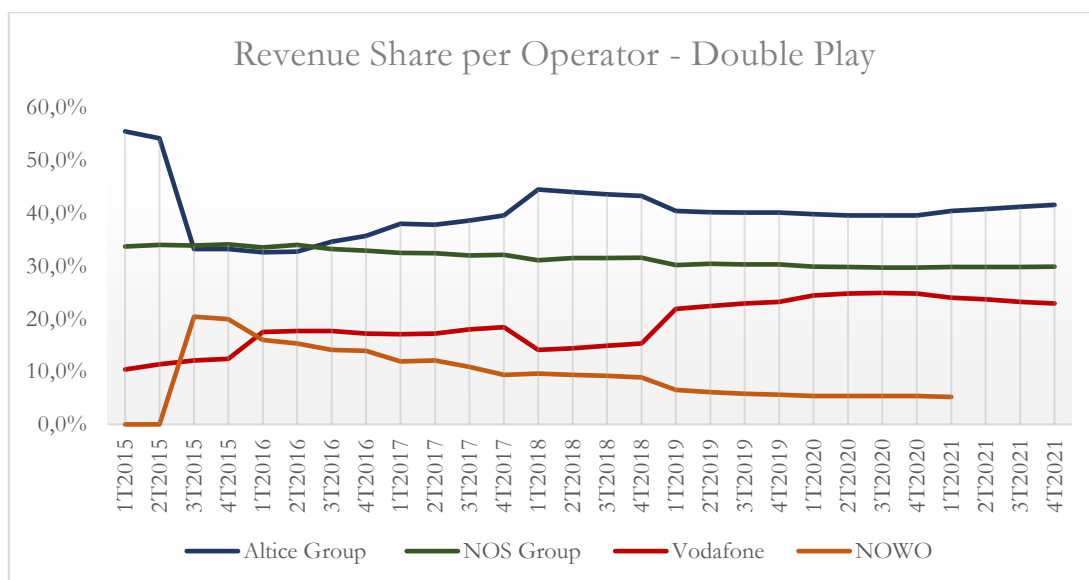


Figure 4.7: Revenue share per operator in the double-play sub-industry, 2015-2021 (ANACOM)

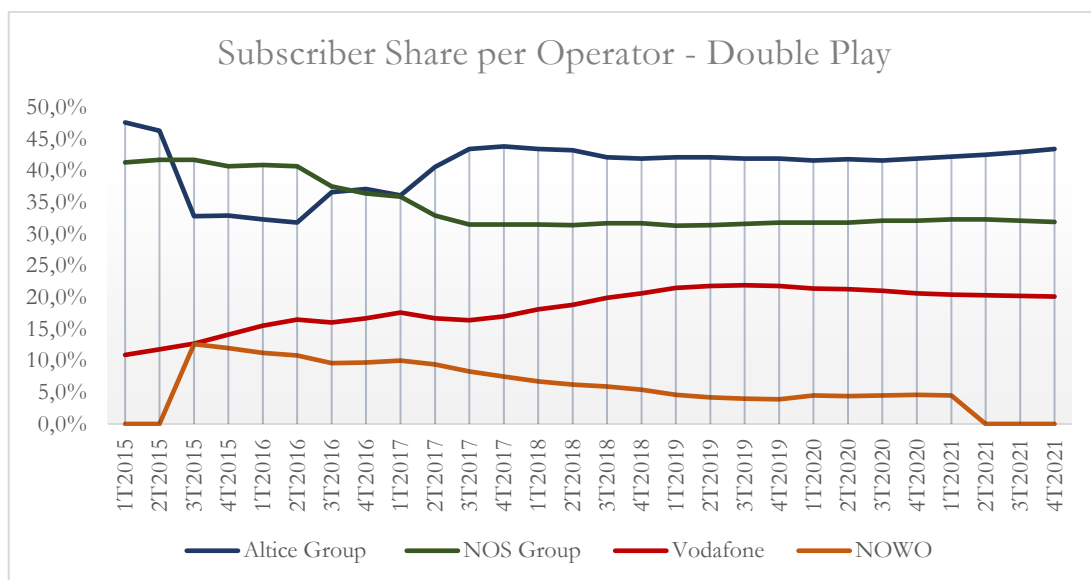


Figure 4.8: Subscriber share per operator in the double-play subindustry, 2015-2021 (ANACOM)

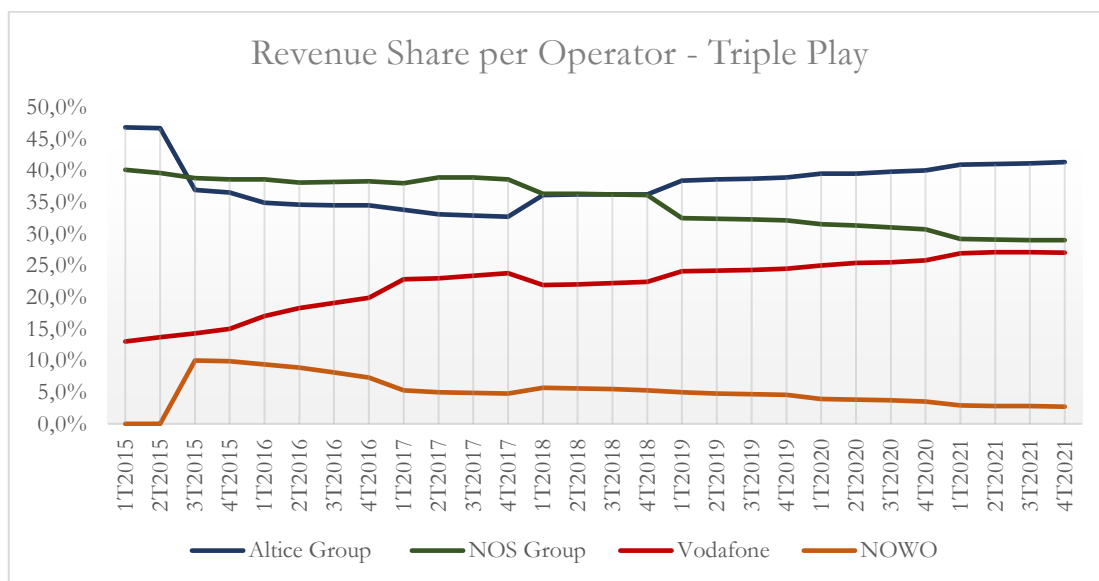


Figure 4.10: Revenue share per operator in the triple-play subindustry, 2015-2021 (ANACOM)

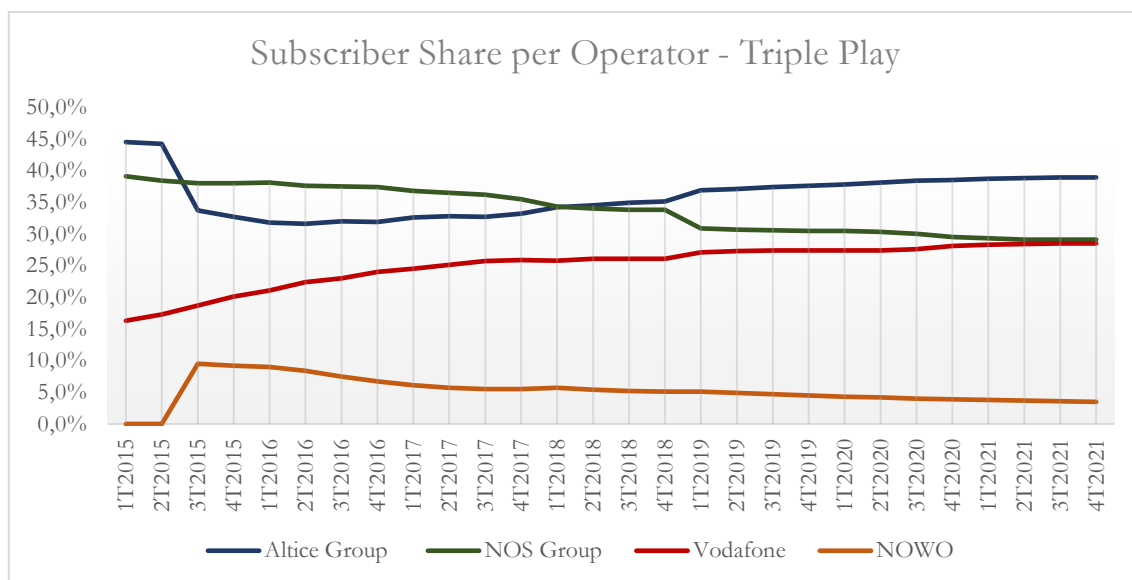


Figure 4.11: Subscriber share per operator in the triple-play subindustry, 2015-2021 (ANACOM)

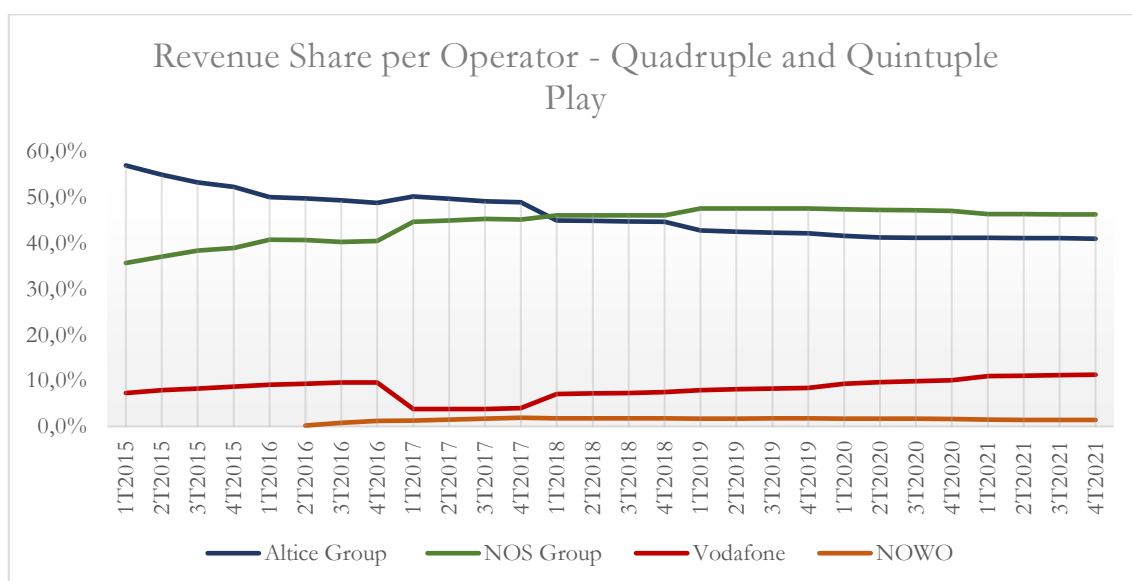


Figure 4.13: Revenue share per operator in the quadruple and quintuple-play subindustry, 2015-2021 (ANACOM)

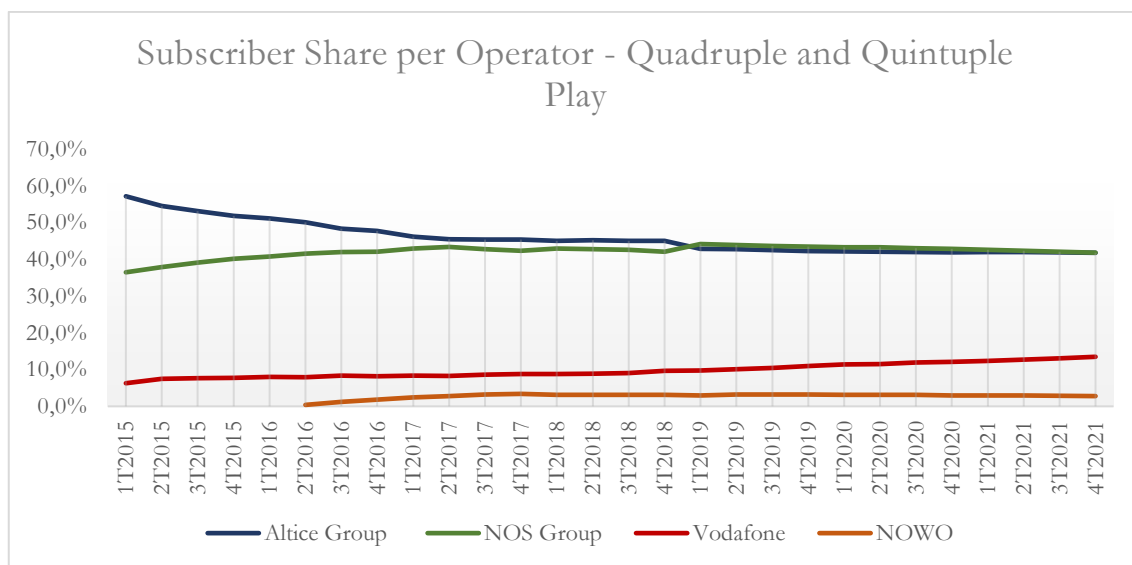


Figure 4.14: Subscriber share per operator in the quadruple and quintuple -play subindustry, 2015-2021 (ANACOM)