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HORIZONTAL MERGERS IN TWO-SIDED PLATFORMS

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Abstract

Platforms, although an existing business model for several years, have recently been penetrating and disrupting the markets. Consequently, it is becoming ever more important to fully understand this industrial organizational structure and its consequent implications on daily market interactions. It is, therefore, for this goal that the present dissertation aims to contribute, being its purpose the analysis of the impacts of the total network effects, the intrinsic characteristic of multi-sided platforms, on merger profitability and consumer welfare.

The methodology followed to fulfill both objectives was the theoretical application of the model of Correia-da-Silva, Jullien, Lefouili, and Pinho (2019) on two different scenarios: a merger from a triopoly to a duopoly and a merger from a duopoly to a monopoly. The model assumes a finite number of platforms competing *à la Cournot*, offering a homogeneous good under linear demand. In addition, it was assumed that the cost of serving one of the sides is null, while the cost of serving the other side is proportional to the number of users.

The findings from these analyses suggest that the presence of network effects is able to yield profitable mergers for the participating firms on both scenarios studied for a given magnitude of the latter. Additionally, it was observed that the merger may benefit the agents on one side of the market if the total network effects are strong enough, which contrasts with standard Cournot model outcomes on unilateral markets.

JEL Codes: D43, L41

Keywords: Multi-Sided Markets; Platforms; Horizontal Mergers; Cournot Competition.

Resumo

As plataformas, ainda que um modelo de negócios existente há vários anos, têm vindo recentemente a penetrar e a impactar intensivamente o mercado. Consequentemente, é cada vez mais importante estudar e entender esta estrutura de organização industrial e as suas consequentes implicações nas interações e dinâmicas de mercado. É, portanto, para este objetivo que a presente dissertação pretende contribuir, sendo o objecto de estudo desta dissertação a análise dos impactos dos efeitos da externalidade de rede total, a característica intrínseca das plataformas multi-laterais, na rentabilidade das fusões e no bem-estar do consumidor.

A metodologia seguida para completar estes dois objetivos passou pela aplicação teórica do modelo de Correia-da-Silva et al. (2019) em dois cenários distintos: uma fusão de um triopólio para um duopólio e uma fusão de um duopólio para um monopólio. O modelo assume um número finito de plataforms competindo *à la Cournot*, oferecendo um bem homogéneo sob procura linear. Adicionalmente, foi considerado o custo incorrido pela plataforma de um dos lados como nulo, enquanto o mesmo custo do outro lado foi assumido como proporcional ao número de agentes.

Os resultados destas análises sugerem que a presença dos efeitos da externalidade de rede total é capaz de gerar fusões lucrativas para as empresas participantes em ambos os cenários estudados, para uma dada magnitude destes efeitos. Adicionalmente, foi observado que a fusão pode beneficiar os agentes de um dos lados do mercado se os efeitos de externalidade de rede total forem fortes o suficiente, o que contrasta com os resultados obtivos com um modelo de Cournot padrão para mercados unilaterais.

Códigos JEL: D43, L41

Palavras-Chave: Mercados Multi Laterais; Plataformas; Fusões Horizontais; Competiação *à Cournot*.

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1. Introduction

A distinct structure of an industrial organization has gained the interest of several academics in recent years. This structure concerns multi-sided markets, where firms are commonly called platforms. Despite its somewhat newly-earned interest, this type of organization has existed for a long time, for example, in the newspaper industry, where readers and advertisers contact through a platform — the newspaper. However, it is only recently that academics have acknowledged its revolutionary and disruptive character in several industries.

Lin, Pang, Bitar, and Wierman (2017)'s brief description of a platform might be considered an explanatory rationale for the mentioned performance of such industrial organization's structure. These authors pinpoint a factor that differentiates a platform from the remaining traditional industrial organization structures. According to the latter, a platform provides a base or "space", either tangible or intangible, which agents of all sides can use to interact with each other, thus enhancing and easing their interaction and consequently creating value for all parties that are involved. Taking into account the present digital revolution that is currently being experienced, this new structure of industrial organization further shines and becomes even more relevant leading Abdelkafi, Raasch, Roth, and Srinivasan (2019) to consider it as one of the most solid business models that one can identify in the digital markets, being a platforms' dynamism, aptitude to lever complexity, ease of quick scale-up and the value it captures, the main arguments supporting such claim. Some examples of currently successful platform business models in the digital market can be found in, Netflix, Spotify, Uber, Facebook, YouTube, and Amazon.

Hence, from the above-presented information, it is not surprising that the interest in this topic by the existing literature, regardless of its novelty, is immense, a trend far from being shifted.

Intending to contribute to the existing literature concerning platforms, the present dissertation comprises a study of mergers between such industrial organization's structure, under the Cournot model scope, with the following main objectives: the presentation of a summary of the existing literature on multisided platforms; the identification of the necessary conditions for a merger to be profitable for the participating platforms, that is, the platforms that partake on the merger; and, the study of the impact on consumer welfare of these profitable mergers.

Consequently, given the market dynamic to be analyzed in the present dissertation, the latter can likewise be linked with the existing literature on mergers. In addition, by studying the effects on consumer welfare of a merger among platforms, this dissertation also aspires to contribute to aid the antitrust authority practice on assessing and evaluating the impacts of proposed mergers on consumer welfare, which is still an arduous and complex assignment.

The methodology outlined to perform the proposed analyses consisted of a theoretical application of Correia-da-Silva et al. (2019)'s model, which considers a limited number of homogeneous platforms competing *à la Cournot* under linear demand and further assumes mergers where the average marginal costs are preserved, for all platforms. In addition, the cost of serving one side was considered null, whereas the same cost for the other side was considered proportional to the number of users. The analysis was carried out orderly, that is, firstly it was assessed for which conditions merger profitability was assured and subsequently it was analyzed the impact of those mergers on consumer welfare, for two scenarios: a merger from a triopoly to a duopoly and a merger from a duopoly to a monopoly.

The present dissertation is organized with the following structure: this first chapter encompasses the introduction, followed by chapter 2 which presents a review on the existing literature of multi-sided markets/platforms, mergers, and a brief recalling of the Cournot competition model, being thusly divided into three sub-sections, one regarding each topic. The analysis and application of the model can be found in chapter 3, followed by the discussion of the results obtained in chapter 4. Finally, in chapter 5 the main conclusions of this dissertation are presented.

2. Literature Review

In this chapter, it will be presented the existing literature on the subjects of multi-sided markets, mergers, and Cournot competition. Firstly, the works and conclusions of groundbreaking authors on the topic of multi-sided markets/platforms, namely Rochet and Tirole (2003), Rochet and Tirole (2006), Armstrong (2006), and Caillaud and Jullien (2003), will be set forth, followed by an introduction of the most recent developments on this field. Secondly, an overview of the topic of mergers will be conducted, by resorting to seminal works such as Farrell and Shapiro (1990), Perry and Porter (1985), and Belleflamme and Peitz (2015), ending with a specific approach on mergers among multi-sided platforms. Finally, a brief recalling of the Cournot competition will be presented, given that the model chosen to conduct the forthcoming theoretical analysis assumes this type of competition.

2.1 Multi-Sided Markets

2.1.1 Seminal Works

Several authors have attempted to define the concept of multi-sided markets/platforms from an economic perspective, yielding numerous definitions differing mainly on the depth degree and assumptions considered. Notwithstanding, there is still no consensus on an absolute/corroborated definition (Sanchez-Cartas & Leon, 2019), aiding to this reality the considerable recent academic interest on this subject, despite its growing presence on today's market's organizations. Thus, with the aim of aver these statements, some definitions are presented below.

Resorting to the groundbreaking works of Rochet and Tirole (2006), the concept of multi-sided markets is defined as "markets in which one or several platforms enable interactions between end-users and try to get the two (or multiple) sided "on board" by appropriately charging each side". Rysman (2009) deepens this definition by postulating that the agents from different sides do not merely interact through the platforms with each other, further stating that each sides' actions also condition the other's decisions and outcomes.

On the other hand, Weyl (2010) identifies three attributes that, on his perspective, are fundamental for a market to be classified as multi-sided: firstly, the author establishes that different services must be provided to different groups; secondly, he identifies that the participation of one side is impactful on the participation's benefit of the other side; and, finally, the author pinpoints the obligation of platforms setting the prices to both sides.

Years later, Evans and Schmalensee (2013) set forward a specific environment framework, adopting a value-focused perspective, that leads, in their judgment, to the creation/existence of a multi-sided platform: the obligation of the presence of two or more groups of agents who have the necessity to interact with each other, but which, on their own, are unable to achieve such interaction, thus not extracting the potential value of doing so; consequently, these agents "rely on the catalyst to facilitate value-creating interactions between them", being the catalyst, as logically inferred, the multi-sided platform (Evans & Schmalensee, 2013).

From the several definitions above presented and the structural context in which platforms can arise proposed by Evans and Schmalensee (2013), one can conclude that the subject of multi-sided markets/platforms entails various elements that need to be considered when analyzing/working on this subject.

Firstly, as alluded by Rysman (2009), one cannot talk about multi-sided markets without considering network externalities, being the latter defined by Katz and Shapiro (1985) as the additional increase in the utility of consuming a good that derives from other agents consuming the same good, being higher the greater the number of other agents consuming it, for a positive externality. According to Belleflamme and Peitz (2016), there are two types of externalities that must be contemplated. On the one hand, there are cross-group externalities which can either be positive or negative depending on the effect of one side on the other. One example of both is described by Belleflamme and Peitz (2016): "if consumers' utility is decreasing in the volume of advertising, advertisers exert a negative cross-group external effect on consumers, while consumers exert a positive cross-group external effect on advertisers". On the other hand, the same authors further acknowledged the concept of within-group externalities, which are characterized by the effect that one side has on itself, being portrayed in any congestion scenario: in the case of one side having too many agents that could result in an impact on those same agents of that same side.

Another component of high relevance that one needs to contemplate is the behavior of the agents on all sides of the market/platform. The first challenge a multi-sided market/platform faces is the initial gathering of agents on all its sides, since, as stated by Armstrong (2006) "one group's benefit from joining a platform depends on the size of the other group that joins the platform". Consequently, a logical questioning of how a multi-sided market/platform is supposed to gather all agents on all its sides at the very beginning of its activity, given that it will not have any agents on the remaining sides to foment the corresponding other sides' agent to joint, naturally follows. This problem is set forward by Caillaud and Jullien (2003) as the *Chicken & Egg Problem*, also known in the existing literature as the coordination problem, of which they present the following description: "to attract buyers, an intermediary should have a large base of registered sellers, but these will be willing to register only if they expect many buyers to show up". Intending to solve this problem, the same authors set forward a solution that relies on the subsidization of one side, to have it join the platform, in order to allure the other remaining sides' agents. This solutions coincides with Jullien (2011)'s divide-and-conquer strategy that he defines as "strategies rely[ing] on cross-subsidy to resolve issues of coordination failure: they target some sides with low prices in a way that ensures that all sides are willing to join the platform". Notwithstanding, by doing so, some inefficiencies might arise due to the possible attraction of unprofitable users, that is, agents that will not be committed to the platform and are just partaking to access the subsidy offered, a warning presented by Jullien (2005) who further characterizes this phenomenon as prompting "adverse selection and moral hazard problems".

Still on the subtopic of the agents' behavior and having already overtaken the first step of gathering agents on all sides, one needs to consider their behavior of "loyalty" to the platform. According to Belleflamme and Peitz (2019) agents might either single-home - "that is, users are restricted to join a single platform" - or, on the other hand, agents are able to multi-homing - "that is, they can join several platforms". It is of the utmost relevance and importance to consider and understand this differentiation on the agents' behavior as it will affect the strategies conducted by each platform on the matters of prices, competition, among others. In addition, its significance is heightened by the reality portrayed by Rysman (2009) who asserts that "two-sided markets often seem to evolve toward to a situation where members of one side use a single platform and the other side uses multiple platforms". One possible explanation for such behavior is posited by Caillaud and Jullien (2003) who allege that the reasoning for an agent to choose to multi-home relies on the increase of the likelihood of realizing a deed, while also availing from savings resulted from cheaper transaction fees as the agent is able to choose the cheapest platform, an explanation summarized by Rochet and Tirole (2006) on the following statement: "multihoming stems from the users' desire to reap the benefits of network externalities in an environment of non-interconnected platforms". Hence, this phenomenon of agents' behavior is immensely interconnected with and it will shape and condition the price strategy and subsequently the competitiveness of a platform, a topic that will be covered below.

To conclude, it is vital to analyze both the price and competition of a multi-sided market/platform since they are intertwined. Regarding pricing, Armstrong (2006) found three determining factors to take into consideration when designing a platforms' price structure: "the magnitude of cross-group externalities; whether fees are levied on a lump-sum or per-transaction basis; and whether agents join one platform or several platforms". Concerning the first factor, Armstrong and Wright (2007) hinted that in the case of cross-group externalities, with different impacts for different sides, the side that is more attractive to the other is subsidized. Rochet and Tirole (2003) complement this idea by pointing that "platforms often treat one side as a profit center and the other as a loss, leader, or at best, as financially neutral". Regarding the second factor, Armstrong (2006) enlightens that the difference between lump-sum and per-transaction fees resides on the externalities. The author defends that while lump-sum fees are charged regardless of an agent finalizing a deed, making them disassociated from how well the platform performs, the per-transaction fees, on the other hand, does not trigger the same mechanism. Armstrong (2006) reiterates that "cross-group externalities are weaker with per-transaction charges since a fraction of the benefit of interacting with an extra agent on the other side is eroded by the extra payment incurred". Finally, the last determining factor identified by Armstrong (2006) concerns the multi-homing of agents, a factor already approached in the present literature review. Nonetheless, it is of great importance to reference Armstrong and Wright (2007)'s introduction of the concept of *competitive bottlenecks*, pertinent on a scenario where only one side of a platform multi-homes, characterizing it as the competition between platforms for signing single-homing agents, through subsidies and recovering their profits through the multi-homing agents that desire to access the platform's monopoly of those single-homing agents, a mechanism likewise endorsed by Rysman (2009). The result of this mechanism is disclosed by Armstrong (2006) that affirms that the monopoly power acquired by the platforms from their single-homing agents leads to the charging of higher prices (monopoly ones) to the multi-homing side. Notwithstanding, platforms are not devoid of tools to fight multisideness. One example of them is the exclusive contracts suggested by Armstrong and Wright (2007) who "enforce" single-homing to the previously multi-homing side.

While Armstrong (2006) focused on horizontal differentiation, Ribeiro, Correia-da-Silva, and Resende (2016) analyzed both vertical and horizontal competition. These authors concluded that price was impacted by the magnitude of inter-group externalities and the degree of vertical differentiation. While the impact of the first factor was found to be the same as observed on Armstrong (2006), regarding to the latter, these authors found that platforms with higher-quality were able to practice higher prices and capturing a larger market share (Ribeiro et al., 2016).

Still on the subtopic of the pricing of a platform, Rysman (2009) articulates the relationship between the price structure of a platform and its particular features. The author states that "pricing to one side of the market depends not only on the demand and cost that those consumers bring but also on how their participation affects participation on the other side and the profit that is extracted from that participation". This relationship is corroborated by Evans and Schmalensee (2007) who infer the impacts of a price increase on one side of a two-sided platform. These authors demonstrate that a price increase will lead to a reduction of agents on that side due to "the direct effect of the price elasticity of demand"; subsequently the platform will notice a decrease in the number of agents on the other side "as a result of indirect effects from externalities", which for the same reason will lead to a further reduction of the agents on the side that suffered the price increase.

On the matter of competition, one can logically withdraw some conclusions from the contents presented so far. Firstly, one can deduce that the competition between platforms is upon the single-homing agents, as demonstrated by Armstrong and Wright (2007). Furthermore, Jullien (2011) observed that "divide-and-conquer strategies in multi-sided markets intensify competition" but equally "help to reduce barriers of entry". On the other hand, regarding multi-homing, Rochet and Tirole (2003) show that "competition is more intense when platforms cannot deter multihoming". Lastly, Rysman (2009) introduces a relation among platforms that can be classified into three categories: compatibility, incompatibility, and some "sort of integration" and further states that "providers of platforms often prefer incompatibility on the grounds that it locks in current customer and locks out competitors". On an overall assay, Evans (2003) reiterated that platforms internalize the indirect network externalities that stem from the interdependent demand of the different agents when competing on the multi-sided market.

Given the relevance of multi-sided markets/platforms and its rising presence on the world's economy, as predicted by Evans (2003), this subject kept being studied, throughout the years, by several academics being some of the most recent works on this field presented on the following sub-section.

2.1.2 Recent Works

The recent works on multi-sided markets come to highlight and reinforce the relevance and importance of multi-sided platforms in today's economy. Abdelkafi et al. (2019) advocate that "platforms play an important role throughout the economy, as they minimize transaction costs between market sides [...] [and] MSPs [multi-sided platforms] appear to be the most powerful business models in the digital economy due to their adaptability and ability to handle complexity, rapid scale-up and value capture". The vast and continuous development of technology and the proliferation of the internet are the two key factors, considered by Sabourin (2016), to have fostered the rise of multi-sided platforms.

On the other hand, the definition of platforms is still puzzling academics as there is still no consensus on an overall and absolute definition. One of the causes that might explain the prevalence of the absence of a global definition relies on the shift of direction that current works took from trying to define the general concept itself to identifying and understanding the characteristics of platforms. One example of such comes from Yoffie, Gawer, and Cusumano (2019) who present a classification process for platforms into two categories: the *Innovation Platforms*, which they define as platforms that "enable third-party to add complementary products and services to a core product or technology", and the *Transaction Platforms*, characterized as platforms that "enable the exchange of information, goods and services". Other works focus on specificities of platforms such as its linkage with business models (Zhao, Von Delft, Morgan-Thomas, & Buck, 2019), (Guijarro, Vidal, Pla,

& Naldi, 2019); the architecture and design of platforms (Otto & Jarke, 2019), (Baldwin & Woodard, 2009); antitrust (Lenard, 2019); among others.

Resuming the subtopic of the platform's definitions, the first conflicting opinions start to emerge. Hagiu and Wright (2015) demonstrate their differing view to that of the seminal works, such as Armstrong (2006) or Caillaud and Jullien (2003). The divergent touchpoint relies on the importance given to the indirect network effects as a fundamental determinant of multi-sided platforms. Hagiu and Wright (2015) do not hold this particular belief, further asserting that "indirect network effects are neither necessary nor sufficient in our definition of MSP [multi-sided platforms]". With the aim of supporting this premise, these authors expose two examples of different organizations where there are *de facto* indirect network effects, and where these organizations are undoubtedly not multi-sided platforms, concerning one of the two examples consulting firms. From the point of view of these two authors, consulting firms that have a larger network of clients tend to signal to potential clients that they have highly qualified consultants since otherwise they would not have such a big customer portfolio. Hence, the authors conclude that even though consulting firms are not platforms they bare some indirect network effects. Consequently, on their perspective, only the enabling of direct interactions among different sides and the affiliation of each side with the platform comprise the key features for a business to be classified as a platform (Hagiu & Wright, 2015).

Another focus of interest in current works concerns the success and failure of platforms. Many academics have studied the reasons behind the failure of a platform being Yoffie et al. (2019) one of these. These authors, in their article entitled "A Study of More than 250 Platforms Reveals Why Most Fail", identify four frequent mistakes that lead to the failing of a platform: "(1) mispricing on one side of the market, (2) failure to develop trust with the users and partners, (3) prematurely dismissing the competition, and (4) entering too late". On a parallel analysis, the identification of success factors was also carried out. On this topic, Yoffie et al. (2019) identify as the "single most important strategic decision for any platform" the setting and choice of the pricing strategy, that is, "knowing which side should get charged and which side should get subsidized". Nevertheless, Abdelkafi et al. (2019) warn that "even if a platform per se is designed and operated well, it may well fail", and further propose the creation of competitive bottlenecks for greater chances at success.

Finally, the analysis of the impacts of multi-sided platforms is likewise a frequent and current theme. Examples of it are the works of Hein, Schreieck, Wiesche, Böhm, and Krcmar (2019) who study the impacts of multi-sided platforms on incumbents, and the work of Pousttchi and Gleiss (2019) who scrutinize the insurance industry. In their analysis, the latter find four possible scenarios risen by the participation of multi-sided platforms in the industry: multi-sided platforms can "(1) sharpen competition among traditional insurer, (2) facilitate coordination among insurers, customer, and other players, (3) cooperate with insurers, or (4) enhance collaboration among insurers and companies" (Pousttchi & Gleiss, 2019).

The study of real applications of this industrial organization, as the latter mentioned study of Pousttchi and Gleiss (2019), is likewise becoming ever more common with works from Gabszewicz, Resende, and Sonnac (2015) who study media multi-sided platforms, Correia-da-Silva and Resende (2013) who focus on the newspaper industry and study whether newspaper overprinting occurs in the presence of asymmetric information between the newspaper and the advertiser and Eferin, Hohlov, and Rossotto (2019) who study the Russian market of digital platforms.

From both the seminal and current works, one can conclude that further works on the area of multi-sided markets/platforms are needed in order to agglutinate all the knowledge discovered with the aim of obtaining a coherent and cohesive theory of multi-sided platforms holding a considerable acceptance.

2.2 Mergers

2.2.1 Overall Introduction

Piesse and Lin (2005) define mergers as being a combination of at least two firms ending up forming a new entity. From this definition, one can expect the existence of different types of mergers, being on the focus of this dissertation the horizontal type, which consists of a merger between direct competitors (Belleflamme & Peitz, 2015). Filistrucchi (2017) deepens this definition by stating that "horizontal effects [of a merger] refer to whether a proposed merger is likely to increase market power, i.e., whether the proposed merger is likely to lead to higher prices (or lower quantity) in the market".

One immediate and expectable outcome of this type of mergers, highlighted by Perry and Porter (1985) and later on by Marino and Zábojník (2006), entails the inevitable reduction of industry competition, which subsequently results in the setting of higher prices for consumers, hence hurting the latter. Nevertheless, these authors also acknowledge a positive outcome to counterweight the latter effect: the "rise to efficiency gains that reduce the cost of production or distribution" (Perry & Porter, 1985). Based on these findings, Nocke and Whinston (2013) introduced as a merger assessment tool the tradeoff between the above-presented effects, an analogous tool to the Williamson trade-off, latter presented by Belleflamme and Peitz (2015).

The underlying motive behind the creation of such tools to help the assessment of mergers is the protection of the consumer from welfare-hurting mergers by the antitrust authorities. According to Nocke and Whinston (2010), an antitrust authority has the role of determining the outcome of the welfare effect of a proposed merger. Filistrucchi (2017) divides the action of the same authorities into the assessment of the possibility of an increase of market power of the merging firms and on the study of the probability increase of market collusion. In a subsequent publication, Nocke and Whinston proposed a threshold for merger proposal acceptance. They established that a merger may be approved "if and only if it improves welfare, whether that be aggregate surplus or just consumer surplus" (Nocke & Whinston, 2013). Hence, one can understand the importance of these authorities who are determinant to aid merger proposals but also help on the handling of distinctive scenarios such as the one Salant, Switzer, and Reynolds (1983) pointed out: when a privately unprofitable merger could give rise to socially desirable efficiency gains.

From the previously pointed out information, one can infer the utmost relevance of understanding and identifying both the efficiency gains that stem from horizontal mergers and the output/price mechanism derived from the competition reduction. Regarding the first, Farrell and Shapiro (1990) stated that "mergers differ enormously in the extent to which productive assets can usefully be recombined, and in the extent to which output decisions can usefully, or anticompetitively, be coordinated". On this subject, Belleflamme and Peitz (2015) posited the numerous efficiency gains that can derive from a merger:

"efficiency gains stem from (1) production reshuffling among the plants that belong to the merged firms [...], (2) scale economies [...], (3) synergies by pooling certain functions, and (4) large innovative capacity leading to future efficiency gains", being this view likewise corroborated by Farrell and Shapiro (1990) on their introduction of the different types of cost savings that can arise from a horizontal merger.

On the other end of the coin, the output/price mechanism triggered by a horizontal merger oughts to be equally analyzed and comprehended, with the final aim of being fully qualified to assess the overall outcome of a merger. Salant et al. (1983) acknowledged that the participating firms of a merger will have the incentive to reduce production, assuming that the non-participating firms would not alter theirs, to which Perry and Porter (1985) added that the consequential increase of the industry price stems from the contraction of the participating firms' output, whom ideate that the price increase will suffice to compensate the output contraction. However, these latter authors further conveyed that the non-participating firms, taking advantage of the natural price increase, expand their own outputs. Deneckere and Davidson (1985) justify this effect by alleging that the observed output expansion from the non-participating firm is due to the typically downward sloping reaction functions that are a characteristic of quantity-setting games, such as the Cournot one.

From these behaviors, Perry and Porter (1985) concluded that "merger participants do not capture all the profits that result from their merger". In fact, from the previously presented mechanism, an opposite outcome can take place. According to Belleflamme and Peitz (2015), "a merger among k firms is profitable as long as the post-merger profit of the merged entity is at least as large as the sum of the pre-merged profits of the merging firms". What Salant et al. (1983) introduce is the possibility of the reduction of the merged firms' profit, derived from the non-participating firms' output expansion, being higher than the scenario where the non-participating firms would not alter their output. Herein, Pepall, Richards, and Norman (2014) go further to assert that not only a horizontal merger may not be beneficial to the participating firms when considering a standard Cournot model. They demonstrate that the post-merger profit of the participating firms, assuming linear demand and equal marginal costs for all firms of the market, is almost always lower than the combined pre-merger profit of these two firms. Furthermore, they state that under these assumptions, no merger from a triopoly to a duopoly is ever profitable to the merging firms. In addition, the authors highlight the positive impact that a merger has on the non-participating firms: the price increase resulting from the reduction on the number of firms on the market and the following gain of additional market share. Finally, they estimate the cut-off value for a merger to be profitable on around 80% of the firms operating in the market, which they subsequently alert to be unrealistic to be observable due to the very unlikely probability of being authorized by the antitrust authorities.

Regarding the current studies of horizontal mergers, the noticed trend is to focus on specific parameters in order to assess the impact of those on the outcome of a merger. One of the most studied parameters concerns the impact of the market size on which the participating firms operate. On this subject, Faulí-Oller (2002) states that "on the profitability side, we obtain that when market size decreases merger profitability increases", a thesis also upheld by Belleflamme and Peitz (2015) who further hinted at an inverse relationship between the number of competitors on a given industry and the potential profits of that same industry. Notwithstanding, the size of the participating firms themselves also conditions the outcome of a merger, as articulated by Deneckere and Davidson (1985) who asserted that "large mergers yield higher profits than smaller ones".

On a different approach, focusing on the strategic framework of business, one can find interesting works such as Padilla (2019) who focus on the impacts of a merger on innovation, analyzing both product and process innovation, the potential efficiencies that can derive from a merger - like the reduction of research and development costs and/or the sharing of technological knowledge -, and concluding that "horizontal mergers do not always reduce the merging parties' incentives to invest in process and/or product innovation [...] they only do so, when the innovation externality is negative".

In light of the above, it becomes evident the high multidisciplinarity of the field of mergers, and more specifically horizontal mergers, being one able to pursue manifold research directions. Thus, given that the focus of this dissertation relies on multi-sided markets/platforms, a brief approach to mergers on this type of industrial framework will be developed in the next section.

2.2.2 Mergers in Multi-Sided Markets/Platforms

From the previous section, one is able to infer about the vast literature that has been developed throughout the years regarding mergers. However, given the novelty of multi-sided markets/platforms, it comes as no surprise that little literature has been carried out about this subtopic.

A substantial portion of the existing literature has focused on the problems and dangers of disregarding the majority of sides of a multi-sided market/platform, and focusing only on one of them, thus treating them as the traditional one-sided markets. Evans and Noel (2008) warn of this situation classifying it as economically incorrect with the potential of leading to erroneous conclusions when significant indirect network effects are to be equated. Following this advertence, these same authors additionally stress the possible inapplication of standard tools of merger assessment when dealing with this type of markets. Filistrucchi (2017) goes further as to say that by failing to consider the indirect network effects that stem from the multi-sidedness character of a platform, "a competition authority basically ignores the functioning of a two-sided market and risks taking decisions based on an inappropriate model of the market".

From the above-presented claims, one can conclude that these indirect network effects constitute the differentiated parameter that must be included in the analysis of mergers that involve multi-sided markets/platforms, a conclusion withdrawn by Evans and Noel (2008) and later by Tremblay (2018).

On the other hand, Filistrucchi (2017) raises an important question regarding the possible decisions that an antitrust authority faces when assessing mergers among platforms. Aside from the usual choice between the consideration of either total or consumer welfare, according to Filistrucchi (2017), if an antitrust authority chooses the latter, it faces a subsequent choice of what weight to bestow on each side. On this subtopic, Jullien and Sand-Zantman (2019) further warn of the possibility of "conflicting interests" from the different sides that may hinder the antitrust authority assessment.

Resuming anew the outcomes of mergers, according to several academics, such as Baranes, Cortade, and Cosnita-Langlais (2019), and as exposed in the previous section, horizontal mergers tend to enlarge market power of the merging firms and lead to higher market prices. However, when talking about multi-sided markets/platforms this may not be necessarily the case, as defended by Chandra and Collard-Wexler (2009) and Jullien and Sand-Zantman (2019). Evans (2003) early concluded that a merger between two multi-sided platforms would not only impact the price levels but, in addition, it could affect the price structure of the merging platforms, leading to a multitude of possible outcomes. Some of these outcomes are exposed in the OECD 2018 publication entitled "Rethinking Antitrust Tools for Multi-Sided Platforms", where there are presented two justifications to support the premise that a merger between multi-sided platforms may not be necessarily anticompetitive. The first one regards the resulting increase in the number of agents on one side that an agent on the other side has access to, being this outcome likewise corroborated by Evans (2003) who states that "mergers that increase the customer base on one side increase the value on the other side"(s). Hence, this value increase mentioned by Evans (2003) may render the final outcome of a merger as positive in terms of consumer welfare, even in the presence of higher post-merger market prices (OECD, 2018).

The second factor exposed in the OECD (2018)'s publication concerns the resulting interoperability of the merging platforms. In this publication it is alleged that the contrary scenario to the expected one on one-sided markets may even occur, that is, due to the internalization of the cross-group externalities between the platforms that will merge, the outcome of this same merger may end in a price reduction. Baranes et al. (2019) endorse this finding by stating that "when merging platforms become "interoperable", then each of the merging platforms will have incentives to lower prices to benefit from the increase in demand on the other platforms".

From the current literature on mergers among multi-sided markets/platforms, other specificities of multi-sided markets/platforms are also studied. An example of such is approached by Filistrucchi (2017) who studies the specific case of mergers in bottlenecks, a concept explained and analyzed in the first subsection of this literature review. The author reiterates that a merger involving competitive bottlenecks will enhance the power that the resulting merged multi-sided platform will have on the agents that multi-home. Filistrucchi (2017) supports his statement on the increase in the number of single-homing agents that the multi-homing ones will have access to, thus increasing the value of the platform for the latter. In addition, related to the agents' behavior, in a recent work, Jullien and Sand-Zantman (2019) study the scenario where some agents on both sides of a two-sided platform multi-home. The authors come to the conclusion that some prompt efficiency gains arise when a merger takes place as a result of "larger network externalities in less fragmented markets".

From this subsection, and in accordance with some conclusions of several recent works such as Filistrucchi (2017) and more recently Baranes et al. (2019), one can infer that further studies on the topic of mergers among multi-sided markets/platforms must be conducted with the final aim of shedding more light on this topic to better equip any academic, antitrust authority or whomever decides to tackle the challenge of analyzing and assessing a merger among multi-sided markets/platforms, an aim to which this present dissertation aspires to contribute to.

2.3 Cournot Competition

In this chapter, it is presented a brief recalling of Cournot competition, since, in the model studied in the next section, the platforms will be assumed to behave and compete *à la Cournot*.

According to Abolhassani, Bateni, Hajiaghayi, Mahini, and Sawant (2014), Cournot competition can be characterized as being a model that portrays competition among firms operating in a market. The unique feature of this model relies on each firm deciding, simultaneously, on what amount of goods (quantity) to produce, bearing in their decision the maximization of their own utility/profit. To this definition, Pepall et al. (2014) further add the necessity of incorporating on a firms' production calculus the estimated output that the remaining firms of the market will produce. Subsequently, the latter will update their best response function with this new estimated quantity of the previous firms leading to a continuous loop until the Nash equilibrium solution is achieved, at which each firm is producing the quantity that maximizes their profits given the remaining firms response.

Being a static model, as defined by Daughety (2006), the model has some limitations, that is, firms are not able to simultaneously decide on the quantity and price, given that the equilibrium quantity-price combination must match the market/consumer demand (Judd, 1996). Hence, on the Cournot model, as stated previously, the firms choose a quantity to produce, being the price determined from the above-mentioned market/consumer demand (Kreps & Scheinkman, 1983). As a consequence of this framework, the equilibrium price achieved from the cross-over of the firms' output and consumer demand is considered to be a "market clearing price", that is, the price at which all quantity is sold (Abolhassani et al., 2014).

Daughety (2006) identified two forms of inefficiencies in consumer welfare that can take place in a Cournot equilibrium. The first one concerns the attainment of an equilibrium price higher than the marginal cost of the firms, not corresponding to the maximization of social welfare's respective outcome. The second regards the allocation of production among firms with different marginal costs. Having the firm that has a lower marginal cost assuming all production appears as a logical strategy, however, the non-verification of this statement constitutes the base for what Daughety (2006) pinpoints as the second inefficiency of Cournot equilibrium: the possibility of a reduction of a firm's marginal cost yielding a welfare decrease. The author provides an example to support his conclusion by hypothesizing a scenario of two firms, one with a higher marginal cost than the other, and a decrease of the marginal cost of the firm with the highest. This decrease will subsequently lead to an increase in the production of this firm and a decrease in the production of the remaining firm, the one with the smaller marginal cost. Consequently, this inefficiency may overpower the efficiencies gain through the marginal cost decrease and consequently have a negative impact on welfare.

Resuming the industry organizational framework understudy in the present dissertation, that is, multi-sided markets/platforms, it is worth mentioning the conclusions from Adachi and Tremblay (2020), who study the Cournot competition in two-sided markets. In their publication, they identify the two sides of the market as having consumers on the one side and correspondingly having sellers on the other side. Concerning competitive bottlenecks, these authors pointed out that the equilibrium resulted from the Cournot competition decreased both the markup of the price to consumers and the markdown of the price to sellers.

On the subject of the agents' behavior, Adachi and Tremblay (2020) determined that having a higher number of agents who single-home further impels the effect that competition has in driving both markups and markdowns down to zero. They further infer that in a scenario where both sides have agents that single and multi-home, the outcome of increased competition among platforms leads to an outcome where the equilibrium price matches the platforms' corresponding marginal cost (Adachi & Tremblay, 2020).

A final remark from Adachi and Tremblay (2020) concerns the number of platforms that operate in a market. These authors acknowledged that on a competitive bottleneck setting, where consumers are assumed to single-home and sellers to multi-home, an increasing number of platforms in the market drives the consumer's equilibrium participation to expand, having the opposite effect on the seller's equilibrium participation, that is, it declines with a higher number of platforms on the market.

Having superficially reviewed the Cournot competition model, one is able to follow through to the next section better equipped to analyze the selected model.

3. Model

As stated previously in the literature review on mergers, a horizontal merger, under a standard Cournot model, is always harmful to the consumers and may likewise be harmful to the participating firms. Pepall et al. (2014) further state that, in the absence of network effects, when assuming linear demand and equal marginal costs across all firms no merger from a triopoly to a duopoly can be profitable for the participating firms.

What the present dissertation aims to study is the impact of the presence of network effects, the main characteristic of multi-sided markets/platforms, on the outcome of a horizontal merger and if it can give rise to a profitable merger for the participating platforms. After assessing this question and in the prospect of finding profitable mergers, it will be studied the impact of the latter on consumer welfare by analyzing the impact of the merger on total participation on each side.

Hence, in this chapter, it will be first presented the set-up of the model chosen, followed by the analysis of the equilibrium and ending with the application of the model on the two proposed scenarios and the subsequent study of the mergers' profitability and impact on consumer welfare.

3.1 Setup

By selecting Correia-da-Silva et al. (2019)'s model, several assumptions/conditions are required to be described and implemented. Firstly, the analysis will fall upon two-sided platforms, having one, therefore, to consider both agents on sides 1 and 2. Secondly, it will be considered that the platforms offer a homogeneous good, being the platforms perceived as homogeneous, which in turn makes agents worries rely only on the mass of agents available on the other side of the platform and the price they are to pay for partaking on the platform (Correia-da-Silva et al., 2019).

Regarding the competitive behavior to be assumed from the platforms operating in the market, it will be considered, as already mentioned in previous sections, a Cournot competition model. Thus, platforms will be simultaneously setting the mass of agents they minister on each side of the market, $n_i^k, i = 1,2$. Correia-da-Silva et al. (2019) support their decision of selecting and applying the Cournot model upon their belief that "the Cournot model can provide useful insights into the welfare effects of such mergers [horizontal mergers between multi-sided platforms]" (Correia-da-Silva et al., 2019).

Concerning the cost, c, within the framework of the current analysis, it can represent either the unit cost or the marginal cost, being henceforward referred to as marginal cost. Furthermore, the latter is assumed to be constant and lower than 1 for each side, $c_i^k \in [0,1[$, which in turn makes the average marginal cost, $\bar{c}_i$, likewise constant and equal to the marginal cost of a given platform, $\bar{c}_i = c_i^k$, given that $\bar{c}_i = \sum_k c_i^k \ /K$. Additionally, this assumption makes platforms symmetric and allows for the calculation of the individual mass of agents for each platform as a fraction of the aggregate one for that side, $n_i^k = \frac{N_i^*}{K}$, where N_i^* represents the total number of agents on side i and K represents the number of platforms on the market.

As for the agents' behavior, they are assumed to single-home on all sides, joining the platform that maximizes their individual utility function (Correia-da-Silva et al., 2019). Hence, intending to incorporate the specificities of a two-sided platform and what it entails for an agent's individual utility function, the same authors formulated the latter as follows:

$$u_i^k = \tilde{v}_i + \alpha_i n_j^k - p_i^k \tag{1}$$

where $\tilde{v}_i$ is an aleatory individual payoff, α_i represents the benefit for agents on side i from accessing the agents' mass of the other side, under the assumption that $\alpha_i + \alpha_j > 0$, being n_j^k, consequently, the mass of agents on side j from the same platform, k, and finally, p_i^k represents the price that the agents of side i have to pay to access and use the platform, the membership fee.

From this individual utility function, Correia-da-Silva et al. (2019) defined the externality-adjusted price as follows:

$$z_i^k \equiv p_i^k - \alpha_i n_j^k \tag{2}$$

where z_i^k represents the externality-adjusted price of agents from side i of the platform k.

As it is foreseeable, the agents, given the homogeneity of all platforms, will therefore choose to adhere to the platform with the lowest externality-adjusted price, which in turn will result in all platforms having the same externality-adjusted price, as long as they have a positive participation, which is mathematically represented in the following equation:

$$p_i^k = Z_i(N_i) + \alpha_i n_j^k \tag{3}$$

(Correia-da-Silva et al., 2019).

By considering the above-mentioned assumptions underlying the selected model and further assuming linear demand for both sides of the market, that is, $Z_i(N_i) = 1 - N_i$, the profit for each platform k is given by:

$$\pi^k = n_1^k(1 - N_1 + \alpha_1 n_2^k - c_1^k) + n_2^k(1 - N_2 + \alpha_2 n_1^k - c_2^k) \tag{4}$$

3.2 Equilibrium Analysis

As previously stated, the equilibrium analysis of a Cournot model is achieved when all firms are producing the quantity that maximized their profit. The same rationale was applied to the platforms competing *à la Cournot* by Correia-da-Silva et al. (2019). The maximization of the profit function of each platform, exhibited in equation (4), n_i^k , to both sides, 1 and 2, yields the first-order condition represented in equation (5):

$$\begin{cases} \frac{\partial \pi^k}{\partial n_1^k} = 0 \\ \frac{\partial \pi^k}{\partial n_2^k} = 0 \end{cases} \Leftrightarrow \begin{cases} 1 - N_1 - n_1^k - c_1^k + (\alpha_1 + \alpha_2) n_2^k = 0 \\ 1 - N_2 - n_2^k - c_2^k + (\alpha_1 + \alpha_2) n_1^k = 0 \end{cases} \tag{5}$$

where, as previously mentioned, N_i represents the number of agents on side i on all platforms; n_i^k represents the number of agents on side i of platform k; c_i^k represents the marginal cost of platform k to minister consumers on side i; and finally, α_i represents the intensity of cross-group network effects experienced by agents of side i.

By summing equation (5) across all active platforms on the market, Correia-da-Silva et al. (2019) further deduced the equation that yields the total participation on each side of the market, represented by N_i^*:

$$\begin{cases} N_1^* = \frac{\frac{K}{K+1}}{1-(\frac{\alpha_1+\alpha_2}{K+1})^2}\left[(1-\bar{c}_1)+\frac{\alpha_1+\alpha_2}{K+1}(1-\bar{c}_2)\right] \\ N_2^* = \frac{\frac{K}{K+1}}{1-(\frac{\alpha_1+\alpha_2}{K+1})^2}\left[(1-\bar{c}_2)+\frac{\alpha_1+\alpha_2}{K+1}(1-\bar{c}_1)\right] \end{cases} \tag{6}$$

where $\bar{c}_i$ represents the average marginal cost of all platforms of side i.

From these equations, two conclusions can be withdrawn from an immediate analysis, that the model's authors also pinpointed. The first is that only the total network effect, $(\alpha_1+\alpha_2)$, is relevant for both the maximization of the platforms' profit and the aggregate mass of agents on each side. The second is that only the average marginal cost across platforms is relevant for aggregate participation.

Before moving to the analysis of the profitability of a merger it is necessary to account for additional restrictions on the total network effect that need to take place for the model to be legitimate. To assure that the second-order condition is satisfied, the following assumption was withdrawn from the model:

for every $(N_1, N_2) \in [0,1]^2$:

$$\begin{cases} 2Z'_1(N_1) + Z''_1(N_1)N_1 < 0 \; and \; 2Z'_2(N_2) + Z''_2(N_2)N_2 < 0 \\ [2Z'_1(N_1) + max\,\{Z''_1(N_1)N_1, 0\}][2Z'_2(N_2) + max\,\{Z''_2(N_2)N_2, 0\}] > (\alpha_1+\alpha_1)^2 \end{cases}$$

(7)

Consequently, by assuming linear demand, $Z_i(N_i) = 1 - N_i$, and that the total network effect has to be positive, $(\alpha_1+\alpha_2) > 0$, one will have:

$$\begin{cases} 2*(-1) + 0*N_1 < 0 \; and \; 2*(-1) + 0*N_2 < 0 \\ (-2+0)(-2+0) > (\alpha_1+\alpha_1)^2 \end{cases} \Leftrightarrow \begin{cases} -2 < 0 \; and \; -2 < 0 \\ 2 > \alpha_1+\alpha_1 \end{cases}$$

From the outcome of this assumption, one will restrict the total network effect, $(\alpha_1+\alpha_2)$, to the interval $]0,2[$.

Furthermore, to assure that all platforms are active, the cost asymmetries may not be too large and the following condition, obtained from Correia-da-Silva et al. (2019, equation (A3)), needs to be satisfied for all K and all $i = 1,2, j \neq i$:

$$\frac{H\,(1 - \alpha^2)}{1 - \alpha^2 H^2}\left[1 - \bar{c}_i + \alpha H(1 - \bar{c}_j)\right] + \bar{c}_i + \alpha\bar{c}_j > c_i^k + \alpha c_j^k \; for\; i = 1,2, j \neq i \tag{8}$$

where $H = \frac{1}{K+1}$, and $\alpha = (\alpha_1 + \alpha_2)$.

Having assumed equal costs across all platforms, that is, $c_i^k = \bar{c}_i$ and $c_j^k = \bar{c}_j$, implies that firstly no cost asymmetries are verified and secondly that in equation (8) the last four terms disappear, leaving only $\frac{H\,(1 - \alpha^2)}{1 - \alpha^2 H^2}\left[1 - \bar{c}_i + \alpha H(1 - \bar{c}_j)\right] > 0$. Additionally, being $c_{i,j}^k < 1$ yields that $\left[1 - \bar{c}_i + \alpha H(1 - \bar{c}_j)\right] > 0$. Therefore, for the inequality to hold, one must have $\frac{H\,(1 - \alpha^2)}{1 - \alpha^2 H^2} > 0$. Thus, the total network effect must be lower than one since if $\alpha > 1 \Rightarrow H\,(1 - \alpha^2) < 0$. As a consequence of this condition, the total network effect is further restricted to the interval $]0, 1[$.

3.3 Merger Analysis

As previously stated on the model setup, by assuming equal marginal costs across all platforms makes the platforms symmetrical, meaning that their quantities and, subsequently, their profits will be identical. Furthermore, this assumption will enable the quantity of each platform to be extrapolated as a function of the total participation of each side, equation (6), yielding the following equations for n_1^k and n_2^k:

$$\begin{cases} n_1^k = \dfrac{\frac{1}{K+1}}{1 - (\frac{\alpha_1 + \alpha_2}{K+1})^2}\left[(1 - \bar{c}_1) + \dfrac{\alpha_1 + \alpha_2}{K+1}(1 - \bar{c}_2)\right] \\ n_2^k = \dfrac{\frac{1}{K+1}}{1 - (\frac{\alpha_1 + \alpha_2}{K+1})^2}\left[(1 - \bar{c}_2) + \dfrac{\alpha_1 + \alpha_2}{K+1}(1 - \bar{c}_1)\right] \end{cases} \Leftrightarrow$$

By assuming the same notation used by the model's authors on their assumption (A3), that is, $H = \frac{1}{K+1}$, and $\alpha = (\alpha_1 + \alpha_2)$, one will have:

$$\begin{cases} n_1^k = \dfrac{H}{1-(\alpha H)^2}[(1-\bar{c}_1) + \alpha H(1-\bar{c}_2)] \\ n_2^k = \dfrac{H}{1-(\alpha H)^2}[(1-\bar{c}_2) + \alpha H(1-\bar{c}_1)] \end{cases}$$

(9)

Having presented the form for all variables to be used on the forthcoming analysis, an additional assumption, undertaken with the aim of aiding the fulfillment of the proposed objectives to attain, will be set forward.

The latter is related to the marginal costs on both sides. Throughout the upcoming scenario analysis, the marginal cost for side 1 will be deemed equal to 0 while the marginal cost for side 2 will be set as a constant, c, whose potential impact will be examined. Mathematically, let $c_1^k = \bar{c}_1 = 0 \wedge c_2^k = \bar{c}_2 = c$.

Considering this assumption, an update of both equations (6) and (9) is in order, intending to have the baseline for the impending analysis properly prepared. Hence, updating equations (6) and (9) will yield the following equations (11) and (12), correspondingly:

$$\begin{cases} N_1^* = \dfrac{KH}{1-(\alpha H)^2}[1-0+\alpha H(1-c)] \\ N_2^* = \dfrac{HK}{1-(\alpha H)^2}[1-c+\alpha H(1-0)] \end{cases} \Leftrightarrow \begin{cases} N_1^* = \dfrac{KH}{1-(\alpha H)^2}[(1+\alpha H(1-c)] \\ N_2^* = \dfrac{HK}{1-(\alpha H)^2}[(1-c)+\alpha H] \end{cases}$$

(11)

$$\begin{cases} n_1^k = \dfrac{H}{1-(\alpha H)^2}[1-0+\alpha H(1-c)] \\ n_2^k = \dfrac{H}{1-(\alpha H)^2}[1-c+\alpha H(1-0)] \end{cases} \Leftrightarrow \begin{cases} n_1^k = \dfrac{H}{1-(\alpha H)^2}[(1+\alpha H(1-c)] \\ n_2^k = \dfrac{H}{1-(\alpha H)^2}[(1-c)+\alpha H] \end{cases}$$

(12)

Finally, the last equation to be set forward is the profit function for each platform, exhibited on equation (4), updated for the framework considered, that is, by substituting on the latter the variables regarding equations (11) and (12). These operations yield the following outcome, further developed in Appendix 1:

$$\pi^k = \frac{H}{1-(\alpha H)^2}[(1+\alpha H(1-c)](1 - \frac{KH}{1-(\alpha H)^2}[(1+\alpha H(1-c)] + \alpha_1(\frac{H}{1-(\alpha H)^2}[(1-c)+\alpha H]) - 0) + \frac{H}{1-(\alpha H)^2}[(1-c)+\alpha H](1 - \frac{HK}{1-(\alpha H)^2}[(1-c)+\alpha H] + \alpha_2(\frac{H}{1-(\alpha H)^2}[(1+\alpha H(1-c)]) \Leftrightarrow$$

$$\boldsymbol{\pi^k = \frac{H[1+(1-c)^2]+H^2[-K+3\alpha(1-c)-K(1-c)^2]-4\alpha H^3K(1-c)+H^4[-\alpha^3(1-c)-\alpha^2K(1-c)^2-\alpha^2K]}{[1-(\alpha H)^2]^2}}$$

(13)

Having obtained the profit equation for each platform, the base equation for the subsequent scenario analysis, one is able to fulfill the first of the two main objectives of this section: assessing if a given merger is profitable for the participating platforms, a prerequisite before evaluating the impact of the merger on the consumer welfare, given that the merger will only take place if it is profitable to the platforms involved.

For a merger to be profitable, the profit of the two merged entities must be higher than the sum of each entities' profit before the merger. Mathematically one has that $\pi^A + \pi^B < \pi^{AB}$. When adapting this condition to the framework and assumptions of the present analysis, it yields that $2\pi^{K+1} < \pi^K$. Consequently, this condition will be applied and evaluated for the two impending scenarios followed by the assessment of the merger's impact on consumer welfare, by analyzing the behavior of the total participation on each side, N_1^* and N_2^*.

3.3.1 Merger from a Triopoly to a Duopoly

In this scenario, it is considered a merger of a triopoly to a duopoly. Therefore, the number of platforms on the market in the pre-merger is 3, reducing to 2 platforms in the post-merger.

Consequently, to assess the profitability of the merger for the participating platforms, equation (13) must be applied to the pre and post-merger environments followed by the verification if the previously stated condition is fulfilled. Thus, the application of the mentioned equation, further developed in Appendix 2, to both $k = 3$ and $k = 2$ yields the following:

$$\pi_{K=3}^{k} = \frac{\frac{1}{4}[1+(1-c)^2]+\left(\frac{1}{4}\right)^2[-3+3\alpha(1-c)-3(1-c)^2]-4\alpha\left(\frac{1}{4}\right)^3 * 3*(1-c)+\left(\frac{1}{4}\right)^4[-\alpha^3(1-c)-\alpha^2*3*(1-c)^2-\alpha^2*3]}{\left[1-\left(\alpha\frac{1}{4}\right)^2\right]^2} \Leftrightarrow$$

$$\pi_{K=3}^{k} = \frac{16 + 16*(1-c)^2 - 3\alpha^2(1-c)^2 - 3\alpha^2 - \alpha^3(1-c)}{256 - 32\alpha^2 + \alpha^4}$$

$$\pi_{K=2}^{k} = \frac{\left(\frac{1}{3}\right)[1+(1-c)^2]+\left(\frac{1}{3}\right)^2[-2+3\alpha(1-c)-2(1-c)^2]-4\alpha\left(\frac{1}{3}\right)^3 2(1-c)+\left(\frac{1}{3}\right)^4[-\alpha^3(1-c)-\alpha^2 2(1-c)^2-\alpha^2 2]}{\left[1-\left(\alpha\left(\frac{1}{3}\right)\right)^2\right]^2} \Leftrightarrow$$

$$\pi_{K=2}^{k} = \frac{9 + 9*(1-c)^2 + 3\alpha(1-c) - 2\alpha^2(1-c)^2 - 2\alpha^2 - \alpha^3(1-c)}{81 - 18\alpha^2 + \alpha^4}$$

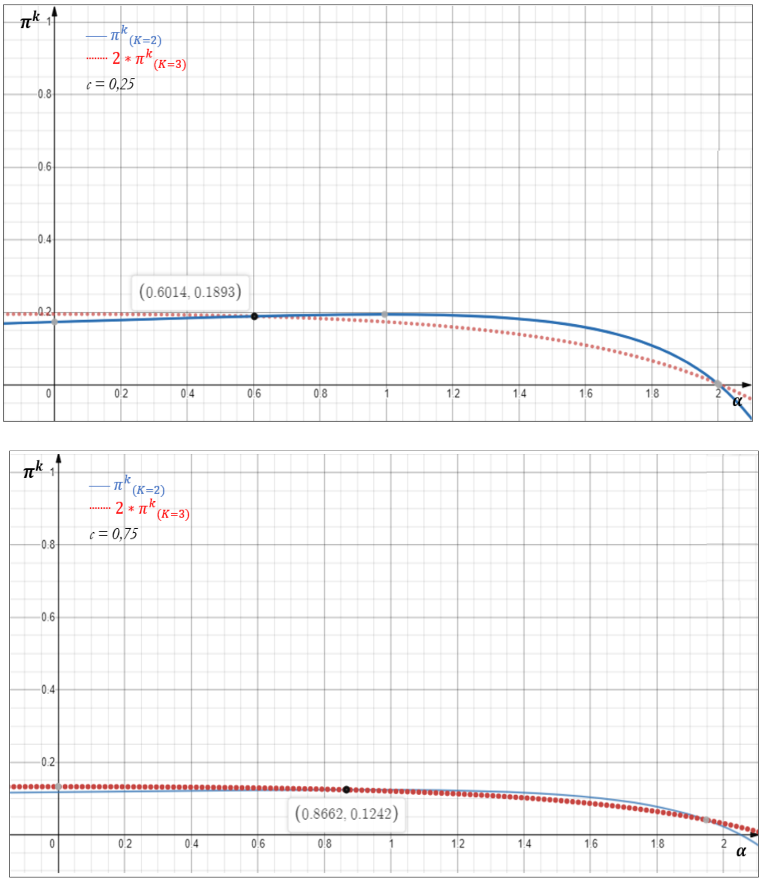
Once the profit for both pre and post-merger environments has been calculated, the condition that ensures the profitability of the merger will be next applied:

$$\pi_{K=2}^{k} > 2 * \pi_{K=3}^{k} \Leftrightarrow$$

$$\frac{9+9*(1-c)^2+3\alpha(1-c)-2\alpha^2(1-c)^2-2\alpha^2-\alpha^3(1-c)}{81-18\alpha^2+\alpha^4} > 2*\frac{16+16*(1-c)^2-3\alpha^2(1-c)^2-3\alpha^2-\alpha^3(1-c)}{256-32\alpha^2+\alpha^4}$$

Given the complexity of the inequality obtained, and to help the reader visualize the mathematical equations and better examine their behavior, a graphic representation of $\pi_{K=2}^{k}$ and $2 * \pi_{K=3}^{k}$ was computed to identify the intervals of α, the total network effect, for which the profitability condition is satisfied. In figure 1, this representation is exhibited for two values of the marginal cost of side 2, c, 0,25 and 0,75.

Figure 1 - Assessment of Merger Profitability, Merger from a Triopoly to a Duopoly



From figure 1, it is observable that for both cost settings the merger from a triopoly to a duopoly can be profitable for the participating firms. For a marginal cost of side 2 of 0,25, the inequality that assures merger profitability is fulfilled for values of the total network effect within the interval $]0.6014, 1[$. On the other hand, for a marginal cost of side 2 of 0,75, the previously mentioned value shifts to the interval $]0.8662, 1[$.

Considering both marginal costs, it can be inferred that for higher marginal costs of side 2, the higher the total network effects must be in order for the merger to be profitable for the participating platforms. In addition, it was also found that for a marginal cost of side 2 of zero, the intersection of the two profit equations occurs for the total network effect of 0.5858.

After discovering the variable's interval of values for which merger profitability is guaranteed, one is able to go to the next step of the analysis' agenda: the study of the impact of such merger on consumer welfare. The methodology of this analysis consists of assessing the impact of the merger on total participation for both sides. Recall that consumer surplus is given by the area between the demand curve and the (externality-adjusted) equilibrium price. This area increases when (externality-adjusted) equilibrium price decreases and equilibrium output increases. This means that consumer surplus on side i increases if and only if N_i increases. Through the application of equation (11), one will have:

• For k=3:

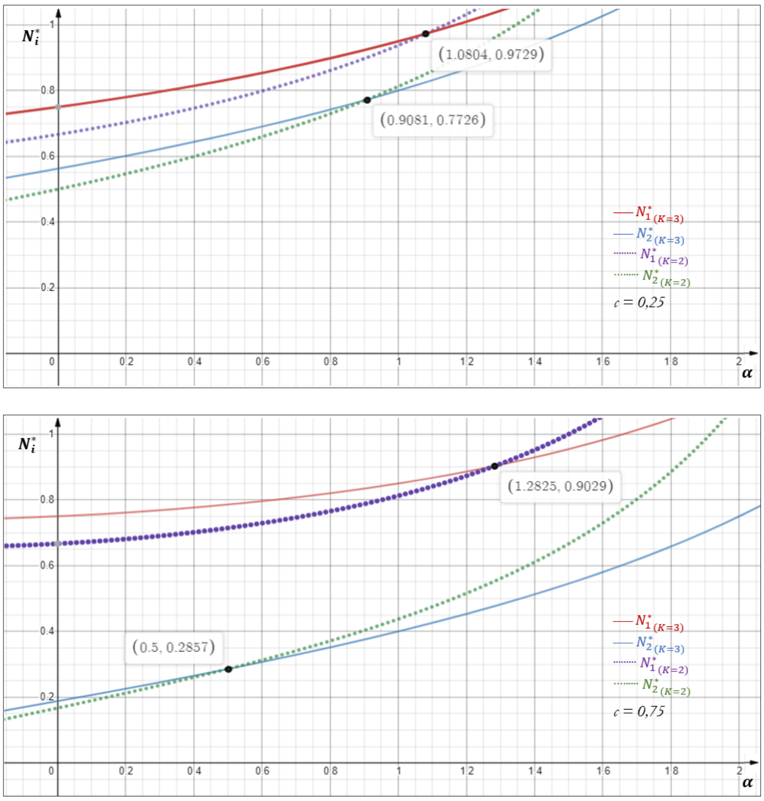
$$\begin{cases} N_1^* = \dfrac{\frac{3}{4}}{1-(\frac{\alpha}{4})^2}\left[(1+\frac{\alpha}{4}(1-c)\right] \\ N_2^* = \dfrac{\frac{3}{4}}{1-(\frac{\alpha}{4})^2}\left[(1-c)+\frac{\alpha}{4}\right] \end{cases}$$

• For k=2:

$$\begin{cases} N_1^* = \dfrac{\frac{2}{3}}{1-(\frac{\alpha}{3})^2}\left[(1+\frac{\alpha}{3}(1-c)\right] \\ N_2^* = \dfrac{\frac{2}{3}}{1-(\frac{\alpha}{3})^2}\left[(1-c)+\frac{\alpha}{3}\right] \end{cases}$$

Once again, graphical representation was used to study the behavior of the total participation for both sides, from the pre to the post-merger environment, being found in figure 2.

Figure 2 - Impact on Consumer Welfare, Merger from a Triopoly to a Duopoly



From the analysis of figure 2, it is observable that the agents of side 1, the side whose marginal cost is equal to zero, will always be harmed by the merger, given that the intersections of the equations for side 1 occur outside the given interval for the total network effect, $\alpha \in]0,1[$. Regarding the agents of side 2, they will always benefit from the merger, as long as total network effects are higher than the cut-off value for each marginal cost setting, that is, for a marginal cost of side 2, c, of 0,25 α must rely on the interval $]0.9081, 1[$ and for c of 0,75 the total network effect must be higher than 0.5. Moreover, it was found that for a marginal cost of 1, the merger would be always beneficial to the agents of side 2 given that the intersection of the equations occurs at $\alpha = 0$. In addition, when comparing the two graphical representations, one can conclude that for higher marginal costs the cut-off value of the total network effect that makes the merger beneficial for the agents of side 2 decreases.

3.3.2 Merger from a Duopoly to a Monopoly

In this scenario, it is considered a merger of a duopoly to a triopoly. Thus, it will be assessed whether a merger of two platforms onto a single unique one will be profitable and the impact that such a merger will have on consumer welfare. The application of equation (13) to the two environments (pre and post-merger), further developed in Appendix 3, yields the following equations:

$$\pi_{K=2}^{k} = \frac{\left(\frac{1}{3}\right)[1+(1-c)^2]+\left(\frac{1}{3}\right)^2[-2+3\alpha(1-c)-2(1-c)^2]-4\alpha\left(\frac{1}{3}\right)^3 2(1-c)+\left(\frac{1}{3}\right)^4[-\alpha^3(1-c)-\alpha^2 2(1-c)^2-\alpha^2 2]}{\left[1-\left(\alpha\left(\frac{1}{3}\right)\right)^2\right]^2} \Leftrightarrow$$

$$\pi_{K=2}^{k} = \frac{9+9*(1-c)^2+3\alpha(1-c)-2\alpha^2(1-c)^2-2\alpha^2-\alpha^3(1-c)}{81-18\alpha^2+\alpha^4}$$

$$\pi_{K=1}^{k} = \frac{\left(\frac{1}{2}\right)[1+(1-c)^2]+\left(\frac{1}{2}\right)^2[-1+3\alpha(1-c)-(1-c)^2]-4\alpha\left(\frac{1}{2}\right)^3 1(1-c)+\left(\frac{1}{2}\right)^4[-\alpha^3(1-c)-\alpha^2 1(1-c)^2-\alpha^2 1]}{\left[1-\left(\alpha\left(\frac{1}{2}\right)\right)^2\right]^2} \Leftrightarrow$$

$$\pi_{K=1}^{k} = \frac{4+4*(1-c)^2+4\alpha(1-c)-\alpha^2(1-c)^2-\alpha^2-\alpha^3(1-c)}{16-8\alpha^2+\alpha^4}$$

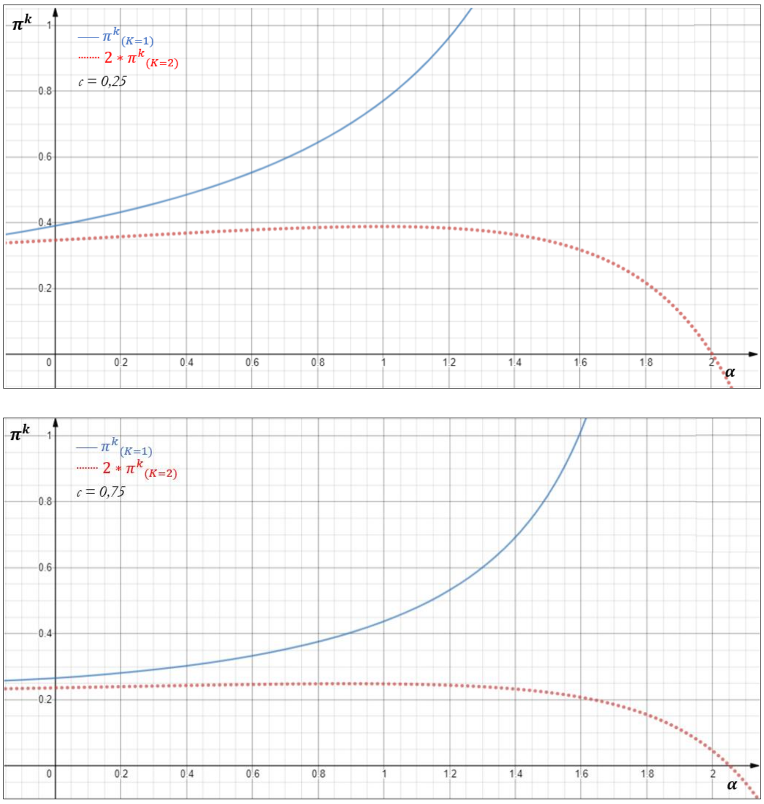
Mirroring the methodology employed in the previous subsection, the additional condition that assures merger profitability was computed with the outcomes previously obtained:

$$\pi_{K=1}^{k} > 2 * \pi_{K=2}^{k} \Leftrightarrow$$

$$\frac{4+4*(1-c)^2+4\alpha(1-c)-\alpha^2(1-c)^2-\alpha^2-\alpha^3(1-c)}{16-8\alpha^2+\alpha^4} > 2*\frac{9+9*(1-c)^2+3\alpha(1-c)-2\alpha^2(1-c)^2-2\alpha^2-\alpha^3(1-c)}{81-18\alpha^2+\alpha^4}$$

In this scenario, it was likewise chosen the graphical representation as the tool of analysis. Consequently, a graphic representation of $\pi_{K=1}^{k}$ and $2 * \pi_{K=2}^{k}$ was computed and can be found in figure 3, for the two same values of the marginal cost, $c = 0{,}25$ and $c = 0{,}75$.

Figure 3 - Assessment of Merger Profitability, Merger from a Duopoly to a Monopoly



Assessing figure 3, one can conclude that the merger from a duopoly to a monopoly will always be profitable for any value of the total network effect, portrayed by the inexistent intersection of the considered equations. Furthermore, it was found that as the marginal cost is increased, the magnitude of the profitability of the merger decreases for the interval of the total network effects considered, since the difference of the profits for a given value of the total network effect is higher when the marginal cost is 0,25.

With the aim of evaluating the impact that a merger from a duopoly to a monopoly has on consumer welfare, the application of equation (11) on the pre and pots-merger was conducted, yielding the following outcome:

• For k=2:

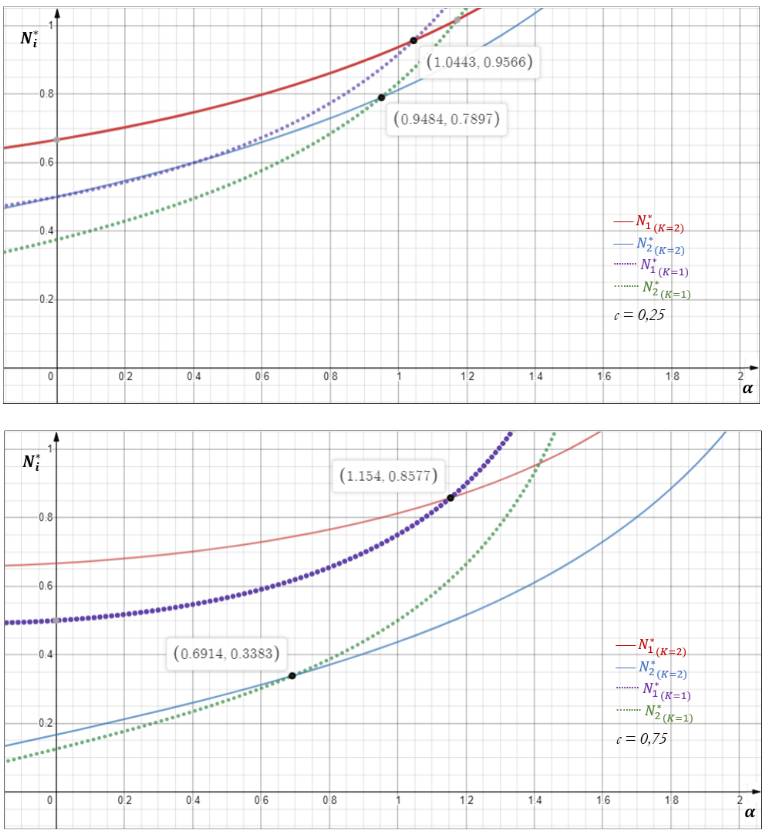
$$\begin{cases} N_1^* = \dfrac{\frac{2}{3}}{1-(\frac{\alpha}{3})^2}\left[(1+\frac{\alpha}{3}(1-c)\right] \\ N_2^* = \dfrac{\frac{2}{3}}{1-(\frac{\alpha}{3})^2}\left[(1-c)+\frac{\alpha}{3}\right] \end{cases}$$

• For k=1:

$$\begin{cases} N_1^* = \dfrac{\frac{1}{2}}{1-(\frac{\alpha}{2})^2}\left[(1+\frac{\alpha}{2}(1-c)\right] \\ N_2^* = \dfrac{\frac{1}{2}}{1-(\frac{\alpha}{2})^2}\left[(1-c)+\frac{\alpha}{2}\right] \end{cases}$$

In figure 4, one can find the graphical representation of the total participation for both sides for the values of the marginal cost of $c = 0{,}25$ and $c = 0{,}75$.

Figure 4 - Impact on Consumer Welfare, Merger from a Duopoly to a Monopoly



From figure 4 several inferences can be withdrawn. Firstly, it is observable that a merger will always be harmful to the agents on side 1, given that the intersection of both equations will always fall outside the interval considered for the total network effect, $]0, 1[$. Secondly, it can be concluded that the merger may be beneficial to the agents from side 2 when considering certain values for α. Furthermore, it was also detected that for decreasing values of the marginal cost, higher values of the total network effect are needed for the merger to be beneficial to the agents of that side. Lastly, when considering a marginal cost of 1, the merger will again be always beneficial to the agents of side 2 regardless of the total network effect value.

4. Discussion of Results

In this chapter, the results obtained from the application of the model to the two scenarios understudied will be discussed, with the aim of withdrawing some overall inferences, through mainly scrutinizing the impacts of the marginal cost of side 2, c, and the value of the total network effect, α, on the two questions investigated. In addition, a hypothetical real application of this market dynamic in a multi-sided market will be conducted with the aim of bridging the theoretical analysis performed in this dissertation with a real-life scenario.

4.1 Results

Regarding the first scenario analyzed, a merger of a triopoly to a duopoly, merger profitability depended on the values of the total network effect, varying the latter accordingly to the marginal cost of side 2 selected. For lower values of the marginal cost, it was found that the value of the total network effect needed to assure merger profitability was lower ($0.6014 \text{ for } c = 0{,}25 \text{ versus } 0.8662 \text{ for } c = 0{,}75$). Concerning the impact of such a merger on consumer welfare and taking into consideration the restrictions imposed to assure merger profitability, it was concluded that the merger would always harm the agents of side 1 and would benefit the agents on side 2 as long as the total network effect considered would be within the necessary intervals obtained. In addition, and contrary to what was observed on the analysis of merger profitability, it was found that for lower values of the marginal cost higher values of the total network effect were necessary for the merger to be beneficial for the agents of side 2.

Recalling the literature review on mergers, more specifically the work of Pepall et al. (2014), and comparing their conclusions with the ones obtained in the present dissertation, one can determine that the results obtained differ from the mentioned authors' since they advocate that a merger of a triopoly to a duopoly will hardly be profitable for the participating firms and it was proven in the present dissertation the existence of several combinations for the marginal cost and total network effect that would yield a profitable merger. As for the impact of a merger on consumer welfare, once again, the outcome obtained is in discordance with the mentioned authors' findings. While the latter stated that such a merger would always harm consumer welfare, when considering two-sided platforms, it was observed that the merger would frequently be profitable for agents on a given side, more specifically, agents from the side for which the platforms have a positive non-null marginal cost.

Concerning the second scenario investigated, a merger of a duopoly to a monopoly, the outcomes obtained did not differ significantly. In this present setting, merger profitability is always observed for any value of the total network effects when restricting the analysis to the range of the total network effects considered. In addition, it was noted that as the marginal cost is increased, the magnitude of the merger profitability decreased.

In regard to the impact on consumer welfare of a merger from a duopoly to a monopoly, it was observed that for the side assumed to have a marginal cost qual to zero, side 1, the merger would always harm the agents of that side regardless of the value of total network effects and marginal cost considered, a conclusion likewise withdrawn from the previous scenarios. As for the remaining side, it was noticed that the merger would be beneficial to consumers of that side, as long as the total network effect was strong enough. Finally, the relationship found between the marginal cost and total network effect for a merger to be beneficial to the agents of side 2 was found to be the same as the one from the previous scenario.

Comparing the outcomes of the second scenario with the expected outcomes that one would obtain if it was considering a standard Cournot competition between unilateral firms, one can find an interesting discrepancy: what would be the most obvious inference regarding the impact of a merger to a monopoly on consumer welfare, the inevitable harming of consumers, may not be asserted when considering multi-sided platforms since for agents of one side, the merger increases their consumer welfare.

For both scenarios, the impact of the total network effect is quite evident and of such strength that it is able to turn harmful mergers of a standard Cournot competition into beneficial ones for one of the two consumer sides that are inherent to two-sided platforms. This phenomenon was named the see-saw effect by Correia-da-Silva et al. (2019) who also observe the existence of this effect on their analysis, demonstrating that for a given interval of total network effects the merger may benefit the consumers from the side which comprises the highest cost and harms the consumers from the other remaining side, a conclusion that is in accordance with the obtained results in this present dissertation.

4.2 Possible Real-Word Application

The assumptions taken throughout the analysis are capable of portraying, to some extent, the reality of content platforms such as Netflix, HBO Max, and Disney Plus. All these platforms' business offers consist of providing a platform through which content produces are able to display their products to interested consumers, having the latter to pay a subscription fee for unlimited content access. As all these entities operate in a digital platform, the marginal cost that they have with the content consumers can be considered residual, even zero. Consequently, one could assume that in the analysis performed throughout the present dissertation, these content consumers would correspond to the agents of side 1. Therefore, content producers would be considered as the agents of side 2, which bear a cost for the platform, e.g., Netflix has to pay for the licenses to display the contents on its platform.

For the purpose of bridging the analysis performed to a possible real-life scenario, let one imagine a merger between Netflix and HBO Max. It is foreseeable that for the agents of side 1, the content consumers, the merger will result in the latter having access to a higher number of contents available. If the subscription price was to be kept constant, this merger would benefit the consumers on side 1, however, assuming no price change at all seems unrealistic, given that the merged platform would gain market power, a mechanism explained in the literature review regarding mergers. Hence, considering a price increase on the subscription fee, the outcome of the impact on consumer welfare would depend on the weight given to the positive impact of the increase in the content available and the negative impact of the price increase.

Considering the agents from side 2, the content producers, the proposed merger would widen the public for which their contents would be available. Consequently, the merger would be beneficial to these agents for the previously mentioned explanation, existing even the possibility of seeing an increase on the payment for their display licenses, given that with a reduction of platforms and price increase for the content consumers, the latter would be less flexible on the unavailability of high demanded content.

With the application of the theoretical analysis into an imagined, but conceivable, real-life scenario, it was concludable that the outcomes obtained in the present dissertation are plausible to be withdrawn from and observed in a real-life scenario. Consequently, this alignment of the theoretical versus semi-practical results and the further corroboration with the results present on Correia-da-Silva et al. (2019) endorse the results obtained and presented in the present dissertation.

5. Conclusions

The main objectives of the present dissertation were to assess the impacts that the total network effects, the core characteristic of multi-sided markets/platforms, could have on merger profitability and consumer welfare.

The methodology employed to attain such objectives consisted of a theoretical application of Correia-da-Silva et al. (2019)'s model on two distinct scenarios: a merger from a triopoly to a duopoly and a merger from a duopoly to a monopoly. The model assumed a limited number of homogeneous platforms under Cournot competition and linear demand. Additionally, it was further assumed that the marginal costs across all platforms were the same, yielding symmetric platforms, and that the marginal cost of side 1 was to be zero.

The analysis was conducted orderly. Firstly, it was assessed the parameters of the total network effects, for a given marginal cost of side 2, for which the merger would be profitable for the participating firms. Secondly, the analysis of the impact of the merger on consumer welfare followed.

The main results obtained from the performed analysis were fourfold. In the merger from a triopoly to a duopoly scenario, it was observed that merger profitability was attainable for a given set of parameters: the marginal cost of side 2 considered and the interval of the total network effect. Regarding consumer welfare, it was found that this type of merger could be beneficial to consumers of side 2, the side having a non-null marginal cost, for a specific interval of the total network effects, and that it would always be harmful to consumers on the remaining side. In the merger from a duopoly to a monopoly scenario, it was concluded that merger profitability would always be verified and further noticed that the merger profitability magnitude increased for lower values of the marginal cost of side 2. Concerning consumer welfare, in this last scenario, it was likewise found that the merger would always be harmful to the agents of side 1 and beneficial for the agents of side 2 for a limited interval of the total network effect. In addition, it was further detected that higher values of the total network effects were required for the merger to be beneficial to agents of side 2 for decreasing values of the marginal cost of side 2 for both scenarios.

Even though some interesting conclusions were able to be withdrawn from this work, the same does not lack limitations. The most evident and impactful concerns the number of assumptions taken so as to not make the analysis too complex and avoid the non-extraction of conclusions. Additionally, the consideration of marginal costs equal to zero for one side of the market, even though reasonable on the existing markets, and the further assumption of equal costs across platforms, which is somewhat distant from reality, limited the analysis of this study preventing the exploration of the impact of different costs on the consumer welfare and merger profitability.

Consequently, one interesting course of study would be to ease some of the assumptions undertaken in order to bring the model closer to reality, being the allowance for agents to multi-home, or the consideration of a multi-sidedness higher than bilateral, two important and fascinating effects to study. Furthermore, the inclusion of the analysis of the impact of different marginal costs of each platform and the resetting of the average marginal cost as a function of the latter would constitute a more complete, yet more complex, analysis of the impact of mergers among platforms on the consumer welfare.

6. Appendix

6.1 Appendix 1

To reach the equation yielding the profit of each platform, it is necessary to apply equations (11) and (12) on equation (4) and the assumption that $c_1^k = 0$ and $c_2^k = c$, yielding the following mathematical resolution, which corresponds to the presented equation (13):

$$\pi^k = n_1^k(1 - N_1 + \alpha_1 n_2^k - c_1^k) + n_2^k(1 - N_2 + \alpha_2 n_1^k - c_2^k) \Leftrightarrow$$

$$\pi^k = (\frac{H}{1-(\alpha H)^2}[(1 + \alpha H(1-c)]) * (1 - (\frac{KH}{1-(\alpha H)^2}[(1 + \alpha H(1-c)]) + \alpha_1 * (\frac{H}{1-(\alpha H)^2}[(1-c) + \alpha H]) - 0) + (\frac{H}{1-(\alpha H)^2}[(1-c) + \alpha H]) * (1 - (\frac{HK}{1-(\alpha H)^2}[(1-c) + \alpha H]) + \alpha_2 * (\frac{H}{1-(\alpha H)^2}[(1 + \alpha H(1-c)]) - c) \Leftrightarrow$$

$$\pi^k = \frac{H+\alpha H^2(1-c)}{1-(\alpha H)^2} - K * \left[\frac{H+\alpha H^2(1-c)}{1-(\alpha H)^2}\right]^2 + \alpha_1 * \frac{[H+\alpha H^2(1-c)]*[H(1-c)+\alpha H^2]}{[1-(\alpha H)^2]^2} + \frac{H(1-c)^2+\alpha H^2(1-c)}{1-(\alpha H)^2} - K * \left[\frac{H(1-c)+\alpha H^2}{1-(\alpha H)^2}\right]^2 + \alpha_2 * \frac{[H(1-c)+\alpha H^2]*[H+\alpha H^2(1-c)]}{[1-(\alpha H)^2]^2} \Leftrightarrow$$

$$\pi^k = \frac{H+\alpha H^2(1-c)+H(1-c)^2+\alpha H^2(1-c)}{1-(\alpha H)^2} - K * \left[\frac{H^2+2\alpha H^3(1-c)+\alpha^2 H^4(1-c)^2+H^2(1-c)^2+2\alpha H^3(1-c)+\alpha^2 H^4}{[1-(\alpha H)^2]^2}\right] + \alpha_1 * \frac{[H^2(1-c)+\alpha H^3+\alpha H^3(1-c)^2+\alpha^2 H^4(1-c)]}{[1-(\alpha H)^2]^2} \alpha_2 * \frac{[H^2(1-c)+\alpha H^3(1-c)^2+\alpha H^3+\alpha^2 H^4(1-c)]}{[1-(\alpha H)^2]^2} \Leftrightarrow$$

$$\pi^k * [1-(\alpha H)^2]^2 = [H + \alpha H^2(1-c) + H(1-c)^2 + \alpha H^2(1-c)] * [1-(\alpha H)^2] - K * [H^2 * [1 + (1-c)^2] + H^3 * 4\alpha(1-c) + H^4 * [\alpha^2(1-c)^2 + \alpha^2]] + \alpha * [H^2(1-c) + \alpha H^3 + \alpha H^3(1-c)^2 + \alpha^2 H^4(1-c)] \Leftrightarrow$$

$$\pi^k * [1-(\alpha H)^2]^2 = H * [1 + (1-c)^2] + H^2 * [\alpha(1-c) + \alpha(1-c) - K - K(1-c)^2 + \alpha(1-c)] + H^3 * [-\alpha^2 - \alpha^2(1-c)^2 - 4K\alpha(1-c) + \alpha^2 + \alpha^2(1-c)^2] + H^4 * [-\alpha^3(1-c) - \alpha^3(1-c) - K\alpha^2(1-c)^2 - K\alpha^2 + \alpha^3(1-c)] \Leftrightarrow$$

$$\boldsymbol{\pi^k = \frac{H[1+(1-c)^2]+H^2[-K+3\alpha(1-c)-K(1-c)^2]-4\alpha H^3 K(1-c)+H^4[-\alpha^3(1-c)-\alpha^2 K(1-c)^2-\alpha^2 K]}{[1-(\alpha H)^2]^2}}$$

6.2 Appendix 2

In this subsection, the application of the previously obtained equation on the merger from a triopoly to a duopoly scenario will be fully developed.

For $K = 3$ the profit of each platform will yield:

$$\pi_{K=3}^{k} = \frac{\frac{1}{4}[1+(1-c)^2]+\left(\frac{1}{4}\right)^2[-3+3\alpha(1-c)-3(1-c)^2]-4\alpha\left(\frac{1}{4}\right)^3*3*(1-c)+\left(\frac{1}{4}\right)^4[-\alpha^3(1-c)-\alpha^2*3*(1-c)^2-\alpha^2*3]}{\left[1-\left(\alpha\frac{1}{4}\right)^2\right]^2} \Leftrightarrow$$

$$\pi_{K=3}^{k} = \frac{\frac{1}{4}+\frac{(1-c)^2}{4}-\frac{3}{16}+\frac{3\alpha(1-c)}{16}-\frac{3(1-c)^2}{16}-\frac{3\alpha(1-c)}{16}-\frac{\alpha^3(1-c)}{256}-\frac{3\alpha^2(1-c)^2}{256}-\frac{3\alpha^2}{256}}{\left[1-\frac{\alpha^2}{16}\right]^2} \Leftrightarrow$$

$$\pi_{K=3}^{k} = \frac{\frac{1}{16}+\frac{(1-c)^2}{16}-\frac{\alpha^3(1-c)}{256}-\frac{3\alpha^2(1-c)^2}{256}-\frac{3\alpha^2}{256}}{1-\frac{\alpha^2}{8}+\frac{\alpha^4}{256}} \Leftrightarrow$$

$$\pi_{K=3}^{k} * \left(1-\frac{\alpha^2}{8}+\frac{\alpha^4}{256}\right) = \frac{16}{256}+\frac{16*(1-c)^2}{256}-\frac{\alpha^3(1-c)}{256}-\frac{3\alpha^2(1-c)^2}{256}-\frac{3\alpha^2}{256} \Leftrightarrow$$

$$\boldsymbol{\pi_{K=3}^{k} = \frac{16+16*(1-c)^2-3\alpha^2(1-c)^2-3\alpha^2-\alpha^3(1-c)}{256-32\alpha^2+\alpha^4}}$$

For $K = 2$ the profit of each platform will yield:

$$\pi_{K=2}^{k} = \frac{\left(\frac{1}{3}\right)[1+(1-c)^2]+\left(\frac{1}{3}\right)^2[-2+3\alpha(1-c)-2(1-c)^2]-4\alpha\left(\frac{1}{3}\right)^3 2(1-c)+\left(\frac{1}{3}\right)^4[-\alpha^3(1-c)-\alpha^2 2(1-c)^2-\alpha^2 2]}{\left[1-\left(\alpha\left(\frac{1}{3}\right)\right)^2\right]^2} \Leftrightarrow$$

$$\pi_{K=2}^{k} = \frac{\frac{1}{3}+\frac{(1-c)^2}{3}-\frac{2}{9}+\frac{\alpha(1-c)}{3}-\frac{2(1-c)^2}{9}-\frac{8\alpha(1-c)}{27}-\frac{\alpha^3(1-c)}{81}-\frac{2\alpha^2(1-c)^2}{81}-\frac{2\alpha^2}{81}}{\left[1-\frac{\alpha^2}{9}\right]^2} \Leftrightarrow$$

$$\pi_{K=2}^{k} = \frac{\frac{1}{9}+\frac{(1-c)^2}{9}+\frac{\alpha(1-c)}{3}-\frac{8\alpha(1-c)}{27}-\frac{\alpha^3(1--c)}{81}-\frac{2\alpha^2(1-c)^2}{81}-\frac{2\alpha^2}{81}}{1-\frac{2\alpha^2}{9}+\frac{\alpha^4}{81}} \Leftrightarrow$$

$$\pi^k_{K=2} * (1 - \frac{2\alpha^2}{9} + \frac{\alpha^4}{81}) = \frac{9}{81} + \frac{9(1-c)^2}{81} + \frac{27\alpha(1-c)}{81} - \frac{24\alpha(1-c)}{81} - \frac{\alpha^3(1-c)}{81} - \frac{2\alpha^2(1-c)^2}{81} - \frac{2\alpha^2}{81} \iff$$

$$\boldsymbol{\pi^k_{K=2} = \frac{9 + 9 * (1-c)^2 + 3\alpha(1-c) - 2\alpha^2(1-c)^2 - 2\alpha^2 - \alpha^3(1-c)}{81 - 18\alpha^2 + \alpha^4}}$$

6.3 Appendix 3

In this subsection, the application of the profit function for each platform will be applied to the merger from a duopoly to a monopoly scenario for $K = 1$.

$$\pi^k_{K=1} = \frac{\left(\frac{1}{2}\right)[1+(1-c)^2] + \left(\frac{1}{2}\right)^2[-1+3\alpha(1-c)-(1-c)^2] - 4\alpha\left(\frac{1}{2}\right)^3 1(1-c) + \left(\frac{1}{2}\right)^4[-\alpha^3(1-c)-\alpha^2 1(1-c)^2-\alpha^2 1]}{\left[1-\left(\alpha\left(\frac{1}{2}\right)\right)^2\right]^2} \iff$$

$$\pi^k_{K=1} = \frac{\frac{1}{2} + \frac{(1-c)^2}{2} - \frac{1}{4} + \frac{3\alpha(1-c)}{4} - \frac{(1-c)^2}{4} - \frac{\alpha(1-c)}{2} - \frac{\alpha^3(1-c)}{16} - \frac{\alpha^2(1-c)^2}{16} - \frac{\alpha^2}{16}}{\left[1 - \frac{\alpha^2}{4}\right]^2} \iff$$

$$\pi^k_{K=1} = \frac{\frac{1}{4} + \frac{(1-c)^2}{4} + \frac{\alpha(1-c)}{4} - \frac{\alpha^3(1-c)}{16} - \frac{\alpha^2(1-c)^2}{16} - \frac{\alpha^2}{16}}{1 - \frac{\alpha^2}{2} + \frac{\alpha^4}{16}} \iff$$

$$\pi^k_{K=1} * (1 - \frac{\alpha^2}{2} + \frac{\alpha^4}{16}) = \frac{4}{16} + \frac{4(1-c)^2}{16} + \frac{4\alpha(1-c)}{16} - \frac{\alpha^3(1-c)}{16} - \frac{\alpha^2(1-c)^2}{16} - \frac{\alpha^2}{16} \iff$$

$$\boldsymbol{\pi^k_{K=1} = \frac{4 + 4 * (1-c)^2 + 4\alpha(1-c) - \alpha^2(1-c)^2 - \alpha^2 - \alpha^3(1-c)}{16 - 8\alpha^2 + \alpha^4}}$$

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