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Multi-Product Firms and Quality Differentiation: Product Bundling and Content Provision in Two-Sided Media Markets

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Introduction

This thesis proposes two oligopoly models of quality differentiation, where multi-product firms can use their leadership in one market in order to restrict rivals' ability to provide high quality products in an adjacent market.

First, I study how a dominant firm in a primary market can profitably use mixed bundling to extract surplus from quality-enhancing investment by a single-product rival in a complementary market, or even force the rival to provide low quality.

Second, I analyse a two-sided media market where a platform can exploit its competitive advantage in terms of superior efficiency in the advertising market in order to achieve an exclusive contract on a premium content and possibly acquire the content provider.

This analysis is particularly relevant in markets where there is a strong strain toward innovation and provision of high quality products, like in high-technology industries. In these markets, vertical differentiation is of crucial importance, and bundling practices, exclusive dealing and vertical integration are widely used business strategies, whose effects on competition and welfare need to be assessed. In the stands of literature on bundling and leverage of market power and on two-sided media markets, quality differentiation choices have not been deeply investigated.

This thesis studies these issues from a theoretical point of view, and is composed of three chapters.

The first chapter reviews the relevant theoretical literature. In the first section, I focus on the strand of literature that has devoted attention to study bundling strategies. First, I give an overview of various rationales, like price discrimination, product differentiation, consumers' loyalty, efficiency, that can induce firms to bundle. Then, I move on presenting the literature that has studied the foreclosure effects of bundling. I also examine the antitrust approach to bundling practices and the debate on the topic. After this presentation, I highlight the main results of the literature, and I propose new directions of analysis, some of which will be examined in chapter 2.

In particular, bundling strategies are found to have potential foreclosing effects, both on rivals' entry and investments. However, firms can find it profitable to practice bundling for efficiency reasons and to price discriminate. The theoretical literature still needs to assess under which conditions bundling can be welfare reducing, when many rationales for bundling coexist. In chapter 2, a formal analysis on this issue is provided.

Antitrust authorities investigate anticompetitive effects of bundling employing a price-cost test

which obeys to predatory pricing principles. Since this approach is found by some authors to be unsatisfactory, then the theoretical literature should suggest helpful instruments. One interesting instrument is proposed by Greenlee *et al.* (2008). They suggest to control that the stand-alone price of the monopoly good when the incumbent practices bundling is not higher than the monopoly price. Chapter 2 presents an extension to their setting, in order to verify if this test can provide interesting results also when services are differentiated, when bundling can affect rivals' investment strategies and when the choice of bundling is endogenous.

In the second section, I first give an introduction to two-sided market theories, then I focus on media markets. I review papers on program mix, advertising and entry choices. These studies are performed in many different frameworks. We can notice that the business model of the platform, the assumptions concerning single- and multi-homing and the formalization of the advertising market play a crucial role in the results. Then, I discuss the literature which is more relevant to my theoretical work in chapter 3, that is, the literature on exclusive provision of premium content and on quality choices. This literature finds that exclusive provision of quality contents is likely to arise in many context. Finally, summing up the main lessons of the literature, I highlight some open questions. Some of these points are considered in the third chapter.

I find that the literature on content provision needs to include in the analysis some important aspects. First, the role of the price structure is found to be crucial in two-sided markets, and it has been neglected in works concerning content provision Then, the formalization of the advertising market in many works on the economics of media seems to be improvable. Platforms can be more or less efficient on the advertising market, and this dimension, that has been disregarded by the previous theoretical literature on the economics of media, can play a role in their entertainment choices. Finally, since in the media industry many distributors of contents try to acquire direct control over content producers through vertical integration, a study over the impact of this change in the vertical structure of the industry on content provision may deserve attention.

The second chapter is written by the candidate with Alessandro Avenali and Pierfrancesco Reverberi. It studies how a monopolist in a primary market can use mixed bundling to deny the rival firm the necessary scale to invest in quality and thus force it to provide low quality.

In the theoretical model, there is a dominant firm active in two complementary markets, one in monopoly and one in oligopoly. The dominant firm can either provide its products a stand alone basis or in bundle (when the bundle is provided, the monopoly product is also available on a stand alone basis). The rival firm in the oligopoly market can either decide to provide a perfect substitute to the incumbent's product at the same marginal cost or it can provide a superior product by

incurring a fixed cost.

We find that mixed bundling is a profitable strategy independently of the rival firm's choice. Thus, we find that bundling is credible and does not rely on a commitment assumption. Indeed, when the rival provides a perfect substitute in the complementary market, bundling introduces vertical differentiation between systems and raises both firms' profits. When the rival provides a superior complementary component, bundling makes the dominant firm's system more competitive relative to stand-alone selling. In addition, the dominant firm can use the stand-alone price of the monopoly component as a price discrimination device to extract surplus from consumers with a strong preference for quality, which buy the system including the rival's complementary component.

We assume that bundling creates efficiency gains. Nonetheless, we find that bundling may be socially harmful even if there is competition in the complementary market, and if the rival's investment is not prevented.

Although this finding builds a relatively strong case against bundling, a *per se* rule prohibiting bundling would not be appropriate, since we also find that bundling is socially beneficial when it precludes some inefficient investment that would occur under stand-alone selling. Thus, we propose to check the viability of a bundled offer using a price test that aims at preserving efficiencies from both bundling and quality investment.

This welfare-enhancing price test simply imposes the dominant firm not to artificially raise the stand-alone price of the monopoly component over the monopoly level as a consequence of the bundled offer. In essence, the proposed test controls price discrimination between consumers who buy the entire system from the dominant firm, and consumers who buy the alternative system including the rival's component.

We show that, when the rival firm invests under the proposed test, consumer surplus and welfare rise compared to the case when the dominant firm freely sets prices, or to a ban on bundling.

Consistent with the results obtained, antitrust authorities usually abstain from imposing such restrictions on the dominant firm as pure stand-alone selling. In practice, they rather investigate anticompetitive effects of bundling according to a rule of reason standard. This, in turn, often employs a price-cost test which obeys to predatory pricing principles. We argue that a predatory pricing test is not well grounded in a setting where products are vertically differentiated. We find that using such tests may be socially detrimental.

Our test does not comply with the logic of predatory pricing, which is usually embraced by antitrust agencies. When the rival invests, our test improves welfare compared with a predatory pricing test.

In the third chapter, I study premium content provision in media markets. In particular, I investigate how exclusive and quality provision of premium contents are affected by various important dimensions in media markets, like vertical integration, the business model of the platform and the ability to reach viewers that are attractive for advertisers.

In the theoretical model, I consider two channels, operated by two rival platforms, located at the two extremes of a Hotelling line. Each platform offers a homogeneous "basic channel". This basic channel can be bundled with a premium content, produced by a monopolist upstream operator. The premium content increases viewers' utility from the "consumption" of the channel.

Since I intend to model a setting where the premium content is a not substitutable good and is an important resource in the downstream market, then I assume that the upstream operator is a monopolist and that it holds bargaining power. The upstream operator can offer an exclusive or non-exclusive contract for the premium content to platforms, making a take-it-or-leave-it offer that extracts all the profits deriving from the sale of the premium content in the downstream market. I assume that the upstream offers its preferred contract just once. The upstream can be an independent firm or vertically integrated with one downstream platform.

First, I model the free-to air case, where platforms charge advertisers but not viewers. Then, I model a mixed case, where I allow platforms to get revenues from both viewers and advertisers. I find that the ability to charge viewers drives toward exclusive provision. Indeed, when platforms compete in price for viewers, relaxing price competition through an exclusive contract can increase the profit deriving from the sale of the quality content.

I assume that platforms are differentiated for advertisers. In order to model this feature, I introduce a "target parameter", that measures the benefit an advertiser gets from interacting with viewers on a given platform, and I assume that platforms are asymmetric in their ability to target viewers. This can be due to different advertising strategies employed by platforms, to the different quality of the service provided to advertisers or to the different audience targeted by the platforms.

I find that the efficiency of a commercial channel on the advertising market pushes toward exclusive provision. Indeed, it can be profitable to provide the exclusive to the most efficient platform in the advertisers market, so as to strengthen its position, and thus increase the profit from the quality provision in the downstream market.

I also find that vertical integration entails more exclusive provision compared to vertical separation. Indeed, an integrated content provider internalizes the private benefit deriving from a relaxed downstream competition when there is exclusive provision.

Then, I compare market outcomes with socially optimal choices. I find that exclusive provision

of quality content to the most efficient downstream platform can be socially optimal when horizontal differentiation is high enough and the mass of advertisers is wide enough. Indeed, in these cases, the surplus generated from an exclusive provision to the most efficient platform on the advertising market is high.

As concerns the quality level, under the free-to-air model, both the independent and integrated content provider can over- and under-provide quality, while under the mixed model there is always under-provision. This occurs because, under the free-to-air scenario, the benefit of viewers from consuming quality content is taken into account at the social but not at the private level. Thus, when the social benefit generated by quality is lower than the private benefit it generates, over-provision can occur. Under the mixed model, a platform charges viewers, but it cannot internalize all benefits coming from the quality provision on downstream markets, since some revenues are passed from advertisers to viewers.

Finally, I internalize the choice of the market structure, allowing platforms to make offers for acquiring the content provider. I find that each platform prefers to be vertically integrated with the content provider rather then being vertically separated. However, each platform might prefer the rival to acquire the upstream provider, rather than being vertically integrated. This occurs when the profit from the control over the premium content is low.

Moreover, I show that the most efficient platform on the advertising market gains more than the rival from vertical integration. When both platforms are interested in acquiring the content provider, the most efficient platform acquires the content provider and the content provider gains more profit from selling the control right over the content rather than from providing the premium content through the market.

I find that consumers would always prefer the least efficient firm to vertically integrate, since it provides higher quality contents. Indeed, the highest efficiency on the advertisers market lowers a platform's incentives to invest in quality for entertainment, since viewers' attention caught by a given quality can be sold on to advertisers at a higher price. Thus, the market outcome concerning the vertical integration decision is not desirable in a wide region of parameters.

In the model, one can observe a trend toward concentration in the industry, since platforms prefer vertical integration and, under vertical integration, they provide exclusive quality content to the most efficient platform on the advertising market, thus strengthening the position of this platform on the downstream market. In my static context, both vertical integration and exclusive content provision might be welfare enhancing, since they push private choices toward static optimal ones. However, their impact should be better investigated in a dynamic context, taking into account their effects on the concentration in the industry.

Chapter 1:
A Literature Review on Bundling and Two-Sided Markets

1 Introduction

In this chapter, I review the most relevant theoretical literature to this thesis. This chapter is composed by two sections.

In the first section, I focus on the strand of literature that has devoted attention to bundling strategies, that are the focus of the theoretical work in chapter 2. Firstly, I give an overview of various rationales that can induce firms to bundle. Secondly, I proceed to the most relevant literature to my work, which is the literature on bundling, entry deterrence and investment foreclosure. Thirdly, I examine the antitrust approach to bundling practices and the theoretical discussion on the topic. Finally, I conclude the section showing the most recent developments of the literature on bundling and I propose some new direction of analysis, highlighting the link with the theoretical work in chapter 2.

In the second section, I first give an introduction to the two-sided market theory, and then I focus on media markets. This analysis is relevant to the theoretical work in chapter 3. Firstly, I present the branch of literature dealing with program mix and advertising choices. Secondly, I consider some works dealing with entry in media markets. Thirdly, I discuss the literature on exclusive provision of premium content and quality choices. Finally, I sum up the main lessons of the literature, and I discuss the most recent works on two-sided markets and media, highlighting some open questions. I present the connection between the literature and the work in chapter 3.

2 Section 1: bundling

2.1 Definitions

Tie-in sales occur when a product is offered by a seller under the condition that another product is also bought. A firm can link products either through marketing or through technology.

When goods are sold together in fixed proportions, one refers to bundling. A bundling strategy is “pure” when the products in the package are not available on a stand alone basis and “mixed” when the products inside are sold on separately. More precisely, under “complete mixed” bundling, all

products in the bundle are available on a stand alone basis, while under "partial mixed" bundling only a subset of the bundle is offered separately.[1] Note that, under mixed bundling, the price of the bundle has not to be higher than the sum of the individual prices when the bundle is commercial, while this is not always the case when the bundle is technological.

Tying refers to the strategy of selling one product (the tying product), conditional on the purchase of another product (the tied product). The tied good is available on a stand alone basis. In such a case, the goods can be sold together in variable proportions, when consumers buy different units of the products.

Note that in models that assume that consumers buy products in fixed proportions and that the tied good is valueless without the tying good there is no distinction between pure bundling and tying.

In what follows, I organize the literature on bundling. I'm mainly interested in rewieving the literature that deals with bundling strategies as a tool to affect rivals' investment and entry decisions. However, firstly, in section 2.2 I give an overview over different rationales for bundling. Then, in section 2.3, I discuss bundling strategies as a tool to foreclose rivals. In section 2.4, I discuss the Antitrust approach to anticompetitive bundling and I present the theoretical debate on the topic. Finally, in section 2.5, I draw the main conclusions and I present some open issue.

2.2 Various rationales for bundling

Bundling strategies can be used by firms for many reasons. A bundle can be used as a price discrimination device, to induce product differentiation and consumers' loyalty. Moreover, a firm can find profitable to practice bundling for efficiency reasons. In the following, we present theories dealing with these rationales for bundling.

2.2.1 Bundling and price discrimination

Bundling has been initially analyzed as a device to achieve price discrimination. A classic analysis in the price discrimination vein is that of metered sales. Bundling may be used as a price discrimination device to sort consumers according to their valuations of the goods. In this argument, consumers vary in terms of the quantity of the tied good demanded, where high-valuation consumers are assumed to have a high demand for the tied good while low-valuation consumers have a low demand. By tying and charging a high price for the tied good, the monopolist is able to extract more of the surplus from the high-valuation/high-demand consumers. This is the standard interpretation for why IBM required consumers of its machines to also purchase cards from IBM.

1 For a monopolist mixed bundling is always a weakly dominant strategy, since it includes all the other options as particular cases (see for example Adams and Yellen, 1976, and Schmalensee, 1982, 1984). Matutes and Regibeau (1992), Economides (1989) and Anderson and Leruth (1993) show that this result does not extend to a duopoly model.

This is discussed by Adams and Yellen (1976), that use a series of examples to illustrate when the bundle of two goods can be profitable for a monopolist. They find that bundling can be a useful price discrimination device. They also state that the effect of bundling on welfare is unclear.

McAfee *et al.* (1989) and Schmalensee (1984) provide a more formalized analysis of this issue. Schmalensee (1984) shows that bundling, both pure and mixed, reduces the diversity of the population and allows to extract higher surplus. Bundling can be profitable also when the valuation of the two goods in the bundle are non-negatively correlated. McAfee *et al.* (1989) provide a generalization of the Adams and Yellen's model, showing that bundling can be profitable when it allows to discriminate between different consumer types.

Bakos and Brynjolfsson (1999, 2000) analyse the profitability of bundles of a large number of information goods, characterized by very low marginal costs. Using the law of large numbers, they argue that bundle of many information goods can be profitable since it is much easier to predict consumers' valuations for a bundle of goods than their valuations for the individual goods when sold separately.

2.2.2 Bundling and product differentiation

Bundling can be used to relax price competition, as Carbajo de Meza and Seidmann (1990) and Chen (1997) show.

Carbajo *et al.* (1990) study the strategic incentives of a dominant firm to bundle. They model a two firms-two products setting. One good is produced in monopoly by a dominant firm and the other one is competitively supplied by two firms. The goods are independent in consumption and production, and they are produced at a constant marginal cost, which is the same for both firms.

When firms compete in prices, bundling introduces differentiation between products and lessens price competition. They find that, under a convenient condition on costs, the dominant firm prefers to bundle and the rival firm's profit rises. When firms compete in quantities, bundling can or cannot be an equilibrium. Differently from the Bertrand case, when bundling is profitable, it negatively affects the rival's profit. Thus, when there are fixed cost, bundling can be used to exclude rivals.

In both the Bertrand and Cournot models, consumer surplus decreases under bundled sales, while total surplus may either increase or decrease.

They also analyze the case of complementary products. Contrary to the basic model, Cournot competition provides stronger incentives to bundle than Bertrand competition.

Chen (1997) analyses a different competitive setting. He models two firms active on two different markets, one perfectly competitive and the other one oligopolistic. Firms can choose between providing the products independently or in bundle. Since he shows that the mixed bundling

strategy is dominated by the pure bundling one, then he focuses on the latter strategy. At equilibrium, one of the duopolists chooses to bundle and the other sells independently. From a welfare point of view, he finds that bundling always reduces social welfare.

2.2.3 Bundling and efficiency reasons

Bundling strategies can be used to achieve efficiency (see Carlton et al., 2008 and Tirole, 2005 for many examples). In particular, firms can find profitable to bundle in order to exploit scope economies in production, sale or distribution. This is the focus of Evans and Salinger (2008), that provide a cost-based explanation for bundling. When firms bundle, there is a reduction in both the cost of the supplier and the price paid by consumers.

Tie-in sales can be used to overcome information asymmetry between producer and consumers. Indeed, when the performance of one product depends on the performance of another one, a firm can find profitable to "guide" consumers choice by bundling the two products. This is the focus of Spier and Dana (2009), that study reputation effects of bundling for experience goods.

Tie-in sales can have also an effect on the demand side, because consumers can save research and transaction costs.

2.2.4 Bundling and loyalty

Bundling can be used to attract consumers and to make them loyal. Gans and King (2006) study bundling strategies of oligopolistic and separated firms, that propose bundling loyalty discounts of unrelated product. These bundles are shown to create strategic interdependence between products and prices, allowing firms to alter price competition. The pair of firms that proposes the bundle gains an advantage over rivals, at the detrimental of consumers and social welfare. When also rival firms respond with a bundle strategy, welfare decreases.

Armstrong and Vickers (2010) find that one-stop shopping discounts can induce too much one-stop shopping, entailing excessive loyalty.

2.3 Bundling and the leverage theory

2.3.1 Chicago School Critique

The leverage theory claims that a firm with market power in one market can use tying in order to gain market power in another market. A formalization of this theory has been missing for a long time.

For many years the leverage theory has been heavily criticized by the Chicago School scholars (Director and Levi, 1956; Bowman, 1957; Posner, 1976; Bork, 1978), using the single monopoly profit critique. According to these authors, a firm cannot increase its monopoly profits, linking the sale (or price) of the monopolized good to a competitive one. When products are complements,

Posner (1976) assesses, a monopolist in one market can only take advantage from the presence of competitors in a competitive market. This implies that when a monopolist practices tying the reason cannot be leverage, but it has to exist an efficiency reason or a price discrimination reason.

2.3.2 Bundling and entry foreclosure

In this section we analyse the branch of literature which is more relevant to our theoretical work. It mainly focuses on studying the foreclosure effects of bundling.

The first paper to reexamine the Chicago School theories on the leverage of monopoly power has been the one by Whinston (1990). He notices that the conclusions of the Chicago School is linked to the assumption that the tied good market is perfectly competitive, with a constant returns to scale structure. In such a setting, it is only possible to analyze if a firm can better extract profits from consumers, given the price of competitors. Whinston, in contrast, models an oligopoly market with scale economies in production. In such a setting tying can be used to affect market structure.

In the basic model, he assumes independent products and that all consumers have an identical valuation of the monopolized good. Then he gradually removes these assumptions.

He considers two firms and two markets. A dominant firm is a monopolist on one market and faces imperfect competition on prices in the other market. The production of the competitive product involves a fixed cost, and the two firms provide differentiated products.

Firms play a game in three stages: first, the dominant firm commits to sell the products in bundle or independently; second, the rival firm decides whether to be active in the competitive market; third, they compete in prices. If firm 1 cannot commit to bundle, then firms play only the last two stages. In such a case, tying is equivalent to an independent pricing strategy. When commitment is possible, then tying can be used to exclude rivals. This occurs since the dominant firm, when it bundles, has the incentive to cut the implicit price on the competitive market, in order to induce sales of the monopolized good. Thus, it can strategically foreclose the rival. However, when the rival firm is active, the dominant firm's profit is higher under independent pricing rather than under tying, thus the dominant firm bundles only when it can exclude the rival. The welfare effect of bundling is however unclear. Indeed, consumer surplus can decrease since there is less variety on the competitive market, but it can go either way due to the price effect. Also the effect on total welfare is not clear.

Then, Whinston provides some robustness check. When consumer valuation of the monopolized good is heterogeneous, commitment to tying does not necessarily leads to foreclosure of rivals and tying can be a profitable strategy also without commitment. Indeed, commitment to bundling may fail to lower rival's profit in two cases: when enough consumers have a low willingness to pay for

the monopolized good (so that the dominant firm has not enough power to leverage in the other market) and when the bundle creates product differentiation. Instead, when there is no commitment, the dominant firm can find it profitable to bundle, but it always lowers rival's profit.

When products are complements and used in fixed proportions, introducing imperfect competition and scale economies in the competitive market is not enough to discard Posner's (1976) conclusion: it is not profitable to tie in order to foreclose rivals, since the dominant firm can earn profits by selling the monopolized good to the rival's consumers. However, in this setting bundling can be used to price discriminate. Bundling is again a profitable and effective exclusionary device, when the setting is modeled so as to uncouple the two markets. If there is an inferior substitute of the previously monopolized market, tying can be used to profitably exclude rivals. If there is an alternative use of the competitive component, the dominant firm may find it profitable to exclude rivals in order to monopolize also the alternative market. From a normative point of view, effects on total welfare are always ambiguous.

The paper by Whinston leaves some open questions, some of which are solved by the subsequent literature. Nalebuff (2004) analyzes the effects of bundling on the entry decision of a firm which faces an entry cost. He breaks down the commitment requirement in Whinston's results.

He considers a setting with two firms and two products. One firm is a monopolist in both markets and an entrant tries to enter one of the two markets. The rival provides a perfect substitute of the monopolist product. Consumer valuations for the two goods are independent and are uniformly distributed on the segment [0,1]. The entrant sets its price after having observed the incumbent's choice.

First, Nalebuff studies how bundling can be used to deter entry. The author identifies two channels that advantage a firm which bundles. First, there exists a pure bundling effect, since when the two firms simply translate the prices they impose when all goods are sold on a stand alone basis in the bundling game, the entrant's profits are cut by half. Second, there is a bundling discount effect, since when prices are re-optimized, there is a discount for bundling, and entry is even less profitable. Moreover, incumbent's profits absent entry increase.

Second, bundling can be used to reduce the losses after entry. This is true when the incumbent just translates its independent prices into the bundling game and the entry of the rival is even less costly for the incumbent when it practices a discount. Bundling continues to be a credible strategy also after entry. Therefore, differently from Whinston (1990), it does not require commitment. This result comes from the assumption of heterogeneity in consumer willingness to pay for the monopolized good. Under this assumption the entrant can take a small part of the market without stealing all the incumbent's sales. The author recognizes that there exist price discrimination reasons

for bundling, but the highest gains come from the entry-mitigation effect and the efficient entry-deterrence effect.

Nalebuff analyses many extensions of his basic model. In particular, he finds that a positive correlation between consumer valuations for goods makes entry less profitable, but if entry is not deterred entry is more costly for the incumbent. The opposite is true when valuations are negatively correlated. In this last case, bundling can be a more effective strategy of price discrimination. In another extension, he analyses the game when firms simultaneously set prices. In such a setting bundling reduces competition, as it induces product differentiation, but it is less effective than independent selling in avoiding entry. Differently from the basic model, bundling increases welfare compared to the independent selling model.

The two papers presented do not provide clear conclusions about the welfare effects of bundled offers. This is the focus of Peitz (2008) that uses a model similar to the ones by Whinston (1990) and Nalebuff (2004). Peitz gives three conditions that should be met to build a strong case against bundling, and provides a theoretical framework in which these conditions are met. First, bundling is the preferred strategy of the incumbent; second, entry is unlikely under bundling but likely under independent selling; third, monopoly bundling reduces welfare compared to competitive independent pricing.

Peitz builds a model so as to have the same result under monopoly as Nalebuff (2004). Differently from Nalebuff, he introduces horizontal differentiation between the two products. Products are enough differentiated, hence firms are local monopolists. He considers a game in three stages: first, the entrant decides whether or not to enter; second, the incumbent decides whether or not to bundle, and finally firms simultaneously set their prices. Note that, due to the timing, the incumbent cannot use commitment to bundling as a deterrence device.

At equilibrium, the incumbent is interested in avoiding entry, since its profits decrease under competition. Since the entrant's profit is lower under bundling than under independent selling, then bundling can be used to blockade entry when the entry cost is sufficiently high, and it is a credible strategy for the incumbent.

From a welfare point of view, welfare under independent selling when entry occurs is higher than welfare with bundling and exclusion. However, welfare with bundling and exclusion is higher than welfare with independent selling and exclusion. Thus, an antitrust intervention of prohibition of bundled offers would be beneficial if entry occurs, but it would be detrimental if entry does not take place. Under uncertainty about the entrant's entry cost, the optimal policy depends on the probability of entry of the new firm.

This welfare conclusions are quite novel, since Whinston has ambiguous conclusions about

welfare and Nalebuff does not provide a welfare analysis. From a consumer surplus perspective, results are the same as those reached by an authority which uses a welfare standard, if the strategic effect of bundling on firm's entry decision is taken into account.

Then, Peitz discusses some extensions to his basic setting. First, he introduces some competition between firms under independent selling, and results still hold if products are differentiated enough. Moreover, if he introduces correlation between the valuations of the two products, all results still hold if correlation is positive (but not perfect). If correlation is negative (but not perfect), bundling is still attractive for the incumbent and the entrant would prefer independent selling. Welfare results are affected: welfare under competitive bundling is higher than welfare under competitive independent selling. However, when bundling changes the market structure, it lowers welfare. Also when bundling is technological and it increases consumers valuation for the package, it can be used to blockade entry and can decrease welfare (if the increase in valuation is not so high).

Whinston (1990), Nalebuff (2004) and Peitz (2008) analyse the case of independent products. Choi and Stefanadis (2001) present a paper that studies the effect of tying on rivals' investment and entry decisions, when products in the bundle are complements. This is the first formalization of the leverage theory in a contest of complementary goods, after the criticisms of the Chicago School. They modify the hypothesis of the Chicago School in many directions. First, the incumbent is initially a monopolist in both markets. Thus, the authors remove the assumption of perfect competition in one market that prevents the strategic use of tying. Second, the incumbent is not a pure monopolist but faces the threat of entry in all markets. Third, they analyze the role of risky investment. Differently from Whinston (1990), in the complementary goods case, tying can be used to preserve market power in both markets.

Choi and Stefanadis assume to have three firms and two markets. The incumbent offers one product in each market and there is one potential entrant in each market that enters with a perfect substitute of the incumbent's product. The two components are always used together. The incumbent has no fixed costs, but it has a marginal cost of production. Each entrant can invest in a new technology that lowers the marginal cost of production. The investment is risky, and the probability of success is an increasing function of the investment expenditure. If the investment succeeds, the entrant has a cost advantage compared to the incumbent, otherwise it is at a disadvantage compared to the incumbent. The timing is the following: first, the incumbent decides whether to bundle; second, the entrants decide their investment levels; third, competition in prices.

First, the authors assume that the entrants are separate firms. The incumbent knows that its tying decision lowers the level of investment made by the entrant and, as a consequence, the probability of success. When the incumbent ties, if only one entrant succeeds, it is foreclosed from the market.

However, if it does not tie, it can sell the complementary good to the consumers of the new entrant and extract a part of the surplus created by the entrant's innovation. Thus, when it decides whether to tie or not, it faces a trade off: if only one entrant succeeds, the incumbent may use its monopoly position in the other market to capture a share in the value of the entrant's innovation; if both entrants succeed, the incumbent exits the market. When the expected loss from being excluded from the market exceeds the expected benefits from one entry, the incumbent chooses to tie. The decision is linked to the degree of price squeeze that the incumbent can exercise, that negatively affects the level of the entrant investment. However, the result depends on the ability of the incumbent to commit to tie, otherwise the entrants' investment decisions are not affected.

Second, the authors study the case when the two firms are integrated. In such a case, the entrant's investment decision is reduced only if the probability of success is lower that ½. This new threshold comes from the existence of two new effects when the entrants are integrated: tying discourages the firm to invest in one market since if it will not be able to sell if it does not succeed also in the other market while it encourages to invest since the success in one market is linked to the success in the other market. Thus, under tying offers, the negative effect dominates the positive one if the probability of success is low enough. If the probability of success is higher than ½, the incumbent never practices tying, since this increases the level of investment and thus the probability of being excluded from the market. If the probability is lower than ½, the incumbent ties if the degree of price squeeze is low enough. In this range of probability, tying lowers consumer surplus and welfare.

Third, the authors provide an extension in which also the incumbent can invest in the cost-reducing technology. Tying increases the ability of the incumbent to invest. It chooses to tie when its ability to price discriminate is low enough and the probability of success is lower than ½. In this game, it is difficult to draw clear welfare conclusions.

An evolution of the Choi and Stefanadis's model is provided by Carlton and Waldman (2002). They investigate how the tying of complementary products can be used to preserve and create monopoly positions in a dynamic setting.[2] It is the use of tying to increase future profits the key innovative point of this article. In particular, they reach two important results. First, they show that a firm that is currently a monopolist in a primary market can use tying of a complementary market in order to preserve its monopoly position by deterring future entry into the primary market. Second, tying can be used to transfer the monopoly market from the primary market to a newly emerging one. They achieve these results in two different dynamic models, one with entry costs and

2 They provide also an analysis of the antitrust case U.S. versus Microsoft, for the bundle of Internet Explorer with Windows.

another with network externalities.

In the first model, an incumbent operates in both a primary and a complementary market. A rival firm can enter the primary market in the second period with a homogeneous product and the complementary market in the first or second period at some cost with a superior product. Without any threat of entry into the primary market, there is no incentive to tying. Instead, when the rival can enter the primary market, tying can be profitable. Indeed, the monopolist can have the incentive to tie, so as to impede the rival from entering the complementary market in the first period. This rules out the possibility to enter the primary market in the second period, because for the rival is impossible to cover the fixed costs of entry into both markets. Note that this mechanism is more effective when products have short lifetimes and imitations lags are long.

In the second model, they consider that the complementary product is characterized by network externalities, that serve the same role as entry cost. Indeed, tying can be used by the incumbent to prevent the rival from capturing in the first period a market share high enough to support entry into the primary market in the second period.

Then, they extend both models so as to find their second finding. Now, there is no threat of entry into the primary market, but it exists a newly emerging market where both the incumbent and the entrant can enter at the beginning of the second period with a homogeneous product. This product can be used alone or in combination with the complementary good. The monopolist has the incentive to tie so as to foreclose entry into the complementary market only when entry into the newly emerging market is possible. Thus, the incumbent monopolizes the newly emerging market. A similar mechanism can be find in a model with network externalities.

Also Choi and Stefanadis (2006) provide a model to study the foreclosure effects of bundling. They use the same logic as in Carlton and Waldman (2002), but they introduce different types of entrants and they study how the bundling decision can affect the allocation of R&D resources across different projects.

They model an incumbent firm that is active in two markets. Products are perfect complements. The bundling decision is taken by the incumbent at the first stage. Competition, if any, is in price.

In the first static model, there is a potential entrant that makes a single entry attempt in both markets. Before making the entry decision, it draws the realization of its marginal cost for the two components from a random distribution. If the realization of the marginal cost is high, it does not enter, while if the realization is low, it enters the market. Thus, it may become a specialist or a generalist innovator. In this model, the incumbent never bundles, since bundling can exclude from the market specialist innovators and thus prevent the incumbent from keeping a part of the cost saving linked to the investment.

In the second dynamic model, there are two periods with a new potential entrant in each period. They assume that the new entrant faces financial constraints, meaning that an entrant does not enter a market unless it realizes non-negative profits. The incumbent prefers to bundle when the displacement effect (the event of being excluded from the market by new entrants) dominates the price squeeze effect with partial entry (the share of the value created by a specialist innovator that is captured by the incumbent). Thus, bundling is profitable when it can be used to exclude specialist innovators from the market, so as to prevent their dynamic coordination. In this model, bundling reduces both consumer surplus and welfare.

In the third model, they refine the second one so as to allow the entrant to choose how to allocate R&D resources across the two components. In this new model, they verify that the incumbent prefers to practice bundling in a wider range of parameters, since bundling forces each entrant to spread out its resources among components in the attempt of becoming a generalist, thus distorting specialization decision and lowering the probability of entry. Still, bundling is detrimental for welfare.

Finally, they introduce different probability of success for an entrant in the two markets. In such a setting, partial mixed bundling can be preferable for the incumbent when it faces low probability of entry in the market served by the independent component and high probability in the other market. In this case, it faces low probability of total displacement and it can profit from the price squeeze effect, by accommodating the entry in the market where it is more likely.

2.3.3 Bundling and investment

There is one strand of the literature on bundling that investigates the effect of bundling on rivals' investment decision.

Choi (2004) analyses the effects of tying on R&D incentives.[3] He considers two markets and two firms. The two products are independent. One market is monopolised and the other market is served by two firms located at the two endpoints of an Hotelling line that compete in prices.

First, he models a setting without R&D. In the first stage the monopolist decides whether to bundle or not, and then firms compete in prices. He shows that bundling is not a profitable strategy for the monopolist, since it pushes firms to compete more aggressively on price.

Then, he assumes that firms can engage in cost-reducing R&D activities in the duopoly market. At the first stage of the game the monopolist takes the tying decision, then the two firms take their R&D activity decisions and finally they compete in prices. He finds that the tying firm's R&D

3 In a previous work, Choi (1996) demonstrates that bundling of complementary products can be used to create an interdependence between the markets, which allows the bundling firm to use its monopoly power in one market to improve its strategic position in the other market. Thus, the two separate R&D games in the two markets become a single R&D game when the incumbent firm bundles, where the monopoly power can be exploit.

investment level increases and the rival firm's R&D investment level decreases. Indeed, tying allows the firm to increase its market share and to appropriate of the benefit from innovation, since the cost reduction translates into high profits. In this setting, Choi also finds that welfare decreases with bundling.

In a subsequent paper, Choi (2008) provides a model to analyse the effects of mergers in complementary system markets when the merged firm is able to engage in bundling. He uses the merger between General Electric and Honeywell as a reference.[4] He uses a non-address model of product differentiation. In his model, there are two markets and two brands on each market. Consumers are willing to consume systems composed by one unit of each good. Thus, there exist four possible systems. Demands are linear and symmetric, and systems are substitutable. Two brands on two different markets can merge and engage in mixed bundling.

First, he analyses the effects of bundling on existing generation of products. Bundling increases the profit of the merging parties and decreases the one of the independent firms. The effects on welfare are difficult to study, since the merger allows to internalize externalities between the complementary products, but it can be harmful from the perspective of mix-and-match systems. However, he finds that when there is foreclosure of the rivals, bundling is welfare detrimental.

Then, he studies the impact of the merger on R&D activities. Firms' profits are affected through two different channels: there is a direct effect of innovation through the cost saving and the indirect effect of price competition. The direct effect is bigger after the merger, since bundling reduces the market available for rivals. The indirect effects are not comparable before and after merger. However, when direct effect are bigger that indirect, the merged firm increases its R&D activities, while the independent firms reduce it. They confirm, through a simulation, that this occurs in a wide ranges of parameters space. Moreover, they also find that this is welfare-reducing.

2.4 Bundling and Antitrust

2.4.1 In practice

Antitrust agencies in Europe employ price-cost tests that follow the logic of predatory pricing to detect restriction of competition due to tying and bundling.

In designing an appropriate price-test, authorities recognize that under multiproduct pricing, a

4 General Electric has a dominant position in the production of aircraft engines and Honeywell is a major player in avionics equipment. They decide to merge in 2000, and the merger was approved in the US and blocked by the European Commission. In 2001, the Commission claimed that the price discounts due to the bundle would bring an advantage over the rivals, inducing the exit of rivals and then strengthening the dominance of the merged parties. Nalebuff (2002) criticized this argument, asserting that the traditional arguments on bundling and foreclosure are not suitable to be applied to this case, since prices are negotiated between vendors and customers and vendors are well-informed about the preferences of customers. Using a model that incorporates these characteristics, he argues that bundling would never lead to higher profits for the merging parties.

crucial issue is the aggregation level of the price test. When there is bundle to bundle competition the test may be applied at the bundle level, otherwise a disaggregated test should be preferred. In the latter case, bundling is deemed not to be anticompetitive when an equally efficient competitor offering only some of the components can compete profitably against the dominant firm's bundle.

Thus, authorities will usually not intervene if the implicit price of each product in the bundle remains above the dominant firm's long run average incremental cost (EC, 2008).

Also in the US, in some case law (Inc. et al. versus 3MCompany, Virgin Atlantic Airways Ltd. versus British Airways PLC), predatory test for assessing the anticompetitive use of bundled offers have been used.

2.4.2 In theory

The debate about how bundling should be treated by antitrust authorities is still open. An interesting chapter of this debate have been published in the first volume of Competition Policy International in 2005. In one paper, Tirole (2005) argues that tying should be submitted to a rule of reason standard and treated as a predation case. In another paper, Nalebuff (2005) advocates that tying should be treated as a separate offence and a per-se rule should be employed when tying is intentionally used by a firm as a tool to foreclose rivals from a large part of the market.

Tirole starts his reasoning recognizing that there are many and different rationales for tying. It can be used as an anticompetitive device by a firm with market power, so as to protect the monopolized market from competition or to extend this power to competitive segments. However, Tirole lists many efficiency reasons for tying, like distribution cost savings, compatibility cost savings, information and liability considerations, protection of intellectual property, legitimate price response, that have a positive impact on welfare. Finally, tying is usually a price discrimination device, and in this sense it has ambiguous effects on welfare. This entails that tying should be submitted to a rule of reason, in order to assess the effect on competition and consumers of this practice. He proposes to use an approach in three steps.

First, it is important to assess the magnitude of the impact of a tie on competition, that depends on the characteristics of competitors and the market. In particular, if the production cost is high, the competitor is not able to differentiate in the tied market and the tied market is not multisided, then there is a high risk that bundling leads to total exclusion of competitors.

Second, the impact on consumer surplus depends on the relative weight of all rationales of a tie. Due to the fact that a tie can be pushed by a mixture of efficiency and anticompetitive rationales, the situation could be very complex.

Third, when a harm on competition and consumers is assessed, an appropriate remedy should be

designed. Since tying is one of the strategies that a firm can use to prey on competitors, then prohibiting tying would just induce a firm to practice other exclusionary strategies, if the final intent is to hurt competitors. Thus, Tirole argues that the proper remedy is a predatory test.

Nalebuff (2005) has a completely different idea, and brings two main reasons to support his view. First, he highlights a basic difference between predation and tying when both lead to foreclose rivals: while the former imposes a short term profits sacrifice, the latter can be profitable. While a critical point of a predatory pricing test is that the monopolist will be able to later recoup its sacrificed profits, in a case of no-cost predation there are no losses to recoup. This no-cost foreclosure of rivals can be achieved in different ways. The monopolist can cut the price of the competitive product, and increase the price of the monopolised one, leaving the sum of the two prices unchanged. In a similar way, the monopolist can threat to overprice the monopoly good unless the customer buys the competitive good. Thus, rivals are excluded from the competitive market, since it appears that they are charging a higher price for the good. In both cases, rivals are excluded without any sacrifice of consumer surplus. As Nalebuff points out, "the potential loss for consumers is in the future".

Second, tying allows a firm to leverage its monopoly power from one market to another. When there are economies of scope and scale, a monopolist can exclude an equally efficient competitor, managing at the same time to increase its profits. Indeed, by providing a little discount on the monopolized good and increasing the price of the competitive good (with a net total price reduction), it can induce many consumers to purchase both products. Assuming that consumers have variable consumption of the two goods, the first order gain on the competitive market more than compensate the second order loss in the monopolized market. Moreover, there is a welfare increase in such a case. Nalebuff argues that these welfare gains could be better achieved in a different manner without causing foreclosure. Indeed, when tying allows a monopolist to disrupt competition in a large number of adjacent or even unrelated markets, this increases the potential harm caused by a monopoly.

All the provided examples show that "a bundle discount leads to foreclosure if even the monopolist could not afford to sell the competitive good at a large enough discount to offset the loss of the bundle discount". Moreover, in all cases exclusion arises when a firm has market power in one market and faces competition in another market. Thus, Nalebuff argues that a bundle does exclude rivals if the incremental price for it over the stand alone price of the monopolised good is less than the long-run average variable costs of the competitive good. This test should not be the sole criterion. An antitrust authority should also evaluate which fraction of the competitive market is foreclosed by the tie. Moreover, if a monopolist understands the foreclosing effects of it bundle

discount on competitor and if a large portion of the market is foreclosed, thus bundling practices should be prohibited.

Carlton, Greenlee and Waldman (2008) contribute to this discussion, supporting the view of Nalebuff. In particular, they discuss the decision of the AMC to use a predatory based approach for multiproduct discounts.[5]

First, they observe that the logic underlying a price below cost is very different when a firm is single-product or multi-product. It is an established result that "thinking of marginal revenue as the price per unit for the next incremental unit, [...] in the continuous case a single product monopolist engaged in second degree price discrimination would have no regions in its price schedule where marginal cost exceeds marginal revenue." Thus, a single-product firm that prices below cost and that can recoup its losses, is actually pursuing a predatory strategy. The reasoning is less straightforward for multi-product firms. Indeed, bundles, loyalty discounts and ties makes a consumer's expenditure on a single good also dependent on the quantity purchased of another good, either provided by the firm itself or by a competitor. Thus, firms are able to link different products through these pricing strategies.

The authors recognize and list many non-exclusionary reasons for non-linear pricing of a multi-product firm, namely, efficiency in production or selling, price discrimination, product differentiation. However, they recognize that bundling and tying can be anticompetitive when they are used to monopolize a second market and to enhance existing market power or maintain monopoly positions.

The AMC recommends a three-prong approach to determine whether a pricing strategy that links a monopoly product to a competitive one violates section 2 of the Sherman Act.[6] As a first prong, the AMC proposes to use a test that "interprets discounts offered on monopoly (or tying) goods as costs of providing the competitive (or tied) good. That is, the approach allocates the discounts provided on one product (or category of products) to the competitive product, and then asks whether the firm sold the latter good below cost." If the price is above cost, then there is no violation. Then, if the price is below cost, it should be checked if the firm is likely to recoup losses. If recoupment is unlikely, then there is no violation. Lastly, if the price is below cost and recoupment is likely, then it should be checked if the loyalty program is likely to have an adverse effect on competition.

The price test at the first step follows the logic of predatory pricing and has the drawback to not distinguish between the price discrimination use and the anticompetitive use of bundling and tying.

5 This decision was first adopted by the Department of Justice, and then revoked.

6 Note that this approach, due to the presence of a monopoly good, is designed for a case where there is not bundle-to-bundle competition.

Indeed, the undiscounted price could be fixed with the goal of selling any units at that price, and thus it is wrong to treat the discount as an opportunity cost. The authors define situations where the test could reject offers that do no exclude rivals.[7] Moreover, when loyalty discounts are used to price discriminate, there is not a profit sacrifice today in order to increase profit tomorrow. This implies that the second step could make no sense.

Since the authors think that joined offers are generally procompetitive, they are not much worried about the fact that the AMC test could fail to identify anticompetitive behaviours, but mainly about the fact that pro-competitive bundles can fail the test. Thus, they propose a different approach focused on the competitive effects of tying and bundle. In particular, they propose a set of tests as a safe harbor based on the elements that the theory recognizes as essential for anticompetitive nonlinear pricing. First, they require a plaintiff to prove the presence of scale economies in its production of the competitive good, and that the pricing scheme of the defendant denies the necessary scale to survive or to reduce its marginal costs. Second, an anticompetitive behaviour could arise when the defendant firm has market power in the tying good. Third, if there are consumers that purchase only the competitive good, it should be shown that the price of this good is increased for those consumers. Finally, it should be shown that the competitive constrain of rivals has been relaxed, since rivals have exited the market or because their marginal costs have risen. All these requirements have to be met in order to assess a violation of the antitrust law.

Since the authors recognize efficiency reasons for linked pricing schemes, they allow for an efficiency defence of such offers. However, as in merger cases, this efficiency defence should count only if the efficiencies are not otherwise attainable, and these benefits outweigh the competitive harm. Given the possibility of a harm on welfare by price discrimination and that it can lead to rival exclusion, this should not be recognize as an efficiency defence.

Greenlee, Reitman and Sibley (2008) provide a similar analysis in a more formalized framework. They are interested in assessing which body of Antitrust case law applies to bundle discount and which are the effects of these strategies on social welfare. In particular, they analyse bundled loyalty discounts practised by a monopolist in one market that faces competition in another market. Whichever is the market structure of the latter market, they find that existing tests for bundled rebates that adopt a predatory price approach are not well suited to analyze bundle discounts. Indeed, bundled discounts do not entail losses and the test is not informative about the welfare effects of the joined offer (the offer can fail the test when it is welfare enhancing and pass the test when it is welfare reducing).

The authors find that when the competitive market is perfectly competitive, bundled discounts

7 We will further discuss this point, presenting the paper by Greenlee, Reitman and Sibley (2008).

reduce consumer surplus. From an antitrust perspective, bundled rebates are equivalent to tie-in sales, since the stand alone price of the monopolized good has the sole role of inducing consumers to buy the competitive good.

When the competition is imperfect, a firm could practice bundling or tying for creating product differentiation, price discrimination and affecting entry and exit decisions of rivals. When bundled discounts are used to increase product differentiation, this entails an increase of all prices in the market, that cause a reduction of consumer surplus. Moreover, when there are fixed cost, then the bundled discount can be used to deny the necessary scale to rivals so as to foreclose rivals. When products are differentiated in the competitive market, bundled discount can be used to price discriminate. Indeed, the monopolist can fix a high price for consumers who strongly prefer the rival firm good and it can raise the discount for the bundle so as to compete more aggressively for the marginal consumer in the competitive market. The highest is the discount, the highest is the price of the competitive good offered by the monopolist and the lowest the price of the rival.

Given the market configuration, they assess, using numerical simulations, that bundled discounts can have a positive effect on welfare. However, the positive effect disappears when one takes into account that bundled discount can induce exit or deter entry. In this new setting, due to the fact that bundled rebates entail price discrimination, they do not resemble tying but mixed bundling.

The formalization of the analysis allows the authors to provide a test for bundled offers that verify if the stand alone price of the monopolized good has raised compared to the pre-bundling situation, where the firm fixes the monopoly price for this good. In the model where goods are homogeneous on the competitive market, welfare is found to increase. When goods are horizontally differentiated the welfare effect of this test is ambiguous. A further complication arise since the bundling strategy can affect the entry and exit decisions of competitors.

2.5 The lesson of the literature and new directions

Bundling can be used to leverage market power, protecting actual monopoly positions and creating new ones. These results can be reached by an incumbent firm either through rival entry deterrence or thought investment foreclosure. The literature investigate many different situation under which this result can be found. One common ingredient to these theories is the presence of scale economies.

However, the literature also assesses that firms can have many different rationales for bundling, different from anti-competitive ones. Indeed, bundling can be used to price discriminate, to differentiate products, to save on production and distribution costs, to fill information asymmetry between sellers and buyers, and to save in compatibility costs.

This entails that it can be difficult to identify when the exclusion of rivals is due to anti-competitive or efficiency reasons. Moreover, it can be difficult to assess the net effect of bundling strategies on welfare, when many rationales coexist. Thus, the literature still needs to investigate under which conditions bundling can be detrimental for consumers and social welfare when anti-competitive and efficiency reasons for bundling coexist, in order to guide public policy on the topic. In chapter 2, this point is analyzed.

Moreover, the leverage theory has been investigated with horizontal product differentiation, but in these models scarce attention has been devoted to the vertical differentiation dimension. An exception is Kramer (2009). An investigation of the role of quality differentiation in models of leverage is proposed in chapter 2.

An open and heated debate concerns the classification of bundling cases law. Antitrust authorities and some authors argue that bundling strategies should be treated as predation case (see section 2.4). However, some recent papers argue that predatory test are not apt to study bundled offers. Indeed, non-linear pricing and predatory pricing are different in the nature and in the effects (as argued in section 2.4.2) and existing tests that adopt a predatory pricing approach are not informative about welfare effects of joined offers. Thus, new tests should be carefully analyzed in a theoretical environment, in order to be proposed to antitrust authorities. The paper by Greenlee *et al.* (2008) provides an interesting analysis on this point. However, the test gives interesting results only with homogeneous products and when rival firms' entry and exit decisions are not affected by the bundling decision. Thus, this test needs to be theoretically analyzed in many other different context. Some further analysis is proposed in chapter 2.

Bundling has been traditionally an issue for antitrust authorities. Recently, there has been renewed interest in bundling practices from the perspective of ex ante regulation. Indeed, technological convergence is changing the boundaries of electronic communications markets and is shaping the structure and pricing of firms' services, so as we have triple-play (telephony, high-speed broadband Internet access and video) and quadruple-play offers (that also include mobile). These bundles collect services from relevant markets with different competitive conditions and regulatory regimes. In such a context, a regulation focus on enduring economic bottlenecks could not be sufficient, since there are competitive problems specific to retail markets. Thus, also in these situations, suitable price tests have to be identified in order to assess the replicability of incumbent's bundle offers. Agcom (499/10/CONS) makes some analysis in this direction.

The bundling literature has a long tradition. However, there are still open questions on the issue. In particular, bundling strategies start to be investigated in two-sided markets (this is the focus of a new paper by Choi, 2010) and as a mean to sustain collusion (as Baranes, 2009 shows). All these

topics should be more deeply investigated.

The traditional literature on bundling could also find some advantageous contamination with the behavioral economics. Indeed, a wrong perception by consumers of their usage can make non-linear prices convenient for firms.

3 Section 2: Two-sided markets

3.1 Definition

In two-sided markets two groups of agents interact through an intermediary or a platform in presence of externalities. For instance, media, credit cards, video games, shopping malls, internet backbones, dating agencies are markets that possess these characteristics.

In order to be successful, in these markets is important to "get both sides on board", in the sense that the intermediary has to be able to attract consumers on both sides of the market.

One classical issue arises from cross-group externalities, and is the "chicken and egg" problem: to attract consumers on one side it is important to have attracted consumers on the other side and vice-versa. Thus, in two-sided markets the sequentiality choice is central, and one platform can handle this issue choosing to subsidize one side, to integrate or to be a venture capitalist.

Due to these cross-group externalities, the choice of the price structure is very important, not only the price level. When a platform chooses the price, it has to take into account what each side can bear and remember the surplus generated on the other side: the highest the value generated to the other side, the lowest the price on this side and the highest on the other side.

When many intermediaries exist, the structure of the price depend on the single- or multi-homing choices of consumers. Single-homing means that one consumer uses only one platform, multi-homing that it uses several. Multi-homing on one side intensifies price competition on the other side, since platforms are willing to induce consumers on this latter side to an exclusive relationship. If one side becomes "more multi-homing", the other side is better off.

Another important issue when there are competing platforms concerns the use of fixed fees or per-transaction charges. In the latter case, the payment is an explicit function of the number of consumers on the other side. Hence, cross-group externalities are weaker, since a part of them is internalized by the payment and platform profit can be higher.

As Rochet and Tirole (2003) point out, the two-sided market theory "puts issues related to network economics and to multiproduct pricing together." Indeed, the literature on network economics highlights the presence of externalities, while the multi-product pricing literature the role of cross-elasticities. However, the first branch of literature has ignored multisidedness and price

allocation issue, while the second one has not considered affiliation externalities that are important in the network economics literature.

In the next section we present the three seminal papers on two-sided markets. However, we do not provide a comprehensive analysis of the theory on two-sided market, but in this survey we focus on media markets (for surveys on two-sided markets, see Evans and Schmalensee 2005; Rochet and Tirole, 2006; Roson, 2005; Rysman, 2009). In section 3.3, we present papers on advertising choices and program mix choices in media markets. In section 3.4, we proceed to analyse entry choices. Then, in section 3.5, we present the most relevant paper to the theoretical work of chapter 3. They study exclusivity strategy. In section 3.6 we pool papers that endogenize the vertical differentiation choice of a platform. Finally, in section 3.7, I sum up the results and I present some open questions, some of them will be analysed in chapter 3.

3.2 The theory on two-sided markets

Three seminal papers on two-sided market theory are the ones by Armstrong (2006), Caillaud and Jullien (2003), Rochet and Tirole (2003). These papers discuss the general theory, but the analysis of each of these papers fits better a given market: the media market for the Armstrong's paper, the internet market for the Caillaud and Jullien's paper, and the credit card market for the Rochet and Tirole's one.

Caillaud and Jullien (2003) discuss the case of competing matchmakers, studying the chicken and egg problem. First, they discuss the case where all agents must single-home. Platforms are intermediaries between two groups of agents, and they provide a way for them to match. Platforms can charge each user a registration fee, that can be negative, and they can charge a transaction fee when the trade between the agents occurs. Platforms are ex-ante equal, so agents have no intrinsic preference for one platform or another. However, there are network externalities that can induce concentration: agents prefer to join the platform which attracts more agents on the other side. In order to get some consumers, an entrant has to adopt a “divide and conquer” strategy, that means it has to subsidize one group and extract profits from the other group.

When users can join only one platform, the authors show that the only equilibrium that can arise involves the incumbent platform attracting all users. The incumbent charges the maximal transaction fee and subsidizes registration, making zero profits. In this way it deters entry, since no agent is willing to register on the other platform. Thus, the divide and conquer strategy of the entrant fails in this case. The equilibrium with a dominant firm is also the efficient one.

Then, the authors go on studying the case where agents can multi-home. There exist two classes of pure equilibria, where users of the same population all make the same choice: equilibria with

global multi-homing or dominant firm equilibria. For a given set of parameters just one equilibrium exists and it is efficient. A global multi-homing equilibrium exists when the increased probability of a match due to multi-homing is higher than the cost of the match. In this case, the entrant imposes a higher transaction fee and performs only the transactions that the dominant firm fails to match, earning lower profits than the dominant firm. On the contrary, a dominant firm equilibrium exists when the dominant firm can exclude the rival imposing zero transaction fees and earning profits through the registration fees. This is a different dominant firm equilibrium compared to the case of single-homing, since in this case the dominant firm excludes the rival preventing it from conquering the market.

There can also be mixed equilibria, that involve some degree of multi-homing on one side and single-homing on the other side. In this case, a platform makes loss (or zero profits) on the single-homing side and profits on the multi-homing one.

Rochet and Tirole (2003) build a model of platform competition with two-sided markets, considering different competitive situations and ownership structures. First, the paper provides a simple model that comprehends the main feature of a two-sided market (and can be more easily red having in mind the features of a credit card market). They model a monopoly platform, that connect a group of buyers to a group of sellers. Buyers and sellers receive a different surplus from the transaction, and each population is internally heterogeneous in this surplus. The platform imposes linear prices (thus, they assume that there is no fixed usage cost), and stands a positive cost for each transaction. The benefit of buyers and sellers are independent from the price of the transaction. The "quasi-demand functions" are given by the probability that the benefit from the transaction overcome the cost of it. The volume of transactions is given by the product of quasi-demands.

A private monopolist chooses the total price level for the two groups (i.e. the sum of the price on the seller and the buyer side) according to the standard Lerner formula, where the elasticity is given by the sum of the elasticities of the two groups quasi-demands. However, also the price structure plays an important role, and it is given by the ratio of elasticities.

A public monopolist that maximizes welfare subject to the budget constraint chooses the total price level to be equal to the cost of the transaction. The price structure is given by the ratio of elasticities, where each ratio is corrected for the average surplus that each group gets from the transaction.

After, they model the case where two platforms compete for the market. First, they assume that platforms are profit-organization. In this case, buyers have different benefits from transacting on one platform or the other, while the seller gets the same benefit. The transaction can occur only if the two groups have at least one platform in common. When assessing the transactions volumes, the

possibility of single-homing or multi-homing choice makes the analysis more difficult. They find that sellers multi-home only if they have a benefit from the transaction which is high enough. When sellers multi-home, platforms have an incentive to undercut prices in order to induce sellers to stop multi-homing, and this strategy is called “steering”. The effectiveness of this steering strategy depends on the level of loyalty of consumers to the platform, that can be measured by a so-called “single-homing index”: if consumers are infinitely loyal to a given platform, a platform does not have any advantage from steering. From these observations we can take the intuition of the price formula that the authors get in this context: they find a kind of Lerner's formula, where the elasticities on both the buyer's and the seller's side are replaced by “own-brand” elasticities.

Second, they study the case where platforms are non-profit associations. In this case, the price structure is the same as in the profit scenario, but the total level of the price is lower. By the comparison with the Ramsey formula, we discover that associations do not generate efficient outcome, since they do not internalize end-users externalities and they aim at steering sellers and stealing buyers to competing institutions.

The authors study the impact of some other important dimensions of the industry conduct and performance. If there are marquee buyers, a platform, whatever is the industry and the governance structure, increases the price for sellers and decreases the one for buyers. The opposite is true when there are captive buyers.[8] When there is competition, if there is an increase in the number of multi-homing buyers, the platform increases the buyer price and decreases the seller one.

When one considers linear demand on the buyer side, the price structure is the same, regardless of the industry structure. When also seller's demand is linear, the price structure is Ramsey optimal.

Finally, authors generalize their model so as to include fixed user fees and usage cost. They confirm the general form of the results they get in other sections, highlighting in this section the role of network externalities.

Armstrong (2006) studies different market structure in order to highlight the determinant of the equilibrium price in a two-sided market context. First, he studies the case where the two groups of agents interact through a monopoly platform. Each agent has a given benefit from each member of the other group that is connected with the platform. Moreover, agents pay a lump-sum fee to the platform (there are no transactions fee). Equilibrium prices are Lerner's formula. One group can be subsidized when the group's elasticity of demand is high and/or when the externality it enjoy from the other group is high.

Then, he studies the case of competing platforms. First, he imposes that agents on both sides single-home. The benefit that each agent gets from interacting with members of the other group is

8 Under competition between associations, these results require some regularity conditions.

independent of the platform (differently from the Rochet and Tirole's model). The number of agents of each group is given by the Hotelling specification (see Hotelling, 1929). At equilibrium, the classical Hotelling prices are adjusted, since the platform targets more aggressively the group on the more competitive side and/or the group that causes a high benefit to the other group. Compared to the monopoly prices, the author assesses that a competitive platform puts more emphasis in the external benefit of one group to the other, since being able to attract one agent on a given group means being more able to attract agents on the other group.

Second, he analyses the case when one group single-homes and the other multi-homes. This case is called "competitive bottlenecks", and a platform has monopoly power over providing access to its single-homing consumers. This monopoly power leads to high prices for multi-homing consumers and low price for single-homing ones, and the latter are always subsidized.

Each platform chooses the number of multi-homing agents on each platform so as to maximize the join surplus of the platform and the single-homing group. Thus, in absence of intra-group externalities, there are too few agent on the multi-homing side, given the distribution on the single-homing side. In order to investigate how the surplus is shared between the single-homing group and the platform, the author puts more structure on the model and proposes an application to media. Readers are on the single-homing side and advertisers on the multi-homing one. At equilibrium, there are too few advertising, and advertisers pay the monopoly price also when there is competition. As concerns the price for readers, it depends on the way in which advertising charges are levied. When platforms charge per-reader fees and readers like ads, the price for readers and platforms profits are higher than when advertisers are charged on a lump-sum basis.

3.3 Advertising and program mix choices

Traditional oligopoly theories suggest that firms prefer high degree of product differentiation, in order to relax competition. However, the well-established principle of maximum differentiation (d'Aspremont *et al.*, 1979) is contradicted by some papers , that find that media can have incentives to reduce differentiation. The fact that media choose "close" positions can be observed in reality.

The traditional theory suggests that mainstream programs offer sufficient rents, in the form of advertising revenues, to absorb duplication (Steiner, 1952; Spence and Owen, 1977). However, these papers provide an unsatisfactory formalization of the advertising market. An improvement from this point of view is provided by the literature on two-sided markets.

The first paper to address the issue of program differentiation in media market in a two-sided model is the one by Gabszewicz, Laussel and Sonnac (2001). They study the impact of advertising on the political positioning of newspapers.[9] Since advertisers are an important source of revenues,

9 The same authors analyse the same issue in a very similar framework in the article Gabszewicz, Laussel and Sonnac

editors are willing to keep these revenues and to increase them by attracting readers. One strategy to increase their readers market share is to soften their political opinions. The authors present a simple Hotelling game with quadratic transportation costs (see d'Aspremont *et al.*, 1979) with an additional stage. The timing is as follow: in the first stage each editor chooses their political positioning, in the second stage each editor selects the price of the newspaper and in the third stage they choose the advertising tariff. They assume that readers buy only one newspaper, while advertisers chooses if advertising on both, one or none platform. The game without the third stage entails maximal opinion differentiation. When this stage is considered, minimal political differentiation can be an equilibrium when there are weak political preferences and with high unit advertising receipts.[10]

Gal-Or and Dukes (2003) explain programming duplication from a different perspective. They model a setting with two channels and two producers. Products are maximally differentiated and channels choose endogenously their differentiation. Producers can choose to advertise on both platforms, while viewers watch only one channel and consume only one of the product advertised. They face a quadratic transportation cost and a nuisance cost from advertising. They find that platform coordinate on the equilibrium with minimal differentiation in order to reduce advertising level. Since consumers are less informed, producers gains higher margins thanks to advertising, and this increases the bargaining power of platforms vis-à-vis advertisers. Thus, platforms can increase their prices for advertising space and earn higher profits.[11]

In a following paper, Gabszewicz, Laussel and Sonnac (2004) study the impact of advertisements on the mix choice made by broadcasters when channels are provided for free to viewers. Differently from the previous case, viewers have an utility loss due to watching ads, that is modelled as a non

(2002).

10 In a following paper Gabszewicz, Laussel and Sonnac (2006) address a similar issue. In a pure pay TV, media decide for maximal political diversity, like in an Hotelling setting. When they add advertising to the model, the same conclusion still holds if advertising rates and volumes do not depend on the size of the audience. When they assume that advertising rates are positively related to the size of the audience, they find that media decide for minimal political diversity when political preferences are weak and/or advertising receipts are high.

11 In another paper, Dukes and Gal-Or (2003) study how the competitive conditions of the market can affect the terms of the advertising contract. In particular, they are interested to assess under which conditions the parties negotiate exclusive contracts. Thus, they endogenize the extent of multi-homing on the advertising market. Exclusive contracts entail less informed consumers, and they can be profitable for producers when they are able to mitigate price competition between producers. In such a way, platforms, that extract a fraction of platforms' profits, are better off. Thus, exclusive contract are profitable when from advertising is an important source of information on products. A similar mechanism is used by Gal-Or and Dukes (2006) to study horizontal non-consolidating mergers in media markets. They isolate one of the possible trade-offs that can arise in horizontal mergers in media market. On the one hand, merging stations gain bargaining power in the negotiation with advertisers, since they offer access to more listeners. On the other hand, this advantage entails more advertising (on all the stations, since the advertising levels are strategic complements), that results in higher price competition between producers (since consumers become better informed), and then this lowers the producer's ability to pay for the advertising space, ultimately undermining stations' profits. Thus, media mergers can or cannot be profitable. In particular, they are profitable when the degree of competition is high enough, since in this setting the merger's benefit exceeds the losses. The presence of advertising constraints in certain media can soften the detrimental effect of intensified post-merger advertising, and it can improve the benefit of a merger.

linear function of the advertising ratio.[12] Moreover, viewers divide the time they spend watching tv between the two channels.

The parameter that measure the ad aversion plays an important role in the analysis. Indeed, when the ad aversion is small, broadcasters choose maximal differentiation, since the positive strategic effect on advertisement (advertising ratios are strategic complements) dominates the negative direct effect on market share. When the ad aversion raises, broadcasters choose to differentiate less (even if pure duplication is never observed), due to the increment of the marginal cost of advertising to viewers. Thus, niche strategies are less and less effective as advertising aversion becomes stronger.

The most relevant paper on two-sided market and media is the one by Anderson and Coate (2005). This paper provides a theory of market provision of programming and advertising, and investigates the market failures in the broadcasting industry. They consider two types of programs, each one located at the two extremes of an Hotelling line. Consumers have a disutility from not watching their preferred program specification and have also a disutility from advertising. Advertisers are monopoly producers of goods which want to inform viewers.[13] They pay a per-viewer price for the advertisement. Since producers extract all the benefit from the transaction, there are no informational benefit for viewers, which make their channel choice just maximizing their viewing benefit. Each program is "consumed" by viewers and advertisers. First, each broadcaster decides what type of program to broadcast, and in the second stage broadcasters decide the level of advertising. If both broadcasters provide programs, they provide different programs, in order to have positive profits.

At equilibrium, there can be over- or under- provision of advertising. With one or two programs, there is under- (over-) provision of advertising, if the nuisance cost of advertising is low (high) enough. The critical value that the authors find with two products is decreasing in the transportation cost, so the more programs are substitutes the more under-provision is likely to occur. Broadcasters

12 Kaiser and Song (2009) propose a model that empirically tests the hypothesis -used by many scholars- that consumers dislike advertising. Using data on German magazines, they find that readers mostly appreciate advertising. However, they find that there exist differences across magazines segments, that can be due to heterogeneity across segments or to heterogeneity across the level of information contained in advertising. They cannot test the first hypothesis, while they confirm the second one.
There is quite agreement in assessing that viewers and listeners are usually advertising adverse, while readers can be willing to see advertisements. However, this hypothesis should be better empirically investigated.
Gabszewicz, Laussel and Sonnac (2006) propose a model to explain concentration in media, as a result of the impact of the advertising market, when a part of the market is composed by advertisers lover and another one by advertisers avoiders. When the percentage of the former group is bigger, the editor which is expected to sell more advertising can exclude the rival (when the ad-attraction is strong) or can impose higher price and enjoy larger market shares in both markets. However, there could exist symmetric equilibria, and the symmetric equilibrium is the only one when the bigger portion of the market is ad adverse.
Anderson and Gabszewicz (2006) present a discussion on this topic.

13 All the models that we present assume informative, and not persuasive, advertising. Indeed, as Anderson and Coate (2005) point out, the implications on the welfare analysis of the persuasive assumption are not clear.

can be interested to keep advertisers demand low so as to keep up advertising price and to keep their programs attractive for viewers.

Broadcasters can over- or under-provide also programming. The last case obviously follows from the impossibility of broadcasters to capture all the benefit from programs. The former situations occurs when the social benefit from the program are less than the private benefit.

Then, the paper goes on analysing if there exist pricing strategy or ownership structures that can improve market performances. First, they assume that platforms can charge viewers and that each one provides a different program. Broadcasters can still find profitable to provide free programs to viewers. At equilibrium, there are the same or more types of programs. Moreover, there are fewer advertising but higher total price (where the total price is the sum of the monetary price and the disutility from advertising). Given the same provision of programs, when viewers are charged, the surplus is redistributed from advertisers and viewers to the platforms, with a positive or a negative net effect on total welfare. Welfare can increase or decrease also when pricing leads to an increase of programming.

Second, they assume that the two channels are controlled by a monopolist broadcaster, coming back to the free-to-air model. Given that both programs are provided, there are more advertising at a lower per-viewer advertising price. Monopoly can result in less programming when the nuisance cost of advertising is sufficiently small.

When both programs are delivered under both market structure, under monopoly broadcaster profits and advertisers surplus are higher, while viewer surplus is lower compared to the competitive ownership. When monopoly entails less programs, broadcasters profits are still higher, but either advertisers or viewers retain less surplus. The impact on welfare of the monopoly ownership can be, in all cases, negative or positive.

This paper uses the competitive bottleneck model, as much of the literature on two-sided media markets. However, the multi- and single-homing assumptions have important effects on the results, and the competitive bottleneck model can be debatable.

Kaiser and Wright (2006), using data from the magazine industry in Germany, test which among the three models proposed by Armstrong (2006) (monopoly platform, two-sided single-homing, competitive bottlenecks) fit better the data. They find evidence of price-competition on both side of the platform and that there are more users on each side that single-home rather than multi-home. Hence, their data support a two-sided single-homing specification. However, they point that a partial multi-homing model would be more apt to study this industry, but it make the analysis too complex in many cases.[14]

14 They provide also an empirical analysis of the price structure in a two-sided market. They find that advertisers value

Reisinger (2004) departs from the multi-homing assumption on the advertising market of much of the literature, and studies advertising provision in a model where platforms compete both for advertisers and viewers. The single-homing assumption on both sides of the market allows the author to study how the degree of competition on one side affect the degree of competition on the other side.

He shows that the level of advertising can be too high or too low at equilibrium when users are not charged, while the efficient outcome is reached when viewers pay for accessing the platform.

In the free-tv case, he notices that platforms profits are increasing in the level of differentiation only when the level of differentiation is high enough. Indeed, when platforms are enough differentiated for viewers, viewers do not switch easily to the other platform. Thus, platforms have incentive to attract advertisers, and this competition keeps demands unchanged but lowers prices, and thus results in lower profits.[15]

Also the business model of a platform is a key point in two-sided markets, and this is the focus of Peitz and Valletti (2007). They investigate the market failure of media companies in providing advertising and programming and they show how the result depends on the business model of the platform. They investigate both the pay-tv and free-to-air models.

In the pay-tv case, concerning the program mix choices of the platform, they replicate the classical results of the Hotelling model with quadratic transportation costs, that is, maximal differentiation. This differentiation is always excessive from a welfare point of view. When platforms air ads, the equilibrium amount of advertising depends on the disutility parameter for advertising in a way related to the shape of the function that represents the advertising revenue per viewer. Platforms decide to air ads only when the disutility from advertising is lower than the maximal quality of the advertised goods. Note that advertising revenues do not affect equilibrium profits of the platforms, but they are all passed to viewers into lower subscription fees.

In the free-to-air case, the advertising level is decreasing in the nuisance cost. However, the sensitiveness of the advertising level to this parameter depends on the program mix choice of the platforms: the more similar channels are, the less sensitive the advertising level is to the nuisance cost. As concerns program mix choices, they find that contents are never duplicated when the nuisance cost is positive, in order to avoid Bertrand competition, and the differentiation is increasing in the nuisance parameter. For the same reasons, given a level of the nuisance parameter,

readers more than readers value advertisers, and thus magazines subsidize cover prices and make most of their profits on the advertisers side. From comparative statics, they find that an increase in readers' demand results in an increase in ads rates, while an increase in advertising demand results in a decrease in cover prices. Moreover, they find evidence that magazines are differentiated in the eyes of advertisers.

15 Ambrus and Reisinger (2006) allow viewers to multi-home. They find that channels tend to increase the level of advertising in order to induce viewers to single-home.

they find maximal differentiation only when the transportation cost is low enough. In this case, from a welfare point of view, there is too little differentiation if viewers do not strongly dislike ads, and too high differentiation in the opposite case.

Then, the authors compare the two business models. First, they observe that the choice of program mix and the differentiation parameter affect the advertising level in the free-to-air case, but not in the pay-tv one. Then, when the choice of content is endogenous, there is less advertising under free-to-air than under pay-tv for a low nuisance cost and viceversa. Indeed, when the nuisance cost is low, programs are close substitute under free-to-air and maximally differentiated under pay-tv, then there is less advertising under free-to-air.

First, they compare the welfare levels under the two business level, given the content choice. In this case, when consumers strongly dislike ads, there is optimal provision of ads under pay-tv and over-provision under free-to-air, thus, the welfare level is higher in the former case. When the nuisance cost is low enough and the differentiation between the channels is not too high, the advertising provision under free-to-air is close to the optimal level and under pay-tv there is strong under-provision; when the differentiation starts rising, there is more under-provision under free-to-air, and the disequality between the welfare levels is reversed. Second, when the content choice is endogenous, for intermediate values of the nuisance cost, the free-to-air model is preferred with respect to the advertising and the program mix choice, thus it leads to a higher level of welfare. For extreme values of the nuisance cost, welfare level is higher under pay-tv. When it is very small, the advertising level under pay-tv is socially preferred but content provision is preferred under free-to-air. However, given content, we observe more under-provision under free-to-air. When the nuisance cost is high, there is maximal differentiation under both models, but under pay-tv the optimal level of advertising is provided. Results could be red with respect to the differentiation parameter, and in this case they find that welfare under pay-tv is higher when the differentiation between the channels is small enough.

3.4 Entry

The expansion of the transmission capacity due to the digitalization of the signal and the proliferation of new platforms have eliminated the transmission bottleneck and have produced new opportunities for entry. The concern in such a setting can be excessive entry. In this section we present models that assume free entry.

Spence and Owen (1977) analyse the issue of program selection in a monopolistically competitive market with free entry. They find that mainstream programs are excessively provided while some niche programs are not provided. However, as we already noticed, their formalization of

the advertising market is insufficient.

Choi (2006) develops a model of broadcast competition with free entry. He addresses the nature of market failure in the industry with respect to the level of advertising and the level of entry, studying two alternative financing models: free-to-air regime and a mixed regime. He uses the circular city model à la Salop (1979) and he models the market for advertisers as in Anderson and Coate (2005). He finds that under the pay regime, advertising is under-provided and there is excessive entry. These are the standard results of the Salop model, with the only difference of revenue composition due to the two-sided specification. Under the free-to-air regime there are no clear-cut results.

From a social planner point of view, since under the pay regime the number of entrants and the level of advertising are determined by disjoint set of parameters, the two distortions can be dealt separately. This is not true under the broadcasting model, and the use of a single instrument to correct one distortion can exacerbate the other one.[16]

Also Crampes, Haritchabalet and Jullien (2009) present a model with free entry, where media are financed both with advertising and subscription fees. They give a general form to the returns from advertising for broadcasters and to the disutility of advertising for households, and they study the implication of such non linear advertising technology on platforms' entry and advertising decisions.

In a competitive model, they assess that when the number of active platforms become large, the subscription fee is below cost, since the presence of viewers make raise profits from advertising. The level of advertising on each platform changes with the number of active platforms if the marginal advertising revenue per customer depends on the size of the audience (if the marginal revenue per costumer is increasing (resp. decreasing) in the audience, then the level of advertising decreases (resp. increases) in the number of active platforms) otherwise it is unchanged.

Then, the authors compare the level of firms' profits and consumer surplus with and without adversing. The profit of the platform is not affected by advertising when the advertising revenue per customer is linear, since revenues from advertising are passed to consumers in the form of lower subscription fees. Under increasing (decreasing) returns to scale, platforms' profits are lower (higher) with advertising. Consumers are better off with advertising when the revenue per customer increases with the audience. When it decreases with the audience, consumers surplus is higher in the model with advertising if the number of active platforms is large enough, or when the impact of

16 In this model the choice of the financing model is not endogenized. Kind, Nilssen and Sørgard (2009) show that competition and strategic interactions between media firms may be decisive for their financing choice. In particular, they find that the scope for raising revenues from consumers is constrained by other media offering close substitutes, while the scope for raising revenues from ads is constrained by the number of media firms. Thus, determining if the main competitive constraint derive from the substitutability of other media or from the number of other media is a key point for making a choice concerning financing.

the audience on the revenue per customer is not so high or when they have a positive utility from advertising.

The return of scale in the audience are also the key element to understand the level of entry in the industry. Indeed, following from the effect on profits, the authors verify a higher level of entry with advertising than without under decreasing returns to scale in audience and viceversa.

Comparing with welfare maximizing results, they find that there is under-provision of advertising and excessive entry, in the case of constant and increasing return to scale in the audience.

The authors provide some alternative modes of competition. First, they model the case in which platforms compete in price on the advertising market. They find that there is more entry compared to the case when platforms set the advertising volume. Second, they model the case of free media. A free platforms gain higher profits than a pay one, when the equilibrium price is negative. Moreover, there is (weakly) more entry when price are constrained to be positive, than when they are free.

3.5 Exclusivity choices

There is a large literature about exclusive dealing, about vertical contracting and access to an essential input. This literature, in one-sided markets, has been surveyed in a paper by Rey and Tirole (2007) that analyse economics of foreclosure. Moreover, there is also a literature dealing with licensing of a cost reduction/quality-enhancing innovation, that is relevant to premium content provision (see Katz and Shapiro (1986)). However, all this wide literature deals with one-sided market, while here the two-sidedness of the market play an important role.

In media markets, one can observe that, although the distribution bottleneck has widened, the market is still very concentrated and it will probably remain as such. Motta and Polo (1997) and Seabright and Weeds (2007) explain the concentration in mature media markets using the concept of endogenous sunk cost. The digital technology has enabled a more efficient use of the existing band and the coexistence of different platforms (terrestrial, satellite, cable) has further enhanced the distributive capacity. However, barriers to entry in the sector are not eliminated, since channels compete by raising quality, and total cost of production does not fall. Therefore the investment required in order to be successful on the market raises as the pressure of competition raises. Motta and Polo (1997) point out that if viewers continue to demand a narrow subset of horizontal program quality, we can expect the concentration in the industry to persist, since key content rights are scarce, and these rather than transmission capacity accrue scarcity rents and become potential source of market power. Seabright and Weeds (2007) observe that, with the growth of the number of channels, the price for premium content has increased dramatically.

These discussions entail that airing quality content is a vital resource for tv companies. Exclusive strategy can be used to increase the quality of the offer compared to rivals. Exclusivities and quality choices in a platform environment have been the focus of some recent works.

Armstrong (1999) studies this issue in the pay-tv industry. First, he analyses the incentives of two vertically integrated pay-tv to enter into a collusive agreement to exchange programming with each other. He finds that, when firms practice a per-subscriber access charge, they have an incentive to set high mutual access charge in order to sustain collusion. Collusion occurs when programs are not close substitutes.

Second, he constructs a model to analyse the incentive to exclusive provision of premium contents under various contract forms. He considers two asymmetric firms on the viewers market, and an independent premium content provider. When the rights for the premium content are allocated on a lump sum basis, then the content provider chooses to provide exclusive contract to the firm with the initial competitive advantage. However, this result depends on the ability of the upstream provider to commit to grant the exclusive to the rival, when the first firm refuses the contract. Exclusive provision can be welfare maximizing when the initial advantage of the firm that receives the offer is wide.

When rights are sold on a per-subscriber basis, non-exclusive provision can be the result of a three-stage negotiation, in which the content provider offers in sequence exclusive and non-exclusive contract to the downstream firms. In this case all the surplus generated from the premium content is extracted by the content provider.

Harbord and Ottaviani (2001) study the sale and resale of premium content under different contractual arrangement. In their model, broadcasters finance themselves only through fees for viewers, and one firm has a competitive advantage over the rival. There is an upstream producer of premium content that can offer the rights for the premium content exclusively or not to the downstream broadcasters, for a lump-sum fee, a per-subscriber fee or under two-part tariff. They find that the provider prefers to offer the content in exclusive for a lump-sum payment. The firm which gets the premium content chooses to resell it for a per-subscriber fee. The authors find that this outcome is not optimal, since the exclusive contract allows the upstream to transfer its monopoly power downstream and the resale contract to relax price competition. The authors propose various possible policy intervention, finding that forced right reselling and non-exclusive sale of rights under lump-sum fee reallocate the gains from the upstream operator to consumers.

Hagiu and Lee (2008) study competition for contents in the case of strategic interaction between content distributors and content providers. In their model, the content provider can join one or two platforms in two different ways: it can either cedes all the rights to the platform, that will price the

content, or it can join the platform keeping the right to price the content. In their model, there are two platforms, that charge consumers and do not air ads. Platforms make take-it-or-leave-it offers, specifying the fixed fee that they are willing to pay to have the content in exclusive or not.

They show that the results on exclusivity crucially depend on whether or not the content provider maintains control over the pricing of its own good. Indeed, if the content provider sells control rights and there is no market expansion, it provides the content on an exclusive basis to one platform, whatever the quality of the content is. If there is a small market expansion, a low quality content is provided to both platforms, while a high quality content to one platform. When market expansion effect are high, multi-homing prevails. If the content provider maintains control rights and it prices simultaneously with platforms, then it always multi-home. If platforms price first, the exclusivity choice is not monotonic in the quality of the content: low and high quality content are given to both platforms, while intermediate one are granted on an exclusive basis.

The authors find that total industry profits are higher when the content provider affiliates with one platform and independently prices its own content. However, platforms and content provider preferences may not aligned, and thus the industry characteristics may depend on the negotiation power of the parties.

Hogendorn and Ka Yat Yuen (2009) study the incentives to exclusive or non-exclusive contracts among platforms and must-have content providers. They extend the model by Crémer, Rey and Tirole (2000) to analyse this issue, since they are mainly interested in analysing the effect of platforms interconnection on exclusivity choices. In the formal model, there are two platforms, each one with an installed customer base, that compete for new consumers. They consider a parameter that captures the level of connection between platforms. Each platform receives an offer from the must-have content provider. The contract specify the lump-sum transfer (positive or negative), given the exclusive or non-exclusive provision of the content. If the bargaining fails, the upstream makes another offer.

The platform that has access to the must-have component experiences higher sales, price and profitability, both under exclusive or non-exclusive access. The transfer price that the content provider pays to the platform increases with the popularity of the content and decreases with the initial market share difference.

They find that exclusivity is more likely when cross-platform indirect network effects are weak and the initial market share difference is high. A policy intervention oriented to increase technological interconnection between platforms can have a contractual impact, encouraging non-exclusive contracts, since non-exclusive contracts are more likely when more components are ported between platforms.

Stennek (2007) analyses the relation between exclusive contracts and product quality in a Rubinstein-style bargaining model. He considers two platforms and one content producer. Platforms finance themselves through subscription fees for viewers, while distributors receive advertising revenues. Platforms are assumed to be maximally horizontally differentiated. Then, platforms negotiate with the distributor for exclusive or non-exclusive rights, and if they receive the content they pay a fixed price for it. He finds that parties agree on an exclusive right on the content if the extra-price that one party pays for the exclusivity overcomes the foregone revenues (in terms of advertising and price of the content).

The paper is mainly focused in understanding the role of quality in the exclusive or non-exclusive outcome of the negotiation. The author finds that the quality content is distributed with exclusive rights if the quality is high enough, if competition for viewers is intense enough and if the price of advertisements is low enough. Moreover, a channel distributed exclusively is of higher quality than one distributed non-exclusively. Thus, banning exclusive distribution might have the effect of reducing quality, and consequently welfare.

He also shortly addresses the issue of vertical integration, that is surprisingly found to reduce exclusive distribution.

The TV industry is organized in three vertical stages: (1) production of content, (2) packaging of contents, (3) transmission of packages through a distribution system. Since in recent years the degree of vertical integration in the industry has increased, some authors have analyze the impact of vertical integration on content provision.

Theory suggests that vertical integration may be used by an integrated firm to practice market foreclosure, strategically limiting or denying rivals' access to an important supplier (upstream foreclosure) and/or to a buyer (downstream foreclosure) (Tirole, 1998; Motta, 2004). Transposing the reasoning to the media market, Rubinfeld and Singer (2001) suggest that it may be observed two strategies of vertical foreclosure: conduit and content discrimination. The first one consists in limiting distribution of affiliated content over rival platforms; the second one consists in refusing to carry rivals' contents. In recent years, since the digital encryption of signals and the increasing level of inter-platform competition, the attention is shifting toward the second type of foreclosure.[17]

17 Rubinfeld and Singer (2001) are mainly worried by downstream foreclosure. Using the merger between AOL and Time Warner as an example, they argue that content discrimination is likely to be a significant problem. Indeed, when there are economies of scale in the production of new contents, denying to rivals the access to the conduit could entail the exit from the market, if the rival cannot cover its costs. Moreover, in such a way an integrated firm can limit the scale of unaffiliated upstream and can prevent a competitor in the downstream market from effectively competing in the future. Thus, the position on the downstream market of the affiliated firm can improve, and the integrated firm can save the cost of acquiring other contents. The authors believe that loss in demands from consumers that demand the denied content can easily be compensated by the advantages of content discrimination.
Chipty (2001) presents an empirical paper on the effect of vertical integration on content provision. In particular, he is interested in verifying whether vertically integrated operators tend to refuse to carry rival services. He finds

Weeds (2009) develops a model to study incentives to exclusive provision of premium content. In her paper, the content is a channel and it is controlled by one of the two downstream platforms. First, she models a static setting where broadcasters compete in prices for consumers after the decision of supplying or not the content to the rival. The content provider can decide to keep the content in exclusive or to make a take-it-or-leave-it offer to the rival, using a two-part tariff. Note that the content provider receives advertising revenue (since the content is a channel) and that the advertising price is a parameter of the model. Also the quality of the premium content is not endogenized. She finds that non-exclusive provision is always more profitable. Indeed, since the seller has enough instruments to extract profits it chooses the efficient outcome.

Then, the author introduces some dynamic aspects. In particular, she assumes that a firm, in addition to actual profits, receives a future benefits that depends on the actual market share. In this setting, exclusive distribution may arise when there is a strong dynamic competition, when the content is valuable and when there is little horizontal differentiation. The author provides two instances of this dynamic competition in order to perform a normative analysis. First, she studies the case where platforms invest in the technological quality of the platform. She finds that consumers always prefer non-exclusive distribution, while at the social level non-exclusive distribution is preferred only for a quality level low enough. Second, she builds a two periods game, where at the second period consumers have to pay a switching cost if they want to change operator. When platforms are asymmetric, the higher the asymmetry the more likely exclusivity is. When horizontal differentiation is strong enough, the non-exclusive result arises again. In this model, consumers prefer exclusivity when the quality of the content is low enough. At the welfare level, exclusivity is always desirable when there is high asymmetry, while non-exclusive is preferable when the asymmetry is low and the content is not very attractive.

Exclusive provision of quality content has been widely investigated by many Antitrust Authorities. Nicita et al. (2004) analyse the UK, the Italian and the Australian media market. In past years the European Commission considered exclusivity over content or vertical integration as ways to win subscribers and recover initial investments. However, in the analysis of more recent cases (NewsCorp/Telepiu' in Italy and Sogecable/ViaDigital in Spain) the Commission has changed its traditional approach: it has imposes limits on the duration of exclusivity, the removal of exclusivity clause for alternative platforms and the obligation to wholesale offers. They notice that this last

evidence for the existence of exclusionary practices by vertically integrated operator, mostly when the integrated program is premium. In this case, premium operators offer fewer services in their package, both premium and basic. He also finds evidence of efficiency gains from integration, since integrated operators prefer to carry their own contents and they achieve higher penetration rates. However, he finds evidence that harmful effects of integration due to foreclosure are offset by the efficiency-enhancing effects of integration. Indeed, consumers in integrated markets are statistically no worse off and weakly better off than consumers in unintegrated markets.

obligation involves some important issues, like the economic criterion to be applied to compute the price for the wholesale offer, that are difficult to solve.

3.6 Quality choice

In this section we present two models that endogenize the quality choice of a platform. We have already discuss in the previous paragraph the relevance of this choice.

Seabright and Weeds (2007) present a simple model about entry in the broadcasting sector with endogenous quality choices, using the Salop's model. The fixed cost of production of the premium content has two components: an exogenous cost and an endogenous cost proportional to the square of the quality and to a parameter representing the cost of raising quality. They show that the reduction in cost of content production has an ambiguous effect on the number of firms, depending if the reduction is in the exogenous component or in the cost of investment in program quality. When the exogenous component decreases, the number of platforms tend to increase, while when the cost of investment in program quality decreases, the number of platforms tend to decline. Moreover, when the exogenous fixed cost decreases, the number of firms increases and quality decreases, while when the cost of raising quality decreases, the number of firms decreases and quality increases. Thus, variety (linked to the number of the firms) and quality are inversely related.

They point out that the digitalisation can have the effect of reducing the cost of making quality. Moreover, a reduction in variety, thus in the number of firm, reduces the duplication of fixed costs, and, thanks to competition, this advantages are passed on to consumers. As concerns rents, a reduction in the exogenous fixed cost reduces them, while a reduction in the cost of making quality increases them.

Armstrong and Weeds (2007) analyse different issues regarding program quality provision under alternative funding regimes and market structures. Using the classical Hotelling formulation, they find that under a duopoly pay-tv regime, quality is provided at the optimal level, while it is under-provided in the free-to-air regime. However, consumers can be better off in this last case when quality is not too low, since they pay less.

Then they study the role of a public broadcaster in the digital era. When it competes on the market, it can increase viewers' welfare by increasing its own quality and lowering its price (under the pay-tv regime) or advertising levels (under the free-to-air regime). However, viewers of the rival commercial broadcaster receive poorer quality, even if they benefit from lower price or advertising level. Thus, when there is a positive effect on welfare, it mainly comes from the reduction in price or advertising, rather than an increase in quality.

Then, they explain the co-existence of broadcasters with different funding regimes by modelling

viewers with heterogeneous tastes for quality. When advertising revenues are high enough, the lower quality firm can offers its programs for free. The competition with a free-to-air broadcaster can decrease the quality offered by the higher quality firm. Heterogeneous tastes for quality explain also different quality choices by firms.

Finally, they use a free entry model à la Salop (1979), and study the quality choice of firms when the number of channels proliferate as a consequence of a more efficient use of the spectrum. They argue that quality provision lowers with audience fragmentation. Moreover, entry can be excessive. They find that under pay-tv, there is more program quality, less advertising and more diversity.

3.7 The lesson of the literature and new directions

The theoretical literature on two-sided market and media usually adopt adjusted Hotelling models in order to study program mix and advertising choices, a combination of the Hotelling and Sutton model in order to study quality choices and a Salop model to study entry choices. As concerns the advertising market, the formalization of Anderson and Coate (2005) has been used by the majority part of the literature on the topic.[18]

The literature on product mix choice has found that in two-sided media markets the maximum differentiation principle found in one-sided literature can be contradicted. Indeed, advertising can push toward minimal platform differentiation.

As regards market provision of advertising, it can be too low or too high compared to the social optimal choice, depending on the nuisance cost for viewers. When consumers strongly dislike advertising, platforms tend to air less ads. This result can be influenced by the business model of the platform, by single- and multi-homing assumptions and by the number of active platforms.

Some authors find that excessive entry can be an issue. The assumption on the business model and the formalization of the advertising marker can play a role in the conclusions.

Then, recently the literature has started to investigate the role of the vertical differentiation dimension. The business model of the platform is found to have an impact on the quality of programming. When viewers pay for the service, quality is found to increase. The quality and the variety of programming are found to be inversely related. The reduction in the endogenous fixed cost of producing content is found to decrease the number of active platforms on the market and, as a consequence, the variety of the offer.

From the previous survey, we have seen that some modelling features are of key importance in two-sided markets. We refer to the multi- or single-homing choices of viewers and advertisers, the intensity of the cross-externalities among the different sides of the platforms, the price structure.

18 See Anderson and Gabszewicz (2006) for a model that collects and discusses all these ingredients.

Often, these features are exogenously imposed rather than endogenously derived.[19] Obviously, these choices are needed to keep the models tractable. In this sense, the empirical literature should assist the theoretical one, providing works that point out which assumption fits better in a given context.

We can notice that, in the literature on two-sided media market, dynamic competition is not widely investigated. In general, it would be interesting to study the dynamic dimension in these models, in order to analyse how new platforms build a reputation and an installed base of viewers, and how the concentration of the industry evolves.

Moreover, many themes of the traditional industrial organization should be re-examined from a two-sided market perspective, since the use of the one-sided logic can be misleading (see Wright, 2004). For instance, the effect of collusion, horizontal and vertical mergers, bundling, auction design. Some first analysis on these topics starts to appear (see Ruhmer, 2009 and Dewenter *et al.* 2010 on collusion, and Choi, 2010 on bundling). It would also be important to explicitly consider in these models a suitable framework for the analysis of media markets.

The media industry is a particular one, where each choice is taken by the company considering both political and economic implication. Indeed, mergers and collusion can have more severe and diverse implications than in other markets. Thus, it should be important to develop theories that combine both perspective. A recent example is Anderson and McLaren (2009), that provide an explanation of media mergers, when media owners have both political and profit motives.

Another important issue is that media company can use different platforms for delivering contents, and they can use different price structure on different platforms. Think, for instance, to printed and on-line editions of a newspaper. Assessing which are the implication of these multi-platforms strategies on platforms performances is the focus of Gal-Or *et al.* (2010b), and this is an issue that deserves further attention.

Antitrust and regulation of media markets have an hard task, for many reasons. First, for the relevance of this industry from a social and political point of view, then because the characteristics of the service provided cannot be defined in a close form, and also because the two-sided nature of the market. Due to this features, the effect of market power and of anticompetitive conducts can be more severe than in other markets and more difficult to identify. All this issue should be carefully investigate both from a theoretical and an empirical point of view.

Exclusive provision of premium contents and vertical integration in media markets are important issues in the agenda of authorities. Indeed, the control over premium contents on the downstream

19 There a number of exceptions. For instance, Armstrong and Wright (2007) endogenize the extent of multi-homing of content providers; Ambrus and Reisinger (2006) allow platforms with different business models to compete one against the other, and they derive the conditions under which platforms choose one or the other business model; Hagiu (2009) determines endogenously indirect network effects. However, each dimension is endogenized one at a time.

market through exclusive contracts and the control over the provision of contents to downstream platforms through vertical integration are key strategies in media competition. We know from section 3.5 that some papers analyse the exclusive strategies for quality contents, but that scarce attention has been devoted to the investigation of the effects of vertical integration on exclusive provision.

The literature misses an analysis over the implication of a change in the vertical structure of the industry. The sole exception is offered by Stennek (2007), that shortly discusses a comparison between vertical integration and vertical separation provision of channels. However, this paper disregards many aspect that in two-sided markets are of key relevance. For instance, Stennek, as the other papers on the topic, does not consider the role of the financing model of the platform. In chapter 3, both the role of vertical integration and the platform business model are investigated.

In models of exclusive provision of premium contents, quality differentiation choices should be more deeply investigated, since these decisions are of key importance. I perform this analysis in chapter 3.

A point that misses in the theoretical literature on the economics of media, and that is considered in chapter 3, is the role of the efficiency on the advertising market.[20] When there is competition among different channels, some papers consider one channel to have an advantage over the rival on the viewers market (see, for instance, Harbord and Ottaviani, 2001; Weeds, 2009), but the literature widely assumes that advertisers have the same benefit from interacting with a viewer on different platforms.

However, there are other dimensions, in addition to the number of viewers, that are taken into account by advertisers in their decision to join a platform. Advertisers can prefer to advertise on one channel if its viewership fits better the target of the advertised product. Moreover, a platform can offer better services to advertisers than the other or can use advertising strategy that are more effective in reaching viewers. Thus, platforms are actually differentiated in the eyes of advertisers.

Platforms can decide to differentiate on the advertisers side as well as on the viewers side. While the second choice of differentiation has been investigated, the second one needs to be more deeply investigated.

20 Gal-Or et al. (2010a) takes into account a "target" parameter in a paper where they investigate the role of advertising in media bias (defined as "selective omission, choice of words and varying credibility ascribed to the primary source"). Then, the empirical paper by Kaiser and Wright (2006) assume that advertisers have preferences to advertise on a particular magazine.

Chapter 2:
Bundling, Competition and Quality Investment: a Welfare Analysis

Abstract

We show how a monopolist in a primary market uses mixed bundling to extract surplus from quality-enhancing investment by a single-product rival in a complementary market, or even force the rival to provide low quality. In our model, bundling does not hinge on commitment ability. Although we assume that bundling creates efficiency gains, we find that bundling reduces consumer surplus and may reduce social welfare, even if the rival is not foreclosed, and investment is not blockaded. Nonetheless, bundling improves welfare when prevents inefficient investment. We propose to check bundled offers via a price test that controls the monopoly component stand-alone price to preserve efficiencies from both bundling and investment. When the rival invests, the test improves consumer surplus and welfare compared with the 'do-nothing' scenario, or a ban on bundling. The test is not consistent with the predatory pricing framework. Qualitative results hold when we endogenize the bundling strategy.

1 Introduction

Product bundling is a widely employed strategy in many industries. Public policy and academic research have recognized that bundling by a dominant firm can be an issue when used as a method of predation or a tying arrangement leading to foreclosure of an efficient single-product competitor. This issue is particularly relevant in high-technology industries, where a key feature of competition is continuing innovation. Indeed, in the last years there has been close antitrust scrutiny on bundling practices in high-tech sectors both in the US and Europe.[21] Furthermore, technological convergence has recently raised new interest in bundling strategies in regulated industries such as electronic communications markets.

In this paper, we show that the dominant firm in a primary market finds it profitable to use bundling so as to extract surplus from the rival firm's investment in quality in a complementary market. Provided that there is a sunk cost of investment, bundling may deny the rival firm the necessary scale to invest and thus force the rival to provide low quality. We explicitly assume that bundling creates efficiency gains.[22] Nonetheless, we find that bundling may be socially harmful even if there is competition in the complementary market, and if the rival's investment is not blockaded.

Although this finding builds a relatively strong case against bundling, a *per se* rule prohibiting bundling would not be appropriate since we also find that bundling is socially beneficial when it precludes some inefficient investment that would occur under stand-alone selling. Thus, we propose to check the viability of a bundled offer using a price test that aims at preserving efficiencies from both bundling and quality investment. We show that, when the rival firm invests under the proposed test, consumer surplus and social welfare rise compared with the do-nothing scenario (that is, the case when the dominant firm freely sets prices), or with a ban on bundling.[23] Our test does not comply with the logic of predatory pricing, which is usually embraced by antitrust agencies. We show that, when the rival invests, our test improves welfare compared with a predatory pricing test.

We assume that consumers have heterogeneous willingness to pay (henceforth, wtp) for systems of complementary products. We assume partial market participation, so as consumers with the

21 Major examples are recurring cases against Microsoft in the software industry and the General Electric/Honeywell merger in aircraft engines and avionics equipment industries.

22 Bundling may be achieved through product design, which realizes technical improvements in the quality of products (technological bundle), or through contracting, which realizes consumers' savings on research and transaction costs (commercial bundle). In both cases, product bundling raises consumers' valuation. Although it is widely held that there may be efficiencies from bundling (see e.g. EC, 2008), the academic literature seems to have overlooked this point.

23 When the rival firm does not invest, consumer surplus and welfare are not affected.

lowest wtp are not active. We also assume that the dominant firm's bundle raises consumers' wtp[24] and, to a greater extent, so does the rival firm's quality investment.

In our basic model, we consider an instance of partial mixed bundling, where the monopoly component is sold both in bundle and as a stand-alone product, while the competitive component is sold only in bundle.[25] We find that bundling is a profitable strategy independent of the rival firm's product choice. Thus, bundling is credible and does not rely on a commitment assumption. When the rival provides a perfect substitute in the complementary market, bundling introduces vertical differentiation between systems and raises both firms' profits. When the rival provides a superior complementary component, bundling makes the dominant firm's system more competitive relative to stand-alone selling. In addition, the dominant firm can use the stand-alone price of the monopoly component as a price discrimination device to extract surplus from consumers with a strong preference for quality, which buy the system including the rival's complementary component.

We find that bundling induces less market participation and has a negative effect on consumer surplus. We also find that, when the rival firm's investment is feasible under product bundling, the dominant firm's bundle reduces social welfare. However, bundling may raise welfare by preventing the rival's investment when the sunk cost is (socially) too high relative to quality improvement.

Consistent with the results obtained, antitrust authorities usually abstain from imposing such restrictions on the dominant firm as pure stand-alone selling. In practice, they rather investigate anticompetitive effects of bundling according to a rule of reason standard. This, in turn, often employs a price-cost test which obeys to predatory pricing principles.

We argue that a predatory pricing test is not well grounded in a setting where products are vertically differentiated. Indeed, we find that using such test may be socially detrimental. Therefore,

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24 It follows that there is not any outcome with bundling that the firm can exactly replicate with separate component pricing. For simplicity, we assume that the dominant firm can bundle products at a negligible sunk cost, which is normalized to zero. Qualitative results are not affected when the fixed cost of bundling is sufficiently low.

25 There are several real-world examples. Sky provides its exclusive content in bundle with the satellite TV decoder and on a stand-alone basis, but not the decoder stand-alone. Many retailers offer the video game console Nintendo Wii in bundle with Wii accessories, or the accessories by themselves, but not the console stand-alone. Software firms, having developed a full-featured version, may also provide a second version that removes some functions (think of read-only versions of Adobe Acrobat, or play-only versions of Real Player). A number of telecommunications incumbents in the EU provide triple-play offers with voice calls, broadband access and IP TV. While consumers can choose not to buy IP TV, thus opting for one or both of the other services, they cannot choose to buy IP TV alone. Similar options are offered by cable TV firms. Focusing on partial mixed bundling is thus empirically grounded. In section 6, we show that it is also theoretically grounded, since the main qualitative results are not altered when we endogenize the bundling strategy.

we introduce an alternative welfare-enhancing price test that simply imposes the dominant firm not to artificially raise the stand-alone price of the monopoly component over the monopoly level as a consequence of the bundled offer.[26] In essence, the proposed test controls price discrimination between consumers who buy the entire system from the dominant firm, and consumers who buy the alternative system including the rival's component.

When the incremental wtp for the bundle is low, the proposed test tolerates a margin between the bundle price and the stand-alone price of the monopoly component that is *below* the dominant firm's average incremental cost of producing the complementary component. On the other hand, as the incremental wtp for the bundle rises, the test entails a *strictly above* cost margin. In both cases, the outcome of the test is different from a predatory pricing test, which in our setting would induce the dominant firm to set a margin that *exactly* reflects the relevant cost.

Finally, we extend our basic model to allow the dominant firm to practice pure bundling (so as the firm provides only the bundle) and complete mixed bundling (so as the firm provides the bundle and all products on a stand-alone basis). For simplicity, while extending the model we deal only with the case of technological bundling. We find that, in the do-nothing scenario, mixed bundling is more profitable than pure bundling, and welfare implications are qualitatively the same as in the basic model. Conversely, under the price test regime, the dominant firm may opt for pure bundling. If the bundle is technological, then the rival is foreclosed. Since welfare is negatively affected, then an authority should require the dominant firm to provide the monopoly component on a stand-alone basis. In such a case, we can prove that qualitative results are not altered relative to the basic model.

This paper is organized as follows. Section 2 analyzes the relevant literature. Section 3 presents the basic model. Section 4 derives welfare effects of bundling. Section 5 introduces the price test and discusses policy implications. Section 6 develops model extensions. Section 7 concludes.

2 Relevant literature

The literature strand that is most relevant to our paper is the one which has devoted attention to studying the foreclosure effects of product bundling. Carlton and Waldman (2002) as well as Choi and Stefanadis (2001) analyze the case of pure bundling of complementary products.[27] They set up dynamic models to show how a dominant firm can use tying both to preserve and create a monopoly position. This is to the detriment of alternative producers of single components that may

26 This simple rule is mainly intended to safeguard the practical implementation of the price test (we outline a refined version of the test in section 5.3). Greenlee *et al*. (2008) develop the same idea to manage bundled rebates in a model with exogenous quality of firms' products (we further discuss their work in section 2).

27 In his pioneering work, Whinston (1990) analyzes pure bundling both of independent and complementary products.

serve as superior substitutes for a system composed of a primary and a complementary good.

In the cited papers, bundling produces benefits to the dominant firm only when it deters entry, while it should be avoided when entry is inevitable. Thus, entry deterrence relies critically on the firm's ability to commit to bundling. Conversely, in our model bundling raises the dominant firm's profit even when the rival firm is active, and independent of the rival's product choice.

Nalebuff (2004) and, more recently, Peitz (2008) provide two models where bundling is a credible strategy. Both models consider pure bundling of independent products. The former defines a setting where the entrant's and one of the incumbent's products are perfect substitutes, while the latter assumes that firms produce horizontally differentiated varieties.[28]

When firms simultaneously set prices, these authors obtain partially diverging welfare results. In both models, welfare is higher under competition than monopoly, so that bundling reduces welfare when it achieves foreclosure. However, when the rival firm is active, welfare is higher under product bundling in Nalebuff's model, but under stand-alone selling in Peitz's model. Therefore, when entry costs are such that competition is likely under stand-alone selling, there are opposite policy implications. While Nalebuff's results justify a 'do-nothing' scenario, Peitz's results, conversely, entail a ban on bundling. It is worth noting that things are not so clear-cut in our model of vertical differentiation, where bundling reduces welfare *given* the type of competition (e.g. when the rival firm is high-quality), and either reduces or raises welfare when it *affects* the type of competition (so as the rival firm gives up investing and provides low quality).

Choi (2004) elaborates on the idea that tying by a dominant firm can stifle investment in cost-reducing R&D by a competitor in the tied good market. He finds that tying can be profitable even if the rival firm is active, which is a similar point to ours. However, contrary to our paper, in the absence of investment tying intensifies price competition and reduces the tying firm's profit.[29]

It follows from the review that the literature on bundling and market structure focuses on pure bundling. Since pure bundling is not profitable in our model, then we focus on mixed bundling.[30] Moreover, the literature analyzes the two polar cases where bundling is allowed or prohibited, but

28 In Nalebuff's basic model, firms sequentially set prices and bundling deters entry. In an alternative version, firms simultaneously set prices, as in Peitz's model. Then, bundling facilitates entry, while it deters entry in Peitz's model.
29 Chen (1997) also provides a model where bundling does not require the rival firm's exit to be profitable. Indeed, bundling is used to segment the market and soften competition. However, he does not consider the case of investment.
30 Choi (2008) analyzes the case of a merger where the merged firm becomes able to engage in mixed bundling, and finds that welfare is negatively affected if the merger leads to foreclosure of outsiders. He initially assumes that firms and market demands are symmetric. Thus, in his model outside firms have incentives to counter-merge, which would lead to bundle-to-bundle competition. It is also possible that this prevents the initial merger from taking place at all.

does not consider the case where the viability of a bundled offer is subject to a suitable price test.

A notable exception is Greenlee *et al*. (2008). They show that the incumbent's bundled rebates can fail existing (predation–style) price tests[31] when welfare rises, and pass these tests when welfare declines. Thus, they define an alternative test based on comparing the monopoly component price before and after the institution of bundled rebates. They show that their test has the clear implication of improving consumer surplus when firms produce a homogeneous competitive component. However, this is not necessarily the case when competitive components are horizontally differentiated, where bundled rebates may deter entry or induce exit.

In this paper, we consider vertically differentiated products. An important point is that, with respect to Greenlee *et al*. (2008), we extend the model to endogenize both the dominant firm's choice of bundling strategy (partial mixed, complete mixed, or pure bundling) and the rival firm's product selection (high or low quality). We find that, in this more complex setting, using the proposed price test is socially beneficial compared with the do-nothing scenario, while a predatory pricing test is still not consistent with consumer surplus or welfare maximization.

3 The model

In this section, we present a simple model to analyze how the dominant firm's bundle affects competition and the incentives to invest of a single-product rival firm.

3.1 Basic assumptions

We consider two firms, a dominant firm (firm 1) and a rival firm (firm 2), and two products, A and B. The market for product A is monopolized by firm 1, while the market for product B is served by both firms. Marginal costs are normalized to zero for both products. Products A and B are perfect complements. Thus, consumers receive no benefit from purchasing a unit of either product by itself and are interested in using a system consisting of exactly one unit of product A and one unit of product B.[32] Consumers may choose between buying both products from the dominant firm (system 1) or buying product A from the dominant firm and product B from the rival firm (system 2).

The dominant firm can decide to sell products A and B in bundle or on a stand-alone basis. We assume that, when the dominant firm bundles, it also sells product A stand-alone. Thus, we consider

31 A prominent example is the so-called *Ortho* test. For a bundled discount on two products that are provided one in monopoly and one in a competitive market, the test allocates the bundle rebate to the competitive product and compares the discount-adjusted price of this product to the incumbent's incremental cost of providing the product. If the discount-adjusted price exceeds cost, the bundled rebate is deemed not to be anticompetitive (see Carlton *et al.*, 2008).

32 The main results of this paper are diluted, but not reversed, in the case of imperfect complements.

an instance of partial mixed bundling.[33] We assume that, when purchasing products in bundle, consumers perceive an increase in gross utility. There are two alternative motivations, depending on the type of bundle. Technological bundling realizes some technical enhancement due to integrating products (e.g. an improved system functionality), while commercial bundling enables consumers to save on research and transaction costs (e.g. due to *one-stop shopping*). Under technological bundling, consumers cannot undo the bundle. This means that they cannot add a unit of firm 2's product to system 1, because the former is incompatible with the latter. This is not the case for a commercial bundle, so that consumers are able to undo the bundle. In what follows, we focus on technological bundling, but the main qualitative results are preserved with commercial bundling.

The rival firm has two alternative strategies available in market B. First, it can invest in product quality so as to sell a superior component that raises consumers' wtp for system 2. If the rival firm invests then it incurs a sunk cost *F*, but system 2 is able to capture the highest-wtp consumers (thus, we will refer to the rival firm as the *high*-quality firm). Second, the rival firm can produce a perfect substitute of the dominant firm's component at no cost. In such a case, provided that firm 1 bundles products, system 2 is of lower quality than system 1 (so that we will refer to firm 2 as the *low*-quality firm) and only low-wtp consumers may decide to purchase system 2.

When purchasing system 1 or system 2 respectively, consumer x gets the following utilities:

$$U_{S1} = \begin{cases} V + x - p_A - p_{B1} & \text{under stand - alone selling} \\ V + \beta x - p_{AB} & \text{under product bundling} \end{cases}$$

$$U_{S2} = \begin{cases} V + x - p_A - p_{B2} & \text{if firm 2 is low - quality} \\ V + \gamma x - p_A - p_{B2} & \text{if firm 2 is high - quality} \end{cases}$$

Parameter V in the utility function denotes the gross benefit that each consumer receives from using a system. Parameter x, which is uniformly distributed over the unit interval [0,1], identifies the consumer's type and measures the additional wtp of consumer x for the system. We consider a population of mass 1 of heterogeneous consumers. Parameter β ($\beta > 1$) measures the incremental wtp for the bundle, while parameter γ ($\gamma > 1$) measures the incremental wtp related to firm 2's quality investment.[34] Henceforth, we assume $\gamma > \beta$. Finally, p_A denotes the price of the monopoly component A, p_{Bi} the price of component B set by firm i (i=1, 2), and p_{AB} the price of the bundle.

We focus on market sharing equilibria with partial market participation, where low-wtp consumers may not be active. Under technological bundling, this means that $V \in (0,1)$ and $\gamma \leq \bar{\gamma}$, where the expression of $\bar{\gamma}$ is obtained in the proof of Proposition 4 (see Appendix 1, which reports

33 In section 6, we extend the basic model so as to allow firm 1 to also engage in pure and complete mixed bundling.

34 The multiplicative model specification entails that high-wtp users value quality or time more than low-wtp users.

the proofs of all propositions).[35] We also assume $F \in \left(0, F^{ah}\right]$, where $F^{ah} = (\gamma - 1)/4$ is the critical value of the sunk cost that reduces firm 2's profit to zero when it invests under stand-alone selling. This means that investing is always feasible in the most favourable scenario to firm 2.

We define a game of complete information in the following three stages.

Stage 1. Firm 1 chooses whether or not to bundle products (we use superscript *b* to denote firm 1's partial mixed bundling strategy, and *a* to denote stand-alone selling).

Stage 2. Firm 2 chooses whether or not to invest in product quality (we use superscript *h* to denote firm 2's high-quality production, and *l* to denote low-quality production).

Stage 3. Firms simultaneously set prices.[36]

In this section, we consider the case where firm 1 can freely bundle products (we refer to this case as the *do-nothing* scenario). In section 5, we will consider the case where firm 1's bundled offer is subject to a price test. We solve the game backwards.

3.2 Price competition

At stage 3, firms compete in prices given firm 1's choice whether or not to bundle (stage 1) and firm 2's choice whether or not to invest (stage 2). We thus have to analyze four different subgames.

3.2.1 Stand-alone selling and low-quality production

Assume that the two products are sold separately by firm 1, and that firm 2 is low-quality. Thus, firm 1's profit is $\pi_1 = p_{B1}q_{S1} + p_A(q_{S1} + q_{S2})$ and firm 2's profit is $\pi_2 = p_{B2}q_{S2}$, where q_{Si} denotes the quantity sold of system *i* (*i*=1, 2).

Since firms provide perfect substitutes in market B, then product B is priced at marginal cost (i.e. $p_{B1}^{al} = p_{B2}^{al} = 0$), while firm 1 sets the monopoly price for product A, that is, $p_A^{al} = (V + 1)/2$.[37] Thus, the total quantity sold is $q_{S1}^{al} + q_{S2}^{al} = (V + 1)/2$. Hence, at equilibrium firm 1 achieves the monopoly profit, namely, $\pi_1^{al} = (V + 1)^2/4$, while firm 2 gains $\pi_2^{al} = 0$.

35 For $V \leq 0$, firm 1 would monopolize market B both under stand-alone selling with a high-quality rival firm and under product bundling with a low-quality rival. For $V \geq 1$, there would be full market participation under stand-alone selling. For $\gamma > \overline{\gamma}$, firm 1 would prefer to exit market B under stand-alone selling with a high-quality rival.

36 The timing of the game is tailored to the case of technological bundling. Under commercial bundling, it is reasonable to assume that the rival firm may decide to invest at the first stage, and the dominant firm may decide to bundle at the second stage. Our main results are robust to this change in timing.

37 Since products are complements, then we should more properly state that the monopoly price for product A is the price that firm 1 sets for product A under stand-alone selling when the price of product B is set at cost.

3.2.2 Stand-alone selling and high-quality production

Assume that firm 1 offers the two products separately and firm 2 invests in quality. Thus, firm 1's profit is $\pi_1 = p_{B1}q_{S1} + p_A(q_{S1} + q_{S2})$, while firm 2's profit is $\pi_2 = p_{B2}q_{S2} - F$. High-wtp consumers buy system 2, while the marginal consumer (i.e. the lowest-wtp consumer to be active) is the one who derives zero utility from buying system 1. Thus, the demand curves for system 2 and system 1 respectively are $q_{S2}^{ah} = 1 - \left(p_{B2}^{ah} - p_{B1}^{ah}\right)/(\gamma - 1)$ and $q_{S1}^{ah} = \left(p_{B2}^{ah} - p_{B1}^{ah}\right)/(\gamma - 1) - \left(p_{B1}^{ah} + p_A^{ah} - V\right)$.

Firms' profit maximization leads us to obtain the following equilibrium prices and profits:

$$p_A^{ah} = (V + 1)/2 \qquad p_{B1}^{ah} = 0 \qquad p_{B2}^{ah} = (\gamma - 1)/2;$$

$$\pi_1^{ah} = (V + 1)^2/4 \qquad \pi_2^{ah} = (\gamma - 1)/4 - F,$$

where the value of p_{B1}^{ah} is a corner solution given by the binding non-negativity constraint on that price,[38] while the corresponding quantities are $q_{S1}^{ah} = V/2$ and $q_{S2}^{ah} = 1/2$.

As expected, firm 2's price for product B (and firm 2's profit) rises with γ. Although firm 1's prices (and profit) are the same as when firm 2 is low-quality, the rationale for setting these prices is quite different. If firm 2 is low-quality then firm 1 is not able to gain from products A and B being perfect complements, since there is Bertrand competition with homogeneous products in market B. Conversely, if firm 2 is high-quality then firm 1 can take advantage of product complementarity to the extent that product B is not priced below cost.

3.2.3 Product bundling and low-quality production

If firm 1 bundles and firm 2 is low-quality, then high-wtp consumers buy system 1. Firm 1's profit is $\pi_1 = p_{AB}q_{S1} + p_A q_{S2}$ and firm 2's profit is $\pi_2 = p_{B2}q_{S2}$. Demand curves for system 1 and system 2 respectively are $q_{S1}^{bl} = 1 - \left(p_{AB}^{bl} - p_{B2}^{bl} - p_A^{bl}\right)/(\beta - 1)$ and $q_{S2}^{bl} = \left(p_{AB}^{bl} - p_{B2}^{bl} - p_A^{bl}\right)/(\beta - 1) - \left(p_{B2}^{bl} + p_A^{bl} - V\right)$.

First-order conditions of profit maximization give the following equilibrium prices and profits:

38 Since marginal costs are normalized to zero, then a zero price is a cost-oriented price. If we relax non-negativity constraints on prices, then we find that the dominant firm would set a below-cost price in market B and subsidize the competitive component with profit from the monopoly component. Thus, firm 1 would achieve a virtual tie on complementary products. However, in so doing the dominant firm would restrict competition and the rival firm's ability to invest in quality. Hence, firm 1's strategy would be subject to antitrust scrutiny. We can prove that, in our model, this strategy would be detrimental for consumer surplus and social welfare. Consequently, it is reasonable to assume that, in our full information setting, to prevent antitrust sanctions firm 1 does not set a below-cost price in market B under stand-alone selling. Removing this assumption would not significantly restrict the scope of the results (see footnote 20).

$$p_{AB}^{bl} = (V + \beta)/2 \quad p_A^{bl} = (V(1+2\beta) + 3\beta)/6\beta \quad p_{B2}^{bl} = V(\beta - 1)/3\beta \ ;$$

$$\pi_1^{bl} = (18V\beta + 9\beta^2 + V^2(5+4\beta))/36\beta \quad \pi_2^{bl} = V^2(\beta - 1)/9\beta \ ,$$

while the corresponding quantities are $q_{S1}^{bl} = (V + 3\beta)/6\beta$ and $q_{S2}^{bl} = V/3$.

At equilibrium, the price of the bundle, the price of system 2 (i.e. $p_{S2}^{bl} = p_A^{bl} + p_{B2}^{bl}$) and the price of firm 2's component B rise with β, while the price of the monopoly component decreases with β. Both firms' profits rise with β. It is worth noting that the implicit price of product B in the bundle is always above cost, that is, the margin $\Delta^{bl} = p_{AB}^{bl} - p_A^{bl}$ is always positive.

3.2.4 Product bundling and high-quality production

If firm 1 bundles and firm 2 is high-quality then, since $\gamma > \beta$, high-wtp consumers buy system 2. Firm 1's profit is $\pi_1 = p_{AB}q_{S1} + p_A q_{S2}$ and firm 2's profit is $\pi_2 = p_{B2}q_{S2} - F$. Demand curves for systems 2 and 1 respectively are $q_{S2}^{bh} = 1 - (p_{B2}^{bh} + p_A^{bh} - p_{AB}^{bh})/(\gamma - \beta)$ and $q_{S1}^{bh} = (p_{B2}^{bh} + p_A^{bh} - p_{AB}^{bh})/(\gamma - \beta) - (p_{AB}^{bh} - V)/\beta$.

First-order conditions of profit maximization give the following equilibrium prices and profits:

$$p_{AB}^{bh} = (V + \beta)/2 \quad p_A^{bh} = (3V + \beta + 2\gamma)/6 \qquad p_{B2}^{bh} = (\gamma - \beta)/3 \ ;$$

$$\pi_1^{bh} = (18V\beta + 9V^2 + 5\beta^2 + 4\beta\gamma)/36\beta \qquad \pi_2^{bh} = (\gamma - \beta)/9 - F \ ,$$

while the corresponding quantities are $q_{S1}^{bh} = (3V + \beta)/6\beta$ and $q_{S2}^{bh} = 1/3$.

At equilibrium, the bundle price and the stand-alone monopoly component price rise with β. Contrary to the preceding case, firm 2's component price and the price of system 2 decrease with β. In addition, the stand-alone monopoly component price and firm 2's component price rise with γ.

Since bundling raises consumers' wtp for system 1, then we have that firm 1 sets a higher price for the system than the sum of component prices under stand-alone selling, regardless of firm 2's product choice. This finding is different from the conventional case with no efficiency gains from bundling, where the dominant firm sets a bundled rebate to induce consumers to buy the bundle.

Given that $\gamma > \beta$, we find that $p_{AB}^{bh} < p_A^{bh}$, so as $\Delta^{bh} = p_{AB}^{bh} - p_A^{bh} < 0$. Thus, technological bundling enables firm 1 to evade the non-negativity constraint on the price of product B that it has to fulfil under stand-alone selling.[39] If the bundle is technological and firm 2 invests, then the implicit price

39 This finding is tailored to the case of technological bundling. If the bundle is commercial, then firm 1 cannot set a higher price for the monopoly component than for the bundle. In fact, high-wtp consumers who intend to use firm 2's

of product B within the bundle is below cost. Hence, to persuade some consumers to buy a lower quality system than the one including the rival's component, firm 1 subsidizes the competitive component with the monopoly one. It is worth noting that subsidization occurs at no loss to firm 1.

As expected, firm 2's profit increases with γ and decreases with β. Less intuitively, firm 1's profit may increase or decrease with β. Indeed, the demand for the bundle shrinks when β rises ($\partial q_{S1}^{bh} / \partial \beta = -V / 2\beta^2 < 0$). Thus, the negative effect of β on demand (the higher the value of V, the stronger the negative effect) may offset the positive effect of β on prices. Note that firm 1's profit rises with γ, even though a higher γ provides a competitive advantage to system 2. The motivation is that consumers always have to buy the monopoly component A jointly with firm 2's product.

3.3 Firms' choices about bundling and investment

In this section, first we analyze firm 2's choice about quality investment (stage two), and then firm 1's choice about product bundling (stage one).

3.3.1 The rival firm's choice

At the second stage, firm 2 decides whether to provide low or high quality, depending on whether or not firm 1 bundles products at the first stage. If firm 1 opts for stand-alone selling, then firm 2 always invests when it is feasible. Indeed, we find:

$$\pi_2^{ah} \geq \pi_2^{al} \quad \text{for } F \leq F^{ah} \text{ and } \gamma > 1.$$

If firm 1 bundles then firm 2 chooses to invest provided that the sunk cost of investment is sufficiently low, and consumers' incremental wtp for quality is high enough. In fact, we have:

$$\pi_2^{bh} \geq \pi_2^{bl} \quad \text{for } F \leq F' \text{ and } \gamma > \gamma',$$

where $F' = \left(\beta(\gamma - \beta) - V^2(\beta - 1)\right)/9\beta$ and $\gamma' = \left(V^2(\beta - 1) + \beta^2\right)/\beta > 1$.

We find that $F' < F^{bh}$, where $F^{bh} = (\gamma - \beta)/9$ is the critical value of the sunk cost that reduces firm 2's profit to zero when it invests as a response to firm 1's bundle. Differently from the case of stand-alone selling, if firm 1 bundles then firm 2 may choose to produce low quality even when

component would buy the entire system from firm 1 and then disentangle it to use only the monopoly component. It follows that, at equilibrium, the constraint $p_{AB}^{bh} \geq p_A^{bh}$ is binding on firm 1. We thus find $p_{AB}^{bh} = p_A^{bh} = (V + \beta)/2$ and $p_{B2}^{bh} = (\gamma - \beta)/2$, while the corresponding quantities are $q_{S1}^{bh} = V/2\beta$ and $q_{S2}^{bh} = 1/2$. Compared with technological bundling, the bundle price is the same while the price of system 2 decreases (where the stand-alone monopoly component price decreases and firm 2's component price rises). Moreover, the quantity sold by firm 2 rises while the quantity sold by firm 1 decreases. This entails that firm 2's profit rises while firm 1's profit decreases.

producing high quality would provide firm 2 with a positive profit.

Since consumers value firm 1's bundle, then under product bundling it is more difficult for firm 2 to attain the necessary scale to invest. Indeed, we find that $q_{S2}^{ah} > q_{S2}^{bh}$ and $p_{B2}^{ah} > p_{B2}^{bh}$. This entails that $F^{bh} < F^{ah}$. It follows that $F' < F^{ah}$. Thus, we can state the following proposition.

Proposition 1. Product bundling reduces the rival firm's ability to invest in quality.

3.3.2 The dominant firm's choice and equilibrium of the game

At the first stage, firm 1 decides whether or not to bundle products while anticipating the outcomes of stages 2 and 3. Proposition 2 shows that product bundling is a profitable strategy for firm 1 independent of firm 2's choice.[40] Thus, bundling is a credible strategy.

When the rival firm provides low quality, bundling raises firm 1's profit since it introduces vertical differentiation between systems and softens price competition. In such a case, product bundling also benefits the low-quality rival firm.

When the rival firm invests in quality, bundling reduces vertical differentiation between systems, but enables firm 1 to gain from price discrimination. Indeed, firm 1 sets a high stand-alone price for the monopoly component and a relatively low price for the bundle. This provides firm 1 with a mechanism to attract more consumers to the bundle, while concurrently extracting surplus from high-wtp consumers buying system 2. Since those consumers have to buy the monopoly component from firm 1, then raising the stand-alone price of that component is in a sense a raising rival's cost strategy. Therefore, product bundling harms the high-quality rival firm.

Proposition 2. Product bundling is the preferred strategy of the dominant firm.

Since firm 1 always chooses to bundle, then there are only two possible equilibria of the game: bundling with low-quality, or with high-quality production. Corollary 1 follows from section 3.3.1.

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40 If $\beta = 1$, then bundling is still a profitable strategy, but the case of commercial bundling cannot be distinguished from stand-alone selling. If $\beta > 1$, but we relax non-negativity price constraints under stand-alone selling, then technological bundling is a profitable strategy provided that $V \leq \sqrt{5}/3$, or $V > \sqrt{5}/3$ and $\beta \geq 9V^2/5$. On the other hand, if firm 1 incurs a fixed cost of bundling *K*, then technological bundling is a profitable strategy as long as $K \leq \min\{K_1, K_2\}$, where $K_1 = \left(\beta(5\beta + 4\gamma - 9) - 9V^2(\beta - 1)\right)/36\beta$ and $K_2 = \left(9\beta - 5V^2\right)(\beta - 1)/36\beta$ derive from comparing firm 1's profit respectively when firm 2 is high-quality and when is low-quality.

Corollary 1. At the equilibrium of the game, the dominant firm bundles products. If the sunk investment cost is sufficiently low, and the incremental wtp for quality is high enough then the rival firm provides high quality, otherwise it provides low quality.

4 Welfare analysis

In this section, we assess welfare implications of product bundling. We define social welfare W as the sum of consumer surplus CS and firms' profits, namely, $W = CS + \pi_1 + \pi_2$. Consumer surplus is defined as $CS = \int_{ind}^{1} U_{Sj} dx + \int_{mar}^{ind} U_{Si} dx$, where *ind* is the indifferent consumer, that is, the consumer for which $U_{Si} = U_{Sj}$, and *mar* is the marginal consumer, that is, the consumer for which $U_{Si} = 0$. System S_i, $i \in \{1, 2\}$, is system 1 when firm 2 is high-quality, and is system 2 when firm 2 is low-quality, while system S_j, $j \in \{1, 2\}$, is such that $j \neq i$.[41]

In our model, bundling has no *a priori* clear-cut effects on welfare. In fact, firm 1's bundle raises consumer gross surplus, but it is also a price discrimination device. Moreover, bundling raises firm 1's profit, but reduces the high-quality rival's profit. We solve this potential conflict largely against bundling. First, we show that bundling reduces consumer surplus (Proposition 3). Indeed, firm 1's bundle reduces market participation. When firm 2 invests, bundling extracts surplus from high-wtp consumers buying the high-quality system, and induces some consumers to prefer the low-quality system. When investment is blockaded, consumers have a lower quality system at their disposal.

Proposition 3. Consumer surplus is higher under stand-alone selling than under product bundling.

Then we show that, if investment is viable when firm 1 bundles (namely, if $F \leq F^{bh} < F^{ah}$), then bundling negatively affects welfare. Indeed, bundling harms the high-quality rival firm, and may even deny firm 2 the necessary scale to invest in quality. Even if firm 1's profit rises, this is not enough to offset the loss in consumer surplus and firm 2's profit. Nonetheless, we show that, when $F > F^{bh}$, there are some cases where bundling improves welfare. These occur since firm 1's bundle prevents the rival firm from making inefficient investment, which would take place under stand-alone selling (i.e. if bundling is prohibited). Proposition 4 summarizes the results.

41 Under stand-alone selling, if firm 2 is low-quality then systems are perfect substitutes, so that the indifferent consumer is indeterminate. Thus, consumer surplus can be rewritten as $CS = \int_{mar}^{1} U_{S1}^{al} dx = \int_{mar}^{1} U_{S2}^{al} dx$.

Proposition 4. If quality investment is feasible under product bundling, then welfare is higher under stand-alone selling than with bundling. Otherwise welfare is higher with bundling when the sunk cost of investment is high enough, while the incremental wtp for quality is sufficiently low.

We have shown that firm 1's bundle reduces firm 2's ability to invest (Proposition 1). Since welfare implications depend on the investment cost and consumers' valuation of quality, then a *per se* rule against bundling is not justified. Indeed, antitrust agencies can better adopt a rule of reason standard. In this framework, as we will show in the following section, they can effectively investigate possible anticompetitive effects of bundling by using a suitable price test.

5 A price test for bundled offers

In this section, we introduce a simple price test that controls the stand-alone price of the monopoly component under product bundling. Basically, this test requires that firm 1 do not raise the price of component A under product bundling over the monopoly price of that component so as to limit firm 2's market share when it is high-quality, or blockade firm 2's investment at all.

Formally, the test imposes that $p_A^{bk} \leq (1+V)/2$, $k \in \{l,h\}$, where $(1+V)/2$ is the monopoly price of component A, provided that the price of component B is cost-oriented. Note that, in our stylized model, this is the same price as firm 1 sets under stand-alone selling (sections 3.2.1 and 3.2.2).[42]

In what follows, we show that the proposed test preserves efficiencies from both bundling and quality investment, provided that it is socially beneficial. We also show that such test does not comply with the logic of predatory pricing.

5.1 Equilibrium under the price test regime

Assume that firm 1's bundled offer is subject to the price test (superscript *t* denotes the test regime) and firm 2 is low-quality. In such a case, the price test is not binding. If firm 2 is high-quality, then from constrained profit maximization we obtain the following equilibrium prices and profits:

$$p_{AB}^{th} = \left(\beta\left(2\beta + V - 3\right) - 2\gamma\left(2V + \beta\right)\right)/2\left(\beta - 4\gamma\right)$$

$$p_A^{th} = (1+V)/2 \qquad p_{B2}^{th} = \left(\beta - \gamma\right)\left(2\gamma - 1\right)/\left(\beta - 4\gamma\right);$$

$$\pi_1^{th} = \left(\beta^2(1+V)(V+2\beta-1) - 4\gamma\left(\beta\left(2+2V^2+4V\beta+\beta^2\right) + \gamma\left(4V^2+8V\beta+4\beta+\beta^2\right)\right)\right)/4\beta\left(\beta-4\gamma\right)^2$$

$$\pi_2^{th} = \left(\gamma - \beta\right)\left(4\gamma\left(\gamma - 1\right) + 1\right)/\left(\beta - 4\gamma\right)^2,$$

42 In the absence of a reliable estimate of the monopoly price of product A (given a cost-oriented price of product B), the effectiveness of the test depends on monitoring firm 1's prices before and after the introduction of the bundled offer.

while quantities are $q_{S1}^{th} = \left(V\left(\beta - 4\gamma\right) + \beta\left(1 - 2\gamma\right)\right)/2\beta\left(\beta - 4\gamma\right)$ and $q_{S2}^{th} = \left(1 - 2\gamma\right)/\left(\beta - 4\gamma\right)$.[43]

We find that, compared with the do-nothing scenario, the prices of both firm 1's bundle and of system 2 decrease under the price test regime. Consequently, there is higher market participation. We find that the stand-alone price of the monopoly component decreases, while the price of firm 2's superior component increases, as well as the implicit price of product B within the bundle. We also find that firm 2's profit rises under the test regime. This means that applying the price test improves the rival firm's ability to invest in quality.

Clearly, since firm 1 acts in a constrained environment then it earns lower profit than when it can freely set prices. Nonetheless, we find that product bundling is still the preferred strategy of firm 1 under the test regime. Proposition 5 summarizes the results.

Proposition 5. Under the test regime, product bundling is the preferred strategy of the dominant firm. Moreover, the rival firm has a higher ability to invest compared with the do-nothing scenario.

5.2 Welfare effects of the price test regime

We show that, given that the rival firm invests under the price test regime, both consumer surplus and social welfare are higher when the price test is active than when is not (Proposition 6). First, assume that firm 2 invests both under the test regime and in the do-nothing scenario. In such a case, the price test enables firm 2 to keep more rents from investment, and consumers to retain more surplus. Although firm 1 is worse off, we find that the net welfare effect is positive. Now, assume that firm 2 is high-quality under the test regime, but is low-quality in the do-nothing scenario. Consumer surplus rises under the test regime since the bundle price is lower and there is a higher demand for the high-quality system. Clearly, firm 2's profit rises under the test regime, while firm 1 can be better off (when β is low and γ is high, as in the do-nothing scenario) or worse off (for the remaining parameter values). In any case, we find that the net welfare effect is positive.[44]

Proposition 6. Given that the rival firm invests under the price test regime, both consumer surplus and social welfare are higher when the price test is active than when is not.

The results obtained show that social welfare is higher (or not lower) when the price test is active

43 For $1 < \beta \leq 2$, we need to ensure that $V \in \left(0, \beta\left(3 - 2\beta + 2\gamma\right)\right)/\left(4\gamma - \beta\right)$ holds to have market sharing equilibria with partial market participation under technological bundling, where the upper bound on V is not lower than $1/2$.

44 When firm 2 chooses low-quality production both with and without the price test, social welfare is not affected.

than when is not, while it may be higher when firm 1 freely sets its bundled offer than when bundling is prohibited. This entails that, in a world with asymmetric information, prohibiting bundling may be socially costly since an authority faces a not negligible risk of error. On the other hand, a price test regime is a less intrusive and beneficial remedy.

Having said that, let us compare the welfare effects of the price test regime with the alternative case of a ban on bundling. We find that, when bundled offers are prohibited, firm 2 manages to invest in more cases. Indeed, we can easily check that both $\pi_2^{bh} < \pi_2^{th} < \pi_2^{ah}$ and $\pi_2^{bl} = \pi_2^{tl} > \pi_2^{al}$ hold. Nonetheless we show that, when firm 2 invests under the test regime, both consumer surplus and welfare are higher than when bundling is prohibited. Indeed, the price of system 2 decreases so as high-wtp consumers retain more surplus, while low-wtp consumers benefit from efficiency gains from bundling. Since bundling is a profitable strategy for firm 1, then firm 1 is worse off when bundling is prohibited. Although firm 2 is better off with a ban on bundling, this does not outweigh the loss in consumer surplus and firm 1's profit.[45] Thus, we can state the following proposition.

Proposition 7. Given that the rival firm invests under the price test regime, both consumer surplus and social welfare are higher than in the case when there is a ban on bundling.

5.3 Policy implications

Antitrust agencies in Europe and in the US generally employ price-cost tests that follow the logic of predatory pricing to detect restriction of competition due to tying and bundling. Under multiproduct pricing, a crucial issue is the aggregation level of the price test. When there is bundle to bundle competition the test may be applied at the bundle level, otherwise a disaggregated test should be preferred. In the latter case, bundling is deemed not to be anticompetitive when an equally efficient competitor offering only some of the components can compete profitably against the dominant firm's bundle. Thus, authorities will usually not intervene if the implicit price of each product in the bundle remains above the dominant firm's long run average incremental cost (see e.g. EC, 2008).[46]

We have shown that, in our model, all bundled offers are such that the bundle price exceeds the cost of providing the bundle, so that they would pass a predatory test at the bundle level. However,

45 Assume that firm 2 does not invest under the test regime. If firm 2 invests when bundling is prohibited then consumer surplus rises, but social welfare can be higher or lower. Thus, a ban on bundling may allow some inefficient investment.

46 Price tests for bundled offers in regulated electronic communications markets follow the same line of reasoning, but the relevant cost is that of a *reasonably efficient* rather than equally efficient competitor (see e.g. ERG, 2009).

these offers might allow the dominant firm to blockade efficient investment by a specialized rival.[47] In order to prevent this outcome it is necessary to apply a disaggregated test that controls the implicit price of the competitive component in the bundle. In this framework, a predatory pricing test would force a margin that is not below firm 1's average incremental cost of producing the complementary component. Thus, in our setting a predatory pricing test would impose the dominant firm to set a zero margin, independent of β.

It is worth noting that our test is not consistent with a predatory pricing approach to bundling. Indeed, assume that firm 2 invests under our test, and let $\Delta^{th} = p_{AB}^{th} - p_{A}^{th}$ be the related margin between the bundle price and the stand-alone price of the monopoly component (i.e., the implicit price of product B in the bundle). We find that $\Delta^{th} < 0$ when $1 < \beta < 2$,[48] while $\Delta^{th} \geq 0$ when $\beta \geq 2$. Thus, when the incremental wtp for the bundle is low, firm 2 can effectively invest and provide a superior complementary component even if firm 1 sets an aggressive price for the bundle. On the other hand, when the incremental wtp for the bundle is high enough, a strictly positive margin is necessary to create room for firm 2's efficient investment.

It follows that, in our setting, using a predatory pricing test is not theoretically grounded, since such test does not take account of vertical product differentiation. Indeed, it is not clear what *equally efficient competitor* means when products are vertically differentiated. Moreover, the competitive problem here is not related to market foreclosure but to limiting, or preventing technology adoption (although both issues concern scale, they are different in nature and effects).

Thus, it is not surprising that applying such test may be socially detrimental in our model. This is indeed the case when the incremental wtp for the bundle is low, and passing the predatory pricing test implies setting an implicit price of product B in the bundle that is as high as it induces inefficient investment. We also show that, when firm 2 invests under our test, it is socially desirable

47 The case when bundling achieves foreclosure of an efficient single-product rival without pricing below cost is known as *no cost predation* (see e.g. Nalebuff, 2005). In our case, the rival remains active, but is low- instead of high-quality.

48 This case is ruled out under commercial bundling. If the bundle is commercial, then, when $1 < \beta < 2$, the constraint $p_{AB}^{bh} \geq p_{A}^{bh}$ is binding both on firm 1 and the public agency. We thus find that, if the price test is active, then prices in this region are $p_{AB}^{bh} = p_{A}^{bh} = (1+\beta)/2$ and $p_{B2}^{bh} = (\gamma - \beta)/2$, while the corresponding quantities are $q_{S1}^{bh} = (V + \beta - 1)/2\beta$ and $q_{S2}^{bh} = 1/2$. Compared with technological bundling, when $1 < \beta < 2$, the stand-alone monopoly component price is the same, while the bundle price, firm 2's component price, and the price of system 2 do increase. Furthermore, the quantity sold by firm 2 rises while the quantity sold by firm 1 decreases, with a negative net effect on market participation. Consequently, firm 1's profit decreases while firm 2's profit increases.

to perform the proposed test instead of a predatory pricing test. Since the latter controls only the implicit price of product B in the bundle then it allows higher prices relative to the proposed test, with a negative effect on market participation. Proposition 8 summarizes the results.

Proposition 8. Compared with the do-nothing scenario, a predatory pricing test reduces welfare when it induces inefficient investment. Furthermore, given that the rival firm invests under the proposed test, consumer surplus and welfare are higher than under a predatory pricing test.

Since in our model firm 1's bundle raises consumers' valuation, and thus provides firm 1 with an effective tool to price discriminate, then it would be theoretically appropriate to set a stricter cap on the monopoly component stand-alone price under product bundling relative to stand-alone selling. Assume that the price test imposes $p_A^{bk} \leq (1+V)/2-\mu$, $k \in \{l,h\}$, where $0<\mu \leq (1+V)/2$. We can prove that consumer surplus and social welfare rise with μ in the feasible region, provided that firm 1 still bundles at equilibrium.[49] However, since the "optimal" μ inevitably depends on demand parameters such as β and γ, then it would be difficult to implement such test in practice, and we do not provide additional details here.

6 Model extension: endogenous bundling strategy

We now extend firm 1's strategy space by including pure bundling (henceforth denoted as *m*), where firm 1 provides only the bundle, and complete mixed bundling (denoted as *c*), where firm 1 provides both the bundle and each component on a stand-alone basis. The main purpose is to investigate welfare effects when we endogenize firm 1's choice of bundling strategy, both in the do-nothing scenario and under the price test regime.

For simplicity, in this section we deal only with the case of technological bundling.[50] Thus, if firm 1 practices pure bundling, then firm 2 is foreclosed. If firm 1 practices complete mixed bundling, then there are two alternative cases. When firm 2 sells low quality, system 2 and the system composed by firm 1's stand-alone products are perfect substitutes purchased by low-wtp consumers, while high-wtp consumers buy the bundle. When firm 2 sells high quality, firm 2 offers the superior system while firm 1 offers the two inferior systems.[51]

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49 If the price test imposes $p_A^{bk} \leq (1+V)/2-\mu$, then we have $\Delta^{th}>0$ for $\mu > 1/4$. Thus, when there is a sufficiently tight cap on the stand-alone price of product A, the implicit price of product B in the bundle is above cost.

50 See Appendix 2 for formal details about the third stage of the game.

51 In such a case, the system composed by firm 1's stand-alone products has a positive demand when $V \in (1/2,\ 1)$ and

First, consider the do-nothing scenario. We find that firm 1 prefers to practice mixed bundling, either partial or complete, rather than offering only a technological bundle and thus excluding the rival. Indeed, mixed bundling provides firm 1 with a price discrimination device that enables firm 1 to extract surplus from the high-quality rival and its consumers. Let $F^{ch} = 4(\gamma - \beta)(\gamma - 1)^2 / (3 + \beta - 4\gamma)^2$ be the critical value of the sunk cost that reduces firm 2's profit to zero when it invests while firm 1 practices complete mixed bundling. Note that $F^{ch} > F^{bh}$. We find that, for $F \leq F^{ch}$, firm 1 chooses partial mixed bundling and the equilibrium of the game is exactly the same as in the basic model. If $F > F^{ch}$, then firm 1 chooses complete mixed bundling and firm 2 provides low quality. Welfare implications are qualitatively the same as in the basic model. Thus, consumer surplus is higher under stand-alone selling, and so is social welfare when quality investment is feasible under complete mixed bundling (otherwise welfare may be higher under complete mixed bundling).

When the price test is active, firm 1 cannot freely price discriminate. Hence, firm 1 can find it profitable to choose pure bundling and thus exclude firm 2 when it would have invested under mixed bundling. In such a case, consumer surplus and welfare at equilibrium are at the lowest level. Therefore, a public authority should require firm 1 to provide the monopoly component on a stand-alone basis.[52] If this occurs, then firm 1 may opt for complete rather than partial mixed bundling in some cases when firm 2 invests.[53] Nonetheless, as in the basic model, both consumer surplus and social welfare are higher under the test regime than in the do-nothing scenario.

7 Concluding remarks

We have shown that product bundling is the preferred strategy of a dominant firm in a primary market that faces competition from a single-product rival firm in a complementary market. Thus, in our model product bundling does not hinge on commitment ability of the multiproduct firm. On the one hand, given that the rival firm provides a perfect substitute, bundling introduces vertical differentiation between systems of complements and thus softens price competition. On the other hand, given that the rival firm invests in improving quality of the complementary component, bundling is an effective price discrimination device to extract surplus from the rival's customers. In

$\gamma > (\beta - 3 + V(3 + \beta))/(4V - 2)$. Outside this region, firm 1's strategy collapses to partial mixed bundling.

52 In some countries, such as Spain and Italy, Sky initially proposed a contract that forced consumers to buy or rent the decoder jointly with its exclusive content, thus closing a potentially lucrative competitive market (which in Spain could be worth more than €900 million), but this practice was judged illegal. A similar case is being investigated in Germany.

53 If firm 2 invests under complete mixed bundling, then the non-negativity constraint on p_{B1} in the do-nothing scenario has the same effect as the proposed test on p_A, so that we have $p_{B1} = 0$ and $p_A = (1 + V)/2$.

addition, given that there is a sunk cost of investment, the dominant firm's bundle denies scale and thus reduces the rival firm's incentives to invest. Hence, product bundling may drive high-quality systems out of the market, while creating room for low-quality alternatives.

Although we have explicitly modelled some efficiency gains from bundling, we have shown that bundling reduces consumer surplus and, when quality investment is feasible under bundled sales, social welfare. It follows that product bundling may be socially detrimental even when the rival firm is not foreclosed, and when investment is not blockaded.

Our model setting incorporates many features that have been identified as essential to build a case against bundling, due to potential harm on competition, consumers, and welfare. Nonetheless, we have found that product bundling does improve welfare when it prevents inefficient investment that would occur under stand-alone selling. It follows that a *per se* rule against bundling would not be appropriate. Indeed, prohibiting bundling would mean sacrificing related efficiencies.

We have thus considered a different scenario where the dominant firm is allowed to bundle products, but the bundled offer has to be consistent with a simple price test. Such test denies the dominant firm the possibility to strategically raise the stand-alone price of the monopoly component over the monopoly price of that component (which, in our stylized model, is exactly the price that the dominant firm sets under stand-alone selling). We have shown that such test enhances consumer surplus and welfare when it enables us to preserve efficiencies from both bundling and the rival firm's quality investment (while replicating the do-nothing scenario when the rival does not invest).

When efficiency gains from bundling are relatively low, the proposed test tolerates a margin between the bundle price and the stand-alone price of the monopoly component that is lower than the relevant cost of producing the competitive component. Conversely, if bundling creates large efficiency gains, then the test results in a strictly above-cost margin, which is essential to provide the rival firm with the correct incentives to invest. In both cases, the proposed test is in contrast with a predatory pricing test, which in our model would induce the dominant firm to set a cost-oriented margin independent of efficiencies from bundling. We have shown that, under vertical product differentiation, a predatory test is not consistent with consumer surplus or welfare maximization.

In the main part of our paper, we have focused on partial mixed bundling. Then, we have endogenized the dominant firm's choice of bundling strategy (partial mixed, complete mixed, or pure bundling). We have found that in the do-nothing scenario the dominant firm chooses mixed bundling (either partial or complete), and welfare effects are qualitatively the same as in the basic model. We have also found that under the test regime the dominant firm could profit from excluding the rival by offering only a technological bundle. It is thus socially desirable that the dominant firm

be forced to provide the monopoly component on a stand-alone basis.

The results obtained suggest some policy implications. From an antitrust perspective, product bundling by a dominant firm has typically been deemed anticompetitive when used as a method of predation that deters entry or induces exit. However we have argued that, in a setting of vertically differentiated products, predatory pricing is not the correct framework to employ in the face of the dominant firm's bundle. Furthermore, it follows from our results that antitrust cases about bundling in technologically evolving industries should take account of the effects of bundling on innovation even when the rival firm remains active. Indeed, it would be possible that, due to product bundling, the rival firm has lost scale that has caused, or will cause product quality to decrease. In such cases, if antitrust policy is based on short-term pricing and related welfare effects, then it could be socially harmful in the long run. On the other hand, pursuing dynamic rather than static efficiency goals would move antitrust policy closer to regulatory principles and tools.

Appendix 1

Proof of Proposition 1. If firm 1 opts for stand-alone selling at the first stage, then at the second stage firm 2 chooses to invest when $\pi_2^{ah} - \pi_2^{al} = \pi_2^{ah} \geq 0$, that is when $F \leq F^{ah}$. If firm 1 decides to bundle, then firm 2 chooses to invest when $\pi_2^{bh} - \pi_2^{bl} = \left(\beta(\gamma - \beta) - V^2(\beta - 1)\right)/9\beta - F > 0$, that is when $F \leq F' = \left(\beta(\gamma - \beta) - V^2(\beta - 1)\right)/9\beta$ and $\gamma > \gamma' = \left(V^2(\beta - 1) + \beta^2\right)/\beta$, where $\gamma > \gamma'$ ensures that $F' > 0$. Since we have that $F^{ah} - F' = \left(4V^2(\beta - 1) + \beta(5\gamma + 4\beta - 9)\right)/36\beta > 0$ and $\gamma' > 1$, then firm 1's bundle reduces the scope for firm 2's quality investment. ■

Proof of Proposition 2. Assume that firm 2 provides low quality. Then, we find that $\pi_1^{bl} - \pi_1^{al} = (\beta - 1)\left(9\beta - 5V^2\right)/36\beta > 0$. Assume now that firm 2 provides high quality. Then we find that $\pi_1^{bh} - \pi_1^{ah} = \left(\beta(5\beta + 4\gamma - 9) - 9V^2(\beta - 1)\right)/36\beta > 9(\beta - 1)\left(\beta - V^2\right)/36\beta > 0$. Since firm 1 chooses to bundle products regardless of firm 2's choice, then bundling is the preferred strategy of firm 1. ■

Proof of Proposition 3. Let $F \in \left(0, F^{ah}\right]$. Consequently, firm 2 invests under stand-alone selling. We find that $CS^{ah} = \left(V(2 + V) + \gamma\right)/8$, $CS^{bl} = \left(9\beta(2V + \beta) + V^2(5 + 4\beta)\right)/72\beta$ and $CS^{bh} = \left(9V(V + 2\beta) + \beta(5\beta + 4\gamma)\right)/72\beta$. Since we have that $CS^{ah} - CS^{bl} = \left(5V^2(\beta - 1) + 9\beta(\gamma - \beta)\right)/72\beta > 0$

and $CS^{ah} - CS^{bh} = \left(9V^2(\beta - 1) + 5\beta(\gamma - \beta)\right)/72\beta > 0$, then bundling reduces consumer surplus. ■

Proof of Proposition 4. First, assume that $F \in (0, F']$. Then, firm 2 invests under product bundling. We find that $W^{ah} = 3(V(2+V)+\gamma)/8 - F$ and $W^{bh} = \left(27V(V+2\beta) + \beta(7\beta + 20\gamma)\right)/72\beta - F$. It follows that $W^{ah} - W^{bh} = \left(27V^2(\beta - 1) + 7\beta(\gamma - \beta)\right)/72\beta > 0$. Now, let $F \in (F', F^{bh}]$. Then, although investment is viable, firm 2 provides low quality under product bundling. We find that $W^{bl} = \left(27\beta(2V + \beta) + V^2(7 + 20\beta)\right)/72\beta$. Now, let $F = F^{bh}$, that is the highest value of F in the feasible interval. We find that $W^{ah} - W^{bl} = \left(7V^2(\beta - 1) + 19\beta(\gamma - \beta)\right)/72\beta > 0$. Finally, let $F \in (F^{bh}, F^{ah}]$. Then, investment is not viable under product bundling. We find that $W^{bl} - W^{ah} = -\left(7V^2(\beta - 1) + 27\beta(\gamma - \beta)\right)/72\beta + F > 0$ when $F'' = \left(7V^2(\beta - 1) + 27\beta(\gamma - \beta)\right)/72\beta < F \le F^{ah}$ and $\gamma \le \min\{\underline{\gamma}, \overline{\overline{\gamma}}\}$, where the critical value $\overline{\overline{\gamma}} = \left(7V^2(1 - \beta) + 9\beta(3\beta - 2)\right)/9\beta$ ensures that $F'' \le F^{ah}$, while $\underline{\gamma} = \left(\left(9 + 10V + 9V^2\right) + 3\sqrt{9 + 20V + 22V^2 + 20V^3 + 9V^4}\right)/8$ ensures market sharing equilibria under stand-alone selling when firm 2 is high-quality. We conclude that bundling raises welfare provided that F is high enough (and such that investment is not viable with bundling), and γ is sufficiently low. ■

Proof of Proposition 5. Assume that firm 2 provides low quality. Since the price test is not binding, then it follows from Proposition 2 that $\pi_1^{tl} = \pi_1^{bl} \ge \pi_1^{al}$. Assume now that firm 2 provides high quality. We find that $\pi_1^{th} \ge \pi_1^{ah}$ always holds. Indeed, we have that:

$$\pi_1^{th}/\pi_1^{ah} = 1 + \left((\beta - 1)\left(\beta^2(1 - V^2) + 8\beta\gamma(1 + V^2) - 16V^2\gamma^2\right) + 4\gamma\beta^2(\gamma - \beta)\right)/\beta(1 + V)^2(\beta - 4\gamma)^2 >$$

$$> 1 + \left((\beta - 1)\left(8\beta\gamma(1 + V^2) - 16V^2\gamma^2\right) + 4\gamma\beta^2(\gamma - \beta)\right)/\beta(1 + V)^2(\beta - 4\gamma)^2 >$$

$$> 1 + \left(16V^2\gamma(\beta - \gamma)(\beta - 1) + 4\gamma\beta^2(\gamma - \beta)\right)/\beta(1 + V)^2(\beta - 4\gamma)^2 =$$

$$= 1 + 4\gamma(\gamma - \beta)(\beta - 2V)^2/\beta(1 + V)^2(\beta - 4\gamma)^2 > 1.$$ Thus, bundling is the preferred strategy of firm 1 independent of firm 2's choice.

If firm 2 invests, then it gets higher profit under the test regime than in the do-nothing scenario. Indeed, we find that $\pi_2^{th} - \pi_2^{bh} = (\gamma - \beta)(\beta + 2\gamma - 3)(10\gamma - \beta - 3)/9(\beta - 4\gamma)^2 > 0$. Since firm 2's

profit is not affected when firm 2 is low-quality, then there is a region where firm 2 invests when the price test is active and does not invest when it is not. ■

Proof of Proposition 6. Assume that firm 2 provides high quality under the price test regime. Let us first consider consumer surplus. We find that: $CS^{th} = \left((5+V-10\gamma)(1+V-2\gamma)+16V^2\gamma^2+4\beta\gamma\left(1-2V(3+V)-4\gamma+12V\gamma+4\gamma^2\right)\right)\Big/8\beta(\beta-4\gamma)^2$.

If firm 2 provides high quality in the do-nothing scenario, then we find that: $CS^{th}-CS^{bh} = (\beta+2\gamma-3)\left(4\gamma(18V+10\gamma-3)+\beta(46\gamma-5\beta-18V-15)\right)\Big/72(\beta-4\gamma)^2 > 0$.

If firm 2 is low-quality in the do-nothing scenario, then we find that $CS^{th} \geq CS^{bl}$. Indeed, we have: $CS^{th}-CS^{ah} = V^2(1-\beta)/8\beta + V(\beta+2\gamma-3)/4(4\gamma-\beta)+\left(5\beta+4\gamma-\beta\gamma(20+\beta)+4\gamma^2(7\beta-4)\right)\Big/8(\beta-4\gamma)^2 >$

$> V^2(1-\beta)/8\beta+\left(5\beta+4\gamma-\beta\gamma(20+\beta)+4\gamma^2(7\beta-4)\right)\Big/8(\beta-4\gamma)^2$.

Factorizing and rearranging, the expression above can be rewritten as: $\left((\beta-1)\left(8\gamma^2(\beta-V^2)+V^2\beta(8\gamma-\beta)\right)+(\gamma-1)\beta(5\beta\gamma-\beta-4\gamma)+15\beta^2\gamma(\gamma-1)-8V^2\gamma^2(\beta-1)-4\beta(\gamma^2-\beta)\right)\Big/8\beta(\beta-4\gamma)^2 > 0$,

given that the first two terms are positive, and so is the sum of the last three terms. Since we have shown in Proposition 3 that $CS^{ah} > CS^{bl}$, then it follows that $CS^{th} > CS^{bl}$.

Let us now consider social welfare. We find that:

$W^{th} = 5\beta+4(7V-1+3\gamma)+12V^2/\beta+(\beta-2)\left(6\beta(\beta-2)+(\beta-4\gamma)(\beta-2-12V)\right)\Big/32(\beta-4\gamma)^2-F$.

If firm 2 provides high quality in the do-nothing scenario, then we find that: $W^{th}-W^{bh} = (\beta+2\gamma-3)\left((\gamma-\beta)(22\gamma+7(\gamma+\beta))+27\gamma^2+18V(4\gamma-\beta)+3(4\gamma+5\beta)\right)\Big/72(\beta-4\gamma)^2 > 0$.

Let $F^{th} = (\gamma-\beta)(1-2\gamma)^2/(\beta-4\gamma)^2$ be the critical value of the sunk cost that reduces firm 2's profit to zero when firm 1's bundled offer is subject to the price test. If firm 2 is low-quality in the do-nothing scenario, then we find that $W^{th} \geq W^{bl}$ holds for $F \leq F^{th}$. Indeed, let $F = F^{th}$, that is the highest feasible value of *F* given the assumption that firm 2 invests under the test regime. We have: $W^{th}-W^{bl} = \left((\beta-1)\left(20V^2(\beta-4\gamma)+27\beta^2\right)+9\beta(\gamma-\beta)(1+4\gamma)+(\gamma-1)27\beta+18V\beta(\beta+2\gamma-3)\right)\Big/72\beta(4\gamma-\beta) >$

$> \left((\beta-1)\left(20V^2(\beta-4\gamma)+27\beta^2+27\beta+54V\beta\right)+9\beta(\gamma-\beta)(1+4\gamma)\right)\Big/72\beta(4\gamma-\beta)$, since $\gamma > \beta$.

The expression above can be rewritten as:

$\left((\beta-1)\left(20V^2\beta-80V^2(\gamma-\beta)-80V^2\beta+27\beta^2+27\beta+54V\beta\right)+9\beta(\gamma-\beta)(1+4\gamma)\right)\Big/72\beta(4\gamma-\beta) >$

$\left((\beta-1)\left(20V^2\beta+27\beta^2\right)+9\beta(\gamma-\beta)(1+4\gamma)-80V^2(\gamma-\beta)(\beta-1)\right)\Big/72\beta(4\gamma-\beta)>0$.

We conclude that, when firm 2 invests under the test regime, consumer surplus and welfare are higher when the price test is active than when is not. ■

Proof of Proposition 7. Assume that firm 2 invests under the price test regime. This may occur for $F\in\left(0,F^{th}\right]$. Since $F^{ah}-F^{th}=\left((\gamma-1)\left(\beta^2+8\beta\gamma-4\right)-4(\beta-1)\right)\Big/4(\beta-4\gamma)^2>0$, then from section 3.3.1 firm 2 would also invest under a ban on bundling. We have shown in Proposition 6 that $CS^{th}>CS^{ah}$. In addition, by some tedious algebra we obtain that:

$W^{th}-W^{ah}=\left(4(V-1)-12V^2(\beta-1)/\beta+5\beta+(\beta-2)(\beta-2-12V)/(\beta-4\gamma)-6\beta(\beta-2)^2/(\beta-4\gamma)^2\right)\Big/32>0$.

Thus, if firm 2 invests under the test regime, then both consumer surplus and welfare are higher than in the case where bundling is prohibited. ■

Proof of Proposition 8. Assume that firm 1's bundled offer is subject to a predatory pricing test (superscript *T* denotes such test regime). If firm 2 is low-quality, then the predatory pricing test is not binding. If firm 2 is high-quality, then firms' profits respectively are $\pi_1^{Th}=(V+\beta)^2/4\beta$ and $\pi_2^{Th}=(\gamma-\beta)/4-F$, while social welfare is $W^{Th}=3\left(2V\beta+\gamma\beta+V^2\right)/8\beta-F$. Since we have $\pi_1^{Th}-\pi_1^{ah}=\left(\beta-V^2\right)(\beta-1)/4\beta>0$, then bundling is the preferred strategy of firm 1. Since we also have $\pi_2^{Th}-\pi_2^{bh}=5(\gamma-\beta)/36>0$, then firm 2 has a higher ability to invest compared with the do-nothing scenario. It follows that, at equilibrium, firm 2 may invest under the predatory pricing test, but not in the do-nothing scenario. One such region is found when $\gamma\in\left(\left(4V^2(\beta-1)+9\beta^2\right)/9\beta,\left(V^2(\beta-1)+\beta^2\right)/\beta\right]$ and $F\in\left(0,\left(4V^2(1-\beta)+9\beta(\gamma-\beta)\right)/36\beta\right)$. Let $\gamma=\left(V^2(\beta-1)+\beta^2\right)/\beta$ and $F=V^2(\beta-1)/10\beta$ be two parameter values in this region. Since we find that $W^{bl}-W^{Th}=V^2(\beta-1)/360\beta>0$, then the predatory pricing test induces some inefficient investment. Now, assume that firm 2 invests under our price test. Then, consumer surplus and welfare are higher under our price test than with the predatory pricing test. Indeed, we have that:

$CS^{th}-CS^{Th}=\left((\beta-1)\left(16\gamma^2-4\gamma+4V\gamma-2V\beta\right)+(\gamma-1)(12\beta\gamma+16V\gamma-5\beta)+(\gamma-\beta)(\beta\gamma-4V)\right)\Big/8(\beta-4\gamma)^2>0$, and

$W^{th}-W^{Th}=\left((\beta-1)\gamma(16\gamma+4V-11\beta)+4\left(4V\gamma(\gamma-1)+\gamma(\beta\gamma-1)-V(\gamma-\beta)\right)+\beta(4\beta+\gamma+2V-5)\right)\Big/8(\beta-4\gamma)^2>0$. ■

Appendix 2

Assume that firm 1 provides only a technological bundle. Hence, firm 2 is foreclosed from the market and the demand curve for the bundle is $q_{S1}^{m} = 1 + V - p_{AB}^{m}$. Firm 1's profit maximization leads us to obtain the equilibrium monopoly price $p_{AB}^{m} = (V + \beta)/2$ and profit $\pi_1^{m} = (V + \beta)^2/4\beta$. Consumer surplus is $CS^{m} = (V + \beta)^2/8\beta$ and welfare is $W^{m} = 3(V + \beta)^2/8\beta$.

Now, assume that firm 1 practices complete mixed bundling, and firm 2 provides low quality. We refer to firm 1's bundle by using subscript $BS1$ and to the system of stand-alone products offered by firm 1 using subscript $IS1$. Demand curves for the bundled system 1 and for the two low-quality systems as a whole respectively are $q_{BS1}^{cl} = 1 - (p_{AB}^{cl} - p_{B2}^{cl} - p_{A}^{cl})/(\beta - 1)$ and $q_{IS1}^{cl} + q_{S2}^{cl} = (p_{AB}^{cl} - p_{B2}^{cl} - p_{A}^{cl})/(\beta - 1) - (p_{B2}^{cl} + p_{A}^{cl} - V)$, with $p_{B1}^{cl} = p_{B2}^{cl}$. Since firms provide perfect substitutes in market B, then product B is priced at marginal cost (i.e. $p_{B1}^{cl} = p_{B2}^{cl} = 0$). First-order conditions of profit maximization give equilibrium prices $p_{AB}^{cl} = (V + \beta)/2$ and $p_{A}^{cl} = (1 + V)/2$, and profits $\pi_1^{cl} = (V(2 + V) + \beta)/4$ and $\pi_2^{cl} = 0$. Note that the implicit price of product B in the bundle, that is, the margin $\Delta^{cl} = p_{AB1}^{cl} - p_{A1}^{cl}$, is always positive. Consumer surplus is $CS^{cl} = (V(2 + V) + \beta)/8$ and welfare is $W^{cl} = 3(V(2 + V) + \beta)^2/8$.

Finally, assume that firm 1 provides complete mixed bundling, and firm 2 invests in quality. Demand curves for system 2, the bundled system 1 and the independent system 1 respectively are $q_{S2}^{ch} = 1 - (p_{B2}^{ch} + p_{A}^{ch} - p_{AB}^{ch})/(\gamma - \beta)$, $q_{BS1}^{ch} = (p_{B2}^{ch} + p_{A}^{ch} - p_{AB}^{ch})/(\gamma - \beta) - (p_{AB}^{ch} - p_{B1}^{ch} - p_{A}^{ch})/(\beta - 1)$ and $q_{IS1}^{ch} = (p_{AB}^{ch} - p_{B1}^{ch} - p_{A}^{ch})/(\beta - 1) - (p_{B1}^{ch} + p_{A}^{ch} - V)$. First-order conditions of profit maximization give equilibrium prices $p_{A}^{ch} = (1 + V)/2$, $p_{B1}^{ch} = 0$, $p_{AB}^{ch} = (1 + 2V + \beta)/4 + 3(\beta - 1)^2/4(3 + \beta - 4\gamma)$ and $p_{B2}^{ch} = 2(\gamma - \beta)(\gamma - 1)/(4\gamma - 3 - \beta)$. Note that the margin $\Delta^{ch} = p_{AB1}^{ch} - p_{A1}^{ch}$ is always positive. Hence, firms' profits are $\pi_1^{ch} = \left(9 + 2\beta + 5\beta^2 - 4\gamma(5 + \beta(2 + \beta)) + 4(3 + \beta) + (2V + V^2)(3 + \beta - 4\gamma)^2\right)/4(3 + \beta - 4\gamma)^2$ and $\pi_2^{ch} = \left((\gamma - \beta)(\gamma - 1)^2/(3 + \beta - 4\gamma)^2\right) - F$. We have that consumer surplus is:

$CS^{ch} = \left(\left(2V + V^2\right)\left(3 + \beta - 4\gamma\right)^2 - 27 + \beta^2 + 4\gamma\left(16 + \gamma\left(4\gamma - 13\right)\right) + \beta\left(26 + 4\gamma\left(5\gamma - 12\right)\right)\right) \Big/ 8\left(3 + \beta - 4\gamma\right)^2$, and welfare is $W^{ch} = \left(\left(6V + 3V^2\right)\left(3 + \beta - 4\gamma\right)^2 - 9 + \beta\left(11\beta - 2\right) + 8\gamma\left(7 - \beta^2 + 6\gamma^2\right) - 4\gamma^2\left(23 + \beta\right)\right) \Big/ 8\left(3 + \beta - 4\gamma\right)^2 - F$.

Chapter 3:
Program Quality and Exclusive Provision

Abstract

This paper presents a model to examine incentives to exclusive distribution of premium contents in media markets. It shows that the vertical structure of the industry, the business model of the platforms and the efficiency on the advertisers market are important dimensions for explaining the extent of exclusivity. In particular, exclusivity is more likely when the content provider is vertically integrated with one platform and when viewers are charged. Moreover, when exclusive provision arises, it is in favour of the most efficient platform on the advertising market.

Exclusivity to the most efficient platform can be desirable. Moreover, we find that a free-to-air platform can over- or under-provide quality, while a pay tv always under-provides quality.

When we internalize the vertical integration choice, we find that both platform are willing to acquire the control over the content provider, but the most efficient platform in targeting viewers gains higher profit from vertical integration. When the most efficient platform on the advertising market is vertically integrated, it has less incentives to invest in quality content than the vertically integrated rival.

1 Introduction

Television companies deliver information goods to consumers. They may rely on various sources of profits, depending on which business model they adopt. They may opt for a free-to-air broadcasting model (whereby the broadcaster provides free contents to viewers in order to sell on viewers' attention to advertisers), a pure pay-TV model (whereby viewers pay subscription fees for accessing contents without advertising) or a combination of these two models (whereby broadcasters finance themselves in a mixed way, charging both viewers and advertisers).

When viewers and advertisers interact through a media company the market is two-sided. Each group exerts an externality on the other: viewers usually dislike ads, hence advertisers exert a negative externality on viewers; on the contrary, advertisers are interested in reaching a large public, hence viewers exert a positive externality on advertisers.

To undertake this business, a company needs a wide range of activities, that can be organized into three vertical phases: (1) production of content; (2) packaging of contents; (3) transmission of packages through a distribution system.

Traditionally, market power in the media industry has been originating from the control over distributive capacity, because of the scarcity of the spectrum. Thus, for a long time the debate has mainly been focusing on possible anticompetitive behaviours that might arise from the high degree of concentration, high barriers to entry and in general from the exploitation of market power in the downstream segment of the industry.

In recent years, the digital technology has enabled a more efficient use of the existing band and the coexistence of different platforms (terrestrial, satellite, cable, IPTV) has further enhanced the distributive capacity. Although the distribution bottleneck has widened, the market is still very concentrated and it will probably remain as such.

Motta and Polo (1997) and Seabright and Weeds (2007) explain the persisting concentration that they observe in media markets using the concept of endogenous sunk cost. In fact, despite the so-called “digital revolution”, barrier to entry are not eliminated since competition among firms tends to push service quality up. Since quality programs tend to be more costly, therefore the investment required in order to be successful on the market rises as the pressure of competition rises. If viewers continue to demand a narrow subset of horizontal program quality, we can expect the concentration in the industry to persist.

The technological evolution is indeed shifting market power towards content right holders, to the point that control over premium contents (not by coincidence named by some authors “must-have” contents) seems to become the new competitive bottleneck. Premium contents are very attractive

contents for viewers and, unlike basic ones, they have few substitutes. Moreover, their production and/or the acquisition of their transmission rights implies high fixed costs. Such contents usually consist in important sporting events, blockbuster movies, important television formats, successful television series.

The so-called “must-have” component, due to superior technologies and well-known brand names, has a big power in affecting platforms performances. This type of component has more than ordinary influence on platforms' sales and the owner possesses significant bargaining power vis-à-vis platforms. Hence, premium contents are key resources for a television company, and acquiring exclusive rights is an important strategy.

If traditionally contents have been exchanged on the market (for instance, the MIPTV and MIPCOM are two important events for the television market, in which sellers and buyers of entertainment contents meet), these markets are gradually loosing relevance. Indeed, many mergers and acquisitions among producers and distributors of content have occurred, that affected the industry structure.[54]

In the present work, we investigate how exclusive and quality provision of premium content can be influenced by various dimensions, like vertical integration, the business model of the platform and the ability to reach viewers that are attractive for advertisers. We also provide a normative analysis, studying the socially optimal choices about quality level and exclusivity, and we compare them with private ones. Finally, we endogenize the vertical structure of the industry, allowing platforms to bid in order to acquire the control over the content provider. Also in this case we provide a welfare analysis.

In order to study this issue, we consider a model that presents features of horizontal and vertical differentiation models (see Hotelling, 1929; Shaked and Sutton, 1982). We consider two channels, operated by two rival platforms, located at the two extremes of a Hotelling line. Each platform offers a homogeneous “basic channel”. This basic channel can be bundled with a premium content, produced by a monopolist upstream operator. The premium content increases viewers' utility from the “consumption” of the channel.

Since we intend to model a setting where the premium content is a not substitutable good and it is an important resource on the downstream market, then we assume that the upstream operator is a monopolist and that it holds bargaining power. The upstream operator can offer an exclusive or non-exclusive contract for the premium content to platforms, making a take-it-or-leave-it offer, that extracts all the profits from the sale of the premium content. We assume that the the upstream offers

54 Just to quote few examples, see the acquisition of Endemol operated by Mediaset, the various channels owned by BskyB.

its preferred contract just once. The upstream can be independent or vertically integrated with one downstream platform.

First, we model the free-to air case, where platforms charge advertisers but not viewers. Then, we model a mixed case, where we allow platforms to get revenues from both viewers and advertisers.[55] We assume that viewers exert a positive externality on advertisers, while advertisers exert a negative one on viewers.

We assume that an advertiser gets a different benefit from interacting with viewers on different platforms. This is a measure of the efficiency of a commercial channel on the advertising market, and it is an important dimension. We find that efficiency on the advertising market pushes toward exclusive provision. Indeed, it can be profitable to provide the exclusive to the most efficient platform on the advertisers market, so as to strengthen its position.

We also find that vertical integration entails more exclusive provision compared to vertical separation. Indeed, an independent upstream provider does not internalize the negative effect for platforms of non-exclusive provision on the downstream market, but it only considers the revenues for each platform coming from the provision of the quality content on the downstream market.

Also the ability to charge viewers drive toward exclusive provision. Indeed, when platforms compete for viewers, relaxing price competition through exclusive contract can increase the profits created by the sale of the quality content.

Exclusive provision of the quality content to the most efficient downstream platform can be socially optimal when the mass of advertisers is wide and the transportation cost is high.

When we endogenize the quality choice of the platform under different scenarios and we compare them with social optimal ones, we find interesting results. Under the free-to-air model, both over- and under-provision of quality contents can arise, while under the mixed model there is always under-provision. This occurs because under the free-to-air scenario, viewers are not charged, then their benefit from consuming quality content is taken into account at the social but not at the private level. Hence, when the private benefit created by quality is higher than the social one, over-provision of quality can occur. Under the mixed model, a platform cannot internalize all benefits coming from the quality provision, since some are passed from advertisers to viewers. This entails that the market under-provides quality.

Finally, we show that the most efficient platform on the advertising market gains more than the rival from the control over the premium content. When both platforms are interested in controlling

55 We assume that the premium content is a film, a television format or a sport event, thus advertising revenues are collected by downstream platforms. If one assumes that the premium content is a channel, the upstream firm operates the first two stage of the industry and it controls advertising revenues.

the content provider and they overbid in order to acquire it, the most efficient firm acquires the content provider and the latter gains more profits from selling the control right on the content rather than providing the premium content through the market. However, platforms can prefer the rival to acquire the upstream in some cases. This occurs when the control over the premium content does not generate high rents.

We find that consumers would always prefer the least efficient firm to vertically integrate, since it provides higher quality contents. Indeed, the high efficiency on the advertisers market of a vertically integrated platform lowers its incentives to invest in quality for entertainment. Since the most efficient firm on the advertisers market integrates in a wide region, the market outcome concerning the vertical integration decision is often not desirable.

2 Literature

Our paper relates to the literature on two-sided markets, and in particular to the one on the economics of media (see chapter 1 for more references).

In particular, we deal with exclusive strategies. There is a large literature about exclusive dealings, vertical contracting and access to an essential input. This literature, in one-sided markets, has been surveyed by Rey and Tirole (2007), that analyse the economics of foreclosure. Moreover, there is also a literature dealing with licensing of a cost reduction/quality-enhancing innovation, that is relevant to our work (see Katz and Shapiro (1986)). However, all this wide literature deals with one-sided markets, while here the two-sidedness of the market play an important role.

Exclusive strategies in media markets have been studied by few papers. The first to focus on this issue has been Armstrong (1999). He studies exclusive supply of a premium content, provided by an independent content provider to pure pay-TVs, under different contractual arrangements. He finds that lump-sum payment for contents pushes exclusive contract more than per-subscriber fees. A similar focus is the one of Harbord and Ottaviani (2001). They find that a content provider finds profitable to provide the content in exclusive for a lump-sum payment. Moreover, they find that the platform that receives the content chooses to sell on content rights using a per-subscriber fee. Then, Stennek (2007) studies the relationship between investments in program quality and exclusivity, in a bargaining game with alternating offers. He finds that, since exclusivity can increase quality, it should not be prevented.

Another interesting paper is the one by Hagiu and Lee (2008), that analyses how exclusive provision of quality content is influenced by the control over the retail price of this content. When the content provider keeps the right to price the content, they find non-exclusive provision. On the contrary, total selling of control rights can result in exclusive provision. They consider only a pure

pay-tv model and they give the bargaining power to the platforms. Then, Weeds (2009) studies exclusive distribution of contents, when the content provider is integrated with one platform. The content is a channel, so advertising revenues are earned by the content provider. She considers two-part payments for the content and she does not endogenize the quality choice. She finds that non-exclusive provision is profitable. Hogendorn and Ka Yat Yuen (2009) analyses the effect of the level of platform interconnection on the exclusivity choices, when the content provider is an independent firm and imposes a per-subscriber fee for the content. They do not endogenize the quality of the offer and do not explicitly model the advertising market. They find that exclusivity is more likely when the initial market share difference is high and cross-platform indirect network effect weak.

Among the quoted papers, the majority part assumes that the content provider is an independent firm, while Weeds (2009) study the case of an integrated content provider. Only Stennek (2007) provides a short comparison between the effects of vertical integration and vertical separation on the exclusivity outcome. Moreover, Harbord and Ottaviani (2001) analyse the incentives to resell content rights, once one platform has acquired the exclusive.

Vertical integration is an important issue since we can observe that there is this trend in the industry. Thus, it is interesting to investigate how exclusive strategies are affected by different market structures, and this is one of the focus of the present work.

Moreover, differently from previous works, we study the exclusivity choices under different business models, and we compare how the price structure on the downstream market affects the incentives to exclusive or non-exclusive provision of premium contents.

We also consider the role of efficiency on the advertising market. Indeed, we consider that advertisers have different benefits from interacting with viewers on different platforms. This can be due to the fact that the audience targeted by one platform fits better the target of the producer, or it can be due to the effectiveness of different advertising strategies used by different platform or to the different quality of the service offered to advertisers. This aspect has been disregarded by the previous theoretical literature on the economics of media, while we show that it can have an impact on premium contents provision.[56]

3 The model

3.1 Hypothesis

We consider a game in which two platforms provide channels that are “consumed” by viewers and

56 Gal-Or et al. (2010a) takes into account a “target” parameter in a paper where they investigate the role of advertising in media bias (defined as “selective omission, choice of words and varying credibility ascribed to the primary source”). Then, in their empirical paper, Kaiser and Wright (2006) assume that advertisers have preferences to advertise on a particular magazine.

advertisers. Platforms can adopt different business models, depending on which side of the market they choose to charge. Firstly, platforms can be pure advertising-TVs, in which case they provide free entertainment to viewers, and they charge advertisers. Secondly, platforms can adopt a mixed model: viewers pay a subscription fee in order to watch a channel, and advertisers purchase time slots to advertise their products.[57]

Advertisers are producers of goods, and viewers are also consumers of advertisers' products. Advertisers use ads in order to inform viewers about their products, so as to increase their sales. Viewers dislike ads, so platforms attract viewers' attention through entertainment, and then they sell on this attention to advertisers. Thus, this is a two-sided market, where two groups of agents, advertisers and viewers, interact through a platform. Advertisers exert negative externalities on viewers, and, conversely, viewers exert positive externalities on advertisers.

A channel includes "basic" components, that are produced by studios owned by the platform. Moreover, platforms may include in their bundles "must-have" components, which are premium contents that improve the quality of their offer. Premium contents are provided by a monopolist upstream operator, that may or may not be vertically integrated with one of the platforms.

Platforms. Each platform provides a channel, indexed by $i \in \{1,2\}$. The two channels are located at the two extremes of a Hotelling line. In particular, platform $i = 1$ is located in zero and platform $i = 2$ is located in one. We do not endogenize the horizontal differentiation choice of the platforms, and we assume that there is maximum horizontal differentiation.

We normalize the cost of producing the basic channel and marginal costs of distribution to zero. We distinguish between two different platforms business models. First, platforms may adopt a pure-advertising model, so that platform *i*'s profit function is $\pi_i = b_i M$, where b_i is the price of advertisement and *M* the number of advertisers which join the platform (we assume that advertisers multi-home and that their demand is fixed). Second, we study the case where platforms finance themselves in a mixed way. In this case, platform *i*'s profit function is $\pi_i = p_i q_i + b_i M$, where p_i is the subscription fee and q_i the mass of viewers which join the platform.[58,59]

We assume that platforms fix p_i and b_i.

Viewers. Viewers make a discrete choice of which channel to watch. Indeed, it is reasonable to assume that, in our static context, a viewer can watch only one channel at any given moment. The

57 The pure pay-tv model, in which case platforms provide entertainment to viewers that pay a subscription fee for watching programs without ads, is a particular subcase of the mixed model, as we will show in section 3.4.1.

58 There might exist cross subsidies between the two sides of the market, so that the price for viewers can be lower than zero.

59 We do not endogenize the choice of the business model.

assumption of single-homing for viewers entails that the benefit from accessing both channels is less than paying both subscription fees.

We assume that there is a population of mass one of viewers. Each viewer has a preference parameter x for horizontal quality, that represents its favourite type of programming. Parameter x is uniformly distributed over the [0,1] interval. The net utilities that a consumer of type x can obtain from a channel of type $i=1$ and of type $i=2$ respectively are

$$U_1 = V + \gamma_1 - xt - \delta M - p_1 \quad (1)$$

$$U_2 = V + \gamma_2 - (1-x)t - \delta M - p_2 \quad (2)$$

where V represents the willingness to pay of each viewer for the basic channel without ads. We assume that V is high enough to assure complete market participation. As in models of horizontal differentiation (Hotelling, 1929), we consider that a viewer of type x stands a disutility from watching a channel that is not of the horizontal specification it prefers. This disutility depends on the distance of consumer x from the channel and on the transportation cost t. Then, as in models of vertical differentiation (Shaked and Sutton, 1987), γ_i is the quality of the premium content offered by platform i. Moreover, consumers dislike advertising, so they stand an utility loss that depends on the advertising level M and on the nuisance cost δ. We assume that all viewers have the same marginal disutility from ads. The assumption that viewers dislike advertising is empirically documented in many studies on TV broadcasting.[60] Observe that the term δM does not play any role at equilibrium.

Advertisers. Advertisers are producers that want to inform viewers about their offer. A product is produced at a quality level *1* and consumers have willingness to pay of *1* for a good of this quality. Each producer has monopoly power, and thus it imposes a price for the good that extracts all consumer surplus.

When advertisers decide where to purchase time slots for their ads, they care about two dimensions: the number of viewers reached by the ad and how many of these viewers are in the target of the product they advertise. Both are significant and none can be ignored.

We assume that only a share of the viewers reached by an ad actually purchases the advertiser's product, and the most a platform reaches viewers in the target of the advertiser, the biggest is this share. The target parameter, which measures the benefit advertisers get from interacting with viewers on a given platform, has been disregarded by previous theoretical literature on the topic.

Thus, in this extension, the benefit that each advertiser enjoys from interacting with a viewer on

60 Among others, see Dukes and Gal-Or (2003), Gabszewicz et al. (2006), Peitz and Valletti (2008). As Crampes et al. (2009) suggest, one might reasonably assume that the advertising levels are set by platforms "at a point where the marginal impact on consumers is negative".

a given platform depends from the platform. In more formal terms, the advertiser profit function on platform *i* is:

$$pro_i = \alpha_i q_i - b_i \tag{3}$$

Parameter $\alpha_i \in (0,1)$ with $i \in \{1,2\}$, is a measure of the portion of viewers which have watched the ad on platform *i* that purchases the advertiser's product. We assume that platform *2* reaches more viewers that are in the target of the advertisers than platform *1*, so $\alpha_1 < \alpha_2$. This can be due to the fact that platform *2*'s target audience fits better the firm's ideal target audience. Alternatively, this can be linked to a more effective strategy of advertising employed by platform *2*, to a better services offered to advertisers, to a reputation effect or to the platform program mix choice.

Advertisers are of mass *M*. We assume that each advertiser have enough budget to join both platforms, hence it multi-homes, purchasing one time slot from both platforms. To simplify the analysis, we assume that advertising intensity on each platform is fixed.

Products are produced at a constant marginal cost, which is normalized to zero.

The upstream operator. The upstream operator produces a premium content and sells it to downstream platforms. This type of component has more than ordinary influence on platforms' sales and the owner possesses significant bargaining power vis-à-vis platforms.

We set a simplified bargaining game. We assume that the content provider offers its preferred contract to platforms just once. The content provider proposes a contract to the downstream platforms for the provision of the premium content that specifies the quality γ_i of the offer and its price T_i for each platform $i \in \{1,2\}$. The offer is take-it-or-leave-it. The price is such that it extracts all profits deriving from the sale of the premium content on the downstream market. Each downstream operator may accept or refuse the contract. Once the contract is signed, we assume that an authority verifies the enforcement of the contract, imposing high sanctions if it is not honoured.[61]

The vertically integrated content provider, when offers an exclusive contract to the rival platform, threatens it to air the content if the rival does not accept the exclusive. The threat is credible, since the internal transfer price for the content provision is zero. On the contrary, an independent content provider can never use this threat, since the bargaining process is one-shot.[62]

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61 It is like assuming that there is a reputation cost from not honouring the contract. This hypothesis is intended to give some dynamics to the static model.

62 In our context, the upstream can propose its preferred contract (either an exclusive or non-exclusive contract) to downstream platforms just once, and the parties know that this is the only chance to reach an agreement. Indeed, we assume that, if this contract offered by the upstream is refused, it is too costly to contract again the terms of the provision. Thus, an independent content provider cannot use any threat that involves a new offer to another platform when it proposes an exclusive contract to one platform, since it is not credible. However, a vertically integrated content provider can use this threat, since the internal transfer price for the content provision is zero.

There is a quadratic fixed costs of production of the premium content, proportional to the quality provided, i.e. $\max\left\{\frac{\gamma_1^2}{2k},\frac{\gamma_2^2}{2k}\right\}$. Parameter *k* indicates the benefit from quality. We normalize marginal costs of production and distribution to zero.

Welfare. There are two components of welfare. The first is the gross surplus with respect to content at the net of the fixed cost, that is:

$$W^c = \int_0^{\bar{x}} (V + \gamma_1 - xt)\, dx + \int_{\bar{x}}^1 (V + \gamma_2 - (1-x)t)\, dx - \max\left\{\frac{\gamma_1^2}{2k},\frac{\gamma_2^2}{2k}\right\} \quad (4)$$

The second is the gross surplus with respect to advertising, that is:

$$W^a = \int_0^{\bar{x}} M(\alpha_1 - \delta)\, dx + \int_{\bar{x}}^1 M(\alpha_2 - \delta)\, dx \quad (5)$$

Total welfare is given by the sum of the two components. Consumer surplus is defined as the integral over all purchasing consumers of their utility.

3.2 Timing

We consider a game in two stages. In the first stage the upstream contracts for the provision of premium contents, and in the second stage platforms compete in prices for viewers and/or advertisers. Both stages are played under two scenarios: the vertical separation one is the benchmark scenario, in which case the upstream operator is an independent producer of contents, and the vertical integration one, in which case the upstream operator is vertically integrated either with platform *1* or with platform *2*. Moreover, we consider two different business models: pure advertising-TV model and mixed model.

The game is as follows:

1. The upstream operator produces and sells a premium content. It proposes a contract to both, to one or to none platform, specifying the quality γ_i of the offer and the fixed price T_i of it, with $i \in \{1,2\}$.[63] Platforms can accept or refuse the offer. We well give more details about the contract in sections 3.3 (for the vertical separation case) and 3.4 (for the vertical integration case).
2. Downstream operators compete in prices for viewers and/or for advertisers.

In section 3.3 and 3.4 we derive the extent of exclusivity on premium content under different business models. We allow the quality γ_i of the premium content to vary in the interval $[0,\bar{\gamma}]$, and we assume that the production of the premium content does not entail any fixed cost. In section 3.5 we introduce the fixed cost of production and we derive the level of quality $\bar{\gamma}$ chosen by the

63 Armstrong (1999) provides some empirical istances of lump-sum payments for contents. Harbord and Ottaviani (2001) provide a theoretical foundation for this hypothesis.

content provider at equilibrium under different scenarios and business models. We also derive social optimal choices of quality. In section 3.6 we provide an extension to this game, endogenizing the vertical integration decision.

3.3 Pure advertising scenario with multi-homing

In this section we consider the case in which viewers have free access to platforms' contents and platforms finance themselves through advertising.

3.3.1 Third stage: competition in price for advertisers

In this paragraph, we specify equilibrium demands, prices and profits as a function of quality levels γ_i, for $i \in \{1,2\}$. In order to compute viewers demand, we determine the viewer $\bar{x}$ who is indifferent between the two channels equalizing equation (1) and equation (2), taking into account that $p_1 = p_2 = 0$. Solving for *x*, we obtain:

$$\bar{x} = \frac{1}{2} + \frac{\gamma_1 - \gamma_2}{2t} \tag{6}$$

All viewers to the left of $\bar{x}$ watch channel *1* and all viewers to the right watch channel *2*. Thus, implicit demands are $q_1 = \bar{x}$ and $q_2 = 1 - \bar{x}$. Platforms fix a price for advertisers so as to extract all their profits, hence $b_i = \alpha_i q_i$, for $i \in \{1,2\}$. By substitution, we derive platforms' profit functions:

$$\pi_i = \frac{M\alpha_i}{2t}\left(t + \gamma_i - \gamma_j\right) \tag{7}$$

Quality levels enter linearly in the profit functions.

We concentrate the analysis in the region where there exists market-sharing equilibria (i.e. positive demands for each firm, $1 > q_i > 0$ for $i \in \{1,2\}$, under the complete market assumption $q_1 + q_2 = 1$, and non-negative profits), which is the region where $\bar{\gamma} < t$.

3.3.2 Second stage: vertical separation

We assume that the upstream operator is an independent firm which produces a premium content in monopoly. The upstream operator offers a contract to both platforms or just to one, and each platform can accept or refuse the offer.[64] This contract specifies the quality $\gamma_i \in [0, \bar{\gamma}]$ and its price T_i for platform $i \in \{1,2\}$. The upstream operator fixes the price T_i of the program so as to extract all the profits that platform *i* earns from selling the premium bundle, given the quality level that is proposed to the rival platform. The upstream interacts with platforms just once. We assume that, if the platform is indifferent between purchasing the premium content or not, it purchases it. In formal terms, the fixed price T_i for the content is defined as:

64 Giving the quality content to none is the outside option for the upstream, and it is always dominated.

$$T_i = \pi_i(\gamma_i, \gamma_{-i}) - \pi_i(0, \gamma_{-i}) \tag{8}$$

It follows that the second stage profit of the upstream operator U is $\Pi_U = T_1 + T_2$ and of platform i is $\Pi_i = \pi_i - T_i$. Thus, as a function of γ_i, upstream and downstream profits respectively are:

$$\Pi_U = \frac{M}{2t}(\alpha_1\gamma_1 + \alpha_2\gamma_2) \tag{9}$$

$$\Pi_i = \frac{M\alpha_i}{2t}(t - \gamma_j) \tag{10}$$

Since the upstream profits function is linearly increasing in the quality level of both downstream firm, it is easy to verify that it provides the maximum level of the quality good to both firms. This entails that there is never "partial" provision of the quality level produced: when the upstream provides the premium content to one platform, it does not degrade it. The result holds both when platforms are differentiated on the advertisers market and when they are symmetric. The non-exclusive provision of the quality content allows the content provider to create a prisoner's dilemma on the downstream market: both platforms would prefer not to accept the contract, but they cannot coordinate on that choice. The exploitation of this dilemma is always profitable for the content provider, since it allows it to extract advertising revenues from all the players. Thus, we can state the following Proposition.[65]

Proposition 1. Under the pure advertising model, an independent upstream operator provides the premium content to both downstream platforms, both if they are symmetric and asymmetric.

3.3.3 Second stage: vertical integration

Now the upstream operator is vertically integrated with one downstream platform.

First, assume that platform *1* is vertically integrated with the upstream operator, and that $\alpha_1 < \alpha_2$. The integrated firm decides whether it is profitable or not to provide premium contents to its downstream integrated platform at a zero transfer price. Moreover, it contracts for the provision of the premium content to the non-integrated platform *2* at a price that leaves platform *2* with a profit equal to its outside option. Note that, when the platform *2* refuses an exclusive contract, the integrated firm always finds profitable to use the premium content, thus the fixed tariff for the premium content is:

$$T_2 = \pi_2(\gamma_1 = \bar{\gamma}, \gamma_2) - \pi_2(\gamma_1 = \bar{\gamma}, 0) \tag{11}$$

In this case, the second stage profit of the vertically integrated operator are $\Pi_1 = \pi_1 + T_2$ and of

65 For all proofs, see the appendix in section 5.

platform *2* are $\Pi_2 = \pi_2 - T_2$. Thus, as a function of γ_i, platform *1*'s and platform *2*'s profits respectively are:

$$\Pi_1 = \begin{cases} \frac{M}{2t}\left(t\alpha_1 + (\alpha_2 - \alpha_1)\gamma_2 + \alpha_1\gamma_1\right) & \gamma_1 > 0 \quad \gamma_2 \geq 0 \\ \frac{M}{2t}\left(t\alpha_1 + (2\alpha_2 - \alpha_1)\gamma_2\right) & \gamma_1 = 0 \quad \gamma_2 \geq 0 \end{cases} \tag{12}$$

$$\Pi_2 = \frac{M\alpha_2}{2t}\left(t - \max\{\gamma_1, \gamma_2\}\right) \tag{13}$$

It is easy to verify that platform *1*'s profit is maximized when it provides the exclusive content to the rival platform *2*, since $\alpha_1 < \alpha_2$. This result depends on the profit that the integrated platform is able to extract from the most efficient rival platform when it grants the exclusive, under the threat of using the premium content if the rival does not accept the exclusive contract. Indeed, since the rival is more efficient, it is able to better use the quality content on the downstream market. Thus, the threat of using the premium content if the rival does not accept the contract allows the integrated platform *1* to gain on the upstream market more than it loses from not providing a premium content on the downstream market.

Secondly, assume that platform *2* is vertically integrated and that $\alpha_1 < \alpha_2$. Platforms' profits can be easily obtained exchanging subscripts *1* and *2* in equations (12) and (13). When the quality internally provided is positive, the objective function is linearly increasing in γ_2 and linearly decreasing in γ_1, and the case with exclusive provision to the rival is always dominated by the one of exclusive provision to the integrated platform. Indeed, platform *2* gains more than platform *1* from the downstream market, and the loss on the downstream market in case of non-exclusive provision or exclusive provision to the rival cannot be recouped on the upstream market.

Suppose that platforms are symmetric (i.e. $\alpha_1 = \alpha_2$) and that platform *1* is vertically integrated. It is indifferent among the exclusive provision to the integrated or the rival platform, and the non-exclusive provision to both platforms. When the content is provided to only one platform, the profit function is linearly increasing in quality, and when it is provided to both, it is independent from the quality provided to the rival. Thus, the integrated platform *1* always provides the maximal quality $\bar{\gamma}$ to one platform and to the other platform whatever quality in the interval $[0, \bar{\gamma}]$. There are no extra revenues and no losses created from non-exclusive provision. Thus, we can state the following proposition.

Proposition 2. Under the free-to-air model with asymmetric platforms, a vertical integrated firm

always provides the premium content in exclusive to the most efficient platform on the advertising market. When platforms are symmetric, the vertically integrated operator is indifferent between providing the exclusive to one of the platforms and providing maximum quality to one platform and partial quality to the other platform.

3.4 Mixed scenario with multi-homing advertisers

In this section we analyse a two-sided market where both advertisers and viewers are charged.[66]

3.4.1 Third stage: competition in price for viewers

In this paragraph, we specify equilibrium demands, prices and profits as a function of quality levels γ_i, for $i \in \{1,2\}$. In order to compute viewers demand, we determine the viewer $\bar{x}$ who is indifferent between the two channels equalizing equation (1) and (2). Solving for *x*, we obtain:

$$\bar{x} = \frac{1}{2} + \frac{\gamma_1 - \gamma_2 - p_1 + p_2}{2t} \tag{14}$$

Implicit demands are $q_1 = \bar{x}$ and $q_2 = 1 - \bar{x}$.

Platform *i* maximizes its profit under the constraint that advertisers profit is non-negative. It fixes the price for ads such that $pro_i = 0$, that is $b_i = \alpha_i q_i$. We substitute viewers' implicit demands and ads prices in platforms' profit functions, and we maximize with respect to p_1 and p_2. By solving the system of first order conditions, we find that equilibrium prices for viewers are $p_i = t + \frac{1}{3}\left(\gamma_i - \gamma_j - M\left(2\alpha_i + \alpha_j\right)\right)$. By substitution, we derive equilibrium viewers' demands $q_i = \frac{1}{2} + \frac{1}{6t}\left(\gamma_i - \gamma_j + M\left(\alpha_i - \alpha_j\right)\right)$ and ads prices easily follow. Platform *i* profits is:

$$\pi_i = \frac{1}{18t}\left(3t + \gamma_i - \gamma_j + M\left(\alpha_i - \alpha_j\right)\right)^2 \tag{15}$$

We concentrate the analysis in the region where there exists market-sharing equilibria, which is the region where $\bar{\gamma} \in \left(M\left(\alpha_2 - \alpha_1\right) - 3t, M\left(\alpha_1 - \alpha_2\right) + 3t\right)$. In this region, second order conditions hold.

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66 Observe that when platforms are symmetric on the advertisers market, i.e. $\alpha_1 = \alpha_2$, platforms' profits are the same as under a pure pay-tv scenario. This depends on the fact that a model of a multi-sided market with a competitive bottleneck can be reformulated as one-sided market where utilities are written as:

$$U_1 = V + \Gamma_1 - xt - r_1$$
$$U_2 = V + \Gamma_2 - (1-x)t - r_2$$

where $\Gamma_i = \gamma_i + (\alpha - \delta) M$ for $i \in \{1,2\}$ and r_i represents the sum of the subscription fee and the per viewer advertiser fee multiplied by the mass of advertisers. Platforms' total profits are the same as under a pure pay-tv scenario, however the multi-sided specification allows to study the price structure and the externalities between the different sides of the market. We find that it can be profitable to subsidize the viewers' side of the market, which is the competitive bottleneck.

Both demands and prices are increasing in γ_i and decreasing in γ_{-i}. Thus, both the demand and the price of platform *i* are linearly increasing in $\Delta = \gamma_i - \gamma_{-i}$. Hence, any advantage in quality is magnified into large advantage in income (because profits are function of Δ^2). We observe that profits are convex in Δ, and that the profits of the highest quality firm increases with the asymmetry more than the profits of the lowest quality firm decreases.

We find that the revenues on the advertisers' side are always increasing in the quality of the content for both platforms. The same is not true for the revenues on the viewers' side, that are decreasing in the quality of the offer when *M* is high enough.

3.4.2 Second stage: vertical separation

We assume that the upstream operator is an independent firm which produces a premium content in monopoly. It offers a contract to both platforms or just to one, and the terms of the contract are as in section 3.3.2. The second stage upstream and downstream profits respectively are:

$$\Pi_U = \frac{1}{18t}\left(6t(\gamma_1+\gamma_2)+\gamma_1^2-4\gamma_1\gamma_2+\gamma_2^2-2M(\alpha_2-\alpha_1)(\gamma_1-\gamma_2)\right)^2 \tag{16}$$

$$\Pi_i = \frac{1}{18t}\left(3t-\gamma_j+M(\alpha_i-\alpha_j)\right)^2 \tag{17}$$

In the feasible region, the upstream provider profit function is not concave, so we do not find an interior solution.[67]

By the comparison of corner solutions, we find that the upstream finds profitable to give the quality content in exclusive to platform *2* when $t > \frac{\bar{\gamma}}{3}$ and $M \in \left(\max\left\{0, \frac{6t-3\bar{\gamma}}{2(\alpha_2-\alpha_1)}\right\}, \frac{3t-\bar{\gamma}}{\alpha_2-\alpha_1}\right)$.

Instead, when $t > \frac{\bar{\gamma}}{2}$ and $M \in \left(0, \frac{6t-3\bar{\gamma}}{2(\alpha_2-\alpha_1)}\right]$, it gives the quality content to both platforms.

It is interesting to study the limit case with symmetric platforms. In this case, we can first notice that the mass of advertisers plays no role in the exclusivity choice. All revenues from advertisers are redistributed to viewers. In this case, the content provision decision is taken on the sole basis of the differentiation between platforms. The upstream provides the quality content to both platforms when $t > \frac{\bar{\gamma}}{2}$ and in exclusive to one platform when $t \in \left(\frac{\bar{\gamma}}{3}, \frac{\bar{\gamma}}{2}\right)$. Thus, in the symmetric case, the content provider finds profitable to create vertical differentiation between the platforms when parameter *t* is low, so as to reduce price competition for viewers. When $\alpha_1 < \alpha_2$, price competition

67 It can be easily checked that the Hessian matrix is indefinite (see the appendix).

needs to be softened not only when t is low, but also when M is high.

Proposition 3. Under the mixed model with asymmetric platforms, an independent content provider provides the same content to both platforms when the mass of advertisers is small enough and horizontal differentiation is high enough. It provides the content in exclusive to platform 2 when the mass of advertisers is big enough, or whatever is the mass of advertisers when platforms are close enough. When platforms are symmetric, only the differentiation parameter matters in the choice.

3.4.3 Second stage: vertical integration

Now we assume that the upstream operator is vertically integrated with platform *1* and that platforms are asymmetric. The contract for the premium content provision is specified as in section 3.3.3. Platform *1*'s and platform *2*'s profit respectively are:

$$\Pi_1 = \begin{cases} \frac{1}{18t}\left(\left(3t+\gamma_1-\gamma_2-M(\alpha_2-\alpha_1)\right)^2+\gamma_2\left(6t+\gamma_2-2\gamma_1+2M(\alpha_2-\alpha_1)\right)\right) & \gamma_1>0 \quad \gamma_2\geq 0 \\ \frac{1}{18t}\left(\left(3t-M(\alpha_2-\alpha_1)\right)^2+\gamma_2\left(6t+\gamma_2+6M(\alpha_2-\alpha_1)\right)\right) & \gamma_1=0 \quad \gamma_2\geq 0 \end{cases} \tag{18}$$

$$\Pi_2 = \frac{1}{18t}\left(3t+M(\alpha_2-\alpha_1)-\max\{\gamma_1,\gamma_2\}\right)^2 \tag{19}$$

It can be shown that the integrated platform *1* always provides the quality content to at least one platform and that it always prefers not to provide the quality content to platform *1*, since the profit when $\gamma_1 = 0$ is always higher than the profit when $\gamma_1 > 0$. Since the profits with the exclusive to platform *2* are increasing in γ_2, then the integrated platform *1* provides quality $\bar{\gamma}$ in exclusive to platform *2*.

Assume now that the upstream operator is vertically integrated with platform *2*, which is the most efficient platform on the market for advertisers. Firms profits can be obtained by equations (18) and (19) by exchanging the subscripts *1* and *2*. We find that the vertically integrated platform *2* chooses to provide the quality content only internally in all the feasible region.

Assume now that platform *1* is vertically integrated and that platforms are symmetric. We find that the integrated platform always finds profitable to provide the quality content in exclusive either to the integrated platform or to the rival one. Indeed, when it grants the exclusive to the rival platform, it is able to recoup at the upstream level the losses on the downstream market, but it is not the case when it provide the non-exclusive, since the upstream tariff is too low. Thus, we verify that, when viewers are charged, there is some extra-revenue from exclusive provision that is lost under non-exclusive provision.

Proposition 4. Under the mixed model with asymmetric platforms, a vertically integrated platform always provides the premium content to the most efficient downstream platform. When platforms are symmetric, the vertically integrated operator always provides the premium content in exclusive either to the integrated platform or to the rival one.

3.5 Optimal Vs Market provision of quality

In this section, we introduce a fixed cost of production for the premium content. The content provider chooses the extent of exclusive provision and the quality level simultaneously. We can use the results of sections 3.3 and 3.4 concerning exclusivity, and internalize the quality level $\bar{\gamma}$ under different scenarios, paying attention to the way in which the regions are reshaped by the presence of the fixed cost and the endogenous choice of quality. Moreover, we derive optimal levels of quality provision and we compare optimal social choices with private ones.

3.5.1 Pure advertising

In this section we analyse the case when platforms charge advertisers but not viewers. First we derive equilibrium quality levels and then optimal ones, and finally we compare them. In the following, we use superscript *VI(i)* to denote the scenario of vertical integration of platform *i* and *VS* to denote the scenario of vertical separation.

3.5.1.1 Vertical separation

From section 3.3.2, we know that an independent upstream operator chooses to provide the same level of quality to both platforms. Now, it chooses the level of $\bar{\gamma}$ that maximizes its profits. By solving the first order condition, we find that the equilibrium quality is $\bar{\gamma} = \frac{Mk}{2t}(\alpha_1 + \alpha_2)$.

The welfare level is:

$$W = V + \frac{M}{2}(\alpha_1 + \alpha_2 - 2\delta) - \frac{t}{4} - \frac{Mk(\alpha_1 + \alpha_2)\left(M(\alpha_1 + \alpha_2) - 4t\right)}{8t^2}$$

The same conclusion holds when platforms are symmetric, and it is easy to derive the results by imposing $\alpha_1 = \alpha_2 = \alpha$.

3.5.1.2 Vertical integration

From the analysis in section 3.3.3, we know that the integrated platform *1*, when $\alpha_1 < \alpha_2$, provides the exclusive to platform *2*. By endogenizing the quality level, we find that $\bar{\gamma} = \frac{Mk}{2t}(2\alpha_2 - \alpha_1)$.

As concerns welfare, when the quality content is given to both platforms it is equal to:

$$W = V + \frac{M}{2}(\alpha_1 + \alpha_2 - 2\delta) - \frac{t}{4} + \frac{Mk(\alpha_1 - 2\alpha_2)\left(2t(M\alpha_1 - 2t) + Mk(\alpha_1 - 2\alpha_2)\right)}{16t^3}$$

Assume now that platform *2* is vertically integrated and that platforms are asymmetric. In section 3.3.3, we find that it chooses to provide the quality content only internally. The quality level that maximizes the net profit is $\bar{\gamma} = \frac{Mk\alpha_2}{2t}$.

We find that welfare is:

$$W = V + \frac{M}{2}(\alpha_1 + \alpha_2 - 2\delta) - \frac{t}{4} + \frac{Mk\alpha_2\left(2t\left(2t + M(\alpha_2 - 2\alpha_1)\right) + Mk\alpha_2\right)}{16t^3}$$

Assume now that platforms are symmetric. We found in section 3.3.3 that a vertically integrated firm always provides the highest quality level to one platform, and is indifferent on the quality level provided to the other platform. Equilibrium levels of quality and profits can be easily obtained imposing $\alpha_1 = \alpha_2 = \alpha$

3.5.1.3 Optimum

Total welfare is given by the sum of (4) and (5). We find that it is optimal to provide the premium content in exclusive to platform *2* for $t > \frac{k}{4}\left(1 + \sqrt{17}\right)$ and $M > \frac{\sqrt{2t(2t-k)} - t}{\alpha_2 - \alpha_1}$, at a level $\bar{\gamma} = \frac{k\left(t + M(\alpha_2 - \alpha_1)\right)}{2t - k}$.[68] In the complementary feasible region with market sharing equilibria, it is optimal to provide the quality content to both platforms, with $\gamma_1 = \gamma_2 = k$. When platforms are symmetric, it is always optimal to provide the premium content to both platforms at a level $\gamma_1 = \gamma_2 = k$.

3.5.1.4 Discussion

As concerns the quality level of the premium content, we verify that $\bar{\gamma}^{VS} < \bar{\gamma}^{VI(1)}$ when $\alpha_1 \in (0,1/2)$ and $\alpha_2 \in (2\alpha_1,1)$. Indeed, when α_2 is more than twice α_1, the benefit from quality for the integrated platform *1* is higher than the one created for the independent firm that provide the quality to both firms. This depends on the fact that platform *1* extracts twice the rents deriving from the sale of the premium content on the downstream market from platform *2*, while the independent content provider only once from each platform. Instead, when platform *2* is vertically integrated, it always holds that $\bar{\gamma}^{VS} > \bar{\gamma}^{VI(2)}$ since the vertically integrated firm takes into account the benefit created by

68 Note the the threshold on *t* serves only to assure that the region is not empty, thus that *M* is lower than the upper bound on *M* than defines the feasible region.

quality provision of both platforms, while platform *2* considers only the benefit created by its downstream provision of the quality content.

We find that vertical integration increases the Herfindahl index in all cases compared to the case of vertical separation, since the market passes from a symmetric situation to an asymmetric one.

As regards welfare, it is higher under vertical integration than under vertical separation if M is high enough. The threshold is increasing in t, decreasing in k and α_2. It can be increasing or decreasing in α_1 when platform *1* is vertically integrated, while it is always increasing in α_1 when platform *2* is vertically integrated. This occurs because exclusive provision of quality content can be optimal, and vertical integration can boost the market toward this outcome.

When platform *1* is vertically integrated, consumer surplus is higher under vertical integration if M is high enough, and this region exists only if α_1 is small enough. The threshold on M increases in t and α_1 and decreases in k and α_2. When platform *2* is vertically integrated, consumer surplus is always higher under vertical separation. Since, given $\bar{\gamma}$, consumers are always better off under non-exclusive provision, consumer surplus can be higher under vertical integration because the increase in quality for a part of the market compensates the reduction in quality for the other part.

Comparing equilibrium and optimal values of the quality content, we verify that there can be market under- or over-provision of quality both under vertical integration and vertical separation. In particular, in the region where it is optimal to provide quality to both platforms, there is over-provision for M high enough, and the threshold on M is increasing in t and decreasing in α_2. In the region where it is optimal to provide quality to both platform, there is over-provision when both t and M are high, where the threshold on t is increasing in k and the threshold on M is increasing in t.

3.5.2 Mixed model with multi-homing advertisers

Now, platforms charge both viewers and advertisers. We first derive equilibrium quality levels and then optimal one, and finally we compare them.

3.5.2.1 Vertical separation

In section 3.4.2 we derived the exclusive and non-exclusive choices of the upstream. We need to verify how the endogenization of the choice on $\bar{\gamma}$ affects the region where exclusive and non-exclusive provision occurs. We find that the content provider provides the premium content to both platforms at a level $\bar{\gamma} = \frac{6tk}{9t + 2k}$, for $t > \frac{2k}{9}$ and $M > \left(0, \bar{M}\right]$, where $\bar{M} = \frac{3t}{\alpha_2 - \alpha_1}\left(2\sqrt{\frac{9t - k}{9t + 2k}} - 1\right)$. The quality content is provided in exclusive to platform *2* at a level $\bar{\gamma} = \frac{k\left(3t + M\left(\alpha_2 - \alpha_1\right)\right)}{9t - k}$, for $t > \frac{2k}{9}$

and $M > \left(\bar{M}, \bar{\bar{M}}\right)$,where $\bar{\bar{M}} = \frac{9t - 2k}{3(\alpha_2 - \alpha_1)}$.

When there is non-exclusive provision of quality content, welfare is:

$$W = V + \frac{M}{2}(\alpha_1 + \alpha_2 - 2\delta) + \frac{99t^2 + 5M^2(\alpha_1 - \alpha_2)^2}{36t} - \frac{9t^2(27t + 8k)}{(9t + 2k)^2}$$

while, when the content is provided only to platform *2* the welfare is:

$$W = V + \frac{M}{2}(\alpha_1 + \alpha_2 - 2\delta) + \frac{M(\alpha_2 - \alpha_1)\left(2k(18t - k) - M(\alpha_1 - \alpha_2)(45t - 2k)\right) + t\left(54tk - 2k^2 - 81t^2\right)}{4(k - 9t)^2}$$

When platform are symmetric, the presence of the fixed cost and the endogenous choice of $\bar{\gamma}$, changes the result of the basic model. Indeed, the upstream always finds profitable to provide the quality content to both platforms in the region with market sharing equilibria.

3.5.2.2 Vertical integration

Now assume that platform *1* is vertically integrated with the upstream provider, and that platforms are asymmetric. In section 3.4.3 we find that it prefers to provide the quality content in exclusive to platform *2*. The equilibrium quality level is $\bar{\gamma} = \frac{3k\left(t + M(\alpha_2 - \alpha_1)\right)}{9t - k}$.

As concerns welfare, when the quality content is given to both platforms it is equal to:

$$W = V + \frac{M}{2}(\alpha_1 + \alpha_2 - 2\delta) + \frac{M(\alpha_2 - \alpha_1)\left(6tk(72t + k) + M(\alpha_2 - \alpha_1)\left(18kt + 405t^2 + 20k^2\right)\right) + 9t^2\left(54tk - 2k^2 - 81t^2\right)}{36t(k - 9t)^2}$$

Now, assume that the upstream provider is controlled by platform *2*. We know that it chooses exclusive provision for the integrated platform. The equilibrium quality level is $\bar{\gamma} = \frac{k\left(3t + M(\alpha_2 - \alpha_1)\right)}{9t - k}$.

In this case, welfare is as under vertical separation with exclusive provision.

Assume now that platforms are symmetric. The vertical integrated platform always provides the exclusive to one platform, either the integrated one or the rival. Equilibrium levels of quality and profits can be easily obtained imposing $\alpha_1 = \alpha_2 = \alpha$.

3.5.2.3 Optimum

Total welfare is given by the sum of (4) and (5). When platforms are asymmetric, it is socially optimal to provide the quality content in exclusive to platform *2* when $t > \frac{40k}{63}$ and

$M > \frac{3\sqrt{2t(18t-5k)}-9t}{5(\alpha_2-\alpha_1)}$, at a level $\bar{\gamma} = \frac{k(9t+5M(\alpha_2-\alpha_1))}{18t-5k}$.[69] In the complementary feasible region, quality contents are provided to both platforms, at a level $\gamma_1 = \gamma_2 = k$. Notice that $\frac{k(9t+5M(\alpha_2-\alpha_1))}{18t-5k} > k$ in the interval where it is optimal to provide quality content only to platform *2*. When platforms are symmetric, it is always optimal to provide quality content to both platform, at a level $\gamma_1 = \gamma_2 = k$.

3.5.2.4 Discussion

As regards the provided level of quality, when platform *1* is vertically integrated, quality under vertical separation with non-exclusive provision is higher than quality under vertical integration for $t > \frac{4k}{9}$ and $M < \frac{t(9t-4k)}{(9t+2k)(\alpha_2-\alpha_1)}$. As regards platform *2*, we find that $\bar{\gamma}^{VS} > \bar{\gamma}^{VI(2)}$ when $t > \frac{4k}{9}$ and $M < \frac{3t(9t-4k)}{(9t+2k)(\alpha_2-\alpha_1)}$. Thus, the vertically integrated platform provides the highest quality not only when *t* is low, but also when *t* is high and *M* high. The vertically integrated platform *2* provides a higher quality in a smaller region.

We find that vertical integration increases the Herfindahl index compared to the vertical separation scenario in all cases but when platform 2 is vertically integrated and there is exclusive provision under vertical separation: in this case it is unchanged.

As concerns welfare, when we compare the case of non-exclusive provision under vertical separation and exclusive provision under vertical integration, it is higher under vertical separation than under vertical integration when *t* is high enough and *M* is low enough. The region where at equilibrium there is exclusive provision under vertical separation never intersects the region where the case of vertical integration of platform *1* exists. While welfare with exclusive provision under vertical separation and under vertical integration of platform *2* are the same.

We find similar results when we compare consumer surplus.

From the comparison of optimal and equilibrium provisions, we verify that at equilibrium there is always under-provision of quality.

3.5.3 Comparison of the optimal provision under the two models

Under the free-to-air model, platforms choose the quality level taking into account the benefit created on the advertising markets. They disregard the benefit created for viewers, that is taken into

69 Note the the threshold on *t* serves only to assure that the region is not empty.

account when the optimum is computed. Thus, when private benefit created by quality exceeds the social benefit, the market can over-provide quality. In particular, when the market for advertising is large, downstream platforms are provided with high quality content, in order to increase their ability to attract viewers and to be able to extract higher revenues from advertisers.

Under the mixed model, broadcasters transfer some of the benefit created on the advertising market to viewers, that retain some surplus. At the social level, one considers the total benefit created on both markets, hence the market under-provides quality.

Proposition 5. Under both the pure pay-tv and the mixed models, quality is always under-provided. Under the pure advertising model, quality can be over- or under-provided. In particular, there is over-provision of quality when the transportation cost and the mass of advertisers are high enough.

3.6 Extension: Control over Premium Content

In this section, we add a stage zero to the timing in section 3.2. In this stage, we allow platforms to bid, if interested, in order to acquire the control over the upstream firm. Platforms bid sequentially and just once, and the first bidder is randomly drawn.

We are interested to analyse if the upstream operator might find profitable to give up the control over the premium content and to understand which platform, if any, acquires the content provider. We perform this study for the asymmetric model with endogenous quality.

Note that all players know, by backward induction, their choices concerning exclusive and quality choices under the different scenarios, hence their equilibrium profits under different scenarios. On the basis of these elements, the players decide which scenario they prefer.

In the following, $\Pi_i(VI(j))$ refers to the profit of platform *i* when platform *j* is vertically integrated with $i, j \in \{1,2\}$; $\Pi_i(VS)$ is the profit of firm *i* under the vertical separation scenario and $\Pi_U(VS)$ is the upstream operator profit in the scenario of vertical separation.

3.6.1 Pure Advertising

In this stage, downstream platforms make offers, when they are interested, in order to take control over the content provider. The upstream operator gives up the control over the content only if the bid is equal to or higher than the profit from the direct control over the content. Thus, three different scenarios are possible: vertical separation and vertical integration with platform *1* or *2*.

First, we verify that downstream platforms are always willing to pay the minimum price at which the upstream is willing to give up the control over the premium content, that is $\Pi_U(VS)$. Since we

find that, for $i \in \{1,2\}$,

$$\Pi_i(VI(i)) - \Pi_U(VS) > \Pi_i(VS) \tag{20}$$

then vertical integration always generates enough surplus for a platform to acquire the control over the premium content.

However, it can be the case that a platform prefers the rival to acquire the upstream. The platform which is randomly drawn to bid as first is willing to offer at least $\Pi_U(VS)$ only if

$$\Pi_i(VI(i)) - \Pi_U(VS) > \Pi_i(VI(j)) \tag{21}$$

with $i, j \in \{1,2\}$ and $i \neq j$. If both platforms are willing to acquire the control over the content provider, platform *2* makes the highest bid and acquires the control, since $\Pi_2(VI(2)) - \Pi_2(VI(1)) > \Pi_1(VI(1)) - \Pi_1(VI(2))$. In this region, the upstream receives an extra-profit from ceding the rights over the premium content, since platform *2* pays $\Pi_1(VI(1)) - \Pi_1(VI(2))$, that is higher than $\Pi_U(VS)$.[70] This region is such that $\alpha_1 \in (0,3/4)$, $\alpha_2 \in (4\alpha_1/3,1)$, $M \in \left(0, 2t^2/k(\alpha_2 + \alpha_1)\right)$ or $\alpha_1 \in (0,1/2)$, $\alpha_2 \in (2\alpha_1,1)$, $M \in \left(0, 2t^2/k(2\alpha_2 - \alpha_1)\right)$.

Then, there is a region where disequality (21) is verified for platform *2* but not for platform *1*, thus platform *2* acquires the upstream paying $\Pi_U(VS)$.[71] This region is such that $\alpha_1 \in \left(0, 2\left(\sqrt{2} - 1\right)\right)$, $\alpha_2 \in \left(\alpha_1\left(1/2 + 1/\sqrt{2}\right), \min\{4\alpha_1/3; 1\}\right)$, $M \in \left(0, 2t^2/k(\alpha_2 + \alpha_1)\right)$.

Finally, there is a region where the disequality (21) is violated for both platforms, meaning that both platforms prefer the rival to acquire the control over the premium content rather than acquire the upstream. However, both platforms always prefer to acquire the control over the premium content rather than being vertically separated. Thus, the platform which is drawn to bid as first does not make an offer, while the second one acquires the upstream firm paying a price $\Pi_U(VS)$. Each platform bids as first with a probability equal to $1/2$. This region is such that $\alpha_1 \in (0,1)$, $\alpha_2 \in \left(\alpha_1, \min\left\{\alpha_1\left(1/2 + 1/\sqrt{2}\right); 1\right\}\right)$, $M \in \left(0, 2t^2/k(\alpha_2 + \alpha_1)\right)$.

3.6.2 Mixed Model

Now we study this stage for the mixed business model. First, we verify that disequality (20) is

70 Note that this price could be so high to make the scenario of vertical separation preferable for the platforms to the one of their own vertical integration. It can occur that $\Pi_2(VI(2)) - \left(\Pi_1(VI(1)) - \Pi_1(VI(2))\right) < \Pi_2(VS)$. However, since $\Pi_1(VI(1)) - \left(\Pi_1(VI(1)) - \Pi_1(VI(2))\right) > \Pi_1(VS)$, then platform 2 is always willing to bid $\Pi_1(VI(1)) - \Pi_1(VI(2))$ in order to avoid the vertical integration of the rival. Indeed, at this price, it prefers its own vertical integration to the one of the rival platform.

71 Observe that the region where disequality (21) is verified for platform *1* but not for platform *2* is empy, since $\Pi_2(VI(2)) - \Pi_2(VI(1)) > \Pi_1(VI(1)) - \Pi_1(VI(2))$.

satisfied for $i \in \{1,2\}$. Hence, at equilibrium, platforms are always willing to bid at least the minimum price for acquiring the control over the content right, when the alternative is the vertical separation scenario.[72]

The platform which is randomly drawn to bid as first is willing to make an offer only if disequality (21) is verified. If this is true for both $i \in \{1,2\}$, both platforms are willing to acquire the control over the premium content. Still, platform *2* makes the highest bid (since $\Pi_2(VI(2)) - \Pi_2(VI(1)) > \Pi_1(VI(1)) - \Pi_1(VI(2))$) and acquires the control. The offer for the upstream is always higher than $\Pi_U(VS)$.[73] This occurs when *t* is low enough or when both *t* and *M* are high.

Moreover, there is a region where disequality (21) is verified for platform *2* but not for platform *1*, thus platform *2* acquires the upstream paying $\Pi_U(VS)$. This is verified for high values of *t* and intermediate values of *M*.

Finally, there is a region where the disequality (21) is violated for both platforms. As in the pure-advertising case, the platform which is drawn to bid as first does not make an offer, while the second one acquires the upstream firm paying a price $\Pi_U(VS)$. Each platform bids as first with a probability equal to $1/2$. This occurs when *t* is high and *M* low.

3.6.3 Discussion

Under the pure advertising model, acquiring the control over the premium content is very valuable when platform *2* has a big advantage over platform *1* on the advertising market. In this case, neither the horizontal differentiation between platforms nor the mass of advertisers play any role. The advantage from controlling the content just derives from the possibility to take advantage of the efficiency of platform *2* on the advertisers market, since profits come only from this market.

Under the mixed model, both platforms are willing to acquire the upstream when they are not strongly horizontally differentiated, or when the differentiation parameter is high and the mass of advertisers wide. Indeed, when the transportation cost is low, the revenues coming from the control over the quality content are high, since it is the source of differentiation in the eyes of viewers. When the horizontal differentiation is high enough, the control over the premium content is highly valuable when the mass of advertisers is wide, since in this case the viewers' attention sold on to advertisers generates high revenues.

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72 The regions where there are market sharing equilibria under the scenario of vertical separation with exclusive provision and the scenario of vertical integration of platform *1* never intersect.

73 Note that there is a region where at the price $\Pi_1(VI(1)) - \Pi_1(VI(2))$ the scenario of vertical separation is preferable for both platforms to their own vertical integration. However, for both platforms, the relevant outside option for defining the price that they are willing to pay for acquiring the upstream is always the profit under the vertical integration of the rival, since (20) holds and at least one platforms is always going to integrate.

In our context, we find that the upstream, devolving to downstream platforms the control over the premium content, may increase the rents coming from the sale of the premium content.

Under both financing models, platform *2* complete the acquisition when platforms overbid for acquiring the upstream and it gets higher profit from vertical integration compared to the rival. Note that, when platforms overbid, the price for the upstream could be so high that both platforms would prefer the scenario of vertical separation to the one of their own vertical integration. However, they are not able to coordinate on this choice.

Platform *1* gets the control over the premium content only when it is randomly drawn to bid as second and both platforms prefer the rival to vertically integrated. Indeed, in this region, if platform 2 is called to bid as first, does not bid since it knows that platform 1, which is the second bidder, will always acquire the upstream at the minimum price, since at this price it prefers the scenario of vertical integration to the one of vertical separation.

However, consumer surplus is always higher when platform *1* controls the premium content, since under this scenario a bigger portion of the market enjoys a premium content of higher quality compared to the case of vertically integration of platform *2*. In order to understand why the vertically integrated platform *1* provides a higher quality than the vertically integrated platform *2*, it is interesting to look at the comparative statics of second stage profits. Obviously, the profit of the vertically integrated platform 2 increases in $\overline{\gamma}$, since it keeps the exclusivity over the premium content. When platform 1 is vertically integrated, its downstream profit is decreasing in $\overline{\gamma}$, since it gives the exclusive to the rival, but the fixed tariff for platform *2* is increasing in quality. At the net, total profit of the vertically integrated platform *1* increases more than the profit of the vertical integrated platform *2*. This occurs since the threat of using the premium content that is offered in exclusive to platform *2* allows the integrated platform *1* to extract high profit. Indeed, the integrated platform *1* takes into account both the efficiency level of platform *2* and the advantage of efficiency of platform *2* over platform *1*.

We verify that the profit of the vertically integrated platform 2 are always higher than the profit of the vertically integrated platform 1. Platform 2 can spend less resources in the quality investment, since the attention of viewers that it is able to capture with a lower quality can be sold on to advertisers at a high price. The high efficiency on the advertising market decreases the incentives to invest in quality.

As concerns total welfare, we do not have a clear-cut result under the the pure-advertising model, but we always find that the vertical integration of platform *1* is preferable under the mixed model.

Proposition 6: When the upstream provider is willing to cede the control over the premium content, both downstream platform are willing to acquire it. Platform 2 earns higher profit from the control over the premium content than platform 1. However, from a viewers' point of view, the vertical integration of platform 1 generates higher surplus, since it increases the quality level provision for a bigger share of the market.

4 Conclusions

In the present work, we have investigated exclusivity and quality choices in the tv industry. Exclusivity over valuable programming is an important competitive strategy in the tv industry, since premium contents are key resources for attracting viewers and, as a consequence, advertisers.

Many distributors of contents try to acquire direct control over content producers through vertical integration. Hence, it is interesting to investigate how vertical integration, as opposed to vertical separation, can affect exclusive and quality choices. We find that under vertical integration the premium content is always granted on an exclusive basis to the most efficient platform on the advertising market. Instead, an independent content provider can prefer non-exclusive contracts. Thus, vertical integration drives toward exclusive provision, since the vertically integrated platform internalizes the benefit of a relaxed competition coming from quality differentiation on downstream competition.

Also the business model of a platform is found to have an important role on the extent of exclusive on premium content. We verify that the pay-tv business model drives toward exclusive provision. Indeed, when viewers are charged for accessing a channel, it can be profitable for the content provider to provide an exclusive contract so as to relax price competition for viewers. Price competition needs to be relaxed both when the transportation cost is low and when the market for advertisers is wide.

We also find that efficiency on the advertisers market drives toward exclusive provision, in favour of the most efficient downstream platform. Thus, a higher efficiency on the advertisers market can be used to attract exclusive quality content.

Moreover, when we allow platforms to bid for the content provider, we find that the most efficient platform always earns more profits from vertically integrating than the rival platform, and that the former integrates in a wide portion of the feasible region. However, when the most efficient platform integrates, it has less incentives to invest in quality than the rival vertically integrated platform. Thus, the efficiency on the advertisers market can be used as an alternative source of profits to the investment in quality programming. For this reason, consumers would prefer the least

efficient platform to vertically integrate, since they would receive higher quality programming.

Platforms always prefer to acquire the upstream at the minimum price rather than being vertically separated. Platforms overbid for acquiring the upstream in the region where the control over the premium content is very valuable, and in this region the most efficient platform on the advertising market acquires the upstream. However, in some cases, both platforms prefer the rival to acquire the upstream rather than vertically integrates. This occurs when profits from the exclusive content are low: under the free-to-air, it is the case when platforms are almost symmetric on the advertisers side, while under the pay-tv model when competition in price for viewers is relaxed.

Note that the upstream provider can earn higher profits from the sale of the control right than from the provision of the content.

Then, we compare private and social choices on quality and exclusivity. We find that the exclusive provision of the quality content to the most efficient downstream platform can be socially optimal when the mass of advertisers is wide and the transportation cost is high.

Moreover, under- or over-provision of quality level can occur under the pure free-to-air model. On the contrary, there is always under-provision of quality in the mixed model, since consumers retain some surplus.

Even if the model is static, some dynamic considerations can be drawn. It can be observed a trend toward concentration, since firms always prefer the scenario of vertical integration and vertical integration induces exclusive provision to the most efficient platform. This exacerbates the differences of platforms on the downstream market.

The desirability of exclusive over valuable program is one of the questions in the agenda of public authorities. We find that, in our static context, exclusive provision of quality contents can sometimes be welfare and consumer surplus enhancing. However, the desirability of exclusive contract should be better investigate in a dynamic context, in order to have some insight on the evolution of the concentration in the industry.

5 Appendix

Proof of Proposition 1. Assume that an independent content provider provides a content of quality γ_i to platform $i \in \{1,2\}$, then its profit is $\Pi_U = \frac{M}{2t}(\alpha_1\gamma_1 + \alpha_2\gamma_2)$. Since the profit function is linear in γ_i with $i \in \{1,2\}$, and $\frac{\partial \Pi_U}{\partial \gamma_i} > 0$, then profit is maximal for $\gamma_1 = \gamma_2 = \bar{\gamma}$.■

Proof of Proposition 2. Assume that platform 1 is vertically integrated with the upstream content

provider. If it provides quality $\gamma_1 > 0$ and $\gamma_2 \geq 0$, then its profit is $\Pi_1 = \frac{M}{2t}\left(t\alpha_1 + (\alpha_2 - \alpha_1)\gamma_2 + \alpha_1\gamma_1\right)$. Since this profit is linearly increasing in both γ_i with $i \in \{1,2\}$, then profit is maximal for $\gamma_1 = \gamma_2 = \overline{\gamma}$. If the vertically integrated platform 1 provides a quality $\gamma_1 = 0$ and $\gamma_2 \geq 0$, then its profit is $\Pi_1 = \frac{M}{2t}\left(t\alpha_1 + (2\alpha_2 - \alpha_1)\gamma_2\right)$. Since this profit is linearly increasing in γ_2, then profit is maximal for $\gamma_2 = \overline{\gamma}$. Since $\Pi_1(\gamma_1 = \overline{\gamma}, \gamma_2 = \overline{\gamma}) - \Pi_1(\gamma_1 = 0, \gamma_2 = \overline{\gamma}) = \frac{M\overline{\gamma}}{2t}(\alpha_1 - \alpha_2) < 0$, then the vertically integrated platform 1 provides the quality content in exclusive to the rival.

Assume that platform 2 is vertically integrated with the upstream content provider. If it provides quality $\gamma_2 > 0$ and $\gamma_1 \geq 0$, then its profit is $\Pi_2 = \frac{M}{2t}\left(t\alpha_2 - (\alpha_2 - \alpha_1)\gamma_1 + \alpha_2\gamma_2\right)$. Since this profit is linearly increasing in γ_2 and linearly decreasing in γ_1 with $i \in \{1,2\}$, then profit is maximal for $\gamma_1 = 0$ and $\gamma_2 = \overline{\gamma}$. If the vertically integrated platform 2 provides a quality $\gamma_2 = 0$ and $\gamma_1 \geq 0$, then its profit is $\Pi_2 = \frac{M}{2t}\left(t\alpha_2 + (2\alpha_1 - \alpha_2)\gamma_1\right)$. Since this profit is linear in γ_1, and $\frac{\partial \Pi_2}{\partial \gamma_1} = \frac{M}{2t}(2\alpha_1 - \alpha_2)$, then profit is maximal for $\gamma_1 = \overline{\gamma}$ when $\alpha_1 \geq \alpha_2/2$ and for $\gamma_1 = 0$ when $\alpha_1 < \alpha_2/2$. Since in the interval $\alpha_1 \geq \alpha_2/2$ we verify that $\Pi_2(\gamma_1 = 0, \gamma_2 = \overline{\gamma}) - \Pi_2(\gamma_1 = \overline{\gamma}, \gamma_2 = 0) = \frac{M\overline{\gamma}}{2t}(\alpha_2 - \alpha_1) > 0$ and we already know that $\Pi_2(\gamma_1 = 0, \gamma_2 = \overline{\gamma}) - \Pi_2(\gamma_1 = 0, \gamma_2 = 0) > 0$, then the vertically integrated platform 2 provides the quality content in exclusive to the integrated platform.

Assume that $\alpha_1 = \alpha_2 = \alpha$ and that platform 2 is vertically integrated with the upstream content provider. If platform 2 provides quality $\gamma_2 > 0$ and $\gamma_1 \geq 0$, its profit is linearly increasing in γ_2 and independent of γ_1, then profit is maximal for $\gamma_1 \in [0, \overline{\gamma}]$ and $\gamma_2 = \overline{\gamma}$. If it provides a quality $\gamma_2 = 0$ and $\gamma_1 \geq 0$, then its profit is linearly increasing in γ_1 and independent of γ_2, then profit is maximal for and $\gamma_1 = \overline{\gamma}$ and $\gamma_2 \in [0, \overline{\gamma}]$. Since $\Pi_2(\gamma_1 = 0, \gamma_2 = \overline{\gamma}) = \Pi_2(\gamma_1 = \overline{\gamma}, \gamma_2 = 0)$, then a vertically integrated platform is indifferent between the exclusive to one of the platforms and the non-exclusive, when $\alpha_1 = \alpha_2 = \alpha$.■

Proof of Proposition 3. Assume that an independent upstream provider provides a premium content of quality γ_i to platform $i \in \{1,2\}$, then its profit is

$\Pi_U = \frac{1}{18t}\left(6t(\gamma_1+\gamma_2)+\gamma_1^2-4\gamma_1\gamma_2+\gamma_2^2-2M(\alpha_2-\alpha_1)(\gamma_1-\gamma_2)\right)^2$. The Hessian matrix is $\begin{pmatrix} 1/9t & -2/9t \\ -2/9t & 1/9t \end{pmatrix}$. Since it is an indefinite matrix, then the profit function is not concave in γ_1 and γ_2. Thus we study corner solutions, with $\gamma_i \in [0,\bar{\gamma}]$ for $i \in \{1,2\}$.

Assume that $\alpha_1 < \alpha_2$. Since $\Pi_U(\gamma_1=0,\gamma_2=\bar{\gamma}) - \Pi_U(\gamma_1=\bar{\gamma},\gamma_2=0) = \frac{2\bar{\gamma}M}{9t}(\alpha_2-\alpha_1) > 0$ and $\Pi_U(\gamma_1=\bar{\gamma},\gamma_2=\bar{\gamma}) - \Pi_U(\gamma_1=0,\gamma_2=\bar{\gamma}) = \frac{\bar{\gamma}}{9t}\left(6t-2M(\alpha_2-\alpha_1)-3\bar{\gamma}\right)$, then then the upstream offers the quality content to both platforms if $t > \frac{\bar{\gamma}}{2}$ and $M \in \left(0, \frac{6t-3\bar{\gamma}}{2(\alpha_2-\alpha_1)}\right]$, and to only platform 2 if $t > \frac{\bar{\gamma}}{3}$ and $M \in \left(\max\left\{0, \frac{6t-3\bar{\gamma}}{2(\alpha_2-\alpha_1)}\right\}, \frac{3t-\bar{\gamma}}{\alpha_2-\alpha_1}\right)$.

Assume now that $\alpha_1 = \alpha_2 = \alpha$. Since $\Pi_U(\gamma_1=\bar{\gamma},\gamma_2=\bar{\gamma}) - \Pi_U(\gamma_1=\bar{\gamma},\gamma_2=0) = \Pi_U(\gamma_1=\bar{\gamma},\gamma_2=\bar{\gamma}) - \Pi_U(\gamma_1=0,\gamma_2=\bar{\gamma}) = \frac{\bar{\gamma}}{9t}(6t-3\bar{\gamma})$, then the upstream offers the quality content to both platforms if $t > \frac{\bar{\gamma}}{2}$, and to only one platform if $t \in \left(\frac{\bar{\gamma}}{3}, \frac{\bar{\gamma}}{2}\right)$.■

Proof of Proposition 4. Assume that platform 1 is vertically integrated with the upstream content provider and that $\alpha_1 < \alpha_2$. If it provides quality $\gamma_1 > 0$ and $\gamma_2 \geq 0$, then its profit is $\Pi_1 = \frac{1}{18t}\left(\left(3t+\gamma_1-\gamma_2-M(\alpha_2-\alpha_1)\right)^2+\gamma_2\left(6t+\gamma_2-2\gamma_1+2M(\alpha_2-\alpha_1)\right)\right)$. In order to study the concavity of this function, we compute the Hessian matrix $\begin{pmatrix} 1/9t & -2/9t \\ -2/9t & 2/9t \end{pmatrix}$. Since this is an indefinite matrix, then the profit function is not concave in γ_1 and γ_2. Thus we study the corner solutions, with $\gamma_1 = \bar{\gamma}$ and $\gamma_2 \in \{0,\bar{\gamma}\}$. If it provides quality $\gamma_1 > 0$ and $\gamma_2 \geq 0$, then its profit is $\Pi_1 = \frac{1}{18t}\left(\left(3t-M(\alpha_2-\alpha_1)\right)^2+\gamma_2\left(6t+\gamma_2+6M(\alpha_2-\alpha_1)\right)\right)$, with $\frac{\partial \Pi_1}{\partial \gamma_2} > 0$. Since $\Pi_1(\gamma_1=0,\gamma_2=\bar{\gamma}) - \Pi_1(\gamma_1=\bar{\gamma},\gamma_2=\bar{\gamma}) = \frac{\bar{\gamma}}{9t}\left(\bar{\gamma}+2M(\alpha_2-\alpha_1)\right) > 0$,

$\Pi_1(\gamma_1 = 0, \gamma_2 = \bar{\gamma}) - \Pi_1(\gamma_1 = \bar{\gamma}, \gamma_2 = 0) = \frac{4\bar{\gamma}M}{9t}(\alpha_2 - \alpha_1) > 0$ and

$\Pi_1(\gamma_1 = 0, \gamma_2 = \bar{\gamma}) - \Pi_1(\gamma_1 = 0, \gamma_2 = 0) = \frac{\bar{\gamma}}{18t}\left(\bar{\gamma} + 6\left(t + M(\alpha_2 - \alpha_1)\right)\right) > 0$, then the vertical integrated platform 1 always chooses to provide the quality content in exclusive to platform 2.

Assume that platform 2 is vertically integrated with the upstream content provider. If it provides quality $\gamma_2 > 0$ and $\gamma_1 \geq 0$, then its profit is $\Pi_2 = \frac{1}{18t}\left(\left(3t - \gamma_1 + \gamma_2 + M(\alpha_2 - \alpha_1)\right)^2 + \gamma_1\left(6t + \gamma_1 - 2\gamma_2 - 2M(\alpha_2 - \alpha_1)\right)\right)$. The Hessian matrix, that is the same as before, hence the profit function is not concave in γ_1 and γ_2. Thus we study corner solutions, with $\gamma_1 \in \{0, \bar{\gamma}\}$ and $\gamma_2 = \bar{\gamma}$. If it provides quality $\gamma_2 = 0$ and $\gamma_1 \geq 0$, then its profit is $\Pi_2 = \frac{1}{18t}\left(\left(3t + M(\alpha_2 - \alpha_1)\right)^2 + \gamma_1\left(6t + \gamma_1 - 6M(\alpha_2 - \alpha_1)\right)\right)$, with $\frac{\partial \Pi_2}{\partial \gamma_1} > 0$. Since

$\Pi_2(\gamma_1 = 0, \gamma_2 = \bar{\gamma}) - \Pi_2(\gamma_1 = \bar{\gamma}, \gamma_2 = \bar{\gamma}) = \frac{\bar{\gamma}}{9t}\left(\bar{\gamma} + 2M(\alpha_2 - \alpha_1)\right) > 0$

$\Pi_2(\gamma_1 = 0, \gamma_2 = \bar{\gamma}) - \Pi_2(\gamma_1 = \bar{\gamma}, \gamma_2 = 0) = \frac{4M\bar{\gamma}}{9t}(\alpha_2 - \alpha_1) > 0$ and

$\Pi_1(\gamma_1 = 0, \gamma_2 = \bar{\gamma}) - \Pi_1(\gamma_1 = 0, \gamma_2 = 0) = \frac{\bar{\gamma}}{18t}\left(\bar{\gamma} + 6t + 2M(\alpha_2 - \alpha_1)\right) > 0$, then the vertical integrated platform 2 always chooses to provide the quality content in exclusive to itself.

Assume now that $\alpha_1 = \alpha_2 = \alpha$ and that platform 2 is vertically integrated with the upstream content provider. It easily follows from previous disequalities that an integrated platform always provides the quality content in exclusive either to the integrated platform or to the rival one, when $\alpha_1 = \alpha_2 = \alpha$.■

Proof of Proposition 5. Assume that $\alpha_1 < \alpha_2$ and that platforms charge only advertisers. We substitute the indifferent viewer of equation (6) in the sum of (4) and (5). In order to study the concavity of this function, we compute the Hessian matrix, that is $\begin{pmatrix} -\frac{1}{r} + \frac{1}{2t} & -\frac{1}{2t} \\ -\frac{1}{2t} & \frac{1}{2t} \end{pmatrix}$. Since it is an indefinite matrix, we check corner solutions. We perform the analysis in the region where market sharing solutions exist, and this region is the on defined in section 3.3.1. By using the same procedure as in previous proofs, we compare welfare levels when the quality content is given to

both or one platform with endogenous choice of $\bar{\gamma}$. We find that

$W\left(\gamma_1^o,\gamma_2^o\right)=V+\frac{M}{2}\left(\alpha_1+\alpha_2-2\delta\right)-\frac{t}{4}+\frac{k}{2}$, $W\left(0,\gamma_2^o\right)=V+\frac{M}{2}\left(\alpha_1+\alpha_2-2\delta\right)-\frac{t}{4}+\frac{k\left(M\left(\alpha_2-\alpha_1\right)+t\right)^2}{4t\left(2t-k\right)}$,

$W\left(\gamma_1^o,0\right)=V+\frac{M}{2}\left(\alpha_1+\alpha_2-2\delta\right)-\frac{t}{4}+\frac{k\left(t-M\left(\alpha_2-\alpha_1\right)\right)^2}{4t\left(2t-k\right)}$. It is easy to see that $W\left(\gamma_1^o,0\right)<W\left(0,\gamma_2^o\right)$.

By simple algebra, we find that $W\left(\gamma_1^o,\gamma_2^o\right)<W\left(0,\gamma_2^o\right)$ when $M>\frac{\sqrt{2t\left(2t-k\right)}-t}{\alpha_2-\alpha_1}$. This region is not empty when $t>\frac{k}{4}\left(1+\sqrt{17}\right)$, since the assumption of market sharing equilibria entails that $M<\frac{2t\left(t-k\right)}{k\left(\alpha_2-\alpha_1\right)}$.

We find that quality is $\bar{\gamma}=\frac{k\left(t+M\left(\alpha_2-\alpha_1\right)\right)}{2t-k}$ when exclusive provision is optimal and $\gamma_1=\gamma_2=k$ when there is non-exclusive provision (these values are obtained by maximizing the welfare, respectively under exclusive and non-exclusive provision, with respect to $\bar{\gamma}$).Comparing optimal social levels with equilibrium ones, by using simple algebra, we find that, in the feasible region defined as $\bar{\gamma}\in\left(0,t\right)$, the optimal quality level can be higher or lower than equilibrium ones.

Assume now that $\alpha_1<\alpha_2$ and that platforms charge viewers and advertisers. We substitute the indifferent viewer of equation (14) in the sum of (4) and (5). In order to study the concavity of this function, we compute the Hessian matrix, that is $\begin{pmatrix}-\frac{1}{r}+\frac{5}{18t} & -\frac{5}{18t}\\ -\frac{5}{18t} & \frac{5}{18t}\end{pmatrix}$. Since it is an indefinite matrix, we check corner solutions. We perform the analysis in the region where market sharing solutions exist, and this region is the on defined in section 3.4.1. By using the same procedure as in previous proofs, we compare welfare levels under exclusive and non-exclusive provision, when the quality content is chosen so as to maximize welfare. We find that

$W\left(\gamma_1^o,\gamma_2^o\right)=V+\frac{M}{2}\left(\alpha_1+\alpha_2-2\delta\right)-\frac{t}{4}+\frac{18kt+5M^2\left(\alpha_2-\alpha_1\right)^2}{36t}$,

$W\left(0,\gamma_2^o\right)=V+\frac{M}{2}\left(\alpha_1+\alpha_2-2\delta\right)-\frac{t}{4}+\frac{k\left(10M\left(\alpha_2-\alpha_1\right)+9t\right)+10M^2\left(\alpha_2-\alpha_1\right)^2}{72t-20k}$,

$W\left(\gamma_1^o,0\right)=V+\frac{M}{2}\left(\alpha_1+\alpha_2-2\delta\right)-\frac{t}{4}+\frac{k\left(9t-10M\left(\alpha_2-\alpha_1\right)\right)+10M^2\left(\alpha_2-\alpha_1\right)^2}{72t-20k}$. It is easy to see that $W\left(\gamma_1^o,0\right)<W\left(0,\gamma_2^o\right)$. Moreover, using some algebra we find that $W\left(\gamma_1^o,\gamma_2^o\right)-W\left(0,\gamma_2^o\right)=\frac{k\left(90kt+\left(5M\left(\alpha_2-\alpha_1\right)-9t\right)\left(5M\left(\alpha_2-\alpha_1\right)+27t\right)\right)}{36t\left(18t-5k\right)}<0$ when $M>\frac{3\sqrt{2t\left(18t-5k\right)}-9t}{5\left(\alpha_2-\alpha_1\right)}$, and that this region is not empty when $t>\frac{40k}{63}$, since there are market sharing equilibria only for $M<\frac{9t-4k}{3\left(\alpha_2-\alpha_1\right)}$. In the complementary region the quality content is optimally provided to both platforms.

We find that quality is $\bar{\gamma}=\frac{k\left(9t+5M\left(\alpha_2-\alpha_1\right)\right)}{18t-5k}$ when there is exclusive provision and $\gamma_1=\gamma_2=k$ under non-exclusive provision. Comparing optimal level with equilibrium ones, by using simple algebra we find that, in the feasible region defined as $\bar{\gamma}\in\left(M\left(\alpha_2-\alpha_1\right)-3t,M\left(\alpha_1-\alpha_2\right)+3t\right)$, the optimal quality level is always higher than equilibrium ones.■

Proof of Proposition 6. Assume that platforms charge only advertisers. Note that $\Pi_U(VS)$ is the minimum price at which the upstream cedes the control over the premium content. Since $\Pi_1(VI(1))-\Pi_U(VS)-\Pi_1(VS)=\frac{2kM^2\left(\alpha_2-\alpha_1\right)^2}{8t^2}>0$ and $\Pi_2(VI(2))-\Pi_U(VS)-\Pi_2(VS)=\frac{kM^2\left(2\alpha_2^2-\alpha_1^2\right)}{8t^2}>0$, then both platforms prefer to acquire the upstream paying the minimum price rather than to be vertically separated. This entails that, at equilibrium, either platform 1 or platform 2 is vertically integrated.

Since $\Pi_2(VI(2))-\Pi_1(VI(1))=\frac{M\left(\alpha_2-\alpha_1\right)\left(4t^2-Mk\left(3\alpha_2-\alpha_1\right)\right)}{8t^2}>0$ in the feasible region, then platform 2's profit from vertical integration, under the alternative that platform 1 acquires the upstream operator, are higher than that of platform 1.

Since $\bar{\gamma}^{VI(1)}-\bar{\gamma}^{VI(2)}=\frac{Mk}{2t}\left(\alpha_2-\alpha_1\right)>0$, then it easily follows that the consumer surplus is higher when platform 1 is vertically integrated.

Now, assume that platforms charge viewers and advertisers and that, under vertical separation, there

is non-exclusive provision of the premium content.[74] Since $\Pi_1(VI(1)) - \Pi_U(VS) - \Pi_1(VS) = \frac{k\left(3M^2(\alpha_2-\alpha_1)^2\left(36kt+81t^2+4k^2\right)+2Mt(\alpha_2-\alpha_1)\left(90kt-81t^2+16k^2\right)+3t^2\left(81t^2+8k^2\right)\right)}{6t(9t-k)(2k+9t)^2} > 0$ and $\Pi_2(VI(2)) - \Pi_U(VS) - \Pi_2(VS) = \frac{k\left(M^2(\alpha_2-\alpha_1)^2\left(36kt+81t^2+4k^2\right)+162Mt^2(\alpha_2-\alpha_1)(9t+2k)+9t^2\left(81t^2+8k^2\right)\right)}{18t(9t-k)(2k+9t)^2} > 0$ for all parameters in the feasible region, then both platforms prefer to pay at least the minimum price for the upstream rather that being in the vertical separation scenario. This entails that, at equilibrium, either platform 1 or platform 2 is vertically integrated.

Since $\Pi_2(VI(2)) - \Pi_1(VI(1)) = \frac{2M(\alpha_2-\alpha_1)\left(27t^2-2k\left(3t+M(\alpha_2-\alpha_1)\right)\right)}{9t(k-9t)} > 0$, for all parameters in the feasible region, then platform 2 is willing to make an higher bid than platform 1 in order to acquire the upstream.

Looking at the consumer surplus, we find that $CS^{VI(1)} = V + \frac{M}{2}(\alpha_1+\alpha_2-2\delta) - \frac{t}{4} + \frac{M^2(\alpha_2-\alpha_1)^2\left(36kt+81t^2+4k^2\right)+2Mtk(\alpha_2-\alpha_1)(270t-21k)+3t^2\left(-972t^2+378kt-27k^2\right)}{36t(k-9t)^2}$

and that $CS^{VI(2)} = V + \frac{M}{2}(\alpha_1+\alpha_2-2\delta) - \frac{t}{4} + \frac{9tM^2(\alpha_2-\alpha_1)^2+2Mk(\alpha_2-\alpha_1)(12t-k)+9t\left(18kt-36t^2+18kt\right)}{4(k-9t)^2}$.

Since $CS^{VI(1)} - CS^{VI(2)} = \frac{M^2k^2(\alpha_2-\alpha_1)^2-3Mt(\alpha_2-\alpha_1)\left(3+2k^2\right)-81t^2}{4(k-9t)^2} > 0$ for all parameters in the feasible region, then consumers are better off when platform 1 is vertically integrated.■

74 We do not consider the case when there is exclusive provision of quality content under vertical separation, because the region where this equilibrium occurs and the region where the equilibrium under vertical integration of platform 1 occurs never intersect.

Conclusions

In this thesis, I have shown that multi-product firms can use their leadership in one market in order to affect rivals' access to quality in adjacent markets. We have discussed the effects on welfare and consumer surplus. These effects have been analysed in two models, one on bundling and another one on two-sided media markets, in a context of vertical differentiation.

First, I have surveyed the literature on bundling and two-sided media markets, highlighting some open questions that deserve further attention. In particular, I have pointed out that the quality differentiation decisions have been not deeply considered in both literatures strands.

As concerns the literature on bundling, it still needs to provide more clear conclusions concerning the welfare effects of bundling practices, when they are simultaneously pushed by various rationales. Moreover, the debate concerning the antitrust approach to bundling practices is still open, and the theoretical literature is called to give its contribution. In the second chapter we have analysed these points.

In chapter 2, we have developed a theoretical model to study the effect of bundling on competition and welfare. We have shown that mixed bundling is the preferred strategy of a dominant firm in a primary market that faces competition from a single-product rival firm in a complementary market. In our model product bundling does not hinge on commitment ability of the multi-product firm. On the one hand, given that the rival firm provides a perfect substitute, bundling introduces vertical differentiation between systems of complements and thus softens price competition. On the other hand, given that the rival firm invests in improving quality of the complementary component, bundling is an effective price discrimination device to extract surplus from the rival's customers. In addition, given that there is a sunk cost of investment, the dominant firm's bundle denies scale and thus reduces the rival firm's incentives to invest. Hence, product bundling may drive high-quality systems out of the market, while creating room for low-quality alternatives.

Although we have explicitly modelled some efficiency gains from bundling, we have shown that bundling reduces consumer surplus and, when quality investment is feasible under bundled sales, social welfare. It follows that product bundling may be socially detrimental even when the rival firm is not foreclosed, and when investment is not blockaded.

Our model setting incorporates many features that have been identified as essential to build a case against bundling, due to potential harm on competition, consumers, and welfare. Nonetheless,

we have found that product bundling does improve welfare when it prevents inefficient investment that would occur under stand-alone selling. It follows that a *per se* rule against bundling would not be appropriate. Indeed, prohibiting bundling would mean sacrificing related efficiencies.

We have thus considered a different scenario where the dominant firm is allowed to bundle products, but the bundled offer has to be consistent with a simple price test. Such test denies the dominant firm the possibility to strategically raise the stand-alone price of the monopoly component over the monopoly price of that component (which, in our stylized model, is exactly the price that the dominant firm sets under stand-alone selling). We have shown that such test enhances consumer surplus and welfare when it enables us to preserve efficiencies from both bundling and the rival firm's quality investment (while replicating the do-nothing scenario when the rival does not invest).

When efficiency gains from bundling are relatively low, the proposed test tolerates a margin between the bundle price and the stand-alone price of the monopoly component that is lower than the relevant cost of producing the competitive component. Conversely, if bundling creates large efficiency gains, then the test results in a strictly above-cost margin, which is essential to provide the rival firm with the correct incentives to invest. In both cases, the proposed test is in contrast with a predatory pricing test, which in our model would impose a cost-oriented margin independent of efficiencies from bundling. We have shown that a predatory pricing test is not consistent with consumer surplus or welfare maximization.

In the main part of our paper, we have focused on partial mixed bundling. Then, we have internalized the dominant firm's choice of bundling strategy (partial mixed, complete mixed, or pure bundling). We have found that in the do-nothing scenario the dominant firm chooses mixed bundling (either partial or complete), and welfare effects are qualitatively the same as in the basic model. We have also found that under the test regime the dominant firm could profit from excluding the rival by offering only a technological bundle. It is thus socially desirable that the dominant firm be forced to provide the monopoly component on a stand-alone basis.

The results obtained suggest some policy implications. From an antitrust perspective, product bundling by a dominant firm has typically been deemed anticompetitive when used as a method of predation that deters entry or induces exit. However we have argued that, in a setting of vertically differentiated products, predatory pricing is not the correct framework to employ in the face of the dominant firm's bundle. Furthermore, it follows from our results that antitrust cases about bundling in technologically evolving industries should take account of the effects of bundling on innovation even when the rival firm remains active. Indeed, it would be possible that, due to product bundling, the rival firm has lost scale that has caused, or will cause, product quality to decrease. In such cases,

if antitrust policy is based on short-term pricing and related welfare effects, then it could be socially harmful in the long run. On the other hand, pursuing dynamic rather than static efficiency goals would move antitrust policy closer to regulatory principles and tools.

In the first chapter, I have also pointed out some open questions in the literature on provision of quality content in media markets. Indeed, one can notice that vertical integration between producers and distributors of contents is more and more frequent. However, the impact of this new configuration of the industry on content provision still needs to be investigated. Moreover, the business model of platforms plays a key role in platforms' decisions, and this dimension has been neglected by previous works on premium content provision. I have also studied the impact of the efficiency in the advertising market on exclusive and quality provision. This aspect has been disregarded by the theoretical literature on the economics of media.

In the theoretical work in chapter 3, I have found that vertical integration and the ability to charge viewers drive the market toward exclusive content provision. Indeed, a vertically integrated platform profits more than an independent content provider from an asymmetric provision of quality content, since it internalizes the effect of a relaxed competition coming from quality differentiation on downstream competition. Moreover, exclusive provision can be more profitable under a pay-tv model than under a free-to-air model, since it can relax price competition for viewers.

I have found that, when the exclusive is granted, it is for the most efficient platform on the advertisers market, in order to strengthen its position and profit from its efficiency. The asymmetric efficiency on the advertising market creates instances of exclusive provision that do not occur when platforms are symmetric.

Then, we compare private and social choices of quality and exclusivity. We find that the exclusive provision of quality content to the most efficient downstream platform can be socially optimal when the mass of advertisers is wide and the transportation cost is high.

Moreover, under- or over-provision of quality level can occur under the pure free-to-air model, both when the content provider is integrated and separated. On the contrary, there is always under-provision of quality in the mixed model.

Finally, we find that the most efficient platform earns higher profit from the control over the content rights than the least efficient one, and it acquires the content provider in a wide region of parameters. However, in some cases the former prefers the latter to take the control over the content provider. This occurs when profits from the exclusivity are low: under the free-to-air, it is the case when platforms are almost symmetric on the advertisers side, while under the pay-ty model when

horizontal differentiation is high and the mass of advertisers is low.

We also find that viewers prefer the least efficient platform to vertically integrate since it provides higher quality. This occurs because a high efficiency on the advertising market decreases the incentive of a vertically integrated platform to invest in entertainment. Indeed, even if with a lower quality it captures a smaller market share, it can sell the captured viewers' attention on to advertisers at a high price. Thus, improving efficiency on the advertising market may be used as a strategy to gain profit, and it has the effect to reduce the incentives to invest in quality of entertainment.

Even if the model is static, some comments on the dynamic of the industry can be done. It can be observed a trend toward concentration, since firms always choose the scenario of vertical integration and vertical integration induces exclusive provision to the most efficient platform. This exacerbates the differences of platforms on the downstream market.

The desirability of exclusive over valuable program is one of the questions in the agenda of public authorities. We find that, in our static context, it can sometimes be welfare enhancing. However, the desirability of exclusive contract should be better investigated in a dynamic context, in order to study the effects on the concentration in the industry and related welfare implications.

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