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Chapter 1

Introduction

Perfect competition, though desirable, is a rare phenomenon in the real world. This imperfection is due to, among other factors, the presence of market frictions such as shopping costs, switching costs, information asymmetry or due to product differentiation. As a consequence, firms have market power in a competitive setting. It is well known that firms that wield even a small degree of market power, have incentives to employ a variety of instruments that enable them to extract larger surplus from consumers. In this thesis, the focus is on two instruments, among others, namely, price discrimination and partial ownerships. Price discrimination according to Stigler (1987) is present when similar goods are sold at prices that are in different ratios to marginal costs. In this thesis, agents endogenously sort into different types due to the presence of shopping costs or investment costs. The second instrument, partial ownership in competing firms, helps dampen competition. It is used as a commitment device by the acquiring firm to keep prices high by internalizing the negative impact of a price decrease on it's rivals. Our focus is on the information learning aspect of partial ownerships.

Broadly speaking, the main aim of this thesis is to contribute to the literature on the impact of these two instruments on firm profits, consumer surplus and welfare along with providing clear policy implications.

In this thesis, three papers focusing on the impact of these instruments in the market are presented. The first paper focuses on the supplier-retailer relationships under retail price discrimination in the presence of shopping costs. These shopping costs along with price discrimination creates screening of consumers into multistop shoppers and onestop shoppers. This allows firms to extract more on one good while keeping the margin of the bundle fixed. The second paper, focuses on the role of partial ownerships as a merger synergy learning device. By acquiring a partial ownership in its rival, a firm learns the merger synergy match value between the two firms with certainty. In particular, partial ownerships help to unravel the uncertainty in merger synergy ex-ante and help reduce the downside risks involved when merging. The third paper compares a non-discriminatory pricing regime with a discriminatory pricing regime in a two sided market setting. Price discrimination is contingent on the homing behavior of firms and firms sort into two types of agents, multi-homers and single-homers according to their investment costs.

Chapter 2 is a joint work with Stephane Caprice and is titled "On the Countervailing Power of Large Retailers when Shopping Costs Matter." This chapter studies the interaction of buyer power, seller power and countervailing power in presence of shopping costs on consumer prices and welfare. The recent decades have seen the growing dominance of big retailers which attract consumers through onestop shopping. This trend has created tremendous buyer power for large retailers. Consequently, mid-sized retailers are squeezed out of the market. As a result, competition is mainly between two polarized retail formats, namely- the large retailers and small specialized stores. The presence of two polarized competing retail formats has resulted in heterogeneous shopping cost consumers sorting into multistop and onestop shoppers. Moreover, countervailing power of large retailers is modeled as a threat of demand-side substitution. This paper shows that retail prices are higher, industry surplus and consumer welfare is lower when the large retailer possesses credible countervailing power. The intuition behind higher retail prices when countervailing power is present, is that the supplier reduces screening of consumers and as a result the outside option of the large retailers falls by increasing wholesale prices. Moreover, industry surplus and welfare falls due to this rise in wholesale prices. This is due to the demand effect, total demand falls in the industry due to a rise in wholesale prices and hence industry surplus and consumer welfare falls. This study shows that countervailing power is not necessarily beneficial for consumers or the industry as a whole.

Chapter 3 entitled “Uncertain Merger Synergies, Minority Shareholdings and Merger Control” is a joint work with Christian Wey. Partial ownerships have become a very hotly debated topic in the recent European Commission staff working paper (EC, 2013). Under the current laws, it does not fall under the purview of merger control. The (EC, 2013) argues, that it should fall under the gambit of merger control and has provided many examples citing the anti-competitive effects of partial ownerships. Towards plugging this enforcement gap, they suggest different remedies. In this paper, the competitive effects of a passive partial ownership (PPO) are examined when it serves as an instrument for the acquirer firm to learn the merger synergies with the target firm in advance. Synergies are critical for the profitability and the approvability of a merger by an antitrust authority, using a price test. However, the realization of a synergy is uncertain ex ante, so that a direct merger exhibits a downside risk not only for the merging candidates but also for consumers. We show that minority shareholdings can reduce this downwside risk as they allow for a sequential takeover where the acquirer takes an initial minority share, becomes an insider, learns the match between both merging firms and the realizable merger synergy. This paper shows how this feature of minority shareholdings affects a firm’s takeover strategy and the decision problem of the antitrust authority. We derive implications for a merger control approach to PPO acquisitions, where a forward looking price test and a safeharbor rule is examined.

Chapter 4 is titled “Homing Choice and Platform Pricing Strategies.” In this chapter, the focus is on the recent trends in the internet based service provision industry. Exclusive content on a platform is a very recent phenomenon in internet based industries. For example, Apple through its iOS touts the presence of many essential and exclusive apps and that is one of the appealing factors of their platform. Similarly, the recent emergence of online streaming platforms is another concrete example where exclusive content on a platform is important for consumer platform choice. Moreover, some of these platforms offer discriminatory prices contingent on homing behavior, while others offer uniform prices. We try to look at how these two regimes impact consumers given the presence of exclusive and common content on a platform. Towards this, comparison of a discriminatory pricing regime with a non-discriminatory regime in a competitive bottleneck model is made where content providers endogenously sort into single or multi-homers. Consumer prices rise when the share of single-homers increases in the non-discriminatory case, while they stay constant in the discriminatory pricing regime. A discriminatory pricing regime leads to higher platform profits than the non-discriminatory regime when the share of single-homers is relatively high. When the share of single-homers is relatively high (low), the discriminatory pricing regime leads to higher (lower) consumer surplus and social welfare when compared with the non-discriminatory regime.

Chapter 5 provides concluding remarks.

Chapter 2

On the Countervailing Power of Large Retailers

Co-authored by Stephane Caprice.

I contributed to:

- developing the research idea.
- drafting and revising.
- analyzing the results.

2.1 Introduction

The recent decades have seen the growing dominance of powerful big-box retailers, which attract consumers through one-stop shopping. Another important trend in the retail industry is the polarization of store size. Increasingly, mid-sized general merchandise retailers are squeezed out by big-box retailers and small speciality stores or hard-discount chains (Griffith and Krampf, 1997, or more recently, Igami, 2011). As a result, big-box retailers often dominate the local retail market, in which they mainly compete with much smaller stores (for example, speciality stores).

At the same time, big-box retailers' success allows them to obtain more favorable terms from their suppliers. Competition authorities worldwide have expressed concerns about the impact of this countervailing power on consumers: countervailing power is socially desirable if the lower prices paid by large retailers to their suppliers are passed on to consumers. While the question of whether countervailing power is desirable for reducing retail prices has been discussed by legal and economic scholars since the 1950s without reaching a firm conclusion, this paper shows instead that countervailing power raises retail prices and decreases social welfare. When a large retailer possesses countervailing power it is not necessarily the consumer who benefits! The analysis uses a model that captures the main ingredients of the modern retail industry: the polarization of store size at the retail level and consumer shopping costs.

To be more specific, we consider a situation where a supplier sells to a retail industry. To capture the polarization of the retail industry and consumer shopping costs, we use the retail competition model developed by Chen and Rey (2012): a large retailer attracts consumers through one-stop shopping, and competes with much smaller retailers that focus on narrower product lines. Consumers are heterogeneous in their shopping costs and will be either multistop shoppers or one-stop shoppers depending on their shopping costs. To allow the possibility of profit-sharing between the supplier and the large retailer, we use two-part tariffs for contracts between the supplier and the large retailer.[1] The countervailing power of the large retailer is modeled as a threat of demand-side substitution.[2]

The supplier faces a trade-off between maximizing joint profits and extracting surplus. We show that, in this setting, joint profits maximization calls for wholesale prices equal to marginal cost. The supplier sells at marginal cost to the large retailer

[1]The analysis in two-part tariffs is not restrictive; more general contracts can be considered.

[2]This is in line with Katz (1987), in which the source of large retailers' countervailing power is modeled as a credible threat of securing an independent source of supply.

See also Ellison and Snyder (2010), who find evidence for the importance of supplier competition, for the ability of large buyers to extract discounts from suppliers. They use data on wholesale prices for antibiotics sold to the U.S. market (drugstores and hospitals).

and the small retailers. While the presence of small retailers generates competitive pressure, it allows the large retailer to distinguish consumers according to their shopping costs, and this is best achieved through wholesale prices which are set at marginal cost. By contrast, surplus extraction is effective when the supplier instead charges high wholesale prices. By inducing less intrabrand competition through higher wholesale prices to the small retailers, the supplier makes it less attractive for the large retailer to switch to the alternative sources of supply. The reason is that by increasing the wholesale price to small retailers, the supplier discourages multistop shopping behavior of some consumers. The screening strategy of the large retailer with respect to consumers becomes less effective and higher wholesale price to the smaller retailers can thus be optimal for the supplier to disadvantage the large retailer. At the same time, the screening strategy of the large retailer is best achieved through a higher wholesale price to the large retailer when the wholesale prices of the small retailers increase. The fixed fee paid to the supplier by the large retailer decreases as the countervailing power of the large retailer increases. When the large retailer possesses a large enough countervailing power, the supplier pays a slotting fee (negative fixed fee) to the large retailer. In the end, high wholesale prices appear as a surplus extraction device rather than joint profits maximization. Industry surplus falls, as does consumer surplus, which results in a lower social welfare when the large retailer possesses countervailing power. The lower prices paid by the large retailer to the supplier (through a lower fixed fee) are not passed on to consumers. Countervailing power of the large retailer instead leads to higher prices for consumers, which echoes concerns voiced by many antitrust authorities according to which countervailing power may not lead to lower retail prices (Federal Trade Commission, 2001, Part IV; European Commission, 2011).[3]

Since Galbraith (1952, 1954), who argues that by exercising countervailing power, large retailers are able to lower the prices they pay their suppliers and pass on these savings to their consumers, countervailing power's impact has been elaborately discussed.[4] Our paper is not the first to demonstrate that countervailing power of large retailers can lead to higher consumer prices. In this regard, the analysis by von Ungern-Sternberg (1996) and Dobson and Waterson (1997) is particularly relevant. They show that under certain conditions increased concentration at the retail level may lead to higher retail prices. However their models, while adequate for their purposes, do not capture the retail industry ingredients that we mention

[3]Similar analysis is also suggested by Caprice and Rey (2015) when large retailers join forces to negotiate with suppliers. They show that joint listing decisions can enhance the bargaining position of the retailing chains without affecting final prices or even leading to higher final prices. See also Foros and Kind (2008) and Doyle and Han (2014) for various models leading to higher retail prices when buyer power applies.

[4]Many researchers have investigated this topic in various models. For recent contributions, see Iozzi and Valletti (2014); Chen et al. (2016) and Gaudin (2017). Discussions are available in Snyder (2005) and Chen (2007).

above, such as the polarization of store size. In their models, all retail firms are symmetric. Moreover, these authors assume that upstream firms use linear pricing, which makes their analysis irrelevant to many retail industries in which nonlinear pricing is prevalent, especially when suppliers contract large retailers.[5]

By contrast, Chen (2003), using a model which captures the polarization of store size and nonlinear pricing, shows that countervailing power possessed by a large retailer leads to a fall in retail prices for consumers. The fall in retail prices is achieved through a fall in the wholesale prices of small retailers, which is the result of a supplier trying to offset the reduction in profits caused by the rise in countervailing power of the large retailer.[6] To capture the polarization of store size, Chen (2003) assumes that the downstream market is characterized by a dominant retailer facing a competitive fringe. In reality however, the main evolution of the retail industry is not characterized by this kind of asymmetry. Rather, large retailers offer a wide range of products while small retailers offer a narrower line of products. Moreover, large retailers attract consumers through one-stop shopping. At the theoretical level, Chen's (2003) modeling approach does not take into account this main ingredient.[7] Since Chen and Rey (2012) propose a simple way to consider this phenomenon, we use their retail competition model. Then, we add to their framework a vertical contracting setup to study the impact of countervailing power. It is thus shown that by capturing this feature (consumers are either one-stop shoppers or multistop shoppers) countervailing power can lead to higher retail prices. In other words, it is the combination of both "seller power" and "countervailing power" which explains that the countervailing power of the large retailer reduces social welfare. The results from our analysis confirm the importance of the polarization of store size and the existence of shopping costs in the debates about countervailing power. When shopping costs matter small retailers do not compete fiercely with large retailers. Instead, as shown by Chen and Rey (2012), their existence may benefit the large retailers, as they may exert seller power by screening consumers. Moreover, the value the consumers give to the small retailers play a role in the screening strategy of the large retailers when they discriminate consumers with respect to their shopping costs. Higher wholesale prices for the small retailers can thus make the strategy for large retailers to switch to alternative sources of supply less attractive.

[5]See Villas-Boas (2007), and Bonnet and Dubois (2010) for evidence of such contracts in vertical contracting.

[6]Mills (2013) finds similar results with another mechanism.

[7]Another difference should be mentioned. Unlike in Chen (2003), where the supplier and the large retailer share the joint profits from their transaction, in our model, countervailing power is modeled by demand-side substitution. We will discuss this point in Section 4. With Chen's (2003) modeling of the countervailing power, only wholesale prices of the small retailers are affected when countervailing power changes. However, we will show in our setup that countervailing power still leads to higher retail prices. Moreover, retail prices are now increasing in the countervailing power of the large retailer.

A small range of literature now exists that mixes vertical contracting and shopping costs (Caprice and von Schlippenbach, 2013; Johansen and Nilssen, 2016). Caprice and von Schlippenbach (2013) show that, when one-stop shopping behavior is considered, slotting fees may emerge as a result of a rent-shifting mechanism in a three-party negotiation framework, where a monopolistic retailer negotiates sequentially with two competing or independent suppliers about two-part tariff contracts. The wholesale price negotiated with the first supplier is distorted upwards, and the first supplier may pay a slotting fee, as long as its bargaining power vis-à-vis the retailer is not too large. One-stop shopping behavior involves complementarity between products. This allows the retailer and the first supplier to extract rent from the second supplier. Johansen and Nilssen (2016) study a merger game between retailing stores to look into the incentives of independent stores to form a big store when some consumers have preferences for one-stop shopping. They show that one-stop shopping behavior may lead to an improvement in the bargaining position of the merged entity vis-à-vis producers, through the creation of an inside option that small stores do not have. In the present paper, we are interested in the impact of shopping costs on intrabrand competition between the large retailer and the small retailers when the supplier negotiates contracts with retailers, while Caprice and von Schlippenbach (2013) and Johansen and Tore (2016) focus on the changes in interbrand competition due to these shopping costs. Our findings confirm that shopping costs are a key ingredient of the competition between retailers (intrabrand competition) when a supplier negotiates with retailers.

The paper contributes to the large literature on vertical contracting with both public and secret contracts. Hart and Tirole (1990) document the opportunism problem arising in secret vertical contracts. Retail prices fall and the supplier cannot get the monopoly profits. In secret contracts, threat of demand-side substitution alters only the sharing of industry profits and not the prices.[8] In public contracts, demand-side substitution threat results in a decrease in retail price (Caprice, 2006; Inderst and Wey, 2011; Inderst and Shaffer, 2011).[9] Wholesale prices decrease to impair the outside option of retailers.[10] In this paper, we exhibit a similar mechanism

[8] See also Rey and Tirole (2007) for a review of this literature.

We should mention that, while a supplier faces an opportunism problem when negotiating with competing retailers, such a problem would not arise in our setting. Remember, joint profits maximization (when the countervailing power of the large retailer is absent) calls for wholesale prices equal to marginal cost: the supplier sells at marginal cost to the large retailer and the small retailers to maximize industry profits.

[9] When contracts are secret and an efficient supplier competes against an inefficient fringe of rivals, Caprice (2006) shows that banning price discrimination (which restores the publicity of contracts) may cause per-unit prices to fall and welfare to increase. The dominant supplier takes advantage of a strategic bargaining effect: reducing the price per-unit makes the outside option of buying from the fringe less profitable, allowing the dominant supplier to extract more bargaining surplus through the fixed fee.

[10] A similar trade-off arises in Montez (2007), but in another context.

except that wholesale prices increase to impair the outside option of the large retailer due to the shopping behavior of consumers. Again, our analysis suggests that consumer shopping costs may change the framework of the negotiations between the suppliers and the retailers.

The rest of the paper is organized as follows. We first present the model and the subgame-perfect equilibrium when the large retailer does not possess countervailing power (Section 2.2), before showing how countervailing power may lead to higher retail prices as well as a fall of social welfare (Section 2.3). Section 2.4 considers alternative modelings of the countervailing power and discusses the robustness of our insights. Section 2.5 concludes.

2.2 The Model

Description of the model

The relationships between a supplier, retailers and consumers are modeled as follows. There are two levels of market: the upstream and the downstream market. In the upstream market, a supplier sells its product B to a large retailer L and a competitive fringe S. In the downstream market, these retailers resell the product to consumers. We assume this retail market structure represents the polarization of store size that we mention in the introduction, according to which large chain stores compete against traditional, independent retailers (large-scale retail giants versus small speciality stores).

We assume that the contract between the supplier and the large retailer L takes the form of two-part tariffs. Let w_L and F_L, respectively be the wholesale price and the fixed fee which are paid to the supplier by the large retailer. The two-part tariff in this model is a simple way to approximate nonlinear contracts.[11] Further, contracts between the supplier and the competitive fringe S are linear tariffs. As small retailers are modeled as a competitive fringe, considering nonlinear contracts for small retailers does not add anything in terms of contracting efficiency.[12] Let w_S be the wholesale price paid to the supplier by small retailers.

We use the framework from Chen and Rey (2012) for the retail competition in our setup. General retailing supply and demand conditions are considered. L and S offer different varieties B_L and B_S for the good B. We call this market the

[11]The analysis would not be affected if we considered more general contracts as $T_L(q_L)$, where q_L corresponds to the quantity ordered by the large retailer. The appendix is available upon request.

[12]Linear prices allow the supplier to extract all the surplus from the small retailers as small retailers compete fiercely.

competitive market. The good A, which corresponds to the monopoly market is provided only by the large retailer. We denote the consumer valuations and the constant unit retailing costs for A, B_L and B_S by u_A, u_L and u_S and c_A, c_L and c_S respectively (c_A represents the all-inclusive cost of retailing A). Small retailers supply B_S at cost ($p_S = c_S + w_S$), thus offering consumers a value $v_S - w_S$, where $v_S = u_S - c_S$. We assume that small retailers S are more efficient than L in this segment (otherwise, S would not sell anything, and multistop shopping would never arise): $v_S > v_L = u_L - c_L (> 0)$. For instance, S can include chained, cost cutting hard discounters ($c_S < c_L$), or specialist stores that offer more service ($u_S > u_L$). L, however, benefits from its broader range ($v_A = u_A - c_A > 0$), and overall offers a higher value: $v_A > v_S$ which implies $v_{AL} = v_A + v_L > v_S$ for any $v_L \geq 0$. We allow for general distributions of the shopping cost s, which is characterized by a cumulative distribution function $F(.)$ and a density function $f(.)$. Intuitively, consumers with a high s favor one-stop shopping, whereas those with a lower s can take advantage of multi-stop shopping; the mix of multistop and one-stop shoppers is, however, endogenous and depends on L's prices, p_A and p_L.

We consider the following game (simultaneous public offers):

- At stage one, offers to retailers are made simultaneously and are assumed to be public. L either accepts or rejects.
- Then, at stage two, the large retailer L sets p_A and p_L, and retail prices of the small retailers are given by $p_S = c_S + w_S$.

We will introduce countervailing power of the large retailer in the next section, but first we solve the subgame perfect equilibrium of this game to have a benchmark case in which the large retailer does not possess countervailing power.

The benchmark case[13]

At stage two, let $r_{AL} = p_A - c_A + p_L - c_L - w_L$ denote L's total margin, thus offering the consumer value $v_{AL} - w_L - r_{AL}$ from purchasing A and B_L. One-stop shoppers prefer L to S, as long as $v_{AL} - w_L - r_{AL} \geq v_S - w_S$ and are indeed willing to patronize L, as long as $s \leq v_{AL} - w_L - r_{AL}$. Moreover, consumers favor multistop shopping if the additional cost of visiting S is lower than the extra value it offers: $s \leq v_S - w_S - (v_L - w_L - r_L)$, where $r_L = p_L - c_L - w_L$ denotes L's margin on B_L. Figure 1 provides a description of the buying decision of the consumers according to their shopping cost.

The total demand is given by $F(v_{AL} - w_L - r_{AL})$. L faces a demand $F(v_{AL} - w_L - r_{AL}) - F(v_S - w_S - (v_L - w_L - r_L))$ for both products (from one-stop shoppers) and an additional demand $F(v_S - w_S - (v_L - w_L - r_L))$ for product A only

[13] The large retailer does not possess countervailing power.

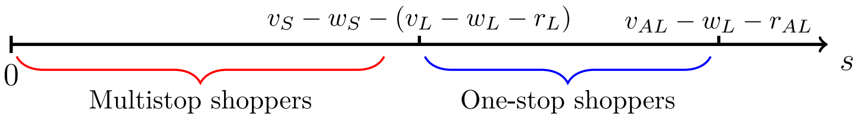

Figure 2.1: Shopping decision according to shopping cost

(from multistop shoppers). Small retailers supply $F(v_S - w_S - (v_L - w_L - r_L))$ for product B. L's gross profit-maximization problem can be written as:

$$\begin{aligned}\max_{r_{AL}, r_L} \pi_{AL} &= r_{AL}\left[F(v_{AL} - w_L - r_{AL}) - F(v_S - w_S - (v_L - w_L - r_L))\right] \\ &\quad + r_A F(v_S - w_S - (v_L - w_L - r_L)) \\ &= r_{AL} F(v_{AL} - w_L - r_{AL}) - r_L F(v_S - w_S - (v_L - w_L - r_L))\end{aligned}$$

where $r_A = p_A - c_A = r_{AL} - r_L$ denotes L's margin on A.

To characterize further the optimal retail pricing strategy, in what follows we assume that the inverse hazard rate, $h(.) = F(.)/f(.)$, is strictly increasing.[14] It results in optimal retail margins r_L^e and r_{AL}^e as follows.[15]

Loss leading arises and r_L^e is characterized by the first-order condition:

$$r_L^e = -\frac{F(v_S - w_S - (v_L - w_L - r_L^e))}{f(v_S - w_S - (v_L - w_L - r_L^e))} = -h(v_S - w_S - (v_L - w_L - r_L^e)) < 0.$$

Moreover, in the absence of any restriction on its total margin r_{AL} (i.e., $v_{AL} - w_L - r_{AL} \geq v_S - w_S$), L maximizes the first term $r_{AL} F(v_{AL} - w_L - r_{AL})$, which is the monopolistic gross profit that L could earn if S were not present. r_{AL}^e is characterized by the following first-order condition

$$r_{AL}^e = \frac{F(v_{AL} - w_L - r_{AL}^e)}{f(v_{AL} - w_L - r_{AL}^e)} = h(v_{AL} - w_L - r_{AL}^e) > 0.$$

Let $r_A^m = h(v_A - r_A^m)$ denote the monopoly A's margin of L, yielding $\pi_A^m = r_A^m F(v_A - r_A^m)$.

We assume in the following analysis that $v_A - r_A^m \geq v_S$.[16]

Assumption 1: $v_A - r_A^m \geq v_S$, the comparative advantage of the large retailer due to its broader range is such that it is not constrained on its total margin.

[14] See Chen and Rey (2012).

[15] For the sake of exposition we ignore here non-negativity price constraint.

[16] Assumption 1 that follows requires that $v_A \geq 2v_S$ for uniform shopping cost case. For details, see Appendix 2.A.

The result is that there is no constraint on the total margin when $v_{AL} - r^m_{AL} \geq v_S$ for $v_L > 0$ with $r^m_{AL} = h\left(v_{AL} - r^m_{AL}\right)$, or when $v_{AL} - w_L - r^e_{AL} \geq v_S - w_S$ if $w_L \leq w_S$.

Comparative statics

Solving the above equations for margins as functions of, among other things, w_L and w_S: $r^e_{AL}\left(w_L, w_S\right)$ and $r^e_L\left(w_L, w_S\right)$, we get:

Lemma 2.1. *Assume $w_L \leq w_S$, we have $\frac{\partial r^e_{AL}}{\partial w_L} \in (-1, 0)$, $\frac{\partial r^e_{AL}}{\partial w_S} = 0$, $\frac{\partial r^e_L}{\partial w_L} \in (-1, 0)$, $\frac{\partial r^e_L}{\partial w_S} \in (0, 1)$. Moreover, we have $\frac{\partial r^e_L}{\partial w_S} = -\frac{\partial r^e_L}{\partial w_L}$, $\frac{\partial^2 r^e_L}{\partial w_S \partial w_L} = -\frac{\partial^2 r^e_L}{\partial w_S^2}$ and an increase in w_L, as well as an increase in w_S reduce the large retailer's profits: $\frac{\partial \pi_{AL}\left(r^e_{AL}, r^e_L, w_L, w_S\right)}{\partial w_L} < 0$ and $\frac{\partial \pi_{AL}\left(r^e_{AL}, r^e_L, w_L, w_S\right)}{\partial w_S} < 0$.*

Proof. See Appendix 2.A. □

Total margin is a decreasing function of the wholesale price at which the large retailer buys from the supplier and does not change with respect to w_S, because of assumption (1) (if $w_L \leq w_S$). L's margin on B_L, which is negative, is a decreasing function of w_L and an increasing function of w_S. So, the large retailer's profits are a decreasing function of the wholesale price at which it can purchase from the supplier, and its profits decrease as the input price of its rivals (small retailers) increases. The last effect is brought about by the screening strategy of the large retailer. Because of loss leading on B_L, the large retailer can extract more of A's value from multistop shoppers due to the presence of its rivals. When $v_S - w_S$ decreases, A's value extraction from multistop shoppers decreases (the surplus extraction is less effective). It results in an increase in w_S (which corresponds to $v_S - w_S$ smaller), which leads to a loss in L's profits. In other words, a decrease in small retailers' wholesale price boosts the sales of the small retailers and imposes a positive externality on the large retailer as the large retailer benefits from multistop shopping behavior of the consumers. As we will see this relation is important. When consumers face shopping costs, in case of a screening strategy of the large retailer, a decrease in the small retailers' wholesale price increases the profits of the large retailer. Furthermore, a new bargaining effect, which was absent from previous models of countervailing power, can arise. In the next section, we will see that an increase in the small retailers' wholesale price can decrease the profits that the large retailer obtains in the case of a disagreement with the efficient supplier, when we assume demand-side substitution for the large retailer as an outside option.

At stage one, the supplier sets contracts. In case the large retailer rejects the contract, L's associated profit is given by the monopoly profit on the product A, π^m_A (at the moment, there is no countervailing power).

The total profit of the supplier is written as:

$$\begin{aligned}&w_L\left[F\left(v_{AL}-w_L-r^e_{AL}\left(w_L\right)\right)-F\left(v_S-w_S-\left(v_L-w_L-r^e_L\left(w_L,w_S\right)\right)\right)\right]+F_L\\&+w_SF\left(v_S-w_S-\left(v_L-w_L-r^e_L\left(w_L,w_S\right)\right)\right)\end{aligned}$$

facing the constraint that the large retailer accepts the contract (w_L, F_L):

$$\pi_{AL}\left(r^e_{AL}\left(w_L\right),r^e_L\left(w_L,w_S\right),w_L,w_S\right)-F_L\geq\pi^m_A.$$

$F\left(v_{AL}-w_L-r^e_{AL}\left(w_L\right)\right)-F\left(v_S-w_S-\left(v_L-w_L-r^e_L\left(w_L,w_S\right)\right)\right)$ represents the demand from one-stop shoppers who buy the product at L, and the demand from multistop shoppers who buy at S is $F\left(v_S-w_S-\left(v_L-w_L-r^e_L\left(w_L,w_S\right)\right)\right)$.

The supplier will offer contracts such that the constraint holds with equality. We thus write the supplier's optimization problem as:

$$\begin{aligned}\max_{w_L,w_S}\;&w_L\left[F\left(v_{AL}-w_L-r^e_{AL}\left(w_L\right)\right)-F\left(v_S-w_S-\left(v_L-w_L-r^e_L\left(w_L,w_S\right)\right)\right)\right]\\&+\pi_{AL}\left(r^e_{AL}\left(w_L\right),r^e_L\left(w_L,w_S\right),w_L,w_S\right)+w_SF\left(v_S-w_S-\left(v_L-w_L-r^e_L\left(w_L,w_S\right)\right)\right).\end{aligned}$$

We omit the outside option of the large retailer π^m_A, because it does not depend on w_L and w_S.

The first-order conditions are (applying the envelope theorem and using the first-order conditions from stage two):

$$\begin{aligned}-w_L\left(1+\frac{\partial r^e_{AL}}{\partial w_L}\right)f\left(v_{AL}-w_L-r^e_{AL}\right)&\\+\left(w_S-w_L\right)\left(1+\frac{\partial r^e_L}{\partial w_L}\right)f\left(v_S-w_S-\left(v_L-w_L-r^e_L\right)\right)&=0\\-\left(w_S-w_L\right)\left(1-\frac{\partial r^e_L}{\partial w_S}\right)f\left(v_S-w_S-\left(v_L-w_L-r^e_L\right)\right)&=0\end{aligned}$$

Straightforward computations show that $w_L = w_S = 0$.[17]

Proposition 2.1. *(When the large retailer does not possess countervailing power) Joint profits maximization calls for wholesale prices equal to marginal cost. The supplier sells at marginal cost to the small retailers, as well as to the large retailer ($w_S = w_L = 0$); the fixed fee is given by $F_L = \pi_{AL}(0,0) - \pi^m_A$.*

[17] Second-order conditions are assumed to hold. Second-order conditions indeed hold for uniform shopping cost case, which is considered in Appendix 2.A.

Proof. See Appendix 2.A. □

Because the outside option of the large retailer, given by the monopoly profits on A is independent from the contracts offered to the small retailers, the supplier maximizes industry surplus to capture the largest share of the surplus. Under assumption 1, the large retailer is not constrained in its total margin r_{AL}, it behaves like a monopoly on the bundle, the result is that $w_L = 0$. Moreover, as $\frac{\partial \pi_{AL}}{\partial w_S} < 0$ (lemma 2.1), industry surplus maximization results in $w_S = 0$. Intuitively, the benefits of loss leading, which come from A's value extraction are larger, when $v_S - w_S$ increases; for this reason, we obtain $w_S = 0$.

2.3 Effects of Countervailing Power

In this section, we study the effects of the countervailing power of the large retailer on consumer prices and social welfare. Some previous papers cited above find that a large retailer with countervailing power will use that power to obtain lower prices that it will pass on to consumers. In this section, by contrast, we show that introducing countervailing power leads to an increase in both wholesale prices (to the large retailer and to the small retailers) and consequently a decrease in consumer surplus, as well as a decrease in social welfare. The failure by the large retailer to bring its wholesale price down, however, does not mean that it pays more to the supplier. We will show that the fixed fee decreases when the countervailing power of the large retailer increases. Moreover, its wholesale price is lower than the wholesale price of the small retailers, however wholesale prices of both large and small retailers are higher compared to the benchmark case (without countervailing power).

The countervailing power of the large retailer is measured by its capacity to obtain access an alternative supplier. The alternative supplier is modeled as a competitive fringe; let $\widetilde{c}$ be the manufacturing cost of the alternative supplier.[18] So, as $\widetilde{c}$ falls the countervailing power of the large retailer increases. We assume that the contracts of the small retailers are non contingent on the supplier-large retailer contract.[19]

Figure 2.2 depicts the industry structure.

[18] See also, Caprice (2006); Inderst and Shaffer (2011).

[19] It is worth noting that a breakdown in contracts between the supplier and L is assumed to be observable but not verifiable (in court) and therefore cannot be contracted upon.

An alternative assumption would be to assume breakdown decision is a contractible contingency, i.e., that different prices between the supplier and small retailers can be proposed after a breakdown between the supplier and L. This point is discussed in Section 2.4. Similar discussion can be found in Caprice (2006).

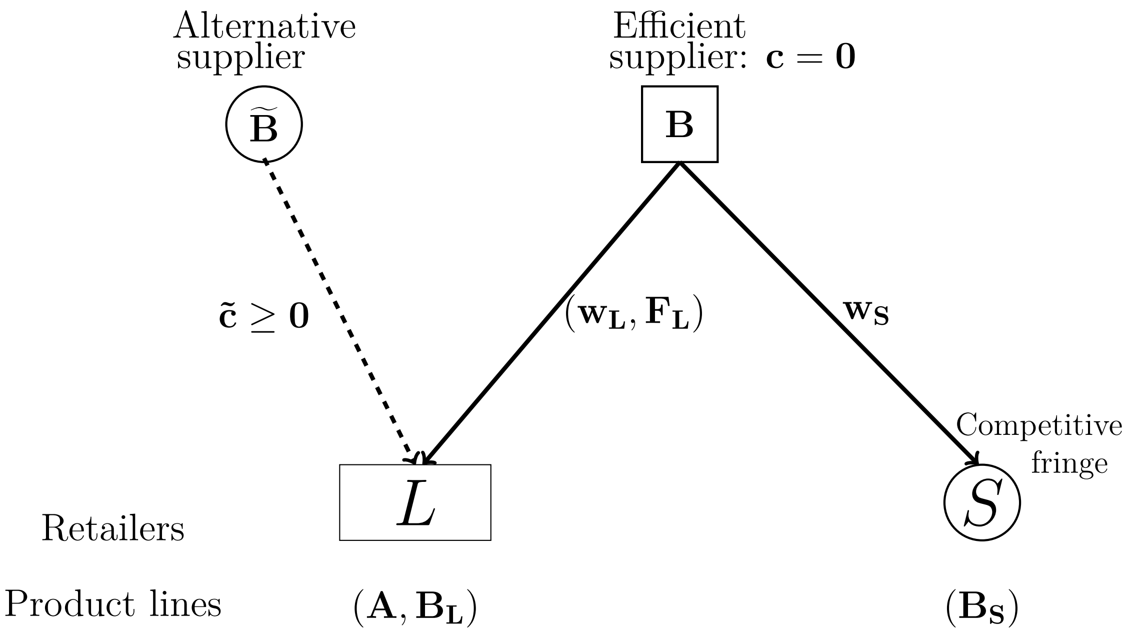

Figure 2.2: Industry structure in case of countervailing power

In the case of refusal, let $\widetilde{r}_{AL} = h\,(v_{AL} - \widetilde{c} - \widetilde{r}_{AL})$ be the total margin of L (in the absence of any restriction) and let $\widetilde{r}_L = h\,(v_S - w_S - (v_L - \widetilde{c} - \widetilde{r}_L))$ be the margin of L on the good B_L yielding to $\widetilde{\pi}_{AL} = \widetilde{r}_{AL}F(v_{AL} - \widetilde{c} - \widetilde{r}_{AL}) - \widetilde{r}_L F(v_S - w_S - (v_L - \widetilde{c} - \widetilde{r}_L))$ as an outside option. Under assumption 1 ($v_A - r_A^m \geq v_S$), the inequality $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} \geq v_S$ is satisfied for $\widetilde{c} < v_L$ which results in the absence of any restriction on the total margin in case of refusal, as $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} \geq v_S - w_S$.[20]

The following lemma helps to understand the bargaining effect we develop next.

Lemma 2.2. *The outside option of the large retailer, which is given by $\widetilde{\pi}_{AL}$, decreases in w_S.*

Proof. See Appendix 2.A. □

[20]Consider instead, the less restrictive assumption ($v_{AL} - r_{AL}^m \geq v_S$) as assumption 1. As a result, the analysis will not change qualitatively. This change in assumption will require $v_{AL} \geq 2v_S$ instead of $v_A \geq 2v_S$ for uniform shopping cost case.

Along the equilibrium path, the large retailer is not constrained in its total margin as long as $w_L < w_S$, which will be the case on equilibrium. Off-equilibrium, constraint on the total retail margin may arise, but the condition ($v_{AL} - r_{AL}^m \geq v_S$) implies that $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} \geq v_S$ is satisfied for a high enough countervailing power, in particular for $\widetilde{c} = 0$, resulting in $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} \geq v_S - w_S$ for $\widetilde{c}$ small (the case in which there is no constraint on the total margin). When $\widetilde{c}$ is large, the analysis changes, but the wholesale price of the small retailers still increases when the large retailer possesses countervailing power, or remains unchanged compared to the benchmark case (without countervailing power).

The analysis can be found for uniform shopping cost in Appendix 2.A.

As the participation constraint of the large retailer holds with equality:

$$\pi_{AL}\left(r_{AL}^{e}\left(w_L\right), r_L^{e}\left(w_L, w_S\right), w_L, w_S\right) - F_L = \widetilde{\pi}_{AL}\left(w_S\right),$$

the resulting objective function of the supplier is given as:

$$\begin{aligned} w_L\left[F\left(v_{AL} - w_L - r_{AL}^{e}\left(w_L\right)\right) - F\left(v_S - w_S - \left(v_L - w_L - r_L^{e}\left(w_L, w_S\right)\right)\right)\right] \\ + w_S F\left(v_S - w_S - \left(v_L - w_L - r_L^{e}\left(w_L, w_S\right)\right)\right) \\ + \pi_{AL}\left(r_{AL}^{e}\left(w_L\right), r_L^{e}\left(w_L, w_S\right), w_L, w_S\right) - \widetilde{\pi}_{AL}\left(w_S\right), \end{aligned}$$

in which $\widetilde{\pi}_{AL}$ depends on w_S.

Differentiating the objective function with respect to w_L and w_S, we obtain the following first-order conditions (we apply the envelope theorem and use the first-order conditions from stage two to simplify the first-order conditions):

$$\begin{aligned} -w_L\left(1 + \frac{\partial r_{AL}^{e}}{\partial w_L}\right) f\left(v_{AL} - w_L - r_{AL}^{e}\right) & \\ + \left(w_S - w_L\right)\left(1 + \frac{\partial r_L^{e}}{\partial w_L}\right) f\left(v_S - w_S - \left(v_L - w_L - r_L^{e}\right)\right) &= 0 \\ -\left(w_S - w_L\right)\left(1 - \frac{\partial r_L^{e}}{\partial w_S}\right) f\left(v_S - w_S - \left(v_L - w_L - r_L^{e}\right)\right) - \underbrace{\frac{\partial \widetilde{\pi}_{AL}\left(w_S\right)}{\partial w_S}}_{<0} &= 0 \end{aligned}$$

Let w_L^* and w_S^* define the equilibrium wholesale prices which are the solutions of these first-order conditions.[21] The first-order condition with respect to w_L remains unchanged when compared to the benchmark case (without countervailing power), while the first-order condition with respect to w_S is higher than in the benchmark case. This is because the outside option only depends on w_S and depends on it negatively. By concavity of the objective function, we can conclude first that $w_S^* > 0$. Then, we can see that the second term of the first-order condition with respect to w_L is $-\frac{\partial \widetilde{\pi}_{AL}(w_S)}{\partial w_S}$ as $\frac{\partial r_L^e}{\partial w_L} = -\frac{\partial r_L^e}{\partial w_S}$ (see lemma 2.1) by using the first-order condition with respect to w_S. As $-\frac{\partial \widetilde{\pi}_{AL}(w_S)}{\partial w_S} > 0$, concavity of the objective function yields $w_L^* > 0$. $w_L^* < w_S^*$ comes from the first-order condition with respect to w_S because the term $-\frac{\partial \widetilde{\pi}_{AL}(w_S)}{\partial w_S}$ is positive.

Proposition 2.2. *Wholesale prices paid by retailers are higher when the large retailer possesses countervailing power; furthermore, we obtain $0 < w_L^* < w_S^*$. Countervailing power of the large retailer reduces the supplier's profits as well as the industry surplus. On the other hand, the profits of the large retailer increase with*

[21] Second-order conditions are assumed to hold.

its countervailing power. Large enough countervailing power involves the payment of a slotting fee from the supplier to the large retailer.

Proof. See Appendix 2.A. □

Due to the participation constraint of the large retailer, the equilibrium fixed fee equals $\pi_{AL}(w_L^*, w_S^*) - \widetilde{\pi}_{AL}(\widetilde{c}, w_S^*)$, we can show that it is decreasing in the countervailing power of the large retailer. A change in $\widetilde{c}$ has a direct effect on $\widetilde{\pi}_{AL}$, while it has an indirect effect on π_{AL}, which results in a decrease in the fixed fee when $\widetilde{c}$ decreases. Moreover, when $\widetilde{c} < w_L^*$, the fixed fee is negative because of $\widetilde{\pi}_{AL}(\widetilde{c}, w_S^*) > \pi_{AL}(w_L^*, w_S^*)$ (See lemma 2.1, $\frac{\partial \pi_{AL}}{\partial w_L} < 0$), which results in slotting fees paid from the supplier to the large retailer when the countervailing power of the large retailer is high. Moreover, the profits of the large retailer, which are given by $\widetilde{\pi}_{AL}(\widetilde{c}, w_S^*)$, increase when its countervailing power increases. In terms of policy implication, banning slotting fees decreases wholesale prices. When $\widetilde{c} < w_L^*$, a ban on slotting fees imposes a binding constraint. As the profits of the large retailer now are smaller, w_S^* is less distorted than if slotting fees were feasible.[22]

Another result we have is that the wholesale price paid by the large retailer is smaller than the wholesale price of the small retailers. Investigating the upstream firm's profits, we breakdown the derivatives of the objective function with respect to the wholesale prices into two terms: industry profit and the outside option. A change in w_L has only a second-order effect on industry profit, while change in w_S has an additional effect on the outside option which is a first-order effect. Hence, it is optimal for the supplier to fix wholesale prices higher than zero and $w_L^* < w_S^*$.

Interestingly, in our model, countervailing power has effects which are different from those commonly envisioned. First, countervailing power causes an increase in the wholesale price paid by the small retailers. Thus, countervailing power results in a waterbed effect for small retailers, which is not seen in the benchmark case (without countervailing power).[23] This effect is brought about by the new mechanism of bargaining that we raise. Countervailing power of the large retailer creates incentives for the supplier to increase the wholesale price of small retailers to decrease the outside option of the large retailer. To understand the incentives of the supplier to do so, remember that the supplier's sales to the fringe retailers imposes a positive externality on the larger retailer; conversely, a reduction in the supplier's sales to the fringe retailers imposes a negative externality on the large retailer, by reducing

[22]Furthermore, applying the analysis which follows, we can claim that banning slotting fees increases industry surplus, as well as consumer surplus. It results in the ban of slotting fees increasing social welfare.

[23]Inderst and Valletti (2011) show that, when a large buyer is able to obtain lower input prices from a supplier, it is possible that other buyers will have to pay more for the same input as a result. The mechanism that we exhibit is different. See later.

screening opportunities. When the wholesale price of small retailers increases, multistop shopping behavior is less valuable for consumers which results in a decrease in screening opportunities of the large retailer. Hence, the outside option of the large retailer falls.

At the same time, as screening opportunities are reduced because small retailers are less attractive, we can see that the supplier has incentives to increase the wholesale price of the large retailer to offset the reduction in total profits, which is caused by the rise in the wholesale price paid by small retailers. Both wholesale prices are higher than in the benchmark case. Consequently, countervailing power is detrimental to the interests of the supplier and retailers as a whole, and causes a reduction in total profits.

Consumer surplus and welfare analysis

We now show that introducing countervailing power decreases the total quantity of goods in the competitive market (as well as in the monopoly market); the quantity sold by small retailers also decreases. The consumer surplus will decrease, as will the social welfare, as the industry surplus is lower when the large retailer possesses countervailing power.

We denote by $d_{AL} = v_{AL} - w_L - r^e_{AL}$ the consumer value of one-stop shopping. d_{AL} decreases as w_L increases.[24] We breakdown the consumer value of multistop shopping into the sum of two terms: the value of one-stop shopping and the additional value of multistop shopping. Let $d_{AS} = v_S - w_S - (v_L - w_L - r^e_L)$ denote the additional value of multistop shopping. d_{AS} decreases (increases) as w_S (w_L) increases as $\frac{\partial r^e_L}{\partial w_S} \in (0, 1)$ (as $\frac{\partial r^e_L}{\partial w_L} \in (-1, 0)$).[25] The consumer value of multistop shopping is given by $d_{AL} + d_{AS}$.

Suppose L possesses countervailing power, the consumer value of one-stop shopping decreases from $\overline{d}_{AL} = v_{AL} - r^e_{AL}(0)$ to $d^*_{AL} = v_{AL} - w^*_L - r^e_{AL}(w^*_L)$, as $w^*_L > 0$. Introducing countervailing power results in a discrete fall in consumer value from one-stop shopping; the total quantity in the competitive market (as well as the total quantity in the monopoly market) decreases. Similarly, going to the additional consumer value of multistop shopping, we find that d_{AS} decreases from $\overline{d}_{AS} = v_S - (v_L - r^e_L(0, 0))$ to $d^*_{AS} = v_S - w^*_S - (v_L - w^*_L - r^e_L(w^*_L, w^*_S))$ in the presence of countervailing power, as $0 < w^*_L < w^*_S$ and $\frac{\partial r^e_L}{\partial w_S} = -\frac{\partial r^e_L}{\partial wL}$ (See lemma 2.1). When L possesses countervailing power, the additional consumer value of multistop shopping falls and the quantity sold by small retailers decreases.[26]

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[24] d_{AL} does not depend on w_S.

[25] See Lemma 2.1.

[26] Note that, we explicitly say that by introducing countervailing power, there is a discrete fall in one-stop shopping consumer value as well as in multistop shopping additional consumer value. It does not mean that d_{AL} and d_{AS} fall as countervailing power increases ($\widetilde{c}$ decreases). On the

The above construction of consumer value from multistop shopping $(d_{AL} + d_{AS})$ makes the analysis easier to explain. It becomes clear that all consumers enjoy at least the one-stop shopping value while the additional value from multistop shopping is enjoyed only by the multistop shoppers. Consumer surplus is given as:

$$\int_0^{d_{AL}} (d_{AL} - s)\, dF(s) + \int_0^{d_{AS}} (d_{AS} - s)\, dF(s)$$

where the first term represents the total value of one-stop shopping (one-stop shoppers and multistop shoppers), while the second term is the value of additional multistop shopping (multistop shoppers only). We first focus on the change of the total value of one-stop shopping (analysis of the change from the additional value of multistop shopping follows).

Suppose L possesses countervailing power, and let Δ_{AL} denote the loss in the total value of one-stop shopping in presence of countervailing power,

$$\Delta_{AL} = \int_{d^*_{AL}}^{\overline{d}_{AL}} (d^*_{AL} - s)\, dF(s) + \left(\overline{d}_{AL} - d^*_{AL}\right) F(d^*_{AL}).$$

We know that $d^*_{AL} < \overline{d}_{AL}$. Thus, consumers with a shopping cost exceeding d^*_{AL} do not visit L and obtain zero, while in the case of no countervailing power they obtain $\overline{d}_{AL} - s$ as consumption value. The first term in Δ_{AL} represents this loss. Consumers with a shopping cost lower than d^*_{AL} shop within both regimes (with and without countervailing power). The second term is thus the difference in the values of one-stop shopping in the two regimes. All consumers (one-stop shoppers and multistop shoppers) face a loss in the value of one-stop shopping due to the countervailing power of the large retailer.

contrary, it is the opposite. The reason behind this is that decreasing the outside option of the large retailer becomes costlier as $\widetilde{c}$ falls. The result is that w^*_S increases when $\widetilde{c}$ increases, as does w^*_L (to offset the reduced attractiveness of small retailers). This can be seen in the comparative statics given below:

$$\begin{aligned}
\frac{\partial d^*_{AL}}{\partial \widetilde{c}} &= -\underbrace{\frac{\partial w^*_L}{\partial \widetilde{c}}}_{\in(0,1)} - \underbrace{\frac{\partial r^e_{AL}}{\partial w_L}}_{\in(-1,0)} \underbrace{\frac{\partial w^*_L}{\partial \widetilde{c}}}_{\in(0,1)} < 0 \\
\frac{\partial d^*_{AS}}{\partial \widetilde{c}} &= -\frac{\partial w^*_S}{\partial \widetilde{c}} + \frac{\partial w^*_L}{\partial \widetilde{c}} + \frac{\partial r^e_L}{\partial w_S}\frac{\partial w^*_S}{\partial \widetilde{c}} + \frac{\partial r^e_L}{\partial w_L}\frac{\partial w^*_L}{\partial \widetilde{c}} = \underbrace{\left(\frac{\partial w^*_L}{\partial \widetilde{c}} - \frac{\partial w^*_S}{\partial \widetilde{c}}\right)}_{<0} \underbrace{\left(1 + \frac{\partial r^e_L}{\partial w_L}\right)}_{>0} < 0
\end{aligned}$$

because $\frac{\partial r^e_L}{\partial w_S} = -\frac{\partial r^e_L}{\partial w_L}$ and $0 < \frac{\partial w^*_L}{\partial \widetilde{c}} < \frac{\partial w^*_S}{\partial \widetilde{c}} < 1$ (See comparative statics on w^*_L and w^*_S in Appendix 2.A).

Alternative modelings of the countervailing power of the large retailer lead to an increase in retail prices as countervailing power increases; see Subsection 2.4.2.

The presence of countervailing power of the large retailer also affects the additional value of multistop shopping ($d^*_{AS} < \overline{d}_{AS}$). Let us denote the loss in the total additional value of multistop shopping from the countervailing power as Δ_{AS}. It is given as:

$$\Delta_{AS} = \int_{d^*_{AS}}^{\overline{d}_{AS}} \left(\overline{d}_{AS} - s\right) dF\left(s\right) + \left(\overline{d}_{AS} - d^*_{AS}\right) F\left(d^*_{AS}\right).$$

Countervailing power discourages consumers with a shopping cost exceeding $d^*_{AS}(< \overline{d}_{AS})$ from visiting S. These multistop shoppers will become one-stop shoppers instead of being multistop shoppers within the regime without countervailing power. This loss is given by the first term. The second term represents the loss of consumers with a shopping cost lower than d^*_{AS}. While they still patronize both retailers, they face a loss due to a decrease in the additional value of multistop shopping $\left(\overline{d}_{AS} - d^*_{AS}\right)$. All consumers who were multistop shoppers within the regime without countervailing power face a loss in the additional value of multistop shopping.

Overall, the countervailing power of the large retailer decreases the consumer surplus by $\Delta_{CS} = \Delta_{AL} + \Delta_{AS}$. We can also breakdown the change in the consumer surplus according to the four groups of consumers we distinguished: $s \in (0, d^*_{AS})$, $s \in \left(d^*_{AS}, \overline{d}_{AS}\right)$, $s \in \left(\overline{d}_{AS}, d^*_{AL}\right)$ and $s \in \left(d^*_{AL}, \overline{d}_{AL}\right)$.

We can write:

$$\begin{aligned}
\Delta_{CS} \quad = \quad & \underbrace{\left[\left(\overline{d}_{AS} - d^*_{AS}\right) + \left(\overline{d}_{AL} - d^*_{AL}\right)\right] F\left(d^*_{AS}\right)}_{s \in \left(0, d^*_{AS}\right)} \\
& + \underbrace{\left(\overline{d}_{AL} - d^*_{AL}\right)\left[F\left(\overline{d}_{AS}\right) - F\left(d^*_{AS}\right)\right] + \int_{d^*_{AS}}^{\overline{d}_{AS}} \left(\overline{d}_{AS} - s\right) dF\left(s\right)}_{s \in \left(d^*_{AS}, \overline{d}_{AS}\right)} \\
& + \underbrace{\left(\overline{d}_{AL} - d^*_{AL}\right)\left[F\left(d^*_{AL}\right) - F\left(\overline{d}_{AS}\right)\right]}_{s \in \left(\overline{d}_{AS}, d^*_{AL}\right)} + \underbrace{\int_{d^*_{AL}}^{\overline{d}_{AL}} \left(\overline{d}_{AL} - s\right) dF\left(s\right)}_{s \in \left(d^*_{AL}, \overline{d}_{AL}\right)}.
\end{aligned}$$

The four regions are provided in Figure 2.3.

We can clearly see that when $s \in (0, d^*_{AS})$, multi-stop shoppers exist in both regimes (with and without countervailing power). This is reflected in the expression above for the region $s \in (0, d^*_{AS})$, where we have the difference in one-stop shopping value as well as the multistop shopping additional value. For the region $s \in (d^*_{AS}, \overline{d}_{AS})$, in the presence of countervailing power, one-stop shopping prevails, while consumers are multistop shoppers in the absence of countervailing power. Since consumer surplus for multistop shoppers has been split into two parts, we

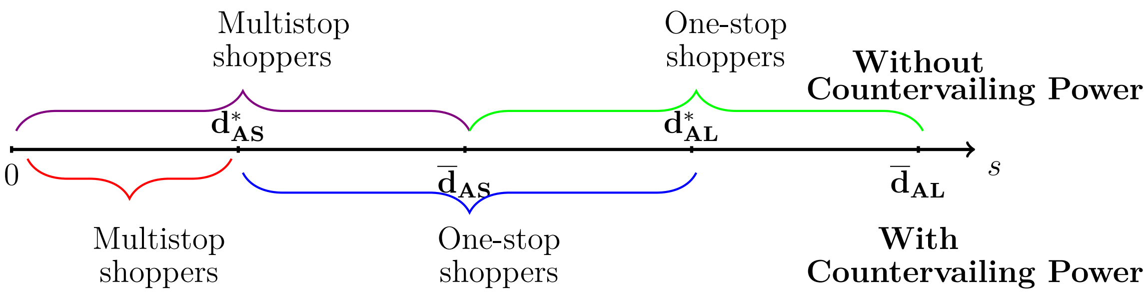

Figure 2.3: Changes in consumers values at the equilibrium

see the difference in one-stop shopping value for the consumers within both regimes along with a term that represents the additional surplus multistop shoppers obtain in absence of countervailing power. In the region $s \in (\overline{d}_{AS}, d^*_{AL})$, in both regimes we have one-stop shoppers and this is represented as the difference in one-stop shopping value. Finally, for $s \in \left(d^*_{AL}, \overline{d}_{AL}\right)$, one-stop shoppers exist only in the absence of countervailing power. The discussion above is summarized in the following proposition.

Proposition 2.3. *Countervailing power of the large retailer decreases the quantity sold by small retailers as well as the total quantity in the competitive market (Good B). Total quantity in the monopoly market also decreases (Good A). Consequently, countervailing power of the large retailer decreases consumer surplus.*

Proof. See Appendix 2.A □

Finally, the countervailing power of the large retailer decreases the social welfare (industry surplus decreases, as well as consumer surplus). The loss in social welfare is equal to

$$\Delta_W = \int_{d^*_{AS}}^{\overline{d}_{AS}} (v_S - v_L - s)\, dF(s) + \int_{d^*_{AL}}^{\overline{d}_{AL}} (v_{AL} - s)\, dF(s)$$

in which the first term corresponds to the fall in the demand from multistop shoppers who now become one-stop shoppers instead of being multistop shoppers and enjoyed $(v_S - v_L - s)$ as additional surplus, and the second term is the fall in the demand from one-stop shoppers who now do not buy.

Corollary 1 *Countervailing power of the large retailer decreases social welfare.*

As noted in the introduction, policy debates suggest that countervailing power is socially desirable if lower prices paid by large retailers to their suppliers are passed on to consumers. By showing that countervailing power can hurt consumers and social welfare, our analysis sheds new light on these debates and can help to qualify the conditions under which lower prices paid by large retailers to their suppliers are not passed on to consumers. We note in our analysis, that the large retailer exerts its market power in various ways: countervailing power (demand-side substitution) and seller power (the large retailer offers a wide range of products while small retailers focus on narrower product lines). It is the combination of both "countervailing power" and "seller power" which explains that the countervailing power of the large retailer reduces the social welfare.

Another policy implication follows: as wholesale prices are less distorted under a ban on slotting fees, we can claim that banning slotting fees increases social welfare.

2.4 Robustness and Discussion

In this section, we first show in Subsection 2.4.1 that our analysis extends when the comparative advantage of the large retailer is smaller (namely, $v_S > v_{AL} - r^m_{AL}$, but still $v_{AL} > v_S$). Then, we discuss the assumptions about the contracts and stress that our insights do not depend on the modeling of the countervailing power of the large retailer (Subsection 2.4.2).

2.4.1 Smaller Comparative Advantage of the Large Retailer

In this subsection, we now assume that L's comparative advantage is smaller: $v_S > v_{AL} - r^m_{AL}$.[27] As a result, L will face a restriction on its total margin r_{AL} in order to keep attracting one-stop shoppers.

At stage two, consider w_L and w_S, which are offered by the supplier at stage one, we assume that $v_S - w_S > v_{AL} - w_L - r^e_{AL}$ with $r^e_{AL} = h\left(v_{AL} - w_L - r^e_{AL}\right)$. Instead of r^e_{AL}, L should, as a result, improve its offer to attract one-stop shoppers. It is then optimal for L to match the value offered by the competitive fringe of small retailers: $v_{AL} - w_L - r_{AL} = v_S - w_S$ or $r_{AL} = v_{AL} - w_L - (v_S - w_S)$ $(< r^e_{AL})$, which gives L's gross profit, by replacing r_{AL}, equal to:

$$\pi_{AL} = \left[v_{AL} - w_L - (v_S - w_S)\right] F\left(v_S - w_S\right) - r^e_L F\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right),$$

with $r^e_L = -h\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right)$. The margin of the good B_L is unchanged. The fringe of small retailers exerts an effective competition for one-stop shoppers, but screening strategy is still best achieved by pricing B_L below cost at $r^e_L (< 0)$.

[27] For uniform shopping cost case, $v_S > v_{AL} - r^m_{AL}$ yields $v_{AL} < 2v_S$, see Appendix 2.A.

Note, we get:

$$\frac{\partial \pi_{AL}}{\partial r_{AL}}|_{r_{AL}=v_{AL}-w_L-(v_S-w_S)} = F(v_{AL}-w_L-r_{AL})-r_{AL}f(v_{AL}-w_L-r_{AL})|_{r_{AL}=v_{AL}-w_L-(v_S-w_S)},$$

which is positive by concavity of the objective function of the large retailer.

At stage one, the supplier sets contracts.

We first consider the case where the large retailer has no countervailing power. The profit-maximization problem of the supplier can be written as

$$\begin{aligned}&\max_{w_L, w_S} \ w_L \left[F\left(v_S - w_S\right) - F\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right)\right] + F_L \\ &+ w_S F\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right),\end{aligned}$$

where the fixed fee is given by $F_L = \pi_{AL}\left(r_L^e\left(w_L, w_S\right), w_L, w_S\right) - \pi_A^m$.

First-order conditions (applying the envelope theorem on $\pi_{AL}\left(.\right)$ and using $r_L^e = -h(v_S - w_S - (v_L - w_L - r_L^e)))$ are

$$\begin{aligned}\left(w_S - w_L\right)\left(1 + \frac{\partial r_L^e}{\partial w_L}\right) f\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right) &= 0, \\ -\left(w_S - w_L\right)\left(1 - \frac{\partial r_L^e}{\partial w_S}\right) f\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right) & \\ -w_L f\left(v_S - w_S\right) - \left(v_{AL} - w_L - \left(v_S - w_S\right)\right) f\left(v_S - w_S\right) + F\left(v_S - w_S\right) &= 0.\end{aligned}$$

Let w_L^{**} and w_S^{**} be the solutions of the above equations. Straightforward computations lead to $w_S^{**} = w_L^{**}$ and $w_S^{**} = -\left(v_{AL} - v_S\right) + h\left(v_S - w_S^{**}\right) > 0$ as

$$\frac{\partial \pi_{AL}}{\partial r_{AL}}|_{r_{AL}=v_{AL}-w_L-(v_S-w_S)} = -(v_{AL} - w_L - (v_S - w_S))f(v_S - w_S) + F(v_S - w_S) > 0.$$

Instead of having $w_S = w_L = 0$, as in the case of non countervailing power, equilibrium wholesale prices are higher to reduce the competitive pressure from small retailers on the total margin of the large retailer.

Subsequently, we introduce countervailing power of the large retailer. The profit-maximization problem of the supplier changes as the large retailer can now substitute the supplier in the case of a refusal. Instead of having π_A^m, in the case of a refusal, let $\widetilde{\pi}_{AL}\left(.\right)$ define the new outside option of the large retailer which is a function of $\widetilde{r}_{AL}\left(\widetilde{c}, w_S\right)$, $\widetilde{r}_L\left(\widetilde{c}, w_S\right)$, $\widetilde{c}$ and w_S. Writing the profit-maximization problem of the supplier, the first-order condition with respect to w_L is unchanged but the first-order condition with respect to w_S now becomes:

$$-\left(w_S - w_L\right)\left(1 - \frac{\partial r_L^e}{\partial w_S}\right) f\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right)$$
$$-w_L f\left(v_S - w_S\right) - \left(v_{AL} - w_L - \left(v_S - w_S\right)\right) f\left(v_S - w_S\right) + F\left(v_S - w_S\right) - \frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} = 0.$$

Without ambiguity, the impact of the countervailing power depends on the sign of $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}$. If $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} < 0$, wholesale prices will be higher, and the opposite will arise if $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} > 0$. In the following, we provide a sufficient condition to get higher wholesale prices in case of countervailing power.

Proposition 2.4. *Assuming $v_S > v_{AL} - r_{AL}^m > v_S - w_S^{**}$, with $w_S^{**} = -\left(v_{AL} - v_S\right) + h\left(v_S - w_S^{**}\right) > 0$, a high enough countervailing power leads to higher wholesale prices.*

Proof. See Appendix 2.A. □

Assume $v_{AL} - r_{AL}^m > v_S - w_S^{**}$, and let $\widehat{\widetilde{c}} = v_S - w_S^{**} - \left(v_{AL} - \widetilde{r}_{AL}\left(\widehat{\widetilde{c}}\right)\right)$ with $\widetilde{r}_{AL}\left(\widehat{\widetilde{c}}\right) = h\left(v_{AL} - \widehat{\widetilde{c}} - \widetilde{r}_{AL}\left(\widehat{\widetilde{c}}\right)\right)$ define a threshold on $\widetilde{c}$; we have on the interval $\widetilde{c} \in \left(0, \widehat{\widetilde{c}}\right)$ that the large retailer is non-constrained on its total margin in the case of a refusal when the wholesale price of small retailers equals w_S^{**}.[28] Previous analysis (see lemma 2.1) shows that $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} < 0$ in this case. Consequently, without ambiguity, a high enough countervailing power which is characterized by $\widetilde{c} \in \left(0, \widehat{\widetilde{c}}\right)$ leads to higher wholesale prices.[29]

Other results follow directly. A high enough countervailing power of the large retailer reduces the supplier's profits as well as the industry surplus. On the other hand, the profits of the large retailer increase in its countervailing power and the supplier pays a slotting fee to the large retailer (as $\widehat{\widetilde{c}} < w_L^{**}$ to get $v_{AL} - \widetilde{c} - \widetilde{r}_{AL}\left(\widetilde{c}\right) > v_S - w_S^{**}$ and $\frac{\partial \pi_{AL}}{\partial w_L} < 0$). Introducing high enough countervailing power decreases consumer surplus and consequently decreases social welfare as industry surplus is lower too.[30]

[28]Considering the uniform shopping cost case, $\widehat{\widetilde{c}}$ corresponds to $\frac{v_A - v_L}{2}$. See Appendix 2.A.

[29]In Appendix 2.A, the analysis of uniform shopping costs helps to illustrate this result.

[30]Note that by introducing countervailing power with $\widetilde{c} \in \left(0, \widehat{\widetilde{c}}\right)$, wholesale prices are higher compared to the case in which the large retailer has no countervailing power but wholesale prices are still equal at the equilibrium $\left(w_L = w_S\right)$. For more, see Appendix 2.A.

As a result, in case $\widetilde{c} \in \left(0, \widehat{\widetilde{c}}\right)$ (large countervailing power), the total demand decreases (which is given by $F\left(v_S - w_S\right)$), but the quantity sold by small retailers does not change $\left(F\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right)\right)$. The demand of multistop shoppers is unchanged; only the de-

2.4.2 Discussion and Alternative Modeling of Countervailing Power

The above framework aims at capturing how the countervailing power can lead to higher retail prices. The modeling choice of the countervailing power, namely, that the supplier is constrained in contracting with the large retailer by the threat of demand-side substitution, is in line with the literature. It also fits well as large retailers often have the ability to turn to other sources of supply if they dislike the supplier's terms.

Alternative modeling of the countervailing power has also been used in the literature. For example, the outcome of the negotiation between the supplier and the large retailer can be determined through the Nash's axiomatic approach. Following the approach developed in Chen (2003), we suppose that the contract between the supplier and the large retailer satisfies the following two properties:[31]

(i) the contract (w_L, F_L) is efficient in the sense that the surplus (joint profits) from *this transaction* is maximized, otherwise the large retailer would want to renegotiate;

(ii) the surplus from this contract is divided according to the sharing rule γ, where $\gamma \in (0, 1)$ denotes the large retailer's share of the joint profits. An increase in the amount of the countervailing power possessed by the large retailer implies a larger share γ.

In this setting, negotiations are sequential: the supplier is able to commit to the contracts with the small retailers, following which, negotiations between the supplier and the large retailer take place according to the above approach. We show that our insights, that is countervailing power can lead to higher retail prices and can decrease social welfare- carry over with this modeling of negotiations.[32]

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mand of one-stop shoppers falls. Let $w_L^{**,C} = w_S^{**,C}$ define the equilibrium wholesale prices (which solve the first-order conditions) in case $\widetilde{c} \in \left(0, \widehat{\widetilde{c}}\right)$, we have $w_L^{**,C} = w_S^{**,C} > w_L^{**} = w_S^{**} > 0$. The loss in social welfare, which is equal to $\Delta_W = \int_{v_S - w_S^{**,C}}^{v_S - w_S^{**}} (v_S - s)\, dF(s)$, now corresponds to the fall in demand from one-stop shoppers who do not buy, in the case of countervailing power.

[31] Discussions of this approach can be found in Christou and Papadopoulos (2015), and Matsushima and Yoshida (2016).

[32] In the approach developed by Chen (2003), contracts between the supplier and the large retailer are assumed to be efficient, so that only the wholesale price paid by the small retailers (and the fixed fee between the supplier and the large retailer) varies in the countervailing power of the large retailer.

Alternatively, one can think of the outcome of the negotiation between the supplier and the large retailer given as a random proposal of take-it-or-leave-it offers before the negotiation takes place (See Chemla, 2003 for an example of this approach in use; or more recently, see Münster and Reisinger, 2015). With probability γ, the large retailer proposes (w_L, F_L), while with probability $(1-\gamma)$ the supplier proposes (w_L, F_L). That is, where $\gamma = 1$, the large retailer has full bargaining power, while where $\gamma = 0$ the supplier has full bargaining power. Offers to the small retailers are

We thus suppose that the sequence of contract negotiations is a two-stage sequence: at stage zero, the supplier makes a take-it-or-leave-it offer to each of the small retailers (w_S); at stage one, the contract between the supplier and the large retailer (w_L, F_L) is determined through the negotiation explained above. Then, stage two is unchanged.[33]

The analysis has been developed for $v_{AL} - r^m_{AL} > v_S$: the large retailer is not constrained on its total margin.[34]

Solving backwards, retail margins of the large retailer at stage two are unchanged. At stage one, the supplier and the large retailer negotiate a contract (w_L, F_L). The joint profits Π_J from the transaction between the supplier and the large retailer can be written:

$$\Pi_J = w_L \left[F\left(v_{AL} - w_L - r^e_{AL}\right) - F\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right)\right] + \pi_{AL}\left(r^e_{AL}, r^e_L\right) - \pi^m_A,$$

where $\pi_{AL}\left(r^e_{AL}, r^e_L\right) = r^e_{AL} F\left(v_{AL} - w_L - r^e_{AL}\right) - r^e_L F\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right)$ and $\pi^m_A = r^m_A F\left(v_A - r^m_A\right)$ where $r^m_A = h\left(v_A - r^m_A\right)$. Differentiating Π_J with respect to w_L and apply the envelope theorem, then w_L satisfies:

$$-w_L[(1 + \frac{\partial r^e_{AL}}{\partial w_L}) f(v_{AL} - w_L - r^e_{AL}) + (1 + \frac{\partial r^e_L}{\partial w_L}) f(v_S - w_S - (v_L - w_L - r^e_L))] = 0,$$

by using $r^e_{AL} = h\left(v_{AL} - w_L - r^e_{AL}\right)$ and $r^e_L = -h\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right)$. The first-order condition reveals that $w_L = 0$. Following the sharing rule suggested by Chen, $F_L = (1 - \gamma)\,\Pi_J$. At stage zero, the supplier chooses the contract offered to the small retailers. In so doing, it wants to maximize the total profits it earns from the sales to both the small retailers and the large retailer:

$$w_S F\left(v_S - w_S - \left(v_L - r^e_L\right)\right) + (1 - \gamma)\,\Pi_J.$$

still made by the supplier, and, simultaneously, with the negotiation between the supplier and the large retailer. We still assume that contracts, in particular contracts with the small retailers cannot be conditional on any action chosen later in the game (acceptance or refusal decision on the offers in the negotiation between the supplier and the large retailer). We can show that, conditional on who makes the proposal, now has an impact on the wholesale price negotiated between the supplier and the large retailer. w_L maximizes the industry surplus, regardless of who makes the proposal, but varies in w_S. As w_S changes according to who makes the proposal in the negotiation between the supplier and the large retailer, w_L varies in w_S. Furthermore, as in Chen's approach, retail prices will increase in γ.

We thank Patrick Rey for suggesting this extension. Details can be found in Appendix 2.A.

[33]Still, contracts to the small retailers are not contingent to the success of negotiation between the supplier and the large retailer.

[34]With $v_S > v_{AL} - r^m_{AL}$, we can show that the results still hold as long as the comparative advantage of the large retailer $(v_{AL} - v_S)$ is not too small. The proof is available upon request.

$\Pi_J = \pi_{AL}\left(r^e_{AL}\left(0, w_S\right), r^e_L\left(0, w_S\right), 0, w_S\right) - \pi^m_A$ corresponds to the gross profits of the large retailer written at $w_L = 0$ minus the monopoly profit on the good A. If we differentiate the objective of the supplier with respect to w_S and apply the envelope theorem, then w_S satisfies:

$$w_S\left(-1 + \frac{\partial r^e_L}{\partial w_S}\right) f\left(v_S - w_S - \left(v_L - r^e_L\right)\right) + \gamma F\left(v_S - w_S - \left(v_L - r^e_L\right)\right) = 0.$$

Let w^*_S denote the solution of the first-order condition. Comparative statics reveals that

$$\frac{\partial w^*_S}{\partial \gamma} = -\frac{F\left(v_S - w^*_S - \left(v_L - r^e_L\right)\right)}{\partial^2 \Pi_J / \partial w^2_S},$$

which is positive. An increase in the countervailing power of the large retailer increases the wholesale price paid by the small retailers.

The countervailing power of the large retailer does not affect the value of one-stop shopping as w_L, which is equal to the marginal cost of production (zero), does not change with respect to γ. w_L maximizes the joint profits from the transaction between the large retailer and the supplier and, because of the double marginalization problem, we get $w_L = 0$. So, the mechanism through which the countervailing power of the large retailer brings up the wholesale price paid by the small retailers is quite similar. Consider the change in the quantities sold in the retail market. When w_S increases, the sales to the small retailers decrease, which imposes a negative externality on the large retailer due to reduced screening opportunities. When γ is larger, the supplier internalizes less of the profits of the large retailer and so is more willing to impose a negative externality on the large retailer by selling less through the small retailers. Therefore, the increase in w_S is the result of the supplier trying to offset the reduction in profits caused by the rise in the countervailing power γ.

Hence, we obtain here that an increase in the countervailing power of the large retailer leads to an increase in the retail prices ($p_S = w_S$). Consequently, consumer surplus decreases. The present analysis in terms of consumer surplus is slightly easier compared to the previous analysis as the value of one-stop shopping does not change in this setting of negotiations.

Let $\overline{d}_{AS} = v_S - \left(v_L - r^e_L\left(0, 0\right)\right)$ with $r^e_L\left(0, 0\right) = -h\left(v_S - \left(v_L - r^e_L\left(0, 0\right)\right)\right)$ denote the additional value of multistop shopping for $\gamma = 0$ as a benchmark and $d^*_{AS} = v_S - w^*_S - \left(v_L - r^e_L\left(0, w^*_S\right)\right)$ with $r^e_L\left(0, w^*_S\right) = -h\left(v_S - \left(v_L - r^e_L\left(0, w^*_S\right)\right)\right)$ as the value for $\gamma > 0$. Adding countervailing power leads to a decrease in the additional value of multistop shopping from $\overline{d}_{AS}$ to d^*_{AS}. The consumer surplus decreases by:

$$\Delta_{CS} = \left(\overline{d}_{AS} - d^*_{AS}\right) F\left(d^*_{AS}\right) + \int_{d^*_{AS}}^{\overline{d}_{AS}} \left(\overline{d}_{AS} - s\right) dF\left(s\right),$$

in which the first term corresponds to the decrease in consumer surplus of multi-stop shoppers who now face a higher price when shopping at smaller retailers, and the second term is the loss of consumers who now become one-stop shoppers due to the countervailing power of the large retailer. Furthermore, since industry surplus is maximized for $w_S = 0$, industry surplus decreases when we add countervailing power, as does social welfare, which decreases by:

$$\Delta_W = \int_{d^*_{AS}}^{\bar{d}_{AS}} (v_S - v_L - s)\, dF(s) .$$

The question of which of model of countervailing power is more relevant (in terms of plausible assumptions and/or of predicted outcomes), is likely to vary across products or industries. In the first approach, both wholesale prices change according to the countervailing power of the large retailer, while in the second approach the wholesale price of the small retailers increases only. However, in both cases adding countervailing power of the large retailer decreases the social welfare.

It is worth noting that results hinge critically on the assumption that the breakdown in negotiation between the supplier, and the large retailer cannot be contracted upon, because of non-verifiability in court. Assume instead that the breakdown in negotiation is contractible (as do Inderst and Wey (2003), for example), the industry surplus maximization and the sharing of the industry surplus will be disentangled and the countervailing power of the large retailer will not affect retail prices along the equilibrium path. The same distinction arises between Caprice (2006) and Inderst and Shaffer (2011), who adopt the same assumption as we do in this paper, and Inderst and Shaffer (2010), who only focus on the industry surplus maximization. In practice, Möller (2007) noted that contingent contracts are rare and hard to enforce.[35]

2.5 Conclusion

A recurring theme in the retail industry is that large retailers offer a wide range of products and are thus able to capture large market shares through one-stop shopping. Their dominance in the retailing markets confers upon buyer power vis-à-vis the suppliers as well, which allows them to obtain more favorable trade terms than other retailers.

[35] See also Milliou and Petrakis (2007) for an interesting discussion on this point.

In this article, we demonstrate that countervailing power possessed by a large retailer can lead to a rise in retail prices for consumers as well as a decrease in social welfare. The fixed fee paid by the large retailer to the supplier decreases, but wholesale prices increase. While joint profit maximization calls for wholesale prices equal to marginal cost of production, high wholesale prices are a supplier's strategy to extract surplus from the large retailer. Such a response by the supplier to the countervailing power of the large retailer increases retail prices and decreases social welfare.

Thus, the countervailing power of large retailers may not lead to lower retail prices. The analysis provides a theoretical foundation for concerns voiced by many antitrust authorities: cost savings which only benefit the large retailers will not suffice; cost savings need to be passed on to consumers. While the question of whether countervailing power is socially desirable has been discussed by legal and economic scholars since the 1950s without reaching a firm conclusion, this article claims that countervailing power decreases social welfare. Our analysis which combines seller power and buyer power captures the main ingredients of the modern retail industry: polarization of the retail industry and shopping costs. In our model, a large retailer, which attracts consumers through one-stop shopping, competes with smaller retailers.

In many countries, retailers' pricing strategies are ruled by the same general competition laws as those of producers. However, during the 1990s, several countries adopted regulations to prevent retailers from engaging in loss-leading against smaller rivals, to the detriment of consumers.[36] At the same time, OECD (2007) argues that rules against loss-leading are likely to protect inefficient competitors and harm consumers. In our analysis, the large retailer sells below the marginal wholesale price. Preventing the large retailer from selling below the marginal wholesale price would shift the retail equilibrium. The first effect would be a price-raising effect as screening opportunities of the large retailer change. The effect of the countervailing power of the large retailer is then far from being clear. However, assume that countervailing power of the large retailer benefits consumers, we would obtain that, preventing the large retailer from selling below the marginal wholesale price harms consumers if the first price-raising effect is larger. Another crucial point in banning loss-leading is the definition of the price threshold. If the price threshold is the unit wholesale price including the fixed fee, the large retailer does not sell below cost in any case. For example, assume the large retailer has high countervailing power, then the supplier pays slotting fees to the large retailer, which suggests that the large retailer

[36] As noted by Chen and Rey (2013), below-cost resale is banned in Belgium, France, Ireland, Luxembourg, Portugal and Spain, whereas it is generally allowed in the Netherlands and the United Kingdom. In the United States, 22 states are equipped with general sales-below-costs laws, and 16 additional states prohibit below-cost sales on motor fuel.

For a contribution to this topic, see for example Allain and Chambolle (2011).

does not sell below the unit wholesale price including fixed fee. Because the large retailer's pricing strategies are not binding in the case of high countervailing power, prohibiting selling at a loss may simply restrain the large retailer in the case of weak countervailing power, which leads to higher retail prices in this case. Even if this issue is important, we make the choice not to deal with it in this article, but to leave it for future investigations.

The countervailing power of large retailers also has an impact on suppliers' investment incentives.[37] When retailers enhance their buying power, suppliers adjust their investments according to the new bargaining position of their buyers. The concern frequently expressed in policy circles is that suppliers respond to growing buyer power by under-investing in innovation and production. Our above analysis argues that high wholesale prices may help to extract surplus from the large retailer, which may tend to reduce suppliers' investment incentives. Low wholesale prices would not favor the surplus extraction from the large retailer, decreasing the supplier's incentives to invest. However, the impact of the supplier's investments with respect to the conditions of retail screening is less clear. Supplier's investments may have effects on the consumer value of the good at the large retailer as well as at the small retailers. The screening opportunities at the retail level may change, as may the seller power of the large retailer. We leave the analysis of the impact of the countervailing power on suppliers' investment incentives, consumer surplus and social welfare, when shopping costs matter to future researches.

[37]See Inderst and Wey (2011) and Caprice and Rey (2015) for contributions to this issue.

2.A Appendix

Proof of lemma 2.1

Recall first-order conditions:

$$\begin{aligned} r_{AL}^e &= \frac{F\left(v_{AL}-w_L-r_{AL}^e\right)}{f\left(v_{AL}-w_L-r_{AL}^e\right)}=h\left(v_{AL}-w_L-r_{AL}^e\right), \\ r_L^e &= -\frac{F\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)}{f\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)}=-h\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right) \text{ with} \\ & h\left(.\right)=\frac{F\left(.\right)}{f\left(.\right)}. \end{aligned}$$

Comparative statics on the first-order conditions reveal that:

$$\begin{aligned} \frac{\partial r_{AL}^e}{\partial w_L} &= -\frac{h'\left(v_{AL}-w_L-r_{AL}^e\right)}{1+h'\left(v_{AL}-w_L-r_{AL}^e\right)}\in\left(-1,0\right) \text{ with } h'\left(.\right)>0, \\ \frac{\partial r_{AL}^e}{\partial w_S} &= 0, \\ \frac{\partial r_L^e}{\partial w_L} &= -\frac{h'\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)}{1+h'\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)}\in\left(-1,0\right) \text{ with } h'\left(.\right)>0, \text{ and} \\ \frac{\partial r_L^e}{\partial w_S} &= \frac{h'\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)}{1+h'\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)}\in\left(0,1\right) \text{ with } h'\left(.\right)>0, \end{aligned}$$

which also implies $\frac{\partial r_L^e}{\partial w_S}=-\frac{\partial r_L^e}{\partial w_L}$. Moreover, using previous expressions, we have $\frac{\partial^2 r_L^e}{\partial w_S \partial w_L}=-\frac{\partial^2 r_L^e}{\partial w_S^2}$ (this equality will be useful in comparative statics later).

Differentiate π_{AL} with respect to w_L and apply the envelope theorem:

$$\frac{\partial \pi_{AL}}{\partial w_L}=-r_{AL}^e f\left(v_{AL}-w_L-r_{AL}^e\right)-r_L^e f\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right).$$

Then, by using first-order conditions, we write

$$\frac{\partial \pi_{AL}}{\partial w_L}=-\left[F\left(v_{AL}-w_L-r_{AL}^e\right)-F\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)\right]$$

which is negative as $\left[F\left(v_{AL}-w_L-r_{AL}^e\right)-F\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)\right]>0$ (one-stop shoppers' demand).

We do the same with respect to w_S:

$$\frac{\partial \pi_{AL}}{\partial w_S}=r_L^e f\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)=-F\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)$$

which is negative as $F\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right) > 0$ (multistop shoppers' demand). Q.E.D.

Proof of proposition 2.1

Differentiate the objective function of the supplier with respect to w_L and w_S, and apply the envelope theorem (as the objective function of the supplier is a function of π_{AL}). We can simplify by using the first-order conditions on r_{AL}^e and r_L^e (with $r_{AL}^e = h\left(v_{AL} - w_L - r_{AL}^e\right)$ and $r_L^e = -h\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right)$), so we have:

$$\begin{aligned} -w_L\left[\left(1+\frac{\partial r_{AL}^e}{\partial w_L}\right)f\left(v_{AL}-w_L-r_{AL}^e\right)\right]& & \\ +\left(w_S-w_L\right)\left[\left(1+\frac{\partial r_L^e}{\partial w_L}\right)f\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)\right] &=& 0, \\ -\left(w_S-w_L\right)\left[\left(1-\frac{\partial r_L^e}{\partial w_S}\right)f\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)\right] &=& 0. \end{aligned}$$

Using the first-order condition on w_S, we can write $w_S = w_L$. Recognizing that the first-order condition on w_L is also a function of the first-order condition on w_S (as $\frac{\partial r_L^e}{\partial w_L} = -\frac{\partial r_L^e}{\partial w_S}$, see lemma 2.1), we get $w_L = 0$. The result is $w_L = w_S = 0$, and the fixed fee follows from the participation constraint of the large retailer $F_L = \pi_{AL}\left(r_{AL}^e(0), r_L^e(0,0), 0, 0\right) - \pi_A^m$. Q.E.D.

Proof of lemma 2.2

Under assumption 1, $v_A - r_A^m \geq v_S$, we get $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} \geq v_S$ which implies $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} > v_S - w_S$ for any $w_S \geq 0$ (the large retailer is not constrained on its total margin $\widetilde{r}_{AL}$ in the case of a refusal). We can apply lemma 2.1 and $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} < 0$. Q.E.D.

Proof of proposition 2.2

With countervailing power, first-order conditions are written as:

$$\begin{aligned} &-w_L\left[\left(1+\frac{\partial r_{AL}^e}{\partial w_L}\right)f\left(v_{AL}-w_L-r_{AL}^e\left(w_L\right)\right)\right] \\ &\qquad +\left(w_S-w_L\right)\left[\left(1+\frac{\partial r_L^e}{\partial w_L}\right)f\left(v_S-w_S-\left(v_L-w_L-r_L^e\left(w_L,w_S\right)\right)\right)\right]=0, \end{aligned}$$

$$-\left(w_S-w_L\right)\left[\left(1-\frac{\partial r_L^e}{\partial w_S}\right)f\left(v_S-w_S-\left(v_L-w_L-r_L^e\right)\right)\right]-\frac{\partial \widetilde{\pi}_{AL}\left(w_S\right)}{\partial w_S}=0.$$

Compared to the case without countervailing power, the first is unchanged while a new term appears in the second. Remember $\frac{\partial \widetilde{\pi}_{AL}(w_S)}{\partial w_S} < 0$ (See lemma 2.2), we have $w_S > w_L$ (as $\frac{\partial r_L^e}{\partial w_S} \in (0,1)$, see lemma 2.1).

Using the first-order condition on w_S (with $\frac{\partial r_L^e}{\partial w_L} = -\frac{\partial r_L^e}{\partial w_S}$, see lemma 2.1), we can write the first-order condition on w_L as follows

$$-w_L \left[\left(1 + \frac{\partial r_{AL}^e}{\partial w_L}\right) f\left(v_{AL} - w_L - r_{AL}^e\left(w_L\right)\right) \right] - \frac{\partial \widetilde{\pi}_{AL}\left(w_S\right)}{\partial w_S} = 0.$$

Using $\frac{\partial \widetilde{\pi}_{AL}(w_S)}{\partial w_S} < 0$ and $\frac{\partial r_{AL}^e}{\partial w_L} \in (-1,0)$ (see lemma 2.1), we have $w_L > 0$. Consequently, at equilibrium $w_S^* > w_L^* > 0$; the large retailer obtains a wholesale price smaller than the wholesale price of the small retailers and the fixed fee, from the participation constraint is written as: $F_L = \pi_{AL}\left(w_L, w_S\right) - \widetilde{\pi}_{AL}\left(w_S\right)$. Recognize that $\widetilde{\pi}_{AL}\left(w_S\right)|_{\widetilde{c}=0} = \pi_{AL}\left(0, w_S\right)$ and remember that $\frac{\partial \pi_{AL}(w_L, w_S)}{\partial w_L} < 0$, the sign of F_L is negative at $\widetilde{c} = 0$. By continuity, there exists $\widehat{\widetilde{c}}$, such that the sign of F_L remains negative for $\widetilde{c} < \widehat{\widetilde{c}}$., which means that the supplier pays a slotting fee for countervailing power which is very large.

Comparative statics with respect to $\widetilde{c}$:
For first-order conditions, we have:

$$\begin{aligned}
&\underbrace{-w_L \left[\left(1 + \frac{\partial r_{AL}^e}{\partial w_L}\right) f\left(v_{AL} - w_L - r_{AL}^e\left(w_L\right)\right) \right]}_{A} \\
&+ \underbrace{\left(w_S - w_L\right) \left[\left(1 + \frac{\partial r_L^e}{\partial w_L}\right) f\left(v_S - w_S - \left(v_L - w_L - r_L^e\left(w_L, w_S\right)\right)\right) \right]}_{-B} \quad = \quad 0, \\
&\underbrace{-\left(w_S - w_L\right) \left[\left(1 - \frac{\partial r_L^e}{\partial w_S}\right) f\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right) \right]}_{B} - \underbrace{\frac{\partial \widetilde{\pi}_{AL}\left(w_S\right)}{\partial w_S}}_{C} \quad = \quad 0.
\end{aligned}$$

For the sake of exposition, let $FOC_{w_L} = 0$ and $FOC_{w_S} = 0$ denote the first-order conditions, so we can write:

$$\begin{aligned}
FOC_{w_L} &= A - B = 0, \\
FOC_{w_S} &= B - C = 0.
\end{aligned}$$

To start with comparative statics with respect to $\widetilde{c}$, we introduce more comparative statics to help us:

- $\partial A/\partial w_L < 0$, which is assumed to hold to satisfy the second-order condition for the case of no screening; moreover, we recognize that $\partial A/\partial w_S = 0$;
- $\partial B/\partial w_S < 0$, which is assumed to hold to satisfy the second-order condition for the case without countervailing power; moreover, by using $\frac{\partial^2 r_L^e}{\partial w_S \partial w_L} = -\frac{\partial^2 r_L^e}{\partial w_S^2}$ (see lemma 2.1), we recognize that $\partial B/\partial w_S = -\partial B/\partial w_L$, which is positive;
- lastly, $\frac{\partial C}{\partial \widetilde{c}} = \frac{\partial^2 \widetilde{\pi}_{AL}}{\partial w_S \partial \widetilde{c}} = -\frac{\partial^2 \widetilde{\pi}_{AL}}{\partial w_S \partial w_S} = -\frac{\partial C}{\partial w_S} < 0$.

Subsequently, recognizing that $\widetilde{c}$ does not appear in A and B, from $FOC_{w_L} = 0$, we can write that w_L is a function of w_S. Comparative statics on the $FOC_{w_L}(w_L(w_S), w_S)$ $= 0$, reveals that:

$$\frac{\partial FOC_{w_L}}{\partial w_L}\frac{\partial w_L}{\partial w_S} + \frac{\partial FOC_{w_L}}{\partial w_S} = 0.$$

Using $FOC_{w_L} = A - B = 0$, we can write:

$$\frac{\partial w_L}{\partial w_S} = \frac{\partial B/\partial w_L}{\partial B/\partial w_L - \partial A/\partial w_L} \in (0,1)\,,$$

with $\partial B/\partial w_L = -\partial B/\partial w_S > 0$ and $-\partial A/\partial w_L > 0$.

With w_L as a function of w_S and w_S as a function of $\widetilde{c}$, we can write:

$$FOC_{w_S}\left(w_L\left(w_S\left(\widetilde{c}\right)\right), w_S\left(\widetilde{c}\right), \widetilde{c}\right) = 0.$$

Comparative statics on FOC_{w_S} reveal that:

$$\frac{\partial FOC_{w_S}}{\partial w_L}\frac{\partial w_L}{\partial w_S}\frac{\partial w_S}{\partial \widetilde{c}} + \frac{\partial FOC_{w_S}}{\partial w_S}\frac{\partial w_S}{\partial \widetilde{c}} + \frac{\partial FOC_{w_S}}{\partial \widetilde{c}} = 0$$

which leads to:

$$\frac{\partial w_S}{\partial \widetilde{c}} = -\frac{\frac{\partial FOC_{w_S}}{\partial \widetilde{c}}}{\frac{\partial FOC_{w_S}}{\partial w_S} + \frac{\partial FOC_{w_S}}{\partial w_L}\frac{\partial w_L}{\partial w_S}}.$$

Using $FOC_{w_S} = B - C = 0$, we can write:

$$\frac{\partial w_S}{\partial \widetilde{c}} = \frac{\partial C/\partial w_S}{\partial C/\partial w_S - \frac{\partial B}{\partial w_S}\left(1 - \frac{\partial w_L}{\partial w_S}\right)} \in (0,1)$$

with $\partial C/\partial w_S = -\partial C/\partial \widetilde{c} > 0$ and $-\frac{\partial B}{\partial w_S}\left(1 - \frac{\partial w_L}{\partial w_S}\right) > 0$ (as $\frac{\partial B}{\partial w_S} < 0$ and $\frac{\partial w_L}{\partial w_S} \in$ $(0,1)$).

Industry surplus: The industry surplus in terms of wholesale prices can be written as:

$$\begin{aligned}\Pi^I &= w_L(F(v_{AL} - w_L - r^e_{AL}) - F(v_S - w_S - (v_L - w_L - r^e_L))) \\ &\quad + w_S F(v_S - w_S - (v_L - w_L - r^e_L)) + r^e_{AL} F(v_{AL} - w_L - r^e_{AL}) \\ &\quad - r^e_L F(v_S - w_S - (v_L - w_L - r^e_L)).\end{aligned}$$

Looking at the change in industry surplus with respect to the wholesale prices:

$$\frac{\partial \Pi^I}{\partial w_S} = -(w_S - w_L) f(v_S - w_S - (v_L - w_L - r^e_L))(1 - \frac{\partial r^e_L}{\partial w_S}) < 0,$$

$$\begin{aligned}\frac{\partial \Pi^I}{\partial w_L} &= -w_L \left[\left(1 + \frac{\partial r^e_{AL}}{\partial w_L} \right) f\left(v_{AL} - w_L - r^e_{AL}\right) \right] \\ &\quad (w_S - w_L) \left[\left(1 + \frac{\partial r^e_L}{\partial w_L} \right) f\left(v_S - w_S - (v_L - w_L - r^e_L)\right) \right].\end{aligned}$$

We can see from the above that industry surplus is maximized at $w_S = w_L = 0$ and any other configuration of the wholesale prices results in a reduction in industry surplus.

Supplier profits: We know that the supplier, by using two- part tariffs, is the residual claimant to the industry surplus after satisfying the large retailer's participation constraint. The supplier's profit is denoted as Π_S and can be broken down as the difference between the industry profit and the outside option of the large retailer. The supplier's profit without countervailing power is given as:

$$\Pi_S(0,0) = \Pi^I(0,0) - \pi^m_A.$$

The supplier's profit with countervailing power is given as:

$$\Pi_S(w^*_L, w^*_S) = \Pi^I(w^*_L, w^*_S) - \widetilde{\pi}_{AL}(w^*_S).$$

Taking the difference between the two, we have:

$$\Pi_S(0,0) - \Pi_S(w^*_L, w^*_S) = \underbrace{\Pi^I(0,0) - \Pi^I(w^*_L, w^*_S)}_{>0} - \underbrace{(\pi^M_A - \widetilde{\pi}_{AL}(w^*_S))}_{<0} > 0.$$

The first term is obtained from the previous result that industry profit is maximized at $w_S = w_L = 0$, while the second term is negative, because for countervailing power being present, we have $\widetilde{\pi}_{AL}(w^*_S)) > \pi^M_A$, otherwise the retailer would prefer to obtain monopoly profits on the good A.

Further, as countervailing power increases ($\widetilde{c}$ falls), we see that wholesale prices fall. This results in industry profits rising along with a rise in the outside option of the large retailer.

Retail profits: By introducing credible countervailing power, the large retailer obtains higher profits since $\widetilde{\pi}_{AL}(w_S^*) > \pi_A^m$. Further,we know that in the presence of credible countervailing the wholesale prices are characterized as $w_S^* > w_L^* > 0$. As countervailing power increases, the outside option increases because the equilibrium wholesale price w_S^* satisfies $1 > \dfrac{\partial w_S^*}{\partial \widetilde{c}} > 0$.

Slotting fees: The fixed fee, from the participation constraint is given as $F_L = \pi_{AL}\left(w_L, w_S\right) - \widetilde{\pi}_{AL}\left(w_S\right)$. Notice that $\widetilde{\pi}_{AL}\left(w_S\right)|_{\widetilde{c}=0} = \pi_{AL}\left(0, w_S\right)$ and remember that $\frac{\partial \pi_{AL}(w_L, w_S)}{\partial w_L} < 0$. Since $w_L^* > 0$ in presence of countervailing power, we have $F_L^* < 0$ as $\pi_{AL}\left(w_L^*, w_S^*\right) < \widetilde{\pi}_{AL}\left(w_S^*\right)$ for $w_L^* > 0$. By continuity, there exists $\widehat{\widetilde{c}}$, such that the sign of F_L remains negative for $\widetilde{c} < \widehat{\widetilde{c}}$, which means that the supplier pays a slotting fee for countervailing power which is very large. Q.E.D.

Proof of proposition 2.3

We need to show that the associated consumer value from one-stop shopping $d_{AL} = v_{AL} - w_L - r_{AL}^e(w_L)$ as well as the additional value of multistop shopping $d_{AS} = v_S - w_S - (v_L - w_L - r_L^e(w_L, w_S))$ are lower in the presence of countervailing power.

We know that without countervailing power $w_S = w_L = 0$, the associated values are given as:

$$\begin{aligned}\overline{d}_{AL} &= v_{AL} - r_{AL}^e\left(0\right), \\ \overline{d}_{AS} &= v_S - (v_L - r_L^e(0,0)).\end{aligned}$$

In presence of countervailing power the wholesale prices are characterized as $w_S^* > w_L^* > 0$:

$$\begin{aligned}d_{AL}^* &= v_{AL} - w_L^* - r_{AL}^e\left(w_L^*\right), \\ d_{AS}^* &= v_S - w_S^* - (v_L - w_L^* - r_L^e(w_L^*, w_S^*)).\end{aligned}$$

We know that d_{AL} is a function of w_L only and taking the derivative with respect to w_L, we get:

$$\frac{\partial d_{AL}}{\partial w_L} = -1 - \frac{\partial r_{AL}^e}{\partial w_L} < 0,$$

where we know $\dfrac{\partial r_{AL}^e}{\partial w_L} \in (-1, 0)$. So we get the result that in the presence of countervailing power, the consumer value of one-stop shopping and hence the total demand are lower.

We continue with the additional value of multistop shopping, which is given as $d_{AS} = v_S - w_S - (v_L - w_L - r_L^e(w_L, w_S))$. We know that in the presence of countervailing power $w_S^* > w_L^* > 0$, the change in r_L^e is given as the total differential:

$$\begin{aligned} dr_L^e(w_L, w_S) &= \frac{\partial r_L^e(w_L, w_S)}{\partial w_L}\Delta w_L + \frac{\partial r_L^e(w_L, w_S)}{\partial w_S}\Delta w_S && (2.1)\\ &= \underbrace{\frac{\partial r_L^e(w_L, w_S)}{\partial w_L}}_{<0}\underbrace{(\Delta w_L - \Delta w_S)}_{<0}. && (2.2)\end{aligned}$$

The first term in the second equation comes from $\frac{\partial r_L^e(w_S, w_L)}{\partial w_L} = -\frac{\partial r_L^e(w_S, w_L)}{\partial w_S}$ and the second term comes from the fact that $w_S^* > w_L^* > 0$ and $\Delta w_i = w_i^* - 0$ for $i \in \{L, S\}$. Here we see that in the presence of countervailing power there is an increase in $r_L^e(w_S, w_L)$, because we know that $r_L^e(w_L^*, w_S^*) > r_L^e(0, 0)$. This result along with $w_S^* > w_L^* > 0$ gives us:

$$d_{AS}(0, 0) - d_{AS}(w_L^*, w_S^*) = (w_S^* - w_L^*) + r_L^e(w_L^*, w_S^*) - r_L^e(0, 0) > 0.$$

This gives us the result that in the presence of countervailing power, there is a jump downwards in the additional value of multistop shopping. Q.E.D.

Proof of proposition 2.4

Assume $v_{AL} - r_{AL}^m > v_S - w_S^{**}$, and let $\widetilde{\widetilde{c}} = v_S - w_S^{**} - \left(v_{AL} - \widetilde{r}_{AL}\left(\widetilde{\widetilde{c}}\right)\right)$ with $\widetilde{r}_{AL}\left(\widetilde{\widetilde{c}}\right) = h\left(v_{AL} - \widetilde{\widetilde{c}} - \widetilde{r}_{AL}\left(\widetilde{\widetilde{c}}\right)\right)$ define a threshold on $\widetilde{c}$. For $\widetilde{c} \in \left(0, \widetilde{\widetilde{c}}\right)$, we get $v_{AL} - \widetilde{c} - \widetilde{r}_{AL}(\widetilde{c}) > v_S - w_S^{**}$, which means that the large retailer is not constrained on its total margin $\widetilde{r}_{AL}(\widetilde{c})$ in the case of refusal. $\widetilde{r}_{AL}(\widetilde{c})$ is written as $\widetilde{r}_{AL}\left(\widetilde{\widetilde{c}}\right) = h\left(v_{AL} - \widetilde{\widetilde{c}} - \widetilde{r}_{AL}\left(\widetilde{\widetilde{c}}\right)\right)$, which corresponds to the interior solution. Lemma 2.1 applies and $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} < 0$.

Let $w_L^{**,C}$, $w_S^{**,C}$ define the equilibrium wholesale prices for $\widetilde{c} \in \left(0, \widetilde{\widetilde{c}}\right)$, $w_L^{**,C}$ and $w_S^{**,C}$ solve the following first-order conditions:

$$\begin{aligned} (w_S - w_L)\left(1 + \frac{\partial r_L^e}{\partial w_L}\right) f\left(v_S - w_S - (v_L - w_L - r_L^e)\right) &= 0,\\ -(w_S - w_L)\left(1 - \frac{\partial r_L^e}{\partial w_S}\right) f\left(v_S - w_S - (v_L - w_L - r_L^e)\right) & \\ -w_L f\left(v_S - w_S\right) - \left(v_{AL} - w_L - (v_S - w_S)\right) f\left(v_S - w_S\right) + F\left(v_S - w_S\right) - \frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} &= 0.\end{aligned}$$

in which $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} = -F\left(v_S - w_S - (v_L - \widetilde{c} - \widetilde{r}_L)\right) < 0$. Straightforward computations show that $w_L^{**,C} = w_S^{**,C}$ and $w_L^{**,C} = w_S^{**,C} > w_L^{**} = w_S^{**}$ by concavity of the objective function as $\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S} < 0$.

Note, countervailing power only impacts the total demand (loss in demand $F(v_S - w_S^{**}) - F(v_S - w_S^{**,C})$) while the demand of multistop shoppers does not change as wholesale prices are still equal at the equilibrium $w_L^{**,C} = w_S^{**,C}$ (see the expression of the demand of multistop shoppers which is given by $F\left(v_S - w_S - (v_L - w_L - r_L^e)\right) = F\left(v_S - (v_L - r_L^e)\right)$ with

$$r_L^e = -h\left(v_S - w_S - (v_L - w_L - r_L^e)\right) = -h\left(v_S - (v_L - r_L^e)\right)). \qquad \text{Q.E.D.}$$

An example: uniform shopping costs

$(v_A > v_S > v_L > 0)$

To illustrate our results, we suppose that shopping cost is uniformly distributed: $F(s) = s$. The monopoly profit on the good A is $r_A(v_A - r_A)$, which results in retail margin $r_A^m = \frac{v_A}{2}$ and profits $\pi_A^m = \frac{v_A^2}{4}$. Thus, as long as $v_A - r_A^m \geq v_S$ (Assumption 1), which corresponds to $\mathbf{v}_A > \mathbf{2v}_S$, L's retail margins are given by:

$$r_{AL}^e = \frac{v_{AL} - w_L}{2} \text{ and } r_L^e = -\frac{v_S - w_S - (v_L - w_L)}{2}.$$

In this way, L obtains:

$$\pi_{AL} - F_L = \frac{(v_{AL} - w_L)^2}{4} + \frac{(v_S - w_S - (v_L - w_L))^2}{4} - F_L.$$

Without countervailing power, the supplier sets:

$$w_S = w_L = 0 \text{ and } F_L = \pi_{AL} - \pi_A^m = \frac{v_{AL}^2}{4} + \frac{(v_S - v_L)^2}{4} - \frac{v_A^2}{4}.$$

With countervailing power, the outside option of the large retailer is given by (instead of π_A^m):

$$\widetilde{\pi}_{AL} = \frac{(v_{AL} - \widetilde{c})^2}{4} + \frac{(v_S - w_S - (v_L - \widetilde{c}))^2}{4},$$

after replacing retail margins, $\widetilde{r}_{AL} = \frac{v_{AL} - \widetilde{c}}{2}$ and $\widetilde{r}_L = -\frac{v_S - w_S - (v_L - \widetilde{c})}{2}$. The participation constraint of the large retailer becomes:

$$\pi_{AL} - F_L \geq \widetilde{\pi}_{AL}.$$

Solving the first-order conditions of the supplier, we obtain:

$$w_S^* = 2w_L^* \text{ and } w_L^* = \frac{v_S - (v_L - \widetilde{c})}{3}.$$

The supplier pays slotting fees for $w_L^* > \widetilde{c}$ which corresponds to $\widetilde{c} < \frac{v_S - v_L}{2}$ (when $v_L < \frac{v_S}{3}$, we obtain slotting fees for any $\widetilde{c} < v_L$).

When instead $2v_S > v_A$, L maintains the subsidy r_L^e but may charge only $r_{AL} = v_{AL} - w_L - (v_S - w_S)$ to one-stop shoppers if $v_{AL} - w_L - r_{AL}^e < v_S - w_S$ with $r_{AL}^e = \frac{v_{AL} - w_L}{2}$.

If $v_{AL} > 2v_S$, which corresponds to $v_{AL} - w_L - r_{AL}^e > v_S - w_S$ as long as $w_L < w_S$, the large retailer is not constrained in its total retail margin along the equilibrium path. Without countervailing power, the results do not change: $w_S = w_L = 0$ and $F_L = \pi_{AL} - \pi_A^m$. With countervailing power, the results may change if $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} < v_S - w_S$ with $\widetilde{r}_{AL} = \frac{v_{AL} - \widetilde{c}}{2}$. If $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} < v_S - w_S$, L should charge $r_{AL} = v_{AL} - \widetilde{c} - (v_S - w_S)$ to attract one-stop shoppers (in the case of refusal); its outside option becomes:

$$\widetilde{\pi}_{AL} = [v_{AL} - \widetilde{c} - (v_S - w_S)](v_S - w_S) + \frac{(v_S - w_S - (v_L - \widetilde{c}))^2}{4}$$

instead of $\frac{(v_{AL} - \widetilde{c})^2}{4} + \frac{(v_S - w_S - (v_L - \widetilde{c}))^2}{4}$.

First, note that for $\widetilde{c} = 0$, $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} = \frac{v_{AL}}{2} > v_S - w_S$ for any $w_S \geq 0$ because $v_{AL} > 2v_S$. The result is that, in $\widetilde{c} = 0$, equilibrium wholesale prices are given by:

$$w_S^* = 2w_L^* \text{ and } w_L^* = \frac{v_S - (v_L - \widetilde{c})}{3} \text{ (from the above case).}$$

In $\widetilde{c} = v_L$, $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} = \frac{v_A}{2} > v_S - w_S$ for $w_S > v_S - \frac{v_A}{2} > 0$. Consequently, for $w_S = 0$, the large retailer is constrained in its total retail margin, off-equilibrium (in the case of refusal). Then, assume that $w_S = w_S^* = \frac{2}{3}[v_S - (v_L - \widetilde{c})]$ (the solution from the above case), we can check that $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} > v_S - w_S^*$ as long as $v_A > \frac{2}{3}v_S$, which is true by assumption as $v_A > v_S$ (the inequality $v_A > \frac{2}{3}v_S$ is obtained for $\widetilde{c} = v_L$). The result is that $w_S^* = \frac{2}{3}[v_S - (v_L - \widetilde{c})]$ is a local solution. Then, we study the conditions under which this local solution is a global solution too. Off-equilibrium, considering $\left.\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}\right|_{w_S=0}$ in the constrained case, we have:

$$\left.\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}\right|_{w_S=0} = -v_A - \frac{1}{2}(v_L - \widetilde{c}) + \frac{3}{2}v_S.$$

We can check that this derivative is negative for any $\widetilde{c} < v_L$ if $v_A > \frac{3}{2}v_S$. The result is that we obtain $\left.\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}\right|_{w_S=0} < 0$ if $v_A > \frac{3}{2}v_S$, $\left.\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}\right|_{w_S=0} < 0$, for any $\widetilde{c} < v_L$, and $w_S^* = \frac{2}{3}\left[v_S - (v_L - \widetilde{c})\right]$ is a global solution (no change from the above case). For $v_A < \frac{3}{2}v_S$, $\left.\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}\right|_{w_S=0}$ becomes positive when $\widetilde{c}$ is very large. Two local solutions should be considered:

$$w_S = w_L = 0 \text{ and } w_S^* = 2w_L^* \text{ with } w_L^* = \frac{v_S - (v_L - \widetilde{c})}{3}.$$

A sufficient condition is to compare the profits of the supplier for $\widetilde{c} = v_L$. Calculations show that when $\frac{3v_S}{2} > v_A > \frac{\sqrt{2}}{\sqrt{3}}\left(\sqrt{6}-1\right)v_S$, $w_S^* = 2w_L^*$ with $w_L^* = \frac{v_S - \left(v_L - \widetilde{c}\right)}{3}$ is a global solution for any $\widetilde{c} < v_L$. Lastly, if $v_S < v_A < \frac{\sqrt{2}}{\sqrt{3}}\left(\sqrt{6}-1\right)v_S$, $w_S = w_L = 0$ becomes a global solution when $\widetilde{c}$ is very large. Comparing the profits of the supplier in the two local solutions, we find that, for $\widetilde{c} > 3v_A + v_L - 4v_S + \sqrt{6}\,(v_A - v_S)$, $w_S = w_L = 0$ is a global solution.

To sum up,

if $v_A > \frac{\sqrt{2}}{\sqrt{3}}\left(\sqrt{6}-1\right)v_S$, $w_S^* = 2w_L^*$ with $w_L^* = \frac{v_S - \left(v_L - \widetilde{c}\right)}{3}$;

if $v_A < \frac{\sqrt{2}}{\sqrt{3}}\left(\sqrt{6}-1\right)v_S$, we obtain $w_S^* = 2w_L^*$ with $w_L^* = \frac{v_S - \left(v_L - \widetilde{c}\right)}{3}$ when $0 < \widetilde{c} < 3v_A + v_L - 4v_S + \sqrt{6}\,(v_A - v_S)$, and, $w_S = w_L = 0$ when $\widetilde{c} > 3v_A + v_L - 4v_S + \sqrt{6}\,(v_A - v_S)$.

As long as the comparative advantage of the large retailer is large enough ($v_A > \frac{\sqrt{2}}{\sqrt{3}}\left(\sqrt{6}-1\right)v_S$), any countervailing power of the large retailer leads to higher wholesale prices for any $\widetilde{c} < v_L$. When the comparative advantage is smaller, only large enough countervailing power ($\widetilde{c} < 3v_A + v_L - 4v_S + \sqrt{6}\,(v_A - v_S)$) leads to higher wholesale prices; by contrast, small countervailing power ($\widetilde{c} > 3v_A + v_L - 4v_S + \sqrt{6}\,(v_A - v_S)$) does not change the equilibrium wholesale prices: $w_S = w_L = 0$. Note, however that fixed fees change as $\widetilde{c}$ varies.

If $v_{AL} < 2v_S$, the constraint on the total retail margin may apply along the equilibrium path and off-equilibrium (in the case of countervailing power). Without countervailing power, the participation constraint of the large retailer is written as $\pi_{AL} - F_L \geq \pi_A^m$ with:

$$\pi_{AL} = \left[v_{AL} - w_L - (v_S - w_S)\right](v_S - w_S) + \frac{\left(v_S - w_S - (v_L - w_L)\right)^2}{4},$$

as the large retailer is constrained on its total retail margin ($r_{AL} = v_{AL} - w_L - (v_S - w_S)$ to attract one-stop shoppers). The optimization problem of the supplier leads to:

$$w_S^{**} = w_L^{**} = v_S - \frac{v_{AL}}{2}.$$

Introducing countervailing power does not change the constraint on the total retail margin along the equilibrium path. Off-equilibrium, the constraint on the total retail margin will depend on $\widetilde{c}$: it is binding if $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} < v_S - w_S$ or it is not binding if $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} \geq v_S - w_S$, with $\widetilde{r}_{AL} = \frac{v_{AL} - \widetilde{c}}{2}$.

Note, $v_{AL} - \widetilde{c} - \widetilde{r}_{AL} \geq v_S - w_S^{**}$ when $\widetilde{c}$ is small, and in particular for $\widetilde{c} = 0$ $\left(\widetilde{c} \leq \frac{v_A - v_L}{2}\right)$; the result is that the large retailer is not constrained on its total retail margin in the case of refusal and $\left.\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}\right|_{w_S = w_S^{**}} = -\frac{v_S - w_S^{**} - \left(v_L - \widetilde{c}\right)}{2} < 0$ (see lemma 1). By concavity of the objective function, we find that wholesale prices are higher when countervailing power is introduced as we have shown in the main text for $\widetilde{c}$ which is close to zero. Let w_S^{***} and w_L^{***} define equilibrium wholesale prices in the case of countervailing power, we find that

$$w_S^{***} = w_L^{***} = v_S - \frac{2}{5} v_{AL} - \frac{1}{5}\left(v_L - \widetilde{c}\right) > w_S^{**} = w_L^{**} = v_S - \frac{v_{AL}}{2} \qquad \text{if } \widetilde{c} \text{ is close to zero.}$$

If $\widetilde{c}$ is larger, two regimes should be considered:

$$\begin{aligned} \text{regime 1:} \quad & w_S^{***} = w_L^{***} = v_S - \frac{2}{5} v_{AL} - \frac{1}{5}\left(v_L - \widetilde{c}\right) > w_S^{**} = w_L^{**}, \\ & \text{(see previously) and,} \\ \text{regime 2:} \quad & w_S^{***} = w_L^{***} = v_S - \left(v_L + \widetilde{c}\right) < w_S^{**} = w_L^{**}. \end{aligned}$$

The second regime is obtained by considering that L is constrained along the equilibrium path and off-equilibrium ($v_{AL} - \widetilde{c} - \widetilde{r}_{AL} < v_S - w_S$, with $\widetilde{r}_{AL} = \frac{v_{AL} - \widetilde{c}}{2}$). In this regime, $\left.\frac{\partial \widetilde{\pi}_{AL}}{\partial w_S}\right|_{w_S = w_S^{**}} > 0$ with uniform shopping cost, which leads to lower wholesale prices in the case of countervailing power. The threshold value in $\widetilde{c}$ is obtained by comparing the maximized profits of the supplier in the two regimes which are

$$\begin{aligned} \text{regime 1:} \quad & w_L[(v_S - w_S) - (v_S - w_S - (v_L - w_L - r_L^e))] + w_S(v_S - w_S - (v_L - w_L \\ & - r_L^e)) + \pi_{AL} - \left[\widetilde{r}_{AL}\left(v_{AL} - \widetilde{c} - \widetilde{r}_{AL}\right) - \widetilde{r}_L\left(v_S - w_S - (v_L - w_L - r_L^e)\right)\right] \\ \text{regime 2:} \quad & w_L\left[(v_S - w_S) - (v_S - w_S - (v_L - w_L - r_L^e))\right] + w_S(v_S - w_S - (v_L - \\ & w_L - r_L^e)) + \pi_{AL} - \left[(v_{AL} - \widetilde{c} - (v_S - w_S))(v_S - w_S) - \widetilde{r}_L(v_S - w_S - (\right. \\ & \left. v_L - w_L - r_L^e))\right] \end{aligned}$$

with $\pi_{AL} = \left[v_{AL} - w_L - (v_S - w_S)\right](v_S - w_S) + \frac{(v_S - w_S - (v_L - w_L))^2}{4}$ and replacing $w_S = w_L = v_S - \frac{2}{5} v_{AL} - \frac{1}{5}\left(v_L - \widetilde{c}\right)$ in regime 1 and $w_S = w_L = v_S - \left(v_L + \widetilde{c}\right)$ in regime 2.

Calculations show that regime 1 leads to higher profits if $\widetilde{c} \leq \frac{v_A - v_L}{3}$ and the supplier is better off in regime 2 if $\widetilde{c} > \frac{v_A - v_L}{3}$. To sum up, introducing countervailing power leads to higher wholesale prices if $\widetilde{c} \leq \frac{v_A - v_L}{3}$ and the opposite occurs if $\widetilde{c} > \frac{v_A - v_L}{3}$:

$$\begin{aligned}
w_S^{***} &= w_L^{***} = v_S - \frac{2}{5} v_{AL} - \frac{1}{5}\left(v_L - \widetilde{c}\right) > w_S^{**} = w_L^{**} = v_S - \frac{v_{AL}}{2} \\
\text{if } \widetilde{c} &\leq \frac{v_A - v_L}{3}, \\
w_S^{***} &= w_L^{***} = v_S - \left(v_L + \widetilde{c}\right) < w_S^{**} = w_L^{**} = v_S - \frac{v_{AL}}{2} \\
\text{if } \widetilde{c} &> \frac{v_A - v_L}{3}. \qquad\qquad \text{Q.E.D.}
\end{aligned}$$

Alternative modeling of the countervailing power of the large retailer

In this Appendix, we assume, before stage one, that there is a random take-it-or-leave-it proposal between the supplier and the large retailer. Bargaining power is modeled as the probability of making the offer (w_L, F_L): the large retailer proposes with probability γ, while the supplier proposes with probability $(1 - \gamma)$. That is, if $\gamma = 1$, the large retailer has full bargaining power, while if $\gamma = 0$ the supplier has full bargaining power. Simultaneously, the supplier makes offers to the small retailers. We still assume that contracts to the small retailers cannot be conditional on any action chosen later in the game, such as acceptance or rejection decision of the offers in the negotiation between the supplier and the large retailer. The second stage is unchanged.

In the following, we assume that $v_{AL} - r_{AL}^m \geq v_S$.

With probability $(1 - \gamma)$, the supplier proposes (w_L, F_L) to the large retailer and, simultaneously, w_S to the small retailers. The large retailer accepts or rejects the offer of the supplier. The solution is given as in the benchmark case (without countervailing power): $w_L = w_S = 0$ and $F_L = \pi_{AL}\left(0, 0\right) - \pi_A^m$.

With probability γ, the large retailer proposes (w_L, F_L) to the supplier and, simultaneously, the supplier proposes w_S to the small retailers. The supplier accepts or rejects the offer of the large retailer.

The large retailer chooses (w_L, F_L) to maximize its profits given as $\pi_{AL}(r_{AL}^e, r_L^e, w_L, w_S) - F_L$ with F_L satisfying:

$$\begin{aligned}
&w_L\left[F\left(v_{AL} - w_L - r_{AL}^e\right) - F\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right)\right] \\
&\qquad\qquad + w_S F\left(v_S - w_S - \left(v_L - w_L - r_L^e\right)\right) + F_L \geq w_S F\left(v_S - w_S\right).
\end{aligned}$$

The participation constraint of the supplier holds with equality, which leads to:

$$\max_{w_L} \; w_L \left[F\left(v_{AL} - w_L - r^e_{AL}\right) - F\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right)\right] \\ + w_S F\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right) + \pi_{AL}\left(r^e_{AL}, r^e_L, w_L, w_S\right) - w_S F\left(v_S - w_S\right).$$

Let $w_L^{BR}(w_S)$ denote the best response of the large retailer for which w_S is given; $w_L^{BR}(w_S)$ maximizes the industry surplus and satisfies the following first-order condition:

$$\left(w_S - w_L\right)\left(1 + \frac{\partial r^e_L}{\partial w_L}\right) f\left(v_S - w_S - \left(v_L - w_L - r^e_L\right)\right) \\ - w_L\left(1 + \frac{\partial r^e_{AL}}{\partial w_L}\right) f\left(v_{AL} - w_L - r^e_{AL}\right) = 0.$$

Let $w_S^m = h\left(v_S - w_S^m\right)$ denote the monopoly margin of the supplier yielding as profits $w_S^m F\left(v_S - w_S^m\right)$. The supplier chooses w_S^m. Consequently, with probability γ, the supplier chooses w_S^m and the large retailer chooses $w_L^{BR}(w_S)$, which results in the following fixed fee:

$$F_L = w_S^m F\left(v_S - w_S^m\right) \\ -\Big[w_L^{BR}\left(w_S^m\right)\Big[F\Big(v_{AL} - w_L^{BR}\left(w_S^m\right) - r^e_{AL}\Big) - F\Big(v_S - w_S^m - \Big(v_L - w_L^{BR}\left(w_S^m\right) - r^e_L\Big)\Big)\Big] \\ + w_S^m F\Big(v_S - w_S^m - \Big(v_L - w_L^{BR}\left(w_S^m\right) - r^e_L\Big)\Big)\Big].$$

Q.E.D.

Contributions to chapter 2 of the dissertation

I, Shiva Shekhar, hereby declare that chapter 2 "On the Countervailing Power of Large Retailers" was written in collaboration with Stephane Caprice.

I contributed to:

- drafting and revising the paper
- analysing the result
- developing the research idea

Stéphane CAPRICE

Signature Co-author I (Dr. Stephane Caprice): ______________________

Chapter 3

Uncertain Merger Synergies, Passive Partial Ownership and Merger Control

Co-authored by Christian Wey.

I contributed to:

- developing the research idea.
- drafting and revising.
- analyzing the results.

3.1 Introduction

Passive partial ownerships (in short: PPOs), also called non-controlling minority shareholdings,[1] create a financial interest of the acquirer firm in the target firm which makes the acquirer a softer competitor and therefore, leads to (upward) price pressure (O'Brien and Salop, 2000). PPOs are often not covered by merger regulations, which require the merging parties to notify the competition authority in advance in order to get approval.[2] Such a laissez-faire approach towards PPOs has sparked a debate whether merger regulations should be changed to better take account of anticompetitive effects of PPOs (see OECD, 2008; EC 2013). The common view on (horizontal) PPOs is that they tend to reduce competitive intensity without creating efficiencies. Put simply, the main practical question is then to determine how large the anticompetitive effects are and whether they justify the administrative costs associated with an ex ante control system as under standard merger control regulations.[3] Interestingly, an efficiency defense and a trade-off analysis in the spirit of Williamson (1968) is not considered as a relevant option in the reports on minority shareholdings recently published by competition authorities.[4] For instance, the EU Commission staff working paper (EC, 2013) states: *"Structural links mainly create a financial interest in the performance of other firms in the market, typically without much scope for rationalization or avoiding cost duplication. Therefore, synergies seem to be limited for horizontal structural links."* Similar reasoning is expressed in OFT (2010, p. 57): *"Overall, the absence of obvious sources of efficiencies suggests that minority cross-shareholdings may be more likely than full mergers to be motivated by anti-competitive objectives."*

In this paper, we qualify this rather gloomy view on PPOs between firms competing horizontally in the same relevant market. Our main assumption is that the acquirer of the minority share is enabled to get information about the realizable synergies *before* merging their businesses. The fact that PPOs allow for better information sharing was also formulated in several policy reports but only with a focus on its anticompetitive effects. Basically, the argument is that information sharing is

[1] Inter-firm ownerships are also called structural links (EC, 2013).

[2] In the EU, PPOs do not fall under the Merger Regulation, a state of affairs currently under scrutiny (see EC, 2013, 2014). The European Commission in its recent white paper on merger control (EC 2014) clearly expresses the view that PPOs should also become part of merger control.

[3] To close the enforcement gap, EC (2013) outlines different regulatory approaches towards PPOs ranging from a self-assessment approach to a notification system in line with standard merger control practice complemented by a safeharbor rule.

[4] Gilo (2000, p. 43) points out that a passive ownership may lead to efficiencies in the allocation of production among firms, whenever a less efficient firms obtains an ownership in a more efficient firm. For decreasing economies of scale, Farrell and Shapiro (1990a,b) showed that a more concentrated ownership structure must create a synergy (i.e., a more efficient technology) in order to keep the price from rising.

used to reduce competition, for instance, because it enables a better coordination of collusive conduct.[5] The possibility that the minority shareholder may get new information about the target firm which he or she can match with the information about its own business to get a better understanding of the potential synergies realizable in case of a merger, has not been examined so far. This apparent deficiency is even more surprising if one takes account of the related finance literature on PPOs (often referred to as toeholds). For instance, Povel and Sertsios (2014) argue that toeholds are an instrument to improve information about possible synergies with the target firm.[6] Thereby, it is assumed that a sequential acquisition strategy (which starts with a minority shareholding) can dominate a single-transaction acquisition strategy (direct merger), whenever there is uncertainty about the merger synergy. Referring to Folta and Miller (2002), Xu, Zhou, and Phan (2010, p. 167) emphasize the role of synergy learning through a toehold acquisition strategy: "The acquirer takes an initial equity stake, becomes an insider, gathers information on the partner and on the technology, and enjoys an information advantage over outsiders when subsequently buying out the majority partner." Using data on Chinese firms, they show that acquirers indeed use a sequential acquisition to overcome the ex ante uncertainty about the profitability of a full takeover. They describe this strategy as a real options approach to addressing uncertainty. The toehold reduces costly-to-reverse investments in tandem with the unfolding availability of new information that resolves uncertainty. An incremental approach may thus be advisable for the acquirer to gather information about the target firm before making further commitments. Similarly, Barclay and Holderness (1991) argue that a minority share makes the acquirer an "insider" in the target firm's business which allows the acquirer to gain new information about the target firm through monitoring and learning activities performed on a routine basis.[7]

[5]The Commission states in EC (2013, Annex I, p.11, para. 47): "The acquisition of a structural link may enhance transparency as it typically offers the acquiring firm a privileged view on the commercial activities of the target. According to OECD (2008), even 'passive minority shareholders may have access to information that an independent competitor would not have, such as plans to expand, to merge with or to acquire other firms, plans to enter into major new investments; plans to expand production or to enter or expand into new markets'." Interestingly, the focus is almost exclusively on strategic decisions which the acquirer becomes informed about, while the simple fact that the acquirer also becomes better informed about the targets technology and organization is not considered any further.

[6]Povel and Sertsios (2014) propose a model of competitive bidding and show that a toehold (which allows to learn the merger synergy in advance) increases the chance of winning the takeover auction. Using data on companies' financials they show that "acquirers are more likely to have owned a toehold if the target is opaque (hard to analyze)" (Povel and Sertsios, 2014, p. 217), which they take as indirect support for their assumption of "synergy learning" through toeholds.

[7]See also Barney (1988) for the view that the acquirer of a PPO will be better able to assess merger synergies between the two companies

We analyze the possibility of synergy learning through a PPO acquisition in a standard Cournot oligopoly setting in which the merger synergy is uncertain ex ante.[8] The acquirer firm can choose between a direct merger and a sequential takeover strategy. In the latter case, the acquirer firm first obtains a PPO in the target firm, then learns the synergy level and may propose a full takeover afterwards.[9] The sequential acquisition strategy allows to reduce the downside risk associated with a direct merger because in case no synergy is realized the ex post equilibrium profit of the merged entity is strictly smaller than the sum of the ex post profits of the PPO acquiring firm and the target firm.[10] If, however, the PPO acquiring firm learns about sufficiently large synergies, so that the merger is profitable, then the merger is also always approvable by an antitrust authority using a price test.[11] It then follows, that the sequential acquisition strategy is always more attractive than the direct merger from the involved firms' perspective. If the maximal possible merger synergy is sufficiently large, then the lowest possible PPO level is chosen which just guarantees the flow of information about the synergy, because a higher PPO level reduces the joint profit of the involved firms when there is no synergy. If the synergy level is relatively small, then a sequential takeover strategy can be used to outplay the AA. In that case, a PPO share above the minimal level, which just ensures synergy learning, is acquired to lower the minimal admissible synergy level to pass the decision screen of the AA using a price test ("sneaky takeover").[12] Thus, there is a fundamental tradeoff when considering benchmark regulations which either allow or block any PPO proposal.

We examine four different regulatory approaches towards PPOs: "only direct merger" ($R1$), "no PPO control" ($R2$), "forward looking price test" ($R3$), and "safe-harbor rule" ($R4$). Comparing the first two regimes, we make the above mentioned tradeoff explicit. A PPO is always blocked if the AA uses a price test to evaluate a PPO, because in the short run a PPO can only increase the market price. It follows that a merger can only occur directly ($R1$). The price test (which takes account of the synergy uncertainty) used to evaluate a direct merger is more restric-

[8]We assume a simple two point distribution where either no synergy is realized or a strictly positive synergy level is realized. Thus, the probability distribution of the synergy level and the strictly positive synergy level are the two primitives of our model which describe the fact that synergies are uncertain.

[9]To simplify our analysis, we assume that the synergy becomes public information when the PPO acquiring firm learns the merger synergy with the target firm. This allows us to abstract from issues of signalling, screening, and costly evidence gathering (see, Cosnita-Langlais and Tropeano, 2012, Banal-Estañol et al., 2010, and Lagerlöf and Heidhues, 2005, respectively).

[10]We assume that a PPO acquisition and a merger is not reversed (at least in the short run) when they turn out to be unprofitable.

[11]The price test is equivalent to a consumer surplus standard when the AA knows the synergy level for sure. Both standards diverge however, when the AA faces uncertainty about the synergy.

[12]The "sneaky takeover" incentive can be derived from Farrell and Shapiro (1990b) and was made explicit in Jovanovic and Wey (2014).

tive than the price test criterion used to evaluate a merger when the merger leads to synergies for sure. It then follows that the “no PPO control” regime ($R2$) leads to more mergers than under $R1$, where some of those additional mergers can be price-decreasing and others price-increasing (in expected terms), where the latter is a result of the sneaky takeover incentive. We consider two more regulatory approaches towards PPOs: a “forward looking price test” ($R3$) and a “safeharbor rule” ($R4$). In the former regime, the AA evaluates a PPO proposal by taking account of the subgame perfect equilibrium following the PPO acquisition.[13] We show that such a test eliminates all sequential takeovers which aim at outplaying the AA (i.e., all sneaky takeovers). The latter regime specifies a certain threshold value of the PPO shareholding in percentage terms below which a PPO is not restricted by the AA, while all larger shares have to be notified to the AA which then decides about them based on a standard price test (i.e., applies standard merger regulations). If the safeharbor rule is above but close to the minimal PPO level necessary to ensure synergy learning, then this rule also effectively eliminates all PPO proposals which would lead to higher prices in case of a subsequent merger (i.e., all sneaky takeovers). This follows from the insight that a PPO level above the minimal one is only chosen in the sneaky takeover instances. Finally, we evaluate our results from a consumer surplus and social welfare perspective. It is worth mentioning, that a price test applied to a direct merger is not the same as a consumers surplus test, whenever there is uncertainty about the synergy level. In those instances, the price test is more restrictive than the consumer surplus test. From this observation, we get that a regime which blocks PPO proposals ($R1$), tends to hurt consumer surplus because it blocks desirable sequential takeovers (which would be executed in $R2$). Evaluating the forward looking price test and the safeharbor rule from a consumer surplus perspective (which is also forward looking in case of a PPO acquisition), we get that the former test leads to type I errors (consumer surplus increasing PPO acquisitions are blocked) and the latter one to type II errors (consumer surplus decreasing PPO acquisitions go through uncontested). From a social welfare perspective, the stance on PPOs should be even more lenient, because any merger increases producer surplus in our model so that even the worst sneaky takeover can be socially desirable.

Our paper contributes to the IO literature dealing with PPOs and mergers in oligopolistic industries. The anticompetitive effects of PPOs and mergers are well documented within Cournot oligopoly frameworks (see Reynolds and Snapp, 1986; Bresnahan and Salop, 1986; Salant, Switzer, Reynolds, 1983).[14] Reitman (1994)

[13]We say that the AA uses a “price test” whenever the AA disregards the subgame perfect outcome following a PPO proposal; i.e., it always expects the market equilibrium given the proposed PPO and does not consider a subsequent merger and the possible realization of a merger synergy. In contrast, if the AA takes account of the subgame perfect equilibrium outcome following a PPO proposal, then we refer to it as a “forward looking price test.”

[14]Another strand deals with controlling partial ownerships, where the anticompetitive effects are often larger than under non-controlling shareholdings (e.g., Foros, Kind, and Shaffer, 2011).

shows that the joint profit of the PPO-acquiring firm and the target firm decline in the level of the PPO under Cournot competition.[15] Salant, Switzer, and Reynolds (1983) derived the 80%-market share rule for profitable mergers, basically saying that a bilateral merger is not profitable in a Cournot oligopoly when there is at least one outsider.[16] Farrell and Shapiro (1990a/b) have shown (in more general settings) that sufficiently large merger synergies are a necessary prerequisite for a merger to be not price-increasing. Based on merger results presented in Farrell and Shapiro (1990b), Jovanovic and Wey (2014) show that acquiring a PPO is a way to reduce the minimal necessary synergy level which ensures that the merger is not price increasing. Gosh and Morita (2015) is the first paper which considers the relation between a PPO and synergies between horizontally related firms.[17] They focus on an alliance of two firms where one firm acquires an equity stake in its alliance partner. The acquiring firm has an incentive to share its superior (tacit knowledge) with the partner firm only when it holds a minority share in the other firm. Thus, a PPO leads to the sharing of superior knowledge which can be interpreted as an "alliance synergy "that is realized without the need to merge. Because of Cournot competition, the PPO is not maximal but rather small to just ensure information sharing. The basic message has a similar flavor to ours as it also highlights a pro-competitive argument for allowing PPOs. In contrast to their assumption of alliance synergies, we consider uncertain merger synergies, where a PPO allows for synergy learning while the synergy is only realized after a merger. By considering sequential acquisitions, we also deal with the dynamics of merger control decisions. Here, we show that a myopic decision rule, which has shown to be dynamically optimal under some conditions (Nocke and Whinston, 2010), runs the risk of being outplayed through a sequential acquisition strategy in our setting.

We proceed in Section 2 with the presentation of the set-up of the model, where we also describe the four regimes mentioned above. In Section 3, we present the equilibrium analysis of our game under the benchmark regime R1 and R2. In section 4, we analyze the two regulatory approaches towards PPOs (R3 and R4). In Section 5, we analyze the implications for consumer and social welfare. Finally, Section 6, concludes.

Finally, Malueg (1992) and Gilo, Moshe, and Spiegel (2006) are works which deal with the effects of PPOs on the collusiveness of an industry.

[15] A PPO can become profitable when competition is more intense than under Cournot (Reitman, 1994).

[16] The 80%-rule is obtained when costs and demand are linear and all firms are symmetric.

[17] In case of shareholdings between vertically related firms, Gilo (2000) argues that efficiencies can be generated if they help to overcome frictions associated with incomplete contracts.

3.2 The Model

We consider three firms denoted by $i \in \{1, 2, 3\}$ supplying a homogeneous good and competing in quantities. The inverse demand is given by $P(Q) = 1 - Q$ with $Q := \sum_i q_i$, where q_i is firm i's output level. Initially, all firms have the same marginal costs which are constant and given by $c \in (0, 1)$. Firm i's profit is, therefore, given by

$$\pi_i = (P(Q) - c)q_i, \text{ for } i = 1, 2, 3, \tag{3.1}$$

which describes the case before a change of the ownership structure within the industry. We consider a possible two-firm merger, where firm 1 is the acquirer and firm 2 is the target firm. A merger may or may not lead to synergies s, which reduce marginal costs of the merged entity to $c - s$ with $s \in (0, c]$. Let $s = 0$ be the no synergy case, while $s > 0$ stands for cases where a synergy is realized. To rule out corner solutions, where the rival firm 3 is driven out of the market, we assume $s < 1 - c$.[18] Taken together, we assume $0 < s < \overline{s} := \min\{c, 1 - c\}$.

The acquirer has an a priori expectation about the probability that a merger synergy will be realized. Let β be the probability with which the synergy level $s > 0$ is realized and $1 - \beta$ be the counter probability that no synergy follows from a merger ($s = 0$). This distribution is common knowledge meaning that all firms and the AA have the same expectation about the possible merger synergies associated with a merger of firms 1 and 2. To rule out obvious cases, we suppose $0 < \beta < 1$, so that there is strict uncertainty with regard to the realizable merger synergy.

We denote by α the PPO firm 1 has in firm 2. The shareholding α gives firm 1 a claim of a share of α of firm 2's profit. The PPO is non-controlling so that firm 2 keeps the right to decide independently about its production output. Accordingly, we suppose that the shareholding is smaller than $1/2$, because a larger shareholding is necessarily interpreted as a controlling one and would then fall under merger control.[19] We assume that the acquirer of the PPO becomes an "insider" in the target firm which enables him or her to get information about the target firm to learn the merger synergy level.[20] This property implies that the shareholding must

[18] Below we show that the equilibrium quantity of firm 3 in case of a merger between firms 1 and 2 realizing a synergy s is strictly positive if $s < 1 - c$.

[19] OFT (2010, Table 1, p. 19) provides an overview of the rights of a shareholder with a percentage of voting shares below 50% of the voting shares (for instance, with regard to the right to request items be placed on the agenda of meetings). Shareholdings above 50% of the voting shares give the right to pass resolutions, so that a stake of more than 50% is generally interpreted as a controlling one.

[20] Povel and Sertsios (2014) assume that toeholds improve the assessment of possible synergies. They argue that it can give the owner the opportunity to interact with the target or its management in ways that are not available to outsider firms: "For example, a toeholder may have the right to nominate a director on the target's board, helping her get a better sense of the target's operations

be larger than a certain minimal value $\underline{\alpha} \in (0, 1/2)$.[21] Thus, any shareholding $\alpha \in [\underline{\alpha}, 1/2)$ is a PPO which allows the acquiring firm 1 to perfectly learn whether or not there will be a merger synergy of $s > 0$ before the execution of the merger.

In sum, the exogenous parameters of our model are given by the vector $(c, s, \beta, \underline{\alpha})$, where the feasible set of parameter constellations, Φ, is given by

$$\Phi := \{(c, s, \beta, \underline{\alpha}) \in \{(0, 1)^4 | s < \bar{s} := \min\{c, 1 - c\}, \underline{\alpha} < 1/2\}.$$

We consider two takeover strategies among which firm 1 can choose. First, the direct merger strategy (D) and second, the sequential takeover via a PPO acquisition (S). In the former case, firms 1 and 2 decide whether or not to merge directly in the first stage. In the latter case, firm 1 buys first a PPO share α of firm 2's assets, which allows firm 1 to perfectly learn the merger synergy. In a next step, firm 1 can decide whether or not to merge with firm 2.

We invoke three assumptions concerning PPO acquisitions and mergers. First, firm 1 only makes a proposal to acquire a certain PPO in firm 2 or to merge with firm 2 if this increases the joint profits of the firms.[22] Second, if a direct merger turns out to be not profitable because of low synergies it cannot be dissolved. Third, a PPO acquisition is also not reversed even if it reduces the joint profit level of the involved firms relative to their pre-merger profits. The second assumption follows from the fact that a merged firm is often not easily disintegrated.[23] The third assumption implies a real cost of the PPO option, because in our Cournot analysis the joint profit of firms 1 and 2 is smaller with a PPO than without such a shareholding.[24]

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and management. A toeholder may also cooperate with the target on the development of a product, or they may combine parts of their distribution networks. After cooperating for a while, the parties should find it easier to tell whether a full combination promises significant synergies, or whether the prospects are bad and a combination should not be attempted" (Povel and Sertsios 2014, p. 201).

[21]We simply assume a certain minimal PPO share above which the generation of the relevant information about the merger synergy is assured. It is reasonable, that the minimal value is above 5% (see OFT, 2010, p.19, for the rights conferred starting at the 5% threshold). However, this value can also be relatively large and the chance of information gathering may be increased with a larger share. For instance, Povel and Sertsios (2014) report that the average toehold in their sample is 27%, which is well above the 5% threshold which triggers SEC or FTC filings. With a larger share the acquirer may be better able to negotiate the right to nominate one or more directors who have direct access to the target's executives, which should increase the ability to learn the realizable merger synergy (see Povel and Sertsios, 2014, p. 217).

[22]In other words, a PPO-acquisition or a merger is treated as a cooperative joint decision of firms 1 and 2. This is, of course, a simplifying assumption which allows us to abstract from the exact takeover process and the price the owner or owners of firm 2 will get for their assets.

[23]This coincides with empirical findings that many mergers are often not profitable (see Gugler et al. 2003).

[24]If the minority share is disposed when the acquirer learns that there are no merger synergies, then our results stay valid if the minority share must be held for a sufficiently long time to enable learning of the merger synergy. Our results also remain valid under price competition (where a

We suppose an antitrust authority (AA) which decides about mergers and asset acquisitions. The AA uses a price test to reach a decision about an acquisition proposal.[25] It either approves a proposal (A) or rejects (R) it.[26] Thus, a merger is only allowed if the price level does not increase after the merger.[27] With regard to PPO control, we consider four regimes.

- *Regime R1 (only direct mergers):* The AA performs a short-run analysis, such that a PPO proposal is not allowed if it leads to a price increase. In our model, the AA never approves a PPO acquisition because it is, per se, always price increasing.[28] The AA is short-sighted because it does not take into account the possibility of synergy learning through PPO acquisition which may lead to desirable merger proposals in the future. Thus, under $R1$, firm 1 can effectively only decide between proposing a direct merger (D) or staying independent (N).
- *Regime R2 (no PPO control)*: There is no PPO control, so that any PPO acquisition is allowed. In addition to $R1$, firm 1 can also choose a sequential takeover strategy (S) under $R2$ by acquiring a PPO in firm 2.
- *Regime R3 (forward looking price test):* The AA takes a forward-looking stance and considers the possibility of synergy learning through a PPO acquisition which may result in desirable mergers in the future. A merger is desirable from the AA's point of view if it reduces the expected price in the future below the level observed before the PPO acquisition. Thus, under $R3$, firm 2 can propose a PPO acquisition to the AA which is then evaluated by the AA according to a forward looking price test.
- *Regime R4 (safeharbor rule):* Merger regulations specify a maximal level of the minority shareholding below which a PPO can be realized without any

PPO always increases the joint operating profit of the involved firms) if we assume additional sunk costs associated with a PPO acquisition.

[25]The price test mirrors perfectly a consumer surplus standard in a world without uncertainty. If there is uncertainty about the synergy level, then the price test is generally more restrictive than the decision rule implied by a consumer standard. We discuss this issue below.

[26]We do not consider the clearance of a merger conditional on remedies, as for instance, asset sales, which tend to increase the set of approvable mergers (Dertwinkel-Kalt and Wey, 2016).

[27]Our analysis focuses on unilateral effects (as opposed to coordinated effects) which arise as a result of a merger, "when competition between the products of the merging firms is eliminated, allowing the merged entity to unilaterally exercise market power, for instance, by profitably raising the price of one or both merging parties' products, thus harming consumers" (ICN, 2006, p. 11). When products are differentiated the Upward Pricing Pressure (UPP) test of Farrell and Shapiro (2010) has recently gained prominance which, incidentally, is closely related to the Price Pressure Index of O'Brien and Salop (2000).

[28]This mirrors also the main point of the literature on the anticompetitive effects of PPOs; i.e., a PPO reduces competition without creating efficiencies (see, for instance, the literature reviews in EC, 2003, and OFT, 2010).

interference by the AA. Above that threshold value, the PPO is evaluated by the AA according to a (short run) price test as under $R1$.

We analyze these regimes in a dynamic game depicted in Figure 3.1.

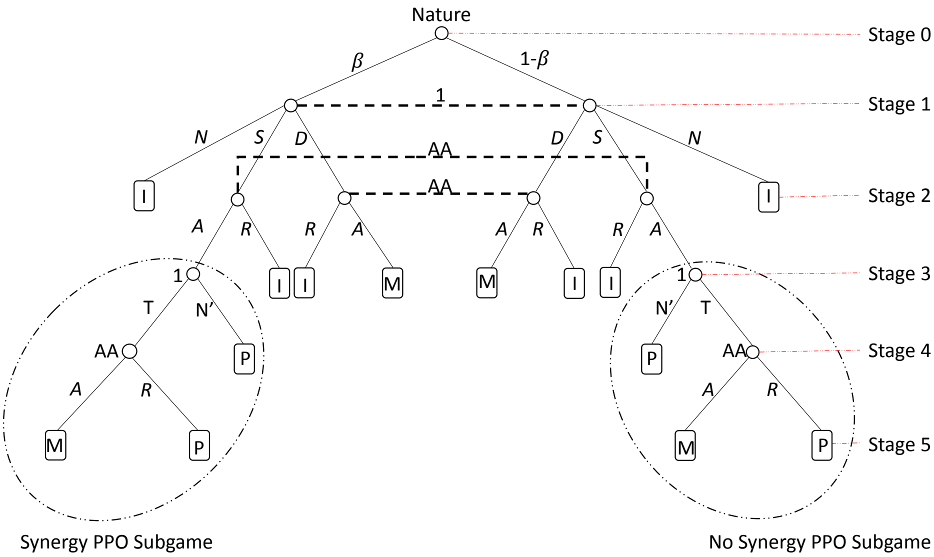

Figure 3.1: The game tree

The timing of the game is as follows. In the initial stage 0, nature determines the synergy level s of a merger between firms 1 and 2 which is either $s > 0$ (with probability β) or $s = 0$ (with probability $1 - \beta$). In the first stage, firm 1 decides about its takeover strategy (direct merger, D, or sequential takeover, S), while having the option to stay independent (N). When firm 1 makes this decision, it is uncertain about the precise level of the merger synergy (information sets are indicated by bold dashed lines in Figure 1). If firm 1 stays independent, then firms compete independently (case I) and the game ends.[29] If a direct merger (D) is proposed, then in the second stage the AA decides about it by either approving (A) the merger or rejecting (R) it.[30] If the merger is approved, then firms 1 and 2 merge and compete with the remaining firm 3 in Cournot fashion (Case M) after which the game ends. If the merger is rejected, then all three firms compete independently (case I) and the game ends. If firm 1 chooses S, it acquires a PPO of α in firm 2. In

[29]In Figure 1, terminal nodes are indicated by boxes labeled by I, M, or P, which stand for the Cournot games played when all firms remain independent, firms 1 and 2 merge, or firm 1 acquires a PPO in firm 2, respectively.

[30]Note that we can suppress the acceptance decision of firm 2, because we assumed that firm 1's decision to acquire a PPO in firm 2 or to merger with firm 2 is a cooperative decision of both firms. Accordingly, such a decision is only made if it is joint profit maximizing.

this case, the game proceeds differently under $R1$-$R4$. Under $R2$ and $R4$ (given the safeharbor rule applies), the PPO is implemented without any merger control and the synergy level of the merger becomes public information. Under regimes $R1$, $R3$, and $R4$ (if the safeharbor rule is surpassed), the AA decides in stage 2 about the PPO acquisition either on a short-run or a forward looking basis. If the PPO is not approved, then all three firms remain independent and they compete in quantities (case I) and the game ends. If the PPO can be implemented, then the true value of the merger synergy s becomes public information. In the third stage, firm 1 (now holding a PPO in firm 2) proposes a complete takeover (T) or not (N'). If it does not propose a takeover, then the three firms compete in Cournot-fashion (case P) and the game ends. If a merger is proposed, then the AA decides about it in the fourth stage. If the merger is approved, then the merged firm and the remaining competitor set their quantities (case M) and the game ends. If the merger is blocked, then the three firms compete in quantities (case P) and the game ends.

Figures 3.1 presents the game trees under regimes $R1$, $R3$ and $R4$, respectively. We get the game tree for regime $R2$ and $R4$ (given the safeharbor rule applies) by neglecting the decision node of the AA in stage 2, which is reached when firm 1 chooses a sequential takeover strategy (S). That is, under $R2$ and $R4$ (given the safeharbor rule applies), the decision node of firm 1 in stage 3 is directly reached when firm 1 chooses S in stage 1. Under all regimes, the game tree always ends with a Cournot competition stage with I indicating the independent firms case, M denoting the merger case and P standing for the partial ownership case. Notice, that the AA is uncertain about the possible synergy level in stage 2 while it has complete information about the synergy level when it decides later in stage 4 about a merger. A PPO acquisition, therefore, informs not only the firms but also the AA about the merger synergy level. Thus, all uncertainty is removed after the PPO acquisition, which allows us to abstract from the difficult question how information about the merger synergy is credibly transmitted to the AA. Consequently, all stages following an approved PPO acquisition constitute a subgame which are encircled by the dash-dotted lines in Figure 3.1. The subgame reached when there are synergies ($s > 0$) is labeled as the “synergy PPO subgame” and the other one (reached when there are no synergies) as the “no synergy PPO subgame.” We solve for the subgame perfect Bayesian Nash equilibrium by working backwards.

Cases\Eq. Values	Price	Joint Profit Firms 1+2	Profit Firm 3
Case I	$p^I = \frac{1+3c}{4}$	$2\pi^I = 2\left(\frac{1-c}{4}\right)^2$	$\pi^I = \left(\frac{1-c}{4}\right)^2$
Case P	$p^P = \frac{1+(3-\alpha)c}{4-\alpha}$	$\sum_{i=1}^{2} \pi_i^P = \left(\frac{1-c}{4-\alpha}\right)^2 (2-\alpha)$	$\pi_3^P = \left(\frac{1-c}{4-\alpha}\right)^2$
Case M	$p^M = \frac{1+2c-s}{3}$	$\pi_1^M = \frac{(1-c+2s)^2}{9}$	$\pi_3^M = \frac{(1-c-s)^2}{9}$

Table 3.1: *Equilibrium values of cases I, P, and M*

3.3 Equilibrium Analysis

3.3.1 Outcomes of the Terminal Cournot Games

The games played under $R1$-$R4$ always end with a proper subgame of Cournot competition for ownership structures I, P, or M.[31] We refer to these three Cournot competition games as cases I, P, and M, respectively. The derivation of the equilibrium outcomes of those subgames is relegated to the Appendix. Table 1 summarizes the values we need for the following analysis.

In case of a merger, firm 1 takes over firm 2, so that the joint profit is given by π_1^M. In case P, firm 1 acquires a minority share in firm 2 and the joint profit is then given by $\pi_1^P + \pi_2^P$. When all firms are independent, then the joint pre-merger profit of firms 1 and 2 is given by two times the independent firm profit π^I, which is the same for all firms. It is noteworthy, that the price in case P is always larger than the pre-merger price; i.e., $p^P > p^I$ for any $\alpha > 0$. Similarly, the joint profit of firms 1 and 2 in case P is always smaller than the sum of both firms' pre-merger profits in case I. Moreover, the joint profit $\pi_1^P + \pi_2^P$ in case P is decreasing in α; i.e., a larger minority reduces the joint profit. This result mirrors the classical merger paradox result of Salant, Switzer, and Reynolds (1983). In fact, if we allow for a minority share close to unity, then $\lim_{\alpha \to 1}(\pi_1^P + \pi_2^P) = \pi_1^M(s = 0)$ holds, so that the full merger profit is realized when the synergy is absent. Of course, such a merger is never profitable because Salant, Switzer, and Reynolds' 80%-rule is not fulfilled on our model. Put another way, a merger can only be profitable if a synergy is realized. The larger the synergy level, the higher the joint profit of the merging firm, π_1^M. Of course, a PPO, per se, can never be profitable, but only if it opens the window for a merger with sufficiently high synergies.

[31] Case I can be reached when firm 1 neither proposes a direct merger or a PPO in stage 1 or the merger proposal is rejected by the AA in stage 2. In those instances the synergy level remains uncertain but this does not affect the analysis of the then resulting terminal Cournot game I.

3.3.2 PPO Subgames

As indicated in Figure 3.1 (see the encircled parts with dashed-dotted lines in Figure 3.1), we obtain two proper PPO subgames depending on whether or not a synergy exists. In the following we solve for the subgame perfect Nash equilibrium outcomes of these two subgames.

No Synergy PPO Subgame. If firm 1 acquires a partial ownership in firm 2 and learns that there are no merger synergies ($s = 0$), then the market equilibrium is given by case M if the merger is allowed and the market equilibrium is given by case P if the merger is not approved. Setting $s = 0$ in case M and comparing the price levels in both cases (see Table 3.1), it is easily checked that the price in the full merger case is always larger than in the partial ownership case. Thus a merger proposal is always blocked in this subgame and the outcome is case P.

Lemma 1. *Consider the no-synergy PPO subgame. The AA always rejects a merger proposal in this subgame and the equilibrium outcome is always case P.*

We turn next to the analysis of the PPO subgame when a synergy $s > 0$ is realized.

Synergy PPO Subgame. In this subgame, firm 1 has learnt that a synergy s, with $0 < s < \overline{s}$, will be realized with a direct merger.[32] We assume that this information becomes public information, so that the AA knows that the market outcome in case of a merger is given by case M. If no merger occurs, then the market outcome is given by case P. Comparing the price levels in both cases we get that the merger is approvable, with $p^M \leq p^P$, if

$$s \geq s_1 := \frac{(1-c)(1-\alpha)}{4-\alpha}. \tag{3.2}$$

We assumed that $\alpha \in [\underline{\alpha}, 1/2)$ with $0 < \underline{\alpha} < 1/2$. Note that $\partial s_1/\partial\alpha < 0$, so that a higher PPO level reduces the minimal synergy level that induces approval by the AA. Note also that $s_1(\alpha = 0) = (1-c)/4$ and $s_1(\alpha = 1/2) = (1-c)/7$. Thus, for all $s \leq (1-c)/7$ no feasible PPO exists to fulfill (3.2) and any merger proposal is rejected. Conversely, if $s \geq (1-c)/4$, then a merger proposal is accepted even with the lowest possible PPO level $\underline{\alpha}$. The feasible intermediate range is given by $(1-c)/7 < s < \min\{c, (1-c)/4\}$, where we considered the additional constraint $s < \overline{s}$. In that range, all PPO levels which fulfill (3.2) are approvable. We obtain the

[32]We assume that $\alpha \geq \underline{\alpha}$ holds always if the PPO subgame is reached. Otherwise, there would be no learning of the merger synergy level which would make this stage irrelevant. The decision problem of the merging firms and the AA would then be same as in stage 1 and stage 2, respectively, of the game under $R1$.

minimal approvable PPO level, α_1, from rearranging (3.2) which yields the condition

$$\alpha \geq \alpha_1 := \frac{1-c-4s}{1-c-s}. \tag{3.3}$$

Thus, for all $\alpha \in [\alpha^*, 1/2)$, with $\alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ the AA allows the merger, while for lower PPO levels, with $\alpha < \alpha_1$, the approvability condition of the AA is violated inducing the AA to reject the proposal. We summarize the AA's merger decision in the following lemma.

Lemma 2. *Consider the synergy PPO subgame. The AA's merger decision depends on the parameter values as follows. If $c \leq 1/8$, then there exists no synergy level s such that a PPO could induce an approval and the equilibrium outcome is case P. If $1/8 < c < 1$, then the following cases have to be distinguished.*

i) If $s \leq (1-c)/7$, then there exists no PPO to induce approvability and the outcome is case P.

ii) If $(1-c)/7 < s < \min\{c, (1-c)/4\}$, then for sufficiently large PPO levels $\alpha \in [\max\{\underline{\alpha}, \alpha_1\}, 1/2)$, the AA approves the merger and the outcome is case M. If the PPO level falls short of the critical value α_1, then the merger is rejected and the outcome is case P.

iii) If $s \geq (1-c)/4$, then any $\alpha \geq \underline{\alpha}$ induces an approval and the outcome is always case M.

If $c \leq 1/8$, then the synergy level is effectively constrained by the condition $s < c$, which implies $s < (1-c)/7$, so that no α exists to meet the approvability constraint (3.2). Parts i)-iii) of Lemma 2 are those cases, where feasible PPO levels exist to meet the approvability constraint (3.2). For that to happen, the synergy level must be sufficiently large. If the synergy level surpasses the value of $(1-c)/4$, then the merger is approved even at the minimal PPO level $\underline{\alpha}$, which could be close to zero. Part ii) mirrors sneaky takeovers (see Jovanovic and Wey, 2014). In the considered region, a merger is never approvable when $\alpha \to 0$; i.e., the pre-merger price level remains virtually the same in case P. A merger is now only approvable with a strictly positive PPO which can very well be larger than $\underline{\alpha}$ in order to meet the approvability condition (3.2). Intuitively, a higher level of the PPO increases the price level in case P which improves the chance that the merger becomes approvable in stage 4, because the merger is then evaluated relative to the price level in case P.

We turn now to the profitability condition for a merger proposal in stage 3 (firm 1 chooses T). The merger is jointly profitable if the joint profit of firms 1 and 2 in case of P is smaller than the merged firm's profit; i.e., $\pi_1^P + \pi_2^P \leq \pi_1^M$ (see Table 1).

Comparison of both profit levels gives that the merger is profitable if

$$s \geq s_2 := \frac{(1-c)(\alpha + 3\sqrt{2-\alpha} - 4)}{2(4-\alpha)}$$

and unprofitable otherwise.[33] Note that $\partial s_2/\partial\alpha < 0$. Moreover, $s_1 > s_2$ holds always for any $s < \overline{s}$ such that any approvable merger fulfills the profitability condition in the synergy PPO subgame.[34] We can therefore conclude, that case M is the equilibrium outcome in the synergy PPO subgame if (3.2) holds, while case P is the equilibrium outcome otherwise.

We next get to stages 1 and 2, where we distinguish between the regulatory regimes $R1$ and $R2$ (in the next section below, we turn to $R3$ and $R4$).

3.3.3 Only Direct Merger ($R1$)

Under $R1$, the AA never accepts a PPO acquisition, because it is always price increasing in the short run. Put another way, the AA disregards the possible learning of merger synergies which may lead to a merger in the future. A direct merger is evaluated under a price test taking properly care of the uncertainty of a merger synergy.[35] For that purpose, the AA relies on the a priori probability distribution of the synergy level, with which the expected price after a merger, Ep^M, can be calculated as

$$Ep^M := \beta p^M(s) + (1-\beta)p^M(s=0) = \beta\left(\frac{1+2c-s}{3}\right) + (1-\beta)\left(\frac{1+2c}{3}\right). \quad (3.4)$$

If the expected price is not larger than the price before the merger, p^I, then the AA accepts the merger, while it blocks it otherwise. Comparing both prices, we get that $Ep^M \leq p^I$ if

$$s \geq s_3 := \frac{1-c}{4\beta} \quad (3.5)$$

[33]Note that the second term in brackets in the numerator is strictly positive for all admissible values of α. Clearly, the denominator is also always positive, so that s_2 is always positive.

[34]The ordering $s_1 > s_2$ follows from noticing that the difference $s_1 - s_2$ is strictly increasing in α; i.e., $\partial(s_1 - s_2)/\partial\alpha = \left(2\sqrt{2-\alpha} - 1\right) / \left(2\sqrt{2-\alpha}\right) > 0$ for all admissible values of α. Evaluating the difference, $s_1 - s_2$, at the lowest possible value of α, we get $3\left(2-\sqrt{2}\right)(1-c)/8 > 0$.

[35]Merger regulations in the US and EU require to take merger efficiencies into account (e.g., Farrell and Shapiro, 2001).

holds. If $\beta \to 1$, then $s_3 = (1-c)/4$ which is equal to s_1, when evaluated at $\alpha = 0$.[36] If there is almost perfect certainty about the synergy level, then the decision rule of the AA is the same in the second stage as in the fourth stage with the only difference that firm 1 does not hold a PPO in firm 2. Note that (3.5) can only be fulfilled for $c \geq 1/5$, because of $s < \overline{s} := \min\{c, 1-c\}$. We can solve condition (3.5) for β and obtain the condition

$$\beta \geq \widetilde{\beta} := \frac{1-c}{4s}. \tag{3.6}$$

Clearly, the critical probability $\widetilde{\beta}$ above which a direct merger should be approved, decreases in s. Using $s < \overline{s} := \min\{c, 1-c\}$, we get that approvable mergers only exist, if β is not smaller than 1/4, which follows from evaluating $\widetilde{\beta}$ at $s = 1-c$, which ensures that in case M the outsider firm stays active in the market.[37]. With conditions (3.5) and (3.6) at hand, we can summarize the AA's merger control decision under uncertainty in the second stage as follows.

Lemma 3. *The AA's merger control decision in stage 2 (for a direct merger proposal) depends on the parameters as follows. If $c \leq 1/5$, then a direct merger is always rejected. If $1/5 < c < 1$, then for synergy levels $s \in [s_3, \overline{s})$ (or, equivalently, values of β with $\beta \geq \max\{\widetilde{\beta}, 1/4\}$) the direct merger is approvable. Otherwise, a merger proposal is rejected. Moreover, $\partial s_3/\partial\beta < 0$ for $\beta > 1/4$.*

Lemma 3 describes the parameter restrictions which have to be met in order to induce the AA to approve the direct merger proposal in the second stage. Quite intuitively, the synergy level s must be large enough according to (3.5) for this to happen. If the marginal cost in the pre-merger situation is already low ($c < 1/5$), then the scope for synergies is also restricted from above, which implies that an approvable merger never exists. When the pre-merger marginal costs are larger, $c \geq 1/5$, then a merger is approvable if the synergy level is large enough according to (3.5). This is more likely to happen, if the probability of a synergy is large enough.

[36] Of course, for any $\alpha > 0$, the AA's decision rule s_3 used in the second stage of the game is always more restrictive than the AA's price test criterion s_1 used in the synergy PPO subgame in the fourth stage of the game. Formally, $s_3 > s_1$ follows from noticing that the difference $s_3 - s_1 = (1-c)\left[4 - \alpha - 4\beta(1-\alpha)\right]/(4\beta(4-\alpha))$ is positive because the term in rectangular brackets is positive. This follows from noticing that this term decreases in β. Setting $\beta = 1$, this term becomes $3\alpha > 0$.

[37] This is an assumption to avoid case distinctions depending on whether firm 3 is active or not in case of a merger with synergies. If we drop this assumption, then a synergy larger than s_3 would induce exit of firm 3 which would increase the price, so that β and s are not monotonically negatively related anymore (i.e., it could be that a higher s must go hand in hand with a higher β to make the merger approvable). By constraining the maximal synergy level, we rule out predatory merger effects so that, ceteris paribus, a higher synergy level and higher synergy probability will never make the merger approval less likely (see Farrell and Shapiro, 2001, and Cabral, 2003, where the latter work considers entry deterring effects of merger synergies).

We next consider the profitability of a direct merger. Again, this assessment is based on the a priori distribution of the synergy level. A merger is profitable in expected terms if $E\pi_1^M - 2\pi^I \geq 0$, where

$$\begin{aligned} E\pi_1^M &= \beta\pi_1^M(s) + (1-\beta)\pi_1^M(s=0) \\ &= \beta\frac{(1-c+2s)^2}{9} + (1-\beta)\frac{(1-c)^2}{9} \end{aligned} \tag{3.7}$$

Using the profit levels stated in Table 1 and solving for the synergy level, we get the profitability condition

$$s \geq s_4 := \frac{(1-c)}{8\beta}\left(-4\beta + \sqrt{2}\sqrt{\beta\,(8\beta+1)}\right).$$

Clearly, s_4 is always positive. Comparing s_3 and s_4, we get that $s_3 > s_4$ holds always, so that any approvable merger is also profitable. The reverse does not hold, so that all mergers with maximal synergy $s_4 \leq s \leq s_3$ are profitable but not approvable. For the purpose of deriving the equilibrium of our game under the considered regimes, it suffices to state the following lemma.

Lemma 4. *An approvable direct merger is always profitable for the merging parties when compared with the pre-merger equilibrium profits (i.e., $E\pi_1^M \geq 2\pi^I$).*

Taking Lemmas 3 and 4 together, we can state the equilibrium outcome under $R1$ as follows.

Proposition 1. *The game has a unique equilibrium outcome under regime $R1$. If $s \in [s_3, \overline{s})$ (or, equivalently, $\beta \geq \max\{\widetilde{\beta}, 1/4\}$), then case M is the equilibrium outcome, while case I is the equilibrium outcome if $\beta < 1/4$ and/or $s < s_3$. Moreover, $s \geq s_3$ implies $c > 1/5$.*

We next turn to regime $R2$ which expands the action set of firm 1 in the first stage of the game by allowing for a PPO acquisition which is assumed to be never challenged by the AA.

3.3.4 No PPO Control ($R2$)

If there is no control of PPO acquisitions ($R2$), then firm 1 can always decide to acquire a PPO in the target firm to learn the merger synergy level in advance. The expected joint profit of firms 1 and 2 from a PPO acquisition (denoted by $E\pi^P$)

depends on the possible synergy level s and is given by

$$E\pi^P = \begin{cases} \beta\pi_1^M + (1-\beta)(\pi_1^P + \pi_2^P), & \text{if merger is approved in stage 4} \\ \pi_1^P + \pi_2^P, & \text{if merger is rejected in stage 4.} \end{cases}$$

Clearly, if the merger is not approved in the synergy PPO subgame, then a PPO can never be profitable in our model of Cournot competition. Thus, to derive the equilibrium under regime $R2$, we notice that a PPO can only be chosen if this induces the AA to approve the merger proposal in stage 4 of the game. That is, the approvability conditions as specified in Lemma 2 must hold. This follows from the fact that the sum of firm 1 and 2's profits in case I, $2\pi^I = 2((1-c)/4)^2$, is always larger than the joint profit of the firms in case P, $\pi_1^P + \pi_2^P = ((1-c)/(4-\alpha))^2(2-\alpha)$, because $\alpha > 0$. If, however, the merger is approved in the synergy PPO subgame, then a PPO can be optimal. Using the profit levels stated in Table 1, the expected joint profit if the merger is approved in the synergy PPO subgame, is given by

$$E\pi^P = \beta\frac{(1-c+2s)^2}{9} + (1-\beta)\left(\frac{1-c}{4-\alpha}\right)^2(2-\alpha). \tag{3.8}$$

Clearly, the joint profit in case of P decreases in the size of the PPO, so that the expected profit $E\pi^P$ from a PPO acquisition must also decrease in α, as the profit in case of a merger does not depend on the chosen PPO level. Note that this implies that the optimal PPO will always be equal to the minimal approvable level. From Lemma 2 we know that a merger will only be approved after a PPO acquisition if the PPO share fulfills

$$\alpha \geq \alpha^* := \max\{\underline{\alpha}, \alpha_1\}.$$

This constraint must be binding. If $\alpha_1 > \underline{\alpha}$, then $\partial\alpha^*/\partial s < 0$, so that a lower synergy level increases the minimal necessary PPO. With that, we have characterized the optimal α chosen in the first stage of the game if the PPO route is optimal for firm 1. Comparing next the expected profits of a sequential takeover strategy (S) with the expected profits of a direct merger (D) in stage 1, it is straightforward to see that the PPO route is always more profitable from firm 1 and firm 2's joint perspective. This follows from comparing the expected profits with a PPO proposal (3.8) and the expected profits from a direct merger proposal (3.7). If a large enough synergy $s > 0$ is realized (which occurs with probability β), then both profit levels are the same, because a full merger with synergies is realized in both scenarios. If, however, no synergy is realized ($s = 0$), then the joint profit is strictly larger under the PPO-strategy than under a direct merger strategy; i.e., $\pi_1^P + \pi_2^P > \pi_1^M(s=0)$ or $((1-c)/(4-\alpha))^2(2-\alpha) > (1-c)^2/9$ for all $\alpha \in [\underline{\alpha}, 1/2)$. Thus, comparing the sequential and the direct merger choices in stage 1 of the game, the former strategy is more attractive because the PPO allows to learn the synergy level perfectly while keeping the committed resources of firm 1 in firm 2 at a relatively low level. Put another way, the downside risk of realizing no synergy is reduced with a PPO which enables the acquirer firm to learn the merger synergy in advance. We summarize these results in the following lemma.

Lemma 5. *If a PPO is chosen under R2, then it is always at the minimal level which ensures synergy learning and approval of a merger proposal in the "synergy PPO subgame;" i.e.,* $\alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ *holds. A sequential takeover strategy (S) is always more profitable than a direct merger (D).*

We now turn to the question when is the PPO strategy better than the outcome under case I, which is reached if firm 1 abstains from proposing either a PPO or a direct merger in stage 1 of the game. Comparing the expected joint profits of firms 1 and 2, $E\pi^P$ (see (3.8)), with the joint profit in case I, $2\pi^I$, we first notice that the probability of a synergy, β, must be sufficiently large to make the PPO option more attractive. This follows from noticing that firm 1 and 2's joint profit decreases with a PPO, $\alpha > 0$, whenever the no-synergy PPO subgame is realized. At the other extreme, if it is almost sure that an approvable synergy will be realized (according to Lemma 2), then the expected profit $E\pi^P$ from the sequential takeover strategy must be larger than the joint profit in case I. If the merger is approvable in stage 4, then the profitability constraint is always satisfied as we showed above. As $E\pi^P$ increases linearly in β, there exists a unique threshold value $\beta^* \in (0, 1)$ such that for all $\beta \geq \beta^*$ the sequential takeover strategy yields highest expected profits. We can characterize this critical value as follows. Note first that the condition $E\pi^P \geq 2\pi^I$ can be written as

$$\beta\pi_1^M + (1-\beta)(\pi_1^P + \pi_2^P) \geq 2\pi^I,$$

which yields the following condition

$$\beta \geq \beta^*(\alpha) := \frac{2\pi^I - (\pi_1^P + \pi_2^P)}{\pi_1^M - (\pi_1^P + \pi_2^P)}, \tag{3.9}$$

where $\beta^* \in (0, 1)$ follows from $\pi_1^M > 2\pi^I > (\pi_1^P + \pi_2^P) > 0$. It is easily checked that $\partial\beta^*/\partial s < 0$ and $\partial\beta^*/\partial\alpha > 0$, where the former derivative says that a higher synergy level makes it, *ceteris paribus*, more likely that the sequential takeover strategy is optimal, while for α an inverse relationship holds. If a sequential takeover strategy is chosen, then $\alpha = \alpha^*$. According to Lemma 2, if $s \geq (1-c)/4$, then $\alpha^* = \underline{\alpha}$ induces an approval. Substituting $\underline{\alpha}$ into the joint profit levels $\pi_1^P + \pi_2^P$, we get

$$\beta^*(\underline{\alpha}) = \frac{2\left((1-c)/4\right)^2 - \frac{(2-\underline{\alpha})(1-c)^2}{(4-\underline{\alpha})^2}}{\frac{(1-c+2s)^2}{9} - \frac{(2-\underline{\alpha})(1-c)^2}{(4-\underline{\alpha})^2}}. \tag{3.10}$$

As long as $\underline{\alpha} > \alpha_1$, this critical value remains valid also for lower synergies with $(1-c)/7 < s < \min\{c, (1-c)/4\}$ (see part ii) of Lemma 2). If, however, in that region $\underline{\alpha} \leq \alpha_1$, then we have to evaluate β^* at $\alpha^* = \alpha_1$, which gives

$$\beta^*(\alpha_1) = \frac{(1-c-4s)^2}{24s\,(1-c+2s)}. \tag{3.11}$$

Note that $\partial\beta^*(\alpha_1)/\partial s < 0$. It is easily checked that $0 < \beta^*(\alpha_1) < 1$ for the considered parameter values. Thus, for all $(1-c)/7 < s < \min\{c, (1-c)/4\}$, there always exist large enough synergy probabilities, β, such that (3.11) holds. We summarize as follows.

Proposition 2. *Consider regime R2. The following cases have to be distinguished.*

i) If $s \leq (1-c)/7$, *then the outcome is case I.*

ii) If $(1-c)/7 < s < \min\{c, (1-c)/4\}$, *then a PPO* $\alpha = \alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ *is chosen if* $\beta \geq \beta^*(\alpha^*)$ *holds. Otherwise, case I is the outcome.*

iii) If $s \geq (1-c)/4$, *then the minimal PPO* $\underline{\alpha}$ *is chosen if* $\beta \geq \beta^*(\underline{\alpha})$ *holds. Otherwise, case I is the outcome.*

Moreover, $s > (1-c)/7$ *implies* $c > 1/8$.

Part ii) of Proposition 2 follows directly from Lemma 5 and the profitability condition (3.9).

3.3.5 Comparison of Regimes $R1$ and $R2$

Comparing Propositions 1 and 2 shows that a merger outcome is supported for a strictly larger set of parameters under $R2$ than under $R1$. In particular, if a direct merger is the outcome under $R2$, then the minimal PPO level $\underline{\alpha}$ is chosen under $R2$. Comparing $\widetilde{\beta}$ (approvable direct merger, see (3.6)) and $\beta^*(\alpha)$ (profitable PPO-acquisition, see (3.9)), we note that $\widetilde{\beta} > \beta^*(\alpha)$ holds always which follows from noticing that $\widetilde{\beta} \geq 1/4$ must hold for an approvable direct merger to exist (see Proposition 1). Note that $\beta^*(\alpha)$ is maximal at $\alpha = 1/2$. Comparing the respective values, we get

$$1/4 - \beta^*(1/2) = \frac{19c^2 + 392cs - 38c - 392s^2 - 392s + 19}{40c^2 + 1568cs - 80c - 1568s^2 - 1568s + 40} > 0,$$

where the numerator is strictly positive if $s > (1-c)\left(3\sqrt{26} - 14\right)/28$ and the denominator is strictly positive if $s > (1-c)\left(3\sqrt{2}\sqrt{3} - 7\right)/14$. Both conditions hold in the considered parameter regions of Proposition 1 and 2. This ordering is quite intuitive. We showed above that any approvable direct merger is also profitable. At the same time, a sequential takeover is always more profitable than a direct merger in expected terms (Lemma 5) and it induces acceptance of a subsequent merger proposal by the AA (Proposition 2). Thus, if case M is the equilibrium outcome under $R1$, then a minimal PPO $\underline{\alpha}$ is acquired in equilibrium under $R2$. The following proposition summarizes the comparison of regimes $R1$ and $R2$ for the entire range of considered parameter constellations.

Proposition 3. *The set of parameters under which a merger is the equilibrium outcome under $R2$ is strictly larger than under $R1$, where the former one is a strict subset of the latter one. The following cases emerge.*

i) If $s \leq (1-c)/7$, then the outcome is case I under $R1$ and $R2$.

ii) If $(1-c)/7 < s < \min\{c, (1-c)/4\}$, then case I is the outcome under $R1$, while under $R2$ a PPO $\alpha = \alpha^* := \max\{\underline{\alpha}, \alpha_1\}$ is chosen if $\beta \geq \beta^*(\alpha^*)$ holds. Otherwise, case I is the outcome.

iii) If $(1-c)/4 \leq s \leq s_3$, then case I is the outcome under $R1$ and also under $R2$, if $\beta < \widetilde{\beta}(\underline{\alpha})$. If $\beta \geq \widetilde{\beta}(\underline{\alpha})$, then the minimal PPO $\underline{\alpha}$ is chosen under $R2$.

iv) If $s_3 < s \leq \overline{s}$ (or, equivalently, $\beta \geq \max\{\widetilde{\beta}, 1/4\}$), case M is the equilibrium outcome under $R1$, while the minimal PPO $\underline{\alpha}$ is chosen under $R2$. In addition, the minimal PPO $\underline{\alpha}$ is also chosen under $R2$, whenever $\beta \geq \widetilde{\beta}(\underline{\alpha})$ holds, while otherwise case I follows under $R2$.

Note that $\lim_{\beta\to 1} s_3 = \lim_{\underline{\alpha}\to 0} s_1 = (1-c)/4$. Thus, a direct merger can never occur for $s < (1-c)/4$, while in that area a sequential takeover strategy is possible under $R2$. Thus, if for $\underline{\alpha} \to 0$, a PPO level of α_1 is chosen in equilibrium (i.e., sneaky takeover), then a direct merger is never approvable under $R1$, because it would be price increasing in expected terms. Overall, Proposition 3 makes the tradeoff associated with a laissez-faire approach towards PPOs ($R2$) explicit. As it increases the set of parameters which support a merger outcome beyond the one under $R1$, it invites both price increasing and price decreasing mergers, which would be blocked when a price test is used to evaluate PPOs.

3.4 Regulating PPO Acquisitions

3.4.1 Forward Looking Price Test ($R3$)

Under a forward looking price test ($R3$), the AA accepts a PPO proposal only when the expected market price is lower than the price realized in the absence of a PPO. In contrast to $R1$, the AA takes a longer run perspective to assess the expected price resulting from a PPO acquisition by acknowledging that the PPO acquisition is the first step of a sequential takeover strategy. The AA thus calculates the expected (equilibrium) market price under the sequential takeover strategy, Ep^P, and compares it with the price which is realized when the PPO acquisition is rejected, p^I. As we showed above (Proposition 3), a sequential takeover strategy is only chosen if the maximal synergy level is sufficiently large, so that a merger proposal will be accepted in equilibrium in stage 4. The expected (equilibrium) price from a PPO strategy is, therefore, given by

$$Ep^P = \beta p^M + (1-\beta)p^P = \beta\frac{1+2c-s}{3} + (1-\beta)\left(\frac{1+(3-\alpha)c}{4-\alpha}\right).$$

A forward looking PPO control allows the PPO acquisition if $Ep^P \leq p^I$, which gives the condition

$$s \geq s_5 := \frac{(1-c)(3\alpha+4(1-\alpha)\beta)}{4(4-\alpha)\beta}. \tag{3.12}$$

Note that $\partial s_5/\partial\beta = -(3(1-c)\alpha)/(4\beta^2(4-\alpha)) < 0$ and that $\lim_{\beta\to 1} s_5 = (1-c)/4$, so that a PPO is never approved when $s < (1-c)/4$. Thus, the entire parameter range under which a sneaky takeover occurs under regime $R2$ is eliminated by a forward looking price test (see part ii) of Proposition 2). If, however, $s > (1-c)/4$, then the PPO acquisition is approvable if the probability of a synergy is large enough. Solving (3.12) for β, we get

$$\beta \geq \beta^{**} := \frac{3\alpha(1-c)}{4(\alpha(1-c-s)-(1-c-4s))}. \tag{3.13}$$

Note that $0 < \beta^{**} < 1$ holds in the considered parameter area and that $\partial\beta^{**}/\partial\alpha > 0$ and $\partial\beta^{**}/\partial s < 0$. The former derivative implies that firm 1 will always choose the minimal PPO level $\alpha = \underline{\alpha}$ because a higher level reduces the expected joint profits of firms 1 and 2 and decreases the chance of approvability. We can summarize the equilibrium outcome as follows.

Proposition 4. *Suppose a PPO is evaluated by the AA according to a forward looking price test. The following cases then emerge.*

i) If $s \leq \min\{c, (1-c)/4\}$, then the outcome is case I.

ii) If $s > (1-c)/4$, then a PPO with $\alpha = \underline{\alpha}$ is chosen if $\beta \geq \beta^{**}(\underline{\alpha})$ holds. Moreover, $\partial\beta^{**}/\partial\alpha > 0$ and $\partial\beta^{**}/\partial s < 0$. Otherwise, case I is the outcome.

It is obvious that the forward looking regime is more restrictive than $R2$. First, the entire area where a sneaky takeover is chosen under $R2$ disappears. Second, even in the area where a PPO would be ex ante price reducing (part ii) of Proposition

4), the forward looking price test is more restrictive than under $R2$. This can be seen from comparing directly the critical values s_1 and s_5, for which we get that $s_5 > s_1$. Or, in terms of the probability of a synergy, $\beta^{**} > \beta^*$ holds always. The reason is that the critical value β^{**} takes account of the downside risk that there will be no synergy in which case the expected price is always larger than in case I. In contrast, the critical value β^* follows from firm 1 and 2's profitability constraint which is less restrictive. Comparing $R3$ with $R1$, we get that the AA can improve its decision by taking a longer run perspective in case of PPO proposals. A (short run) price test only considers the price increasing effect of the PPO, so that any PPO would be blocked under $R1$, leading to the result that only direct mergers can happen. As the analysis of $R3$ reveals, allowing only direct mergers which pass the price test leads to too few merger proposals when compared with the outcomes of the forward looking price test. Comparing the critical values s_5 and s_3, we get that $s_3 > s_5$ holds always which follows directly from the fact, that a sequential takeover strategy reduces the downside risk of allowing the merger not only from the firms' but also from the AA's perspective.

3.4.2 Safeharbor Rule ($R4$)

Another policy alternative to the forward-looking price test is to put a constraint on the maximal minority share holding, such that any PPO proposal below that value can be implemented without notifying the AA ($R4$). Denote that value by $\overline{\alpha}$ to which we refer as the safeharbor rule (assume also $\overline{\alpha} < 1/2$). If the PPO share surpasses the safeharbor rule, then the PPO acquisition has to be notified and the AA decides about it on the basis of standard merger control regulations (i.e., it uses a short run price test as in $R1$).

We can distinguish basically two cases which depend on how restrictive the safeharbor rule $\overline{\alpha}$ is when compared with $\underline{\alpha}$ (above which synergy learning is assured) and α_1 (above which a merger proposal is accepted by the AA in the synergy PPO subgame). If $\overline{\alpha} < \underline{\alpha}$, then the safeharbor constraint is too restrictive to induce a sequential takeover strategy. In this case, a PPO acquisition (for the purpose of synergy learning with $\alpha \geq \underline{\alpha}$) would trigger a merger analysis based on merger control practice as in $R1$. Accordingly, the possibility of a sequential takeover strategy is not taken into account, so that a PPO acquisition is always blocked by the AA. It follows that the only acquisition strategy remaining is the direct merger, so that the equilibrium outcome is the same as under $R1$.

The second case is $\underline{\alpha} < \overline{\alpha} < 1/2$, so that all $\alpha \in [\underline{\alpha}, \overline{\alpha}]$ enable the acquirer to learn the value of the merger synergy by means of a sequential acquisition strategy. Such a regulatory constraint implies two important features. First, it reduces the scope for sneaky takeovers if $\overline{\alpha} < \alpha_1$ which is desirable from a forward looking price test perspective. Second, it never restricts mergers in the range where the post merger price is smaller than before the mergers (i.e., in the area $s > (1-c)/4$). The former follows from condition (3.3) which constraints the PPO from below (only PPOs above α_1 are approvable in the fourth stage of our game). The latter statement follows from noticing that in the respective area firm 1 will always choose the minimal PPO level, $\underline{\alpha}$, which just ensures learning of the synergy level. A higher PPO level always reduces the expected joint profits of the acquirer and the target, and is thus never optimal making the safeharbor constraint always nonbinding. We summarize that reasoning as follows.

Proposition 5. *Suppose that PPOs are regulated according to a safeharbor rule $\overline{\alpha}$, so that a PPO has only to be notified in advance if $\alpha > \overline{\alpha}$, in which case the AA decides on the basis of a (short run) price test. The following cases then emerge.*

i) If $\overline{\alpha} < \underline{\alpha}$, then the outcome is the same as under $R1$ (only direct merger).

ii) If $\overline{\alpha} > \underline{\alpha}$ and if $\underline{\alpha}$ is the equilibrium outcome under $R2$, then the outcome is the same as under $R2$ (no PPO control).

iii) If $\overline{\alpha} > \underline{\alpha}$ and if $\alpha_1 > \underline{\alpha}$ is the equilibrium outcome under $R2$, then two cases have to be considered: a) If $\overline{\alpha} > \alpha_1$, the outcome is the same as under $R2$ (no PPO control). b) If $\overline{\alpha} < \alpha_1$, then the safebarbor rule effectively blocks all equilibrium PPO proposals under $R2$ which are in the interval $(\overline{\alpha}, \alpha_1|_{s=(1-c)/7})$, while all PPO proposals $\alpha_1 \leq \overline{\alpha}$ are allowed (i.e., the same outcome as in $R2$ follows).

Part iii) of Proposition 5 shows that a safebarbor rule can deter PPO proposals which aim at outplaying the AA using a price test (i.e., whenever $\alpha_1 > \underline{\alpha}$ is the equilibrium outcome in $R2$). Clearly, if the safeharbor rule is set equal to the minimal PPO shareholding which ensures synergy learning (i.e., $\overline{\alpha} = \underline{\alpha}$), then all those proposals are effectively eliminated because all of them would fall under standard merger control. By reference to a (short run) price test all the notified proposals are rejected. Of course, to allow for synergy learning in the first place, the safeharbor rule must not fall short of $\underline{\alpha}$ (see part ii) of Proposition 5), because otherwise it would deter any sequential acquisition strategy for the purpose of synergy learning.

3.5 Welfare Implications

We examine the welfare implications of our analysis. Our focus is on consumer surplus, CS, but we also shortly refer to social welfare (which is the sum of consumer surplus and producer surplus, PS). Table 3.2 states consumer and producer surplus for the cases I, P, and M.

Cases \ Eq. Values	Consumer Surplus	Producer Surplus
Case I	$CS^I = \frac{9(1-c)^2}{32}$	$PS^I = 3\left(\frac{1-c}{4}\right)^2$
Case P	$CS^P = \frac{((3-\alpha)(1-c))^2}{2(4-\alpha)^2}$	$PS^P = \frac{(3-\alpha)(1-c)^2}{(4-\alpha)^2}$
Case M	$CS^M = \frac{(2(1-c)+s)^2}{18}$	$PS^M = \frac{(1-c+2s)^2+(1-c-s)^2}{9}$

Table 3.2: *Consumer and producer surplus in cases I, P, and M*

The expected values of consumer surplus, producer surplus, and social welfare if a merger (strategy D) is proposed by firm 1 and approved by the AA in stages 1 and 2, respectively, are given by

$$E\Omega^D := \beta\Omega^M + (1-\beta)\Omega^M(s=0), \text{ with } \Omega \in \{CS, PS, SW\}.$$

If a PPO-strategy is chosen by firm 1 (strategy S) and approved by the AA in the first and second stage of the game, respectively, then the expected values of consumer surplus, producer surplus, and social welfare are given by

$$E\Omega^S := \beta\Omega^M + (1-\beta)\Omega^P, \text{ with } \Omega \in \{CS, PS, SW\}.$$

We first note that the price test is different than the consumer surplus test when there is uncertainty about the synergy. Take a direct merger proposal in stage 1. Under a consumer surplus test, the AA accepts the merger if $ECS^D \geq CS^I$, which gives the condition

$$s \geq s_D := \frac{1-c}{\beta}\left(-2\beta + \frac{1}{4}\sqrt{\beta\,(64\beta+17)}\right).$$

Comparing s_D with the critical synergy level s_3 under regime $R1$, we get

$$s_3 - s_D = \frac{1-c}{4\beta}\left(8\beta - \sqrt{\beta\,(64\beta+17)} + 1\right) > 0.$$

Thus any merger which is approved under a price test is also approvable under a consumer surplus test, but not otherwise around.

Proposition 6. *Any direct merger which is approvable under the price test is also approvable under a consumer surplus test. As a merger is always strictly profitable under a price test, a consumer surplus test would allow more mergers to be completed than the price test. The price test, therefore, blocks profitable mergers which are consumer surplus increasing.*

Proposition 6 already implies that allowing for PPO-induced mergers can be desirable from a consumer surplus point of view because the price test in stage 2 of our game is too restrictive and blocks consumer surplus increasing direct mergers. However, sneaky takeovers are possible under regime $R2$ which may reduce expected consumer surplus. Comparing the expected consumer surplus in case of a sequential takeover with the consumer surplus in case I, we get

$$ECS^S < CS^I \text{ for all } (1-c)/7 < s < \min\{c, (1-c)/4\}.$$

Thus, with no PPO control at all ($R2$), there are too many sequential mergers from a consumer surplus perspective. The forward looking price test deters all sneaky takeovers, which is a desirable feature from a consumer surplus perspective.[38] A comparison of the forward looking price test with the consumer surplus rule occurs only for synergy levels which induce price decreasing mergers (i.e., $s > (1-c)/4$ holds). The expected consumer surplus does not fall with a sequential merger strategy if

$$ECS^S = \beta CS^M + (1-\beta)CS^P \geq CS^I.$$

from which we obtain the condition

$$\beta > \beta_S := \frac{CS^I - CS^P}{CS^M - CS^P}. \tag{3.14}$$

Note that $\beta_S \in (0,1)$, because of $CS^M > CS^I > CS^P > 0$. Comparing β_S with the β^{**} (see 3.13), we get

$$\beta^{**} > \beta_S$$

holds always in the considered parameter range (see Appendix for the proof). Again, the forward looking price test applied to PPO acquisitions is more restrictive than a test based on expected consumer surplus (which is also forward looking in terms of foreseeing the subgame perfect equilibrium outcome of a sequential takeover strategy).

Comparing the safeharbor rule with the expected consumer surplus change, the safeharbor rule should be set at the lowest possible level which just ensures synergy learning; i.e., $\overline{\alpha} = \underline{\alpha}$ should hold from a consumer surplus perspective to deter all sneaky takeovers. But even fixing the safeharbor rule optimally at $\overline{\alpha} = \underline{\alpha}$ invites too many PPO acquisitions, because from Proposition 2 we know that the takeover incentive is then driven by firm 1 and 2's profitability condition; in particular, $\beta \geq \beta^*$ must hold according to (3.10). In the Appendix, we show that $\beta^*(\underline{\alpha}) < \beta_S$ for $s > 0$, so that the profitability condition implies too large takeover incentives for the firms from a consumer surplus perspective. Or, put differently, consumer-decreasing sequential takeovers under a safeharbor rule are possible even if $\overline{\alpha} = \underline{\alpha}$, so that all sneaky takeovers cannot occur.

[38]We show in the Appendix that a sneaky takeover strategy always lowers expected consumer surplus compared to the pre-merger level.

Proposition 7. *The forward looking price test eliminates all sneaky takeovers which are also consumer surplus reducing, which is also true under a safeharbor rule with* $\overline{\alpha} = \underline{\alpha}$. *If* $\underline{\alpha}$ *is the equilibrium outcome in R2, then the forward looking price test is more restrictive than a (forward looking) consumer surplus test, so that profitable sequential acquisitions are blocked under the forward looking price test which are consumer surplus increasing. If, again,* $\underline{\alpha}$ *is the equilibrium outcome in R2, then a safeharbor rule* $\overline{\alpha} \geq \underline{\alpha}$ *is less restrictive than a (forward looking) consumer surplus test, so that some sequential acquisitions are taking place under the safeharbor rule which are consumer surplus decreasing.*

Finally, under a social welfare standard firms' profit changes would also have to be taken into account. It is easily checked that any concentration increases the sum of firms' profits (with and without synergies). It is, therefore, obvious that the price test (as well as a consumer welfare standard) is more restrictive than a social welfare test. Thus, from a social welfare perspective allowing for the opportunity of sequential mergers is even more advisable. In particular, a sneaky takeover can be social welfare increasing in expected terms. The expected social welfare under a sequential merger is higher than the pre-merger social welfare level if

$$ESW^S = \beta SW^M + (1-\beta)SW^P \geq SW^I. \tag{3.15}$$

Substituting the respective values from Table 3.2 into (3.15), setting $\alpha = \alpha_1$, and evaluating at the lowest (approvable) synergy level possible ($s = (1-c)/7$; see part ii) of Proposition 2), we get

$$\beta\, SW^M\Big|_{s=(1-c)/7} + (1-\beta)\, SW^P\Big|_{\alpha=\alpha_1, s=(1-c)/7} - SW^I = \frac{3}{1568}\,(32\beta - 5)\,(1-c)^2\,,$$

which is larger than zero for $\beta \geq 5/32$. Thus, even the worst possible sneaky takeover can be socially desirable.

3.6 Conclusion

We presented a model which takes account of uncertainty about merger synergies. Uncertainty about the synergy level creates a downside risk for both the merging parties and consumers. If no synergy is realized after the merger, then the merging firms and consumers are worse off than before the merger. Acquiring a PPO can be an effective way to reduce this downside risk if it allows the acquiring firm to learn the merger synergy in advance. A PPO reduces the resources which have to be committed and thus also the losses if it turns out that no merger synergies will be realized. Thus, taking the synergy learning property of PPO acquisitions into account, they appear in a better light when compared with the views expressed in recent competition policy reports (OECD, 2008; OFT, 2010; EC, 2013, 2014). However, there is still a tradeoff involved with PPOs as they can be used strategically to reduce the competitive intensity so as to induce the AA to approve a merger proposal which would not be approvable in the absence of a PPO acquisition. This can happen because a lower competitive intensity lowers the minimal synergy level necessary to lower the market price after a merger (sneaky takeover). We have proposed two regulatory approaches to counter those sneaky takeovers to better filter out the pro-competitive PPO acquisitions. First, we examined a forward looking price test which requires evaluating a PPO acquisition by taking account of the possibility of synergy learning and the potential of realizing possible merger synergies in the future. A forward looking price test applied to PPO proposals deters all sneaky takeovers but is still too restrictive from a consumer welfare perspective.

Another problem with the forward looking price test is that it appears to be both informationally demanding and costly in terms of the administrative burden because it involves a detailed market analysis as in a merger control case. We have also investigated a simple safeharbor rule to deal with PPOs which was also proposed in some of the above mentioned competition policy reports. If that rule is adjusted properly just above the minimal necessary PPO level which ensures synergy learning, then virtually all sneaky takeovers are eliminated. However, even if the safeharbor rule is set optimally in this way, it has the drawback that it allows for too many PPO acquisitions from a consumer surplus perspective. Thus, neither the forward looking price test nor the safeharbor rule can perfectly monitor PPO acquisitions from a consumer welfare perspective, where the former one implies type I and the latter one implies type II errors.

An advantage of both regulatory approaches $R3$ and $R4$ (given the safeharbor rule is optimally set at $\overline{\alpha} = \underline{\alpha}$) when compared with the benchmark regimes $R1$ and $R2$ is that they ensure that any merger (resulting always from a sequential takeover strategy) must be price reducing both from an ex ante and an ex post perspective. This is neither the case under $R1$ nor under $R2$. In the former case, any approvable merger cannot increase the expected price, but the price can be higher ex post if no synergy is realized. In the latter case, because of sneaky takeovers, the price can increase both from an ex ante and ex post perspective. In contrast, under regimes $R3$ and $R4$ (with $\overline{\alpha} = \underline{\alpha}$) only sequential takeovers occur and the price cannot increase in expected terms, while the deterrence of sneaky takeovers ensures that the price is also always lower ex post.

We finally, discuss some extensions and robustness checks of our model. Increasing the competitive intensity by considering more than one outsider firm should reinforce our results because a direct merger then becomes less attractive which increases the incentive for synergy learning through a PPO acquisition. Another extension is to allow for a non-linear demand, where we expect that our results remain qualitatively valid as long as standard regularity conditions are fulfilled (e.g., log-concave demand function). Considering other distribution functions of the merger synergy should also not change our basic insight on the downside risk of a direct merger from both the firms' and the consumers' perspective.

3.A Appendix

In this Appendix, we derive the equilibrium values stated in Tables 1 and 2. We also prove the orderings of the critical synergy levels introduced in the analysis of our model. We also prove claims made in Section 5 in association with Propositions 6 and 7.

Derivation of the equilibrium values stated in Table 3.1. *Case I.* When all firms are independent, firm i's profit is given by (3.1). Independent profit maximization gives the symmetric Cournot quantities $q^I = (1-c)/4$ for the firms. We then get the equilibrium price level $p^I = (1+3c)/4$ and the equilibrium profits $\pi^I = ((1-c)/4)^2$.

Case P. Suppose firm 1 acquires a PPO of α in firm 2. Then the profit of firm 1 is given by $\pi_1^I = (1-Q-c)(q_1+\alpha q_2)$, and the profit of firm 2 by $\pi_2^I = (1-\alpha)(1-Q-c)q_2$. Firm 3's profit is the same as before. The first-order conditions of firms 2 and 3 do not change when compared with the case of independent firms, but the first-order condition of firm 1 is now different. Solving all three first-order conditions, we get the following equilibrium quantities $q_1^P = [(1-\alpha)(1-c)]/(4-\alpha)$ and $q_2^P = q_3^P = (1-c)/(4-\alpha) =: q^P$. The equilibrium price is $p^P = [1+(3-\alpha)c]/(4-\alpha)$ and firms' equilibrium profits are given by $\pi_1^P = \left(q^P\right)^2$, $\pi_2^P = (1-\alpha)\left(q^P\right)^2$, and $\pi_3^P = \left(q^P\right)^2$. Note also that the joint profit of firms 1 and 2 is given by $\pi_1^P + \pi_2^P = \left(q^P\right)^2(2-\alpha) = ((1-c)/(4-\alpha))^2(2-\alpha)$. We notice, that the joint profit of firms 1 and 2 is lower with a PPO when compared with the sum of their profits before the merger. Moreover, a larger PPO reduces the joint profit $\partial(\pi_1^P + \pi_2^P)/\partial\alpha = [\alpha(1-c)^2]/[(\alpha-4)^3] < 0$.

Case M. In case of a takeover of firm 2 by firm 1 synergies s (which can be zero) are realized and the profit of firm 1 is given by $\pi_1 = (1-Q-(c-s))q_1$, while the outsider firm's profit function remains the same as in the independent firms case. Calculating the duopoly equilibrium we get the equilibrium quantities $q_1^M = (1-c+2s)/3$ and $q_3^M = (1-c-s)/3$. Note that we assumed $s < 1-c$, so that $q_3^M > 0$ holds always. The equilibrium price is then given by $p^M = (1+2c-s)/3$, while the merged firm realizes equilibrium profits $\pi_1^M = (1-c+2s)^2/9$ and the outsider firm gets $\pi_3^M = (1-c-s)^2/9$.

Derivation of the equilibrium values stated in Table 3.2. We use the equilibrium values stated in Table 3.1 to derive the values of consumer and producer surplus as well as social welfare under the three cases I, P, and M.

Case I. From Table 3.1, we get

$$PS = \sum_i \pi_i^I = 3\pi^I = 3\left(\frac{1-c}{4}\right)^2.$$

Consumer surplus is given by $CS^I = (1-p^I)^2/2$ (p^I is stated in Table 3.1) and we get

$$CS^I = \frac{9(1-c)^2}{32},$$

so that social welfare $SW = \sum_i \pi_i^I + CS^I$ becomes

$$SW^I = \frac{15(1-c)^2}{32}.$$

Case P. We get for producer surplus

$$PS^P = \sum_i \pi_i^P = \frac{(3-\alpha)(1-c)^2}{(4-\alpha)^2}.$$

Consumer surplus is given by $CS^P = (1-p^P)^2/2$ and we get

$$CS^P = \frac{((3-\alpha)(1-c))^2}{2(4-\alpha)^2},$$

so that social welfare $SW^P = PS^P + CS^P$ becomes

$$SW^P = \frac{(1-c)^2\left(15-8\alpha+\alpha^2\right)}{2\left(4-\alpha\right)^2}.$$

Case M. Producer surplus is

$$PS^M = \pi_1^M + \pi_3^M = \frac{(1-c+2s)^2 + (1-c-s)^2}{9}.$$

Consumer surplus is given by $CS^M = (1-p^M)^2/2$ and we get

$$CS^M = \frac{(2(1-c)+s)^2}{18},$$

so that social welfare $SW^M = PS^M + CS^M$ becomes

$$SW^M = \frac{(1-c+2s)^2 + (1-c-s)^2}{9} + \frac{(2(1-c)+s)^2}{18}.$$

Expected consumer surplus under a sequential merger (Prop. 6 and 7). In part i), we first show that expected (equilibrium) consumer surplus under a sequential takeover ECS^S is always smaller than CS^I if a sneaky takeover occurs (see part ii) of Proposition 2). In part ii), we show that the forward looking price test is more restrictive than a consumer surplus test in case of sequential takeovers. Finally, in part iii) we show that an evaluation of a PPO based on a (forward looking) consumer surplus test is more restrictive than the profitability condition for a sequential takeover strategy under $R2$ evaluated at $\alpha = \underline{\alpha}$ (i.e., when the price in case of a merger is lower than the pre-merger market price).

Part i) We show that expected consumer surplus in case of a sneaky takeover is always lower than consumer surplus in case I. From Proposition 2 part ii) we know that the lowest possible PPO level in case of a sneaky takeover is given by $\alpha = \alpha_1$. We then get

$$CS^I - ECS^S(\alpha = \alpha_1) = \frac{17(1-c)^2 - 16s(4(1-c)+s)}{288}.$$

This difference is decreasing in s. Evaluating it at the maximal possible values of $s < \min\{c, (1-c)/4\}$, we get that $CS^I - ECS^S(\alpha = \alpha_1) > 0$ is always true.

Part ii) We show that $\beta^{**} > \beta_S$ holds always for $s > (1-c)/4$. We substitute the values of CS^I, CS^P, and CS^M from Table 2 into (3.14) and comparing that value with (3.13) we get

$$\begin{aligned} \beta^{**} - \beta_S &= -\frac{3}{16}\frac{(1-c)(4-\alpha)\alpha(1-c-4s)}{\tau}, \text{ with} \qquad (3.16) \\ \tau &:= -5c^2\alpha^2 + 22c^2\alpha - 17c^2 - 4cs\alpha^2 + 32cs\alpha - 64cs + 10c\alpha^2 - 44c\alpha \\ &\quad +34c + s^2\alpha^2 - 8s^2\alpha + 16s^2 + 4s\alpha^2 - 32s\alpha + 64s - 5\alpha^2 + 22\alpha - 17. \end{aligned}$$

The numerator of the second fraction on the right-hand side of (3.16) is always negative because $(1-c-4s) < 0$ for $s > (1-c)/4$. The difference ,$(\beta^{**} - \beta_S)$, is therefore, positive if $\tau > 0$. We get $\partial\tau/\partial s = 2\left(4-\alpha\right)^2\left(2(1-c)+s\right) > 0$. Evaluating τ at the lowest possible value $s = (1-c)/4$, we get $\tau(s = (1-c)/4)) = -\frac{9}{16}\alpha\left(7\alpha - 24\right)\left(1-c\right)^2 > 0$ for all α. Thus, $\beta^{**} > \beta_S$ holds.

Part iii) We show that $\beta^*(\underline{\alpha}) < \beta_S$ holds always. This inequality holds if the numerator of $\beta^*(\underline{\alpha})$ is smaller than the numerator of β_S and if the denominator of $\beta^*(\underline{\alpha})$ is larger than the denominator of β_S. The former comparison gives the difference

$$2\pi^I - (\pi_1^P + \pi_2^P) - \left[CS^I - CS^P\right] = \frac{1}{32}\frac{\alpha\left(11\alpha - 24\right)\left(1-c\right)^2}{\left(\alpha - 4\right)^2} < 0,$$

which is obviously strictly negative for $\alpha < 24/11$. The latter comparison gives the difference

$$\pi_1^M - (\pi_1^P + \pi_2^P) - \left[CS^M - CS^P\right] = \frac{\lambda}{18\,(\alpha-4)^2}, \tag{3.17}$$

with

$$\begin{aligned}\lambda \;:\; &= 7c^2\alpha^2 - 20c^2\alpha + 13c^2 - 4cs\alpha^2 + 32cs\alpha - 64cs - 14c\alpha^2 \\ &+40c\alpha - 26c + 7s^2\alpha^2 - 56s^2\alpha + 112s^2 + 4s\alpha^2 - 32s\alpha + 64s + 7\alpha^2 - 20\alpha + 13.\end{aligned}$$

Differentiating λ successively with respect to α, we get

$$\begin{aligned}\frac{\partial\lambda}{\partial\alpha} &= 40c - 32s + 14\alpha - 28c\alpha + 8s\alpha + 14c^2\alpha + 14s^2\alpha \qquad (3.18)\\ &\quad +32cs - 20c^2 - 56s^2 - 8cs\alpha - 20,\\ \frac{\partial^2\lambda}{\partial\alpha^2} &= 14c^2 - 8cs - 28c + 14s^2 + 8s + 14. \qquad (3.19)\end{aligned}$$

Inspecting the right-hand side of (3.19), we see that this expression is decreasing in c. Evaluating accordingly at the largest possible value of c, we get $\frac{\partial^2\lambda}{\partial\alpha^2}\Big|_{c=1} = 14s^2 > 0$ for $s > 0$, so that $\frac{\partial^2\lambda}{\partial\alpha^2} > 0$ holds always for $s > 0$. Evaluating next the right-hand side of (3.18) at $\alpha = 1$, we get

$$\frac{\partial\lambda}{\partial\alpha}\bigg|_{\alpha=1} = 40c - 32s + 14 - 28c + 8s + 14c^2 + 14s^2 + 32cs - 20c^2 - 56s^2 - 8cs - 20,$$

which is increasing in c. We then get $\frac{\partial\lambda}{\partial\alpha}\Big|_{\alpha=1,c=1} = -42s^2$, so that $\frac{\partial\lambda}{\partial\alpha} < 0$ holds always if $s > 0$. Evaluating finally λ at $\alpha = 1$, we get

$$\lambda(\alpha = 1) = 9s(4(1-c) + 7s) > 0,$$

so that (3.17) is strictly positive if $s > 0$. Taking together, we have shown that $\beta^*(\underline{\alpha}) < \beta_S$ holds always for $s > 0$.

Contributions to chapter 3 of the dissertation

I, Shiva Shekhar, hereby declare that chapter 3 "Uncertain Merger Synergies, Passive Partial Ownership and Merger Control" was written in collaboration with Christian Wey.

I contributed to:

- the theoretical results in the main text
- the results in the appendices
- drafting and revising
- the graphical analysis of the results
- developing the research idea

Signature Co-author I (Prof. Dr. Christian Wey): ______________________

Chapter 4

Homing Behavior and Platform Pricing Strategies

4.1 Introduction

Platforms, nowadays have both single-homing and multi-homing agents who develop content on a platform. For instance, two competing platforms such as Apple's App Store and Google's Playstore, have applications that are exclusive to one platform as well as applications that are common on both platforms. One can notice similar trends in music streaming as well as on gaming platforms. This decision to single-home by content developers could stem from their strong preferences to develop on a particular platform arising from either technical difficulties or contractual terms that offer monetary or non-monetary benefits in exchange for exclusivity. Technical difficulties could be a result of different programming languages as well as other platform idiosyncratic requirements like a lack of home button on the iOS platform that creates the necessity for iOS developers to create on-screen buttons.[1]

On the other hand, content developers like Facebook, Google, EA games etc, are present on both the platforms and prefer access to a larger pool of consumers. This homing behavior could arise due to lower development costs due to synergies as well as the ability to access a larger pool of consumers. Other additional benefits could include payoffs that are independent from being at a platform. This could comprise positive externalities in other independent markets due to overlap of consumers across these markets. For example, Microsoft offers the full suite of MS Office tools for free on both Android and iOS ecosystem so as to nudge consumers towards the windows ecosystem in the personal computing market.[2] We call these benefits as "independent payoffs", large independent payoffs suggest greater tendency to multi-home among the pool of content providers.

In this article, we look at how this market structure influences platform profits under two pricing regimes, namely, discriminatory pricing and non-discriminatory pricing. These pricing regimes are present in different platform markets; for example, in gaming platforms we find that discriminatory pricing regime is common, while pricing in app stores is less transparent.[3] The precise terms of a contract between app developers and content providers such as Apple and Google are confidential. While information which is publicly provided on the App store website suggests uniform pricing, exclusivity of an app is an important factor when deciding on

[1] Another example of content provider preference for a platform is the programming languages needed to develop an app. Android requires a C/C++ based Integrated Development Environment (IDE) called Android Studio, while iOS developers require a Java based IDE called Xcode which can be used only on Apples' macs.

[2] http://www.techrepublic.com/article/3-reasons-microsoft-made-office-free-for-iphone-and-android/

[3] For example, Wired magazine published an article on how Sony was offering seed funding, developer kits to Indie game developers on its gaming platform. In some cases, this funding was in return for either limited exclusivity or full exclusivity.

offering promotional assistance and recommendations by their app store editorial team.[4]

A discriminatory pricing regime is relevant if there is no possibility of arbitrage between the two types of agents. Fortunately, public observability of homing behavior is a realistic assumption for most platforms that we focus on like the online streaming services, mobile operating systems and the gaming market. This is justified as the costs of verifying the deviation from contract terms for exclusive content on a competing platform are negligible.[5] It is important to note that we abstract away from cloning and piracy of content on competing platforms.

We consider a model with two competing platforms. Consumers are single-homing while content providers can multi-home or single-home. Platforms are horizontally differentiated á la Hotelling for agents on both sides. Content providers endogenously sort themselves into multi-homers and single-homers. This endogenous homing behavior is a consequence of horizontal differentiation of the platforms. A larger independent payoff obtained by content providers on a platform results in a greater proportion of multi-homing and a lower share of single-homing content providers. We consider two pricing regimes, a benchmark non-discriminatory pricing regime and a discriminatory pricing regime contingent on homing behavior.

In our model, we have demonstrated a new channel through which competition between platforms could be viewed. The independent payoff has an impact on platform profits as well as platform affiliation decisions made by content providers. A rise in independent payoffs results in an increase of the share of multi-homing as well as the total number of content providers on a platform. In the non-discriminatory case, the price charged to content providers rise with a rise in these payoffs, while consumer price falls in the non-discriminatory regime. A rise in profits due to higher revenue from content providers outweighs the fall in profits from lower consumer price. On the other hand, in the discriminatory regime, price to single-homing content providers and consumers do not vary with a change in independent payoffs, while multi-homing price along with total number of content providers rise with independent payoffs. This demonstrates that profits under the non-discriminatory regime are more sensitive to a change in the independent payoffs than the discriminatory regime. As a result, when these payoffs are high (low) enough, discriminatory regime is less (more) profitable than a non-discriminatory pricing regime.

Secondly, a discriminatory regime in comparison to the non-discriminatory regime is consumer surplus and welfare enhancing when independent payoffs are low enough. In the discriminatory regime, total number of content providers are higher along with the consumer price being lower than the non-discriminatory regime when indepen-

[4]https://www.wsj.com/articles/SB10001424052702304626304579510020273541060

[5]Sony could always verify the presence of a deviating content provider.

dent payoffs are low enough. As a result, we obtain higher consumer surplus in the discriminatory pricing regime than in non-discriminatory regime for independent payoffs being low enough. Welfare in our setting is the sum of consumer surplus, content provider surplus and platform profits. For low independent payoffs the sum of consumer surplus and platform profits is higher in the discriminatory regime than the non-discriminatory regime, while content provider surplus is lower in the discriminatory regime. The positive effect on welfare due to higher consumer surplus and platform profits outweighs the negative effect due to lower content provider surplus in the discriminatory regime in comparison to the non-discriminatory regime.

In the extensions, we first look at the long term equilibrium if the pricing regimes were chosen simultaneously by the platforms. We find that the discriminatory pricing regime will be chosen by both the content providers. This pricing regime game resembles a prisoner's dilemma for independent payoffs being large enough. We then look at collusion on non-discriminatory pricing regimes to correct for the prisoner's dilemma and improve welfare. We employ grim trigger strategies and find that collusion is harder with an increase in independent payoffs and cross network benefits. Secondly, we look at the case where consumers obtain different marginal utility from single-homing content than multi-homing content on a platform. Thirdly, we look at the case when multi-homing and single-homing content providers obtain different independent payoffs. Finally, we focus on the case where multi-homers have economies of scale. We find that our main result that with large enough independent payoffs, non-discriminatory pricing regime result in higher platform profits is robust to all these variations.

The remainder of this paper is organized as follows. In section 2, we provide the literature review and compare my results to those known in the literature. In section 3, we present the basic model. In section 4, we provide the analysis for the two pricing regimes. In section 5, we discuss some extensions. Finally, we conclude in section 6.

4.2 Related Literature

Seminal contributions to the topic of two sided markets are Rochet and Tirole (2003) and Armstrong (2006). In Rochet and Tirole (2003), platforms levy per-transaction charges with no fixed subscription fee. The two agents, consumers and retailers, are present on either sides of the platforms. Though retailers can ex-ante choose whether to multi-home or single-home, in equilibrium they are all multi-homers. They show that the share of total transaction charge borne by the either sides depends on how closely consumers view the two platforms as substitutes. Armstrong (2006), considers competition in two sided markets in different market settings like multi-homing on both sides, competitive bottleneck models etc. This paper assumes content providers can either multi-home or single-home. Though platform choice is endogenous, homing choice (multi-homing or single-homing) is not. In our model, we allow for endogenous homing decision among content providers i.e. content providers can either be multi-homers or single-homers. Then we look at impact of price discrimination in such a setting.

Another strand of literature, we contribute to, is spatial competition among firms and price discrimination. Thisse and Vives (1988) look at two pricing regimes discriminatory and non-discriminatory within a Hotelling framework. They find that price discrimination will be chosen when the pricing policy is a simultaneous choice. They further find that consumer prices are lower under price discrimination. While they look at the impact of first degree price discrimination, we focus on homing behavior based price discrimination in a two-sided setting. We confirm their result that a discriminatory pricing regime will be the long term equilibrium in a two-sided setting with spatial competition. We obtain the prisoner's dilemma in pricing regime decision stage as in their model when the independent payoff is sufficient large. Liu and Serfes (2013) further look at first degree price discrimination among the different types of agents within a group. They find that price discrimination results in softening of competition in a two sided market setting when the marginal costs are low relative to network externalities. We obtain similar results and find that competition is lowered when independent payoff of content providers is low enough.

Another paper very close to our work is Belleflame and Peitz (2010). Similar to our paper, they take the decision for multi-homing and single-homing as endogenous. They focus on the impact of for profit and not for profit intermediation on the seller investment incentive. In contrast, we focus on the impact of price discrimination on competition in a two-sided market setting.

Choi (2010) looks at the impact of tying in the presence of exclusive content and common content. The presence of these two types of content providers are exogenously assumed in their model while consumers endogenously decide to multi-home or single-home. Our model focuses on endogenous determination of content provider homing behavior in presence of uniform and discriminatory pricing regimes.

Thomes (2015) shows that platform independent payoff through investment in in-house apps lead to higher consumer surplus and welfare. While he focuses on adding content, we look at the independent payoff of an agent from being on a platform in the two pricing regimes (discriminatory and non-discriminatory regime). We find that when the platform independent payoff is high non-discriminatory regime results in higher platform profits.

In two-sided markets there is an issue of coordination between agents i.e. platform demand on one side depends on expectations about agent participation on the other side. Suleymanova and Wey (2012) look at how different belief structures (strong, weak or mixed expectations) impact competition in the presence of network effects. They find that strong expectation of agents results in lesser competition. Our paper, utilizes what they term as weak expectations (Nash equilibrium) in the presence of indirect network effects of two-sided markets.

4.3 The Model

We consider a two-sided-market model framework along the lines of Belleflame and Peitz (2010) and Armstrong (2006). There exist two sides of the market, the consumer side and the content provider side. Each side of the market has unit mass. Our benchmark model is a competitive bottleneck model with two platforms. Consumers only single-home while content providers either single-home or multi-home. This market structure is very common in the mobile industry or music streaming industry. Consumers typically use only one mobile phone (and operating system such as Android/Google or iOS/Apple) or subscribe to a single music streaming service (e.g., Spotify or Apple Music). At the same time the platform provides access to common and exclusive content. The latter mirrors the fact that content providers both single-home and multi-home.

On the other hand, content providers may also be differentiated in their costs for development of content for a platform. For technical reasons some platform may be preferred by some developers. For example, Google's android platform is more fragmented making it difficult to develop games for it. While iOS is considerably less fragmented but has other issues that create difficulties for some developers. The lack of a back button in iOS forces app developers to introduce it in the user interface and hence making it costlier for some of them to create content for iOS. As a result, some content providers have a strong preference to develop an app for a certain platform, while others do not have such preferences, and therefore, develop apps for both platforms. Developing apps for both platforms allows them to access a larger customer base. We use a Hotelling set-up to model these homing preferences of the content providers.

There exist two competing platforms, $i \in \{1, 2\}$, which act as intermediaries through which consumers interact with content providers. A platform i sets a price, p_i, to consumers for access to its content.[6] Vis-à-vis content providers we consider two pricing regimes D and ND utilized by platforms, where D is the discriminatory

[6]This can be understood as buying a gaming console or an Iphone.

pricing regime and ND stands for the non-discriminatory pricing regime. Under regime D the platform can charge different prices from a content provider depending on whether it single-homes or multi-homes. Under regime ND the platform sets a uniform price to all content providers. Let the price offered to content providers in the non-discriminatory case be denoted as l_i resulting in platforms charging a pair of prices (p_i, l_i). In the discriminatory regime, content providers are charged different prices according to their homing behavior. Let l_i^S be the price for single-homing content providers and l_i^M the price for multi-homing content providers. Thus, under regime D, a platform charges three prices $\{p_i, l_i^S, l_i^M\}$. Firstly, we examine the regime where platforms charge non-discriminatory prices and then compare it to the case where platforms charge discriminatory prices contingent on homing behavior.

From the consumer perspective, platforms are differentiated. To account for platform differentiation, we consider a Hotelling set-up of horizontal product differentiation as in Anderson and Coate (2005), Armstrong (2006), Rasch and Wenzel (2013) and Reisinger (2014). Consumers are uniformly distributed on the unit interval. Thus every consumer has an address x with $x \in [0, 1]$. Platforms are located on the opposite ends of the unit interval, with platform 1 at $x_1 = 0$ and platform 2 at $x_2 = 1$. A consumer incurs linear "transportation" costs proportional to the distance from his preferred platform. A consumer located at x who buys access to platform 1 (2) located at 0 (1) at a price p_1 (p_2) gets the following utility

$$u_i = \mu + \theta n_i - p_i - t_C \cdot |x - x_i| > 0, \text{ for } i = 1, 2, \tag{4.1}$$

where t_C is the constant transportation cost parameter. Consumers derive a "stand-alone" utility of $\mu > 0$ from accessing content (and other services) on a platform. The term θn_i stands for the utility consumers get from getting access to n_i content providers on platform i.[7] Each additional content provider at a platform raises consumer utility by $\theta > 0$.

Content providers are uniformly distributed on a Hotelling line of unit length. This modeling choice is made to take into account that content providers may have a strong preference towards a platform and be single-homers or they may prefer to port content on both platforms and be multi-homers. Content providers obtain a marginal benefit ϕ for an additional consumer at a given platform i and incur a transportation cost of affiliating with a platform. They choose an optimal strategy among multi-homing and single-homing given their location y. A content provider's payoff from affiliating with only platform i under the non-discriminatory pricing regime is given by

$$U_i = k + \phi m_i - l_i - t_S \cdot |y_i - y|, \tag{4.2}$$

[7]An implicit assumption in our set-up is that each consumer which joins a platform i interacts with all the content providers on that platform. As in Reisinger (2014), consumers are homogeneous in their trading behavior and demand all the content offered at a platform.

with $y_1 = 0$ and $y_2 = 1$ being the address of platform 1 and platform 2 respectively. We denote k as the independent payoff from affiliating to a platform and m_i is the total mass of consumers at platform i.[8] We assume that platforms have a fixed benefit as well as a linear benefit from joining a platform. The term ϕm_i is the benefit a content provider gets from having access to m_i consumers on platform i.[9] The payoff of a content provider affiliating with both platforms under non-discriminatory prices is given by[10]

$$U^M = 2k + \phi - l_1 - l_2 - t_S. \tag{4.3}$$

Note that multi-homers' payoff is simply the sum of single-homing content providers.[11] Under discriminatory prices, the payoff of a single-homer is given by

$$U_i = k + \phi \cdot m_i - l_i^S - t_S \cdot |y_i - y|, \tag{4.4}$$

correspondingly, the payoff of a multi-homer is given by

$$U^M = 2k + \phi - l_1^M - l_2^M - t_S. \tag{4.5}$$

Further, we assume that both market sides are symmetric with regard to the transportation cost parameters (with $t_C = t_S$) and the (indirect) network effect parameters (with $\theta = \phi$). This symmetry assumption reduces the number of cases and allows to derive clear-cut results in our model. We ensure that second order conditions are satisfied by assuming $t_S > \phi$. We assume that participation is sufficiently attractive so that all agents on both sides participate in the market. We also invoke the following assumption, which ensures that both single-homing and multi-homing content providers coexist in equilibrium.

Assumption 1. $2t_S - \phi > k > t_S - \phi$.

According to assumption 1, the independent value k from affiliating with a platform should neither be too low not too high. If it is too low, then there exist only single-homers while in the opposite case there would be only multi-homers. Note

[8] k can be thought of the benefits consumers get from accessing a platform. For example, by entering a platform creates a doorway for developers to expand their product into more diverse markets. Apple for instance allows some mobile telephony apps to be used in their mac products. This provides them with a bigger market access than just the app platform. This fixed term encompasses all the fixed benefits from joining a platform.

[9] Consumers may buy the content directly or content providers get revenues through advertisements placed in their content. Another source of revenue comes from generating personal consumer data and selling it to data collection firms/advertisers or interested firms.

[10] We assume that the market is fully covered; see below.

[11] This is of course a simplifying assumption. Note, however, that all the results below remain qualitatively valid if we assume $U^M = U_1 + U_2 - \rho$, where ρ can be positive or negative.

also that a higher value of k implies a higher share of multi-homing content providers (given that Assumption 1 holds).

Given the pricing regime which is either D or ND, we analyze the following two-stage game: In the first stage, platforms simultaneously choose the prices they charge content providers and consumers for affiliating with their platform. In the second stage, content providers sort themselves into single-homers and multi-homers and consumers decide simultaneously which platform to join.

4.4 Analysis

We first analyze the non-discriminatory case and then the discriminatory case. In the next step we compare the results and derive welfare results with regard to consumer and social welfare.

4.4.1 Non-Discriminatory Pricing Regime

The prices charged by platform i are given as $\{p_i, l_i\}$. Using (4.1), we can find the indifferent consumer $\tilde{x}$, which implies the consumer demand m_1 for access to platform 1 as

$$m_1 := \tilde{x} = \frac{1}{2} + \frac{p_2 - p_1 + \theta(n_1 - n_2)}{2t_S}. \tag{4.6}$$

The demand at platform 1 depends on the difference in consumer prices on the two platforms and on the difference in the total number of content providers on the two platforms. It is noteworthy that this difference matters and not the total number of content providers on a single platform. If content providers are allowed to multi-home as well as single-home then this difference is essentially between the number of single-homing content providers on each platform. Accordingly, if all content providers are multi-homers, then this difference would cancel out. Put differently, single-homing content providers are the driving force for consumer demand, while multi-homers have no impact in this regard. From (4.6) we obtain consumer demand for access to platform 2 as

$$m_2 := 1 - \tilde{x}. \tag{4.7}$$

Content providers can multi-home or single-home. Multi-homers are present only if the payoff from multi-homing is larger than from single-homing. Using (4.2) and (4.3) this is the case if the following two conditions hold:

$$U^M \geq U_1 \implies y \geq y_1^* = \frac{-k + l_2 + t_S - \phi m_2}{t_S},$$

Figure 4.1: Distribution of content providers

and

$$U^M \geq U_2 \implies y \leq y_2^* = \frac{k - l_1 + \phi m_1}{t_S}.$$

This results in total content provider demand at platform 1 and 2 as

$$n_1 = y_2^* = \frac{k - l_1 + \phi m_1}{t_S}, \text{ and } n_2 = 1 - y_1^* = \frac{k - l_2 + \phi m_2}{t_S}. \tag{4.8}$$

Note that Assumption 1 will ensure that in equilibrium $0 < y_1 < y_2 < 1$ holds. Figure 1 shows a possible constellation how content providers may select into single-homers and multi-homers. There are three intervals with different types of agents. The interval on the right consists of single-homing content providers on platform 1, the interval in the middle is the area of multi-homing content providers and the interval on the left side gives the single-homing content providers on platform 2. This suggests that multi-homers are the ones that do not have strong preferences for either platforms and therefore prefer to have access to a larger population of consumers. The total number of content providers on a platform includes both the multi-homers as well as the single-homers. The total number of content providers on a platform is falling in the price charged to them and rising in the network benefit. Interestingly, it is independent of the price of the other platform.

We solve simultaneously (4.6), (4.7) and (4.8) to get the demands on the two market sides in terms of prices only. We obtain

$$m_i = \frac{1}{2} + \frac{t_S(p_j - p_i) - \phi(l_i - l_j)}{2(t_S - \phi)(t_S + \phi)} \text{ and} \tag{4.9}$$

$$n_i = \frac{k}{t_S} + \frac{2(-l_i)t_S^2 + t_S(p_j - p_i + t_S)\phi + (l_i + l_j)\phi^2 - \phi^3}{2t_S(t_S - \phi)(t_S + \phi)}, \text{ for } i = 1, 2. \tag{4.10}$$

Equations (4.9)-(4.10) describe consumers' and developers' decision to join a platform for given prices. Note that content provider as well as the consumer demands decrease in prices charged by a platform (p_i, l_i) but increase in the rival platform's prices (p_j, l_j). The total number of content providers on platform i falls in the prices charged to agents on either side. This hinges on the positive externality exerted by the two sides on each other.

Platforms choose prices on both sides of the market to maximize total profits given as

$$\max_{l_i, p_i} \Pi_i^{ND} = p_i m_i + l_i n_i, \text{ for } i \in 1, 2. \tag{4.11}$$

Solving the first order conditions for a symmetric equilibrium, we get the following price relations

$$p_i = p_j = t_S - \frac{\phi(l_i+\phi)}{t_S} \text{ and} \tag{4.12}$$

$$l_i = l_j = \frac{-p_i t_S \phi + (2k+\phi)\left(t_S^2-\phi^2\right)}{4t_S^2 - 3\phi^2}, \text{ for } i = 1, 2. \tag{4.13}$$

One can notice that consumer price is falling in the cross network externality as well as in the price charged to content providers. The first effect is due to the feedback effect of two-sided markets with positive externalities. The fall in consumer prices due to a rise in prices to the content providers is due to prices being substitutes. A rise in price on content providers' side has to be compensated with greater cross-network benefit through a larger consumer base and hence a fall in prices on the consumers' side. The content provider prices also follow similar characteristics. They fall with a rise in consumer prices. Solving equations (4.12) and (4.13) simultaneously, we get the equilibrium prices as stated in the following lemma.

Lemma 4.1. *In the non-discriminatory pricing regime, prices and platform profits are* $l^* = \frac{k}{2}$, $p^* = t_S - \frac{\phi(k+2\phi)}{2t_S}$ *and* $\Pi^{ND,*} = \frac{t_S}{2} + \frac{k^2-2\phi^2}{4t_S}$ *respectively. The total number of consumers and content providers on platform* $i = 1, 2$ *are the same and given by* $m_i^* = \dfrac{1}{2}$ *and* $n_i^* = \frac{(k+\phi)}{2t_S}$*, respectively.*

From Lemma (1) is follows that the number of single-homers and multi-homers on a platform are given by $n_i^{S,*} = \dfrac{2t_S - \phi - k}{2t_S}$ and $n_i^{M,*} = \dfrac{k - t_S + \phi}{t_S}$, respectively. Intuitively, we can see that the number of single (multi)-homers fall (rise) in k. We describe a rise in k as a rise in share of multi-homing content providers. The price to the content providers rise as the number of multi-homers rise through an increase in independent payoff and do not change in the cross network benefit. A higher content provider independent payoff increases the share of multi-homers on a platform. Due to higher total content provider demand as well as relatively greater multi-homing demand the retailer has higher market power on the content providers' side. A relatively larger share of multi-homing content providers through independent payoff implies lower number of single-homers, this suggests that there is competition for a lesser proportion of content providers. So, prices can be raised to increase profits. On the consumer's side, platforms charge the hotelling price less a term that is function of the cross network externality and the platform affiliation benefit. It is interesting to note that consumer prices fall with a rise in multi-homing resulting from a rise in content provider independent payoff. This result is in contrast with the prices charged to content providers. The reason behind this is due to the difference in homing behavior of the two types of agents. A fall in k results in lesser number of multi-homers and a relatively larger number of single-homers. This allows platforms to charge higher prices to consumers. A larger base of single-homers on one side allows platforms to reduce competition on consumers' side and hence increase prices to consumers due to exclusivity of content.

The total number of content providers rise in both k and ϕ and fall in the transportation costs. A rise in k results in two things, a rise in multi-homers as well as a fall in single-homers and a rise in prices for content providers. It is interesting though that a rise in content provider price still leads to an increase in total number of content providers. The reason behind it is that the increase in value from a rise in k outweighs the price effect due to a rise in k.

Platform profits are falling in the cross network benefits and rising as multi-homers rise due to a rise in content provider independent payoff. We know that a rise in k reduces consumers prices and increases content provider prices. A fall in profit from the reduction in consumer prices is outweighed by the rise in profits from the content providers. In particular, fall in profits from the reduction in prices to consumer is given by

$$\frac{\phi}{4t_S},$$

and the rise in profit from increased price to content providers as well as a higher total number of content providers is given by

$$\frac{2k + \phi}{4t_S}.$$

We can clearly see the rise in profits from content providers with an increase in k is larger than the fall in profits on the consumer side. Even though consumer prices fall a rise in content provider independent payoff allows subsidization of consumers as well as a rise in platform profits. In the next section, we look at the discriminatory pricing regime.

4.4.2 Discriminatory Pricing Regime

We now turn to the discriminatory pricing regime. Platforms charge discriminatory prices contingent on homing behavior. It has been a trend that platforms provide different incentive schemes to content providers in exchange for exclusivity. For example, Apple had an understanding with some of the app developers to provide free marketing on the app-store in exchange for exclusivity on their platforms.[12]

[12] http://appleinsider.com/articles/14/04/21/apple-and-google-bring-fight-for-exclusive-games-to-mobile

Marketing as well as visibility is a big factor for content-providers on mobile platforms in their homing decision. Another example is the video game industry, where independent ("indie") game developers are provided with free marketing as well as material support like software plus equipment.[13]

Let l_i^M be the price charged to multi-homers and l_i^S be the price charged to single-homers. We know that multi-homing occurs when utility from multi-homing is larger than from single-homing

$$U^M > U_1^S \implies y > y_1^* = \frac{-k + l_1^M - l_1^S + l_2^M + t_S - \phi m_2}{t_S} \text{ and}$$

$$U^M > U_2^S \implies y < y_2^* = \frac{k - l_1^M - l_2^M + l_2^S + m_1\phi}{t_S}.$$

As before the total number of content providers on a platform is composed of both single-homers and multi-homers. The total number of content providers, single-homers and multi-homers respectively on platform $i \in \{1, 2\}$ are given by

$$n_1 = y_2^*,\ n_2 = 1 - y_1^*,\ n^M = y_2^* - y_1^*,\ \text{and } n_i^S = n_i - n^M. \tag{4.14}$$

Consumer demands are given by (1) and (2). We solve these demands simultaneously to express them in terms of prices,

$$\begin{aligned}
n_i &= \frac{(2(k - l_i^M - l_j^M + l_j^S) + \phi)(t_S^2 - \phi^2) - \phi((p_i - p_j)t_S + \phi(l_i^S - l_j^S))}{2t_S(t_S^2 - \phi^2)}, \\
m_i &= \frac{t_S(-p_i + p_j + t_S) - \phi(l_i^S - l_j^S + \phi)}{2t_S^2 - 2\phi^2}, \\
n^M &= \frac{2k - 2l_i^M + l_i^S - 2l_j^M + l_j^S - t_S + \phi}{t_S}, \\
n_i^S &= n_i - n^M.
\end{aligned}$$

We substitute these demands into the profit expression of platform i, the platform maximizes

$$\max_{l_i^S, l_i^M, p_i} \Pi_i^D = p_i m_i + l_i^S n_i^S + l_i^M n^M,$$

[13] https://www.wired.com/2013/04/sony-indies/

for $i \in \{1,2\}$. Solving the first-order conditions under a symmetric equilibrium results in the following price relations

$$p_i = \frac{t_S^2 - \phi(l_i^S + \phi)}{t_S} \text{ and } l_i^M = \frac{(2k + 3l_i^S - t_S + \phi)}{6}, \tag{4.15}$$

$$l_i^S = \frac{2(t_S^2 - \phi^2)(-k + 3l_i^M + t_S - \frac{\phi}{2}) - t_S p_i \phi}{4t_S^2 - 3\phi^2}. \tag{4.16}$$

Consumer price is falling in the price charged to single-homers and is independent of the price charged to multi-homers. This again demonstrates the positive effect single-homers have on consumer demand on a platform. While consumer prices and single-homing prices are substitutes, it is interesting to note that single-homing price and multi-homing price are complements. A rise in multi-homing price results in higher single-homing price and vice versa. Discriminatory prices help us clearly view which agents impact consumer demands on a platform. Solving the price relations in equations (4.15)-(4.16) simultaneously results in the following equilibrium prices as described in the lemma below.

Lemma 4.2. *In the discriminatory pricing regime, prices and platform profits are* $l^{S,*} = p^* = t_S - \phi$, $l^{M,*} = \frac{(k+t_S-\phi)}{3}$ *and* $\Pi^{D,*} = \frac{4k^2-4kt_S+19t_S^2+4(k-5t_S)\phi+\phi^2}{18t_S}$ *respectively. The total number of consumers, multi-homing content providers and single-homing content providers on platform* i *are* $m_i^* = \dfrac{1}{2}$, $n_i^{M,*} = \frac{2k-t_S+\phi}{3t_S}$, $n_i^{S,*} = \frac{4t_S-2k-\phi}{6t_S}$ *respectively.*

The total number of content providers on a platform is given as $n_i^* = n_i^{M,*} + n_i^{S,*} = \frac{2(k+t_S)+\phi}{6t_S}$. Consumer prices and the single-homing content provider price are qualitatively similar as in Armstrong (2006) and in Belleflame and Peitz (2010). Specifically, without network effects these prices would be as in the standard hotelling model. In the presence of network effects, they are discounted by the cross network benefits each side obtains. The price charged to the multi-homing content providers is larger (smaller) than those for single-homers when $k > (<) 2(t_S - \phi)$. With k being large enough multi-homing price is larger than single-homing price because multi-homing agents obtain double the independent payoff from joining a platform and this could be extracted through higher prices. Single-homing price falls in the marginal network benefit on a platform and is independent of k. Single-homing content providers as well as consumers are charged the same price. When k is small, multi-homing price is low while single-homing price remains unchanged. This results in $l^{S,*}$ being higher than the prices charged to multi-homers. A small k implies shopping costs are relatively high, single-homing content providers being closer to their preferred platform are less elastic. A higher price can be charged to them to extract their surplus and is independent of k. When k increases, single-homers become more elastic as transportation cost is low relative to k and may want to multi-home. The additional benefit from multi-homing increases and transforms the marginal single-homers into multi-homers. Price are increased for the multi-homers to discourage single-homers becoming multi-homers.

The share of multi-homers rise in the independent payoff and cross network benefit. While the share of single-homers falls and is transformed into multi-homers with a rise in content provider independent payoff as well as cross-network benefit. The fall in number of single-homers in ϕ is interesting. The intuition behind this is that a rise in ϕ makes the presence of a larger base of consumers lucrative for content providers. Since single-homing of consumers allows access of consumers on only one platform, a rise in marginal cross network benefit encourages single-homers to multi-home. Surprisingly, total number of content providers rise in all the parameters discussed above. Even though single homers are falling in k, total number of content providers rises. Again, we find that the price effect is outweighed by the increase in value due to an increase in k. Profit of platform i is given as

$$\Pi^{D,*} = \frac{4k^2 - 4kt_S + 19t_S^2 + 4(k - 5t_S)\phi + \phi^2}{18t_S}.$$

Platform profits rise in the transportation costs, content provider independent pay off and fall in cross-network. This is a standard result in two-sided markets. The rise in platform profits occurs due to extraction of higher independent payoff from the content providers or lowering of price elasticity of agents due to increase in transportation costs.The fall in profits is due to increased competitive pressures from higher cross-network benefits. We compare the profits in the two pricing regimes. Taking the difference in platform profits between the discriminatory regime and non-discriminatory regime

$$\Pi^{D,*} - \Pi^{ND,*} = -\frac{(k + 10(t_S - \phi))(k - 2t_S + 2\phi)}{36t_S}.$$

Proposition 4.1. *When $k < (>)2(t_S - \phi)$, platform profits in the discriminatory pricing regime is higher (lower) than in the non-discriminatory pricing regime.*

We know profits in both the regimes are rising in k. Platform profits in the discriminatory pricing regime are higher than in the non-discriminatory pricing regimes when $k < 2(t_S - \phi)$. This suggests that non-discriminatory regime profits are more sensitive to a change in k. This is because a rise or fall in k affects both sides of the market in the non-discriminatory pricing regime, while in the discriminatory pricing regime it affects only the content provider side. In the discriminatory pricing regime, a fall in k results in lower multi-homing prices while single homing as well as consumer prices remain unchanged. While in the non-discriminatory regime, price incident on both types of content providers fall while consumer prices are rising. When k is relatively small, the total number of content providers on a platform are higher in the discriminatory pricing regime along with single-homing prices being higher. While consumers prices in the non-discriminatory regime rise with a fall in k, consumer price in the discriminatory regime stays constant. Increase in profits due to higher content provider price and larger amount of total number of content providers in the discriminatory pricing regime outweighs the higher consumer prices in the non-discriminatory regime. As k falls this difference gets larger due to greater difference in total number of content providers in the two regimes while consumers which single-home divide equally between platforms.

4.4.3 Consumer Surplus and Welfare Implications

In this subsection, we examine at the welfare and consumer surplus implications of the two pricing regimes. Consumer surplus is denoted as

$$\begin{aligned} CS^g &= 2\int_0^{\frac{1}{2}} (\mu + \phi n^* - p^* - t_S x)dx \\ &= \mu + \phi n^* - p^* - \frac{t_S}{4}, \end{aligned}$$

for $g \in \{D, ND\}$. It is multiplied by two to take into account the symmetry as well as consumer surplus on both the platforms. Consumer surplus in the two regimes is given as

$$\begin{aligned} CS^{ND} &= \mu + \phi\frac{2k + 3\phi}{2t_S} - \frac{5t_S}{4}, \\ CS^D &= \mu + \phi\frac{2k + \phi + 8t_S}{6t_S} - \frac{5t_S}{4}, \end{aligned}$$

where CS^{ND} is the consumer surplus in the non-discriminatory regime and CS^D is the consumer surplus in the discriminatory regime. Consumer surplus is rising in platform affiliation benefit, cross-network externality and falling in transportation costs. Comparing the consumer surplus in the two regimes, we get

$$CS^{ND} - CS^D = \frac{2\phi(k - 2(t_S - \phi))}{3t_S}.$$

It is interesting to note that consumer surplus is higher in the discriminatory pricing regime than in the non-discriminatory pricing regime when $k < 2(t_S - \phi)$. The intuition is straightforward because a low k results in lower consumer prices in the discriminatory regime than in the non-discriminatory regime (i.e., $p^{ND} > p^D$).

Turning to social welfare, we get for the content provider surplus, CPS^g for $g \in \{ND, D\}$, the following expressions under the two regimes:

$$CPS^{ND} = 2\int_0^{n^S} (k + \phi m^* - l_1 - t_S y)dy + (2k + \phi - l_1 - l_2 - t_S)(n^M) = \frac{(k+\phi)^2}{4t_S},$$

$$\begin{aligned} CPS^D &= 2\int_0^{n^S} (k + \phi m^* - l_1^S - t_S y)dy + (2k + \phi - l_1^M - l_2^M - t_S)(n^M) \\ &= \frac{4k^2 - 44t_S^2 + 52t_S\phi + \phi^2 + 4k(8t_S + \phi)}{36t_S}, \end{aligned}$$

comparing the content provider surplus we get

$$CPS^{ND} - CPS^D = \frac{(k - 2t_S + 2\phi)(5k - 22t_S + 4\phi)}{36t_S}.$$

Using the above we get the welfare in the regimes as

$$\begin{aligned} W^g &= CS^g + CPS^g + 2\Pi^g \text{ for } g \in \{D, ND\}, \\ W^{ND} &= \frac{3(k+\phi)^2 - t_S(t_S - 4\mu)}{4t_S}, \\ W^D &= \frac{20k^2 + 16k(t_S + 2\phi) - 13t_S^2 + 4t_S(9\mu + 5\phi) + 11\phi^2}{36t_S}, \\ W^{ND} - W^D &= \frac{(k - 2t_S + 2\phi)(7k - 2t_S + 8\phi)}{36t_S}. \end{aligned}$$

Proposition 4.2. *Consumer surplus and social welfare are higher in the discriminatory (non - discriminatory) pricing regime when* $k < (>) 2(t_S - \phi)$ *than the non-discriminatory (discriminatory) pricing regime.*

When k is relatively large then non-discriminatory pricing regime results in larger platform profits as well as greater consumer surplus in comparison to discriminatory pricing regime. This is because under the non-discriminatory regime consumer prices are lower and platform profits are higher. Platform profits rise due to increase in the total number of content providers as well as the prices charged to them. When k is relatively low, we obtain an interesting result that discriminatory pricing regime is welfare as well as consumer surplus enhancing. Furthermore, the content provider surplus is lower in the discriminatory pricing regime, this negative effect on the social welfare is smaller than the positive effect of platform profits and consumer surplus. Hence, we obtain the increase in welfare.

4.5 Extensions

4.5.1 Endogenous Pricing Regimes

We add a new initial stage zero to our two-stage game in which the platforms decide simultaneously about their pricing regime vis-à-vis content providers which can be either discriminatory, D, or non-discriminatory, ND. This pricing policy stage is similar as in Thisse and Vives (1988). We first start with calculating payoffs when firms set asymmetric tariff regime i.e., one firm decides on a discriminatory regime and the other on a non-discriminatory regime. Let us denote profit of the firm charging non-discriminatory prices as $\Pi^{nd,*}$, while the profit of its rival that charges a discriminatory tariff is given as $\Pi^{d,*}$.

Using our results of the previous section we get the following reduced profits in the first stage of the game (in the Appendix, platform profits for the asymmetric constellations of pricing regimes are derived).

Figure 2 is the payoff matrix for the simultaneous regime choice of the two platforms. We compare profits in the payoff matrix and get the following profit relations.

$$\Pi^{D,*} - \Pi^{nd,*} = \Pi^{d,*} - \Pi^{ND,*} = \frac{(k - 2t_S + 2\phi)^2}{9t_S} > 0. \tag{4.17}$$

We can clearly notice that the above expression is positive for all feasible parameter configurations. This suggests that a discriminatory pricing strategy is clearly the dominant strategy for both agents. This gives us the result that the nash equilibrium is unique and is given by the pricing strategy (D, D).

Proposition 4.3. *If platforms choose pricing strategies simultaneously, a discriminatory pricing strategy will be chosen in equilibrium.*

This results echoes the result as in Thisse and Vives that suggest a discriminatory pricing regime is an equilibrium when firms that compete spatially decide on the pricing regime. The reason behind this result is that discriminatory pricing is more flexible and does better against any generic pricing strategy of a rival. This can be clearly seen in equation (4.17). Moreover, we also confirm that when $k < 2(t_S - \phi)$ the platform profits, consumer surplus and welfare are higher in the discriminatory tariff regime than in the non-discriminatory pricing regime. This result implies that the above equilibrium is Pareto optimal for low values of k. When $k > 2(t_S - \phi)$, the pricing strategy game resembles a prisoner's dilemma where $\Pi^{d,*} > \Pi^{ND,*} > \Pi^{D,*} > \Pi^{nd,*}$. Furthermore, prices charged to the two types of content providers are lower in the discriminatory case than in the non-discriminatory case, while prices

		Player 2	
		ND	D
Player 1	ND	$(\Pi^{ND,*}, \Pi^{ND,*})$	$(\Pi^{nd,*}, \Pi^{d,*})$
	D	$(\Pi^{d,*}, \Pi^{nd,*})$	$(\underline{\Pi^{D,*}}, \underline{\Pi^{D,*}})$

Table 4.1: Payoff matrix for different pricing regime constellations

for consumers are higher in the discriminatory pricing regime. This result again fits with the discussion as in Thisse and Vives (1988). This hurts the consumers and social welfare is lower. It is inefficient from a social planner's perspective. We look at pricing regime collusion as a remedy to solve this inefficiency in the market. This is done through allowing pricing regime collusion among the platforms. We use grim trigger strategies towards this where σ is the discount factor of the repeated game. We obtain that for pricing regime collusion to be sustainable

$$\sigma > \tilde{\sigma} = \frac{\Pi^{d,*} - \Pi^{ND,*}}{\Pi^{d,*} - \Pi^{D,*}} = \frac{4(k - (2t_S - \phi))}{5k + 2(t_S - \phi)} \in [0, 1].$$

This minimum discount factor $\tilde{\sigma}$ is rising in k and ϕ, while it falls in the transportation cost parameter. Pricing regime collusion is harder when content provider independent benefit is higher k or marginal cross-network benefit ϕ is higher. On the other hand, pricing regime collusion is easier when platforms are more differentiated through the increase in transportation costs. Furthermore, a decrease in k implies a greater share of single-homers and hence greater differentiation between platforms resulting in easier pricing regime collusion.

4.5.2 Heterogeneous Consumer Utility Contingent on Homing Behavior

In this subsection, suppose consumers have different utilities for different types of content providers. Let consumers obtain γ from single-homing content providers and ϕ from multi-homing content providers. The utility of a consumer on platform i will be given as

$$u_i = k + \phi(n^M) + \gamma(n^S) - p_i - t_S|x - x_i|,$$

and solving for the indifferent consumer we get consumer demands as,

$$m_1 = \tilde{x} = \frac{1}{2} + \frac{p_2 - p_1 + \gamma(n_1^S - n_2^S)}{2t_S} \text{ and } m_2 = 1 - \tilde{x}. \tag{4.18}$$

The above indifferent We clearly notice that the single-homing content providers are critical for consumer competition. We need to make an assumption on the permitted range of platform affiliation benefit such that both the types of content providers exist on equilibrium.

Assumption 2. $\dfrac{2t_S - \gamma - \phi}{2} < k < \dfrac{4t_S - \gamma - \phi}{2}$.

We solve the game and obtain the following lemma.

Lemma 4.3. *For the two pricing regimes, we get the following equilibrium outcomes.*

- *In non-discriminatory pricing regime, equilibrium prices and the platform profits are given as* $p^* = t_S - \dfrac{\phi(2k + 3\gamma + \phi)}{4t_S}$, $l^* = \dfrac{(2k - \gamma + \phi)}{4}$ *and* $\Pi^* = \dfrac{t_S}{2} + \dfrac{4k^2 - (\gamma + \phi)^2 - 2\gamma\phi}{16t_S}$ *respectively. Total number of content providers are given as* $n^* = \dfrac{2k + \gamma + \phi}{4t_S}$.
- *In the discriminatory pricing regime, equilibrium prices and the platform profits are given as* $p^* = t_S - \phi$, $l^S = t_S - \gamma$, $l^{M,*} = \dfrac{(2k - 3\gamma + \phi + 2t_S)}{6}$ *and* $\Pi^* = \frac{-9\gamma t_S + 4k^2 - 4kt_S + 4k\phi + 19t_S^2 - 11t_S\phi + \phi^2}{18t_S}$ *respectively. Total number of content providers are given as* $n^* = \dfrac{2(k + t_S) + \phi}{6t_S}$.

Non-discriminatory platform profits are higher than discriminatory when k is relatively large. Specifically, for $k > \dfrac{4t_S - 3\gamma - \phi}{2}$, the non-discriminatory regime results in higher platform profits than the discriminatory regime. This confirms our benchmark results. Furthermore, comparing platform profits in the two regimes with profits when consumers have homogeneous marginal network benefit. We obtain the following proposition.

Proposition 4.4. *When* $\gamma > (<)\phi$ *exclusive content is valued more (less) than common content, platform profits are lower (higher) in both the regimes than the platform profits when consumers have homogeneous marginal network benefits.*

This is an interesting but counterintuitive result. It suggests that higher consumer value for single-homing content results in lower platform profits. The reason behind this is that higher utility for exclusive content results in greater competition for content providers and this leads to feedback effects where consumer price as well as content provider price falls.

4.5.3 Heterogeneous Intrinsic Benefit for Content Providers

In this subsection, we suppose that different independent payoff are provided to multi-homing and single-homing content providers. For example, platforms could provide better consumer accessibility to single homers. Spotify for instance, was found discriminating against artists who released songs on Spotify after releasing on another platform by burying their results or not promoting a song on their play lists.[14] Let's denote k_S as the independent payoff for single-homers and k the independent payoff for multi-homers.

Assumption 3. $2k - 2t_S + \dfrac{\phi}{2} < k_S < 2k - (t_S - \phi)$.

This assumption is made so that both types of agents exist in the market. The utility of a single-homing content provider on platform i and address y is given as

$$U_i = k_S + \phi m_i - l_i - t_S|y_i - y|,$$

while the utility of the multi-homers and consumers do not change. We solve for the equilibrium prices in the two pricing regimes and obtain the following lemma.

Lemma 4.4. *For the two pricing regimes we get the following equilibrium outcomes.*

- *In the non-discriminatory pricing regime, equilibrium prices and platform profits are given as* $l^* = k - \dfrac{k_S}{2}$, $p^* = t_S - \dfrac{(2k - k_S + 2\phi)\phi}{2t_S}$ *and* $\Pi^* = \frac{(k_S-2k)^2+2(t_S-\phi)(t_S+\phi)}{4t_S}$ *respectively. Total number of content providers are given as* $n^* = \frac{2k-k_S+\phi}{2t_S}$.
- *In the discriminatory pricing regime, equilibrium prices and platform profits are given as* $p^* = l^S = t_S - \phi$, $l^{M,*} = \dfrac{(2k - k_S - \phi + t_S)}{3}$ *and* $\Pi^* = \frac{4((k-k_S)^2+(k_S-2k)(t_S-\phi))+\phi^2+19t_S^2-20t_S\phi}{18t_S}$ *respectively. Total number of content providers are given as* $n^* = \frac{4k-2k_S+2t_S+\phi}{6t_S}$.

[14] https://www.bloomberg.com/news/articles/2016-08-26/spotify-said-to-retaliate-against-artists-with-apple-exclusives

Comparative statics on the profits in the two-regimes give some interesting results. When $k_S > 2k - 2(t_S - \phi)$, then discriminatory pricing regime results in higher profits. This gives us the interesting result that high platform independent payoff of single-homers in discriminatory pricing regime result in higher platform profits. The reason behind this is that in the non-discriminatory case platforms are unable to charge the single-homers separately. This results in a fall in prices for the single-homers along with single-homers comprising a higher proportion of the total number of content providers. In the discriminatory pricing regime, platforms are able to charge different prices to the content providers and hence result in higher profits as the prices to single-homing content providers are not impacted by a rise in k_S. This results in higher profits in the discriminatory regime with a large k_S. Moreover, we can notice that a higher platform independent payoff k for multi-homers confirms our previous idea that with higher k discriminatory prices are lower. This is due to the fact that k and k_S act in the opposite direction on the platform profits. This section shows us how higher single-homing platform independent payoff can impact platform profits.

Comparing these profits with our benchmark case, when $k_S > k$, platform profits in this setting is lower than in our benchmark setting where content providers obtain homogeneous independent payoff. This result of ours echoes with the previous result that if exclusivity is valued more either on the content provider's side or on consumer's side, we get lower platform profits.

4.5.4 Economies of Scale

Here we look at the impact of economies of scale in our model. Let's suppose that multi-homers have economies of scale when moving from one platform to another i.e., multi-homing. This can be understood as reduction in planning and creativity costs or also ease of porting content onto another platform. Let $\delta \in [0, 1]$ be the parameter describing economies of scale for multi-homers.

Assumption 4. $t_S - \phi < k < (2 - \delta)t_S - \phi$.

The above assumption ensures that both types of content providers are present in the market. The payoff of a multi-homer in the non-discriminatory regime is then given as

$$U^M = 2k + \phi - l_1 - l_2 - t_S(1 - \delta),$$

while in the discriminatory regime, the corresponding prices are just replaced by l_1^M and l_2^M.

Lemma 4.5. *For the two pricing regimes, we get the following equilibrium outcomes.*

- *In the non-discriminatory regime, equilibrium prices and platform profits are given as* $l^* = \frac{(\delta t_S + k)}{2}$, $p^* = t_S - \frac{(k+2\phi+\delta t_S)\phi}{2t_S}$, $\Pi^{D,*} = \frac{t_S}{2} + \frac{(k+\delta t_S)^2 - 2\phi^2}{4t_S}$ *respectively. Total number of content providers are given as* $n^* = \frac{\delta t_S + k + \phi}{2t_S}$
- *In the discriminatory regime, equilibrium prices and platform profits are given as* $p^* = l^S = t_S - \phi$, $l^{M,*} = \frac{(k-\phi+t_S(1+\delta))}{3}$ *and* $\Pi^{ND,*} = \frac{(4(\delta-1)\delta+19)t_S^2 + 4(\delta-5)t_S\phi + 4k^2 + 4k((2\delta-1)t_S+\phi)+\phi^2}{18t_S}$. *Total number of content providers are given as* $n^* = \frac{2(\delta t_S + k + t_S)+\phi}{6t_S}$.

We find that for $k > 2(t_S - \phi) - \delta t_S$, profit under the non-discriminatory pricing regime results in higher profits in comparison to the discriminatory pricing regime. As δ rises this result is feasible for a larger parameter range. This result provides us with the insight that greater compatibility between platforms non-discriminatory pricing regime would be preferred by platforms. Further, comparing the platform profits in these two pricing regime along with economies of scale with our benchmark case we find that economies of scale result in higher platform profits.

4.6 Conclusion

We analyze the effects of price discrimination based on homing behavior on the competition in markets with indirect network effects. In particular, we develop a variant of the competitive bottleneck model with single-homing consumers and where content providers endogenously decide on their homing behavior given their compatibility towards a platform.

This analysis was motivated by the prevailing condition in the mobile phone OS market as well as the gaming industry where two main competing platforms exist. In these industries, we notice the presence of both exclusive as well as common content on a platform. In our setting, on the Hotelling line there exist two types of content providers: the multi-homers in the center and single-homers on the extreme ends. Content providers who are more compatible with a platform prefer single-homing while content providers in the center who are relatively indifferent between joining the two platforms port their content on both the platforms and multi-home.

We find that in a model with non-discriminatory pricing regime, consumer prices fall with a rise in content provider independent payoff. As content providers' independent payoff falls there exists a relatively larger share of single-homers and lower share of multi-homers. This allows platforms to charge higher consumer prices due to the presence of a larger gamut of exclusive content. The profits of platforms are rising in this independent payoff. This is because the price effect due to an increase in content providers' independent payoff is outweighed by the value effect resulting in larger number of total content providers. This allows platforms to obtain a larger payoff from a bigger pool of content providers. The main result of our paper is that a discriminatory pricing regime leads to lower profits than the non-discriminatory regime for large independent payoff. The intuition here is that platform profits in the non-discriminatory are more susceptible to changes in independent payoffs as they cannot discriminate between content providers. Since profits are rising in independent payoffs, large independent payoffs imply greater profits in the non-discriminatory regime than the discriminatory regime. On the other hand, low independent payoffs result in lower platform profits in the non-discriminatory regime than the discriminatory regime. Price discrimination and its impact on competition in a one-sided setting has been debated extensively. We add to this debate in a two-sided framework. We find that content provider independent payoff is crucial when making homing decisions and hence influences platform profits. We further find that consumer surplus and welfare are higher in the discriminatory pricing regime for low levels of content provider independent payoff.

We then look at some extensions of our model. Firstly, we let pricing regime be endogenous and decided simultaneously at stage zero. We find that the price discrimination regime is a long run equilibrium outcome. Then we look at variants of our model and show that our results are robust. We start by looking at the case when consumers obtain different marginal benefits from multi-homing and single-homing agents on the other side. Then we analyze the case where single-homers are provided different independent payoff of being on a platform than multi-homers. Finally, we look at how our results vary with economies of scale. All of these variations of our benchmark model confirm our main result that relatively higher content provider independent payoffs result in lower platform profits in the discriminatory pricing regime.

In our model, we have assumed that homing behavior is common knowledge and contracts are perfectly enforceable. This assumption is justified as in the mobile-industry as well as gaming industry a platform can confirm the presence of specific content on the rival platform with little or no cost. This allows platforms to formulate binding contracts.

An extension to our model could focus on the direction where content providers obtain negative network benefits from a larger presence of content providers. Another direction for further research could be where consumers are charged different prices for single-homing and exclusive content. This may provide interesting intuition into the pricing strategies of premium content on a platform and its implications on competition.

4.A Appendix

Proof of Lemma 3. *Non-Discriminatory Pricing Regime:* We solve the consumer and content provider demands in (4.18) and (4.8) simultaneously and get the following reduced demands,

$$
\begin{aligned}
n_i &= \frac{-\gamma\phi^2 + \phi(\gamma(-2k + l_i + l_j) + t_S(-p_i + p_j + t_S)) + 2t_S^2(k - l_i)}{2\left(t_S^3 - \gamma t_S \phi\right)}, \\
m_i &= \frac{\gamma(l_i - l_j + \phi) + t_S(p_i - p_j - t_S)}{2\gamma\phi - 2t_S^2}.
\end{aligned}
$$

The resulting profit of each platform in the non-discriminatory pricing regime is given as

$$\Pi_i^{ND} = p_i m_i + l_i n_i,$$

Solving the first order conditions with respect to p_i and l_i we get the following price relations

$$
\begin{aligned}
p_i &= \frac{-\gamma\phi - l_i(\gamma + \phi) + \gamma l_j + t_S(p_j + t_S)}{2t_S}, \\
l_i &= \frac{2k\left(t_S^2 - \gamma\phi\right) + \phi(\gamma(l_j - \phi) + t_S(p_j + t_S)) - p_i t_S(\gamma + \phi)}{4t_S^2 - 2\gamma\phi}.
\end{aligned}
$$

Using symmetry and solving simultaneously we get

$$
\begin{aligned}
p^* &= t_S - \frac{\phi(2k + 3\gamma + \phi)}{4t_S}, \\
l^* &= \frac{(2k - \gamma + \phi)}{4},
\end{aligned}
$$

and the resulting platform profits as $\Pi^{ND,*} = \frac{t_S}{2} + \frac{4k^2 - (\gamma + \phi)^2 - 2\gamma\phi}{16t_S}$, total number of content providers are given as $n^* = \frac{2k + \gamma + \phi}{4t_S}$.

Discriminatory Pricing Regime: We solve simultaneously the content provider and consumer demands as in (4.4.2) and(4.18) and obtain the following reduced demands

$$
\begin{aligned}
n_i &= \frac{\begin{array}{l}-\gamma\phi^2 + \phi(t_S(-p_i + p_j + t_S) \\ \quad - \gamma(2k - 2l_i^M + l_i^S - 2l_j^M + l_j^S)) + 2t_S^2(k - l_i^M - l_j^M + l_j^S)\end{array}}{2(t_S^3 - \gamma t_S \phi)}, \\
m_1 &= \frac{\gamma(l_1^S - l_2^S + \phi) + t_S(p_1 - p_2 - t_S)}{2\gamma\phi - 2t_S^2} \text{ and } m_2 = 1 - m_1, \\
n_i^S &= 1 - n_j \text{ for } i \neq j \in \{1, 2\}, \\
n^M &= n_1 - n_1^S = n_2 = n_2^S,
\end{aligned}
$$

profit of the platform is given as

$$\Pi_i^D = p_i m_i + l_i^S n_i^S + l_i^M n^M,$$

taking first order conditions with respect to p_i, l_i^S and l_i^M we get the following price relations,

$$
\begin{aligned}
p_i &= \frac{-\gamma\phi - l_i^S(\gamma + \phi) + \gamma l_j^S + t_S(p_j t_S)}{2t_S}, \\
l_i^S &= \frac{\begin{array}{l}\gamma\phi^2 + \phi(-2\gamma t_S + \gamma(2k - 4l_i^M - 2l_j^M + l_j^S) + p_j t_S - t_S^2) \\ \quad + 2t_S^2(-k + 2l_i^M + l_j^M + t_S) - p_i t_S(\gamma + \phi)\end{array}}{4t_S^2 - 2\gamma\phi}, \\
l_i^M &= \frac{(2k + 2l_i^S - 2l_j^M + l_j^S - t_S + \phi)}{4}.
\end{aligned}
$$

Using symmetry and solving simultaneously we get

$$
\begin{aligned}
p^* &= t_S - \phi, \\
l^S &= t_S - \gamma, \\
l^{M,*} &= \frac{(2k - 3\gamma + \phi + 2t_S)}{6}.
\end{aligned}
$$

The resulting platform profits and total number of content provider are

$$
\begin{aligned}
\Pi^{D,*} &= \frac{-9\gamma t_S + 4k^2 - 4kt_S + 4k\phi + 19t_S^2 - 11t_S\phi + \phi^2}{18t_S} \text{ and} \\
n^* &= \frac{2(k + t_S) + \phi}{6t_S} \text{ respectively.}
\end{aligned}
$$

Taking the difference between platform profits in the two regimes, we obtain

$$\Pi^{ND,*} - \Pi^{D,*} = \frac{(-3\gamma + 2k + 20t_S - 17\phi)(3\gamma + 2k - 4t_S + \phi)}{144t_S}$$

we can see that the above expression is positive for $k > \frac{4t_S - 3\gamma - \phi}{2}$.

Proof of Lemma 4. *Non-Discriminatory Pricing Regime:* The payoff of a single-homer on platform 1 in the non-discriminatory regime is then given as

$$U_1 = k_S + \phi m_1 - l_1 - t_S(y),$$

and on platform 2 is

$$U_2 = k_S + \phi m_2 - l_2 - t_S(1-y).$$

The corresponding demands of the content providers are given by

$$U^M > U_1 \implies y > y_1^* = \frac{-2k + k_S + l_2 + t_S + m_1\phi - \phi}{t_S}$$

and

$$U^M > U_2 \implies y < y_2^* = \frac{2k - k_S - l_1 + m_1\phi}{t_S}$$

This results in the following content provider demands on the two platforms as $n_1 = y_2^*$ and $n_2 = 1 - y_1^*$. We solve simultaneously n_1, n_2 and consumer demands are as in (4.6) and (4.7) to get the following demands

$$\begin{aligned}
m_1 &= \frac{t_S(-p_1 + p_2 + t_S) - \phi(l_1 - l_2 + \phi)}{2(t_S - \phi)(t_S + \phi)}, \\
m_2 &= 1 - m_1 \\
n_i &= \frac{\phi^2(-4k + 2k_S + l_i + l_j) - 2t_S^2(-2k + k_S + l_i) + t_S\phi(-p_i + p_j + t_S) - \phi^3}{2t_S(t_S - \phi)(t_S + \phi)}.
\end{aligned}$$

The resulting profit of each platform in the non-discriminatory pricing regime is given as

$$\Pi_i^{ND} = p_i m_i + l_i n_i.$$

We solve first-order conditions with respect to p_i and l_i and obtain the following price relations

$$\begin{aligned}
p_i &= \frac{\phi(-2l_i + l_j - \phi) + t_S(p_j + t_S)}{2t_S}, \\
l_i &= \frac{\phi^2(-4k + 2k_S + l_j) + 2t_S^2(2k - k_S) + t_S\phi(-2p_i + p_j + t_S) - \phi^3}{4t_S^2 - 2\phi^2}.
\end{aligned}$$

Using symmetry and solving simultaneously, we get

$$p^* = t_S - \frac{(2k - k_S + 2\phi)\phi}{2t_S},$$
$$l^* = k - \frac{k_S}{2},$$

and the resulting platform profits as $\Pi^{D,*} = \frac{(k_S-2k)^2+2(t_S-\phi)(t_S+\phi)}{4t_S}$, total number of content providers are given as $n^* = \frac{2k-k_S+\phi}{2t_S}$.

Discriminatory Pricing Regime: The payoff of a single-homer of platform in the discriminatory regime is then given by

$$U_1 = k_S + \phi(m_1) - l_1^S - t_S(y),$$

and on platform 2 is

$$U_2 = k_S + \phi * m_2 - l_2^S - t_S(1-y).$$

The corresponding demands of the content providers are given by

$$U^M > U_1 \implies y > y_1^* = \frac{-2k + k_S + l_1^M - l_1^S + l_2^M + t_S + m_!\phi - \phi}{t_S}$$

and

$$U^M > U_2 \implies y < y_2^* = \frac{2k - k_S - l_1^M - l_2^M + l_2^S + m_1\phi}{t_S}.$$

This results in the following content provider demands on the two platforms as $n_1 = y_2^*$ and $n_2 = 1 - y_1^*$. We solve simultaneously n_1, n_2 and consumer demands are as in (4.6) and (4.7) to get the following demands

$$\begin{aligned}
m_1 &= \frac{t_S(-p_1 + p_2 + t_S) - \phi(l_1 - l_2 + \phi)}{2(t_S - \phi)(t_S + \phi)}, \\
m_2 &= 1 - m_1, \\
n_i &= \frac{1}{4}(\frac{2(4k - 2k_S - 2l_i^M + l_i^S - 2l_j^M + l_j^S)}{t_S} + \frac{-l_i^S + l_j^S - p_i + p_j}{t_S - \phi} \\
&\quad + \frac{-l_i^S + l_j^S + p_i - p_j}{t_S + \phi} + \frac{2\phi}{t_S}), \\
n_i^S &= 1 - n_j, \\
n^M &= n_i - n_i^S.
\end{aligned}$$

the profit of the platform is given by

$$\Pi_i^D = p_i m_i + l_i^S n_i^S + l_i^M n^M.$$

Solving the first order conditions with respect to p_i and l_i, we get the following price relations,

$$\begin{aligned}
p_i &= \frac{\phi(-2l_i^S + l_j^S - \phi) + t_S(p_j + t_S)}{2t_S}, \\
l_i^S &= \frac{\begin{array}{r}\phi^2(4k - 2k_S - 4l_i^M - 2l_j^M + l_j^S - 2t_S) + 2t_S^2(-2k + k_S + 2l_i^M + l_j^M + t_S) \\ + t_S\phi(-2p_i + p_j - t_S) + \phi^3\end{array}}{4t_S^2 - 2\phi^2}, \\
l_i^M &= \frac{(4k - 2k_S + 2l_i^S - 2l_j^M + l_j^S - t_S + \phi)}{4}.
\end{aligned}$$

Using symmetry and solving simultaneously we get

$$\begin{aligned}
p^* = l^S &= t_S - \phi, \\
l^{M,*} &= \frac{(2k - k_S - \phi + t_S)}{3},
\end{aligned}$$

and the resulting platform profits and total number of content providers are respectively given as

$$\Pi^{D,*} = \frac{4((k - k_S)^2 + (k_S - 2k)(t_S - \phi)) + \phi^2 + 19t_S^2 - 20t_S\phi}{18t_S} \text{ and} \quad (4.19)$$

$$n^* = \frac{4k - 2k_S + 2t_S + \phi}{6t_S}. \quad (4.20)$$

Proof of Lemma 5. *Non-Discriminatory Pricing Regime:* The payoff of a multi-homer in the non-discriminatory regime is then given as

$$U^M = 2k + \phi - l_1 - l_2 - t_S(1 - \delta),$$

The corresponding demands of the content providers are given by

$$U^M > U_1 \implies y > y_1^* = \frac{-\delta t_S - k + l_2 + t_S + m_1\phi - \phi}{t_S}$$

and

$$U^M > U_2 \implies y < y_2^* = \frac{\delta t_S + k - l_1 + m_1\phi}{t_S}.$$

This results in the following content provider demands on the two platforms as $n_1 = y_2^*$ and $n_2 = 1 - y_1^*$. We solve simultaneously n_1, n_2 and consumer demands are as in (4.6) and (4.7) to get the following demands

$$\begin{aligned} m_1 &= \frac{t_S(-p_1+p_2+t_S)-\phi(l_1-l_2+\phi)}{2(t_S-\phi)(t_S+\phi)}, \\ m_2 &= 1-m_1, \\ n_i &= \frac{2t_S^2(\delta t_S+k-l_i)+\phi^2(-2\delta t_S-2k+l_i+l_j)+t_S\phi(-p_i+p_j+t_S)-\phi^3}{2t_S(t_S-\phi)(t_S+\phi)}. \end{aligned}$$

Given the demands above, the profit of each platform in the non-discriminatory pricing regime is given as

$$\Pi_i^{ND} = p_i m_i + l_i n_i.$$

We solve first-order conditions with respect to p_i and l_i we get the following price relations

$$\begin{aligned} p_i &= \frac{\phi(-2l_i+l_j-\phi)+t_S(p_j+t_S)}{2t_S}, \\ l_i &= \frac{2t_S^2(\delta t_S+k)+\phi^2(-2\delta t_S-2k+l_j)+t_S\phi(-2p_i+p_j+t_S)-\phi^3}{4t_S^2-2\phi^2}. \end{aligned}$$

Using symmetry and solving simultaneously, we get

$$\begin{aligned} p^* &= -\frac{\delta t_S\phi+\phi(k+2\phi)-2t_S^2}{2t_S}, \\ l^* &= \frac{1}{2}(\delta t_S+k). \end{aligned}$$

and the resulting platform profits as $\Pi^{ND,*} = \dfrac{t_S}{2} + \frac{(k+\delta t_S)^2-2\phi^2}{4t_S}$, total number of content providers are given as $n^* = \frac{\delta t_S+k+\phi}{2t_S}$.

Discriminatory Pricing Regime: The payoff of the single-homer remains as in (4.4). The payoff of a multi-homer in the discriminatory regime is then given by

$$U^M = 2k+\phi-l_1^M-l_2^M-t_S(1-\delta),$$

The corresponding demands of the content providers are given by

$$U^M > U_1 \implies y > y_1^* = \frac{-\delta t_S-k+l_1^M-l_1^S+l_2^M+t_S+m_1\phi-\phi}{t_S}$$

and

$$U^M > U_2 \implies y < y_2^* = \frac{\delta t_S+k-l_1^M-l_2^M+l_2^S+m_1\phi}{t_S}.$$

This results in the following content provider demands on the two platforms as $n_1 = y_2^*$ and $n_2 = 1-y_1^*$. We solve simultaneously n_1, n_2 and consumer demands are as in (4.6) and (4.7) to get the following demands

$$
\begin{aligned}
m_1 &= \frac{t_S(-p_1+p_2+t_S)-\phi(l_1^S-l_2^S+\phi)}{2(t_S-\phi)(t_S+\phi)},\\
m_2 &= 1-m_1,\\
n_i &= \frac{1}{4}(4\delta+\frac{2(2k-2l_i^M+l_i^S-2l_j^M+l_j^S)}{t_S}+\frac{-l_i^S+l_j^S-p_i+p_j}{t_S-\phi}\\
&\quad +\frac{-l_i^S+l_j^S+p_i-p_j}{t_S+\phi}+\frac{2\phi}{t_S}),\\
n_i^S &= 1-n_j,\\
n^M &= n_i-n_i^S.
\end{aligned}
$$

Given the demands above, the profit of each platform in the discriminatory pricing regime is given as

$$\Pi_i^D = p_i m_i + l_i^S n_i^S + l_i^M n^M.$$

We solve first-order conditions with respect to p_i and l_i we get the following price relations

$$
\begin{aligned}
p_i &= \frac{\phi(-2l_i^S+l_j^S-\phi)+t_S(p_j+t_S)}{2t)S},\\
l_i^S &= \frac{2t_S^2(-\delta t_S-k+2l_i^M+l_j^M+t_S)+\phi^2(2(\delta-1)t_S+2k-4l_i^M-2l_j^M+l_j^S) + t_S\phi(-2p_i+p_j-t_S)+\phi^3}{(4t_S^2-2\phi^2)},\\
l_i^M &= \frac{1}{4}(2\delta t_S+2k+2l_i^S-2l_j^M+l_j^S-t_S+\phi).
\end{aligned}
$$

Using symmetry and solving simultaneously, we get

$$
\begin{aligned}
p^* = l^{S,*} &= t_S-\phi,\\
l^{M,*} &= \frac{1}{3}(\delta t_S+k+t_S-\phi).,
\end{aligned}
$$

and the resulting platform profits as $\Pi^{D,*} = \frac{(4(\delta-1)\delta+19)t_S^2+4(\delta-5)t_S\phi+4k^2+4k((2\delta-1)t_S+\phi)+\phi^2}{18t_S}$, total number of content providers are given as $n^* = \frac{2(\delta t_S+k+t_S)+\phi}{6t_S}$.

Taking the difference between the profits in the two pricing regimes, we obtain the following expression

$$\Pi^{D,*}-\Pi^{ND,*} = -\frac{((\delta+10)t_S+k-10\phi)((\delta-2)t_S+k+2\phi)}{36t_S}.$$

This expression clearly implies that when $k < 2(t_S-\phi)-\delta t_S$, the discriminatory pricing regime results in higher profits. When $k > 2(t_S-\phi)-\delta t_S$, the non-discriminatory pricing regime results in higher profits.

Derivation of platform profits in the table in section 5.1 Without loss of generality let us assume that firm 2 is the firm that discriminatory pricing regime and firm 1 chooses the non-discriminatory pricing regime. The payoff of single-homer at platform 1 is given by

$$U_1 = k + \phi m_1 - l_1 - t_S(y)$$

and payoff of the single-homing content provider at platform 2 is given by

$$U_2 = k + \phi m_2 - l_2^S - t_S(1-y)$$

The payoff of a multi-homer is then given by

$$U^M = 2k + \phi - l_1 - l_2^M - t_S.$$

The corresponding demands of the content providers are given by

$$U^M > U_1 \implies y > y_1^* = \frac{-k + l_2^M + t_S + m_1\phi - \phi}{t_S}$$

and

$$U^M > U_2 \implies y < y_2^* = \frac{k - l_1 - l_2^M + l_2^S + m_1\phi}{t_S}.$$

This results in the following content provider demands on the two platforms as $n_1 = y_2^*$ and $n_2 = 1 - y_1^*$. We solve simultaneously n_1, n_2 and consumer demands are as in (4.6) and (4.7) to get the following demands

$$\begin{aligned}
m_1 &= \frac{t_S(-p_1 + p_2 + t_S) - \phi(l_1 - l_2^S + \phi)}{2(t_S - \phi)(t_S + \phi)}, \\
m_2 &= 1 - m_1, \\
n_1 &= \frac{2t_S^2(k - l_1 - l_2^M + l_2^S) + \phi^2(-2k + l_1 + 2l_2^M - l_2^S) + t_S\phi(-p_1 + p_2 + t_S) - \phi^3}{2t_S(t_S - \phi)(t_S + \phi)}, \\
n_2 &= \frac{\phi^2(-2k + l_1 + 2l_2^M - l_2^S) + 2t_S^2(k - l_2^M) + t_S\phi(p_1 - p_2 + t_S) - \phi^3}{2t_S(t_S - \phi)(t_S + \phi)}, \\
n_i^S &= 1 - n_j, \\
n^M &= n_1 - n_2.
\end{aligned}$$

Given the demands above, the profit of platform 1 is given by

$$\Pi_1^{nd} = p_1 m_1 + l_1 n_1.$$

We solve the first-order conditions and get the following price relations

$$\begin{aligned} p_1 &= \frac{\phi(-2l_1 + l_2^S - \phi) + t_S(p_2 + t_S)}{2t_S}, \\ l_1 &= \frac{2t_S^2(k - l_2^M + l_2^S) - \phi^2(2k - 2l_2^M + l_2^S) + t_S\phi(-2p_1 + p_2 + t_S) - \phi^3}{4t_S^2 - 2\phi^2}. \end{aligned}$$

Profit of platform 2 is given by

$$\Pi_2^d = p_2 m_2 + l_2^S n_2^S + l_2^M n_2^M.$$

We solve first-order conditions with respect to p_2, l_2^S and l_2^M we get the following price relations

$$\begin{aligned} p_2 &= \frac{\phi(-2l_2^S + l_1^S - \phi) + t_S(p_1 + t_S)}{2t)S}, \\ l_2^S &= \frac{2t_S^2(-k + l_1 + 2l_2^M + t_S) - \phi^2(-2k + l_1 + 4l_2^M + 2t_S) + t_S\phi(p_1 - 2p_2 - t_S) + \phi^3}{4t_S^2 - 2\phi^2}, \\ l_2^M &= \frac{1}{4}(2k - l_1 + 2l_2^S - t_S + \phi). \end{aligned}$$

We solve the above price relations simultaneously and get the following equilibrium prices.

$$\begin{aligned} p_1^* &= -\frac{\phi(k + 2\phi) - 3t_S^2 + t_S\phi}{3t_S}, \\ l_1^* &= \frac{1}{3}(k + t_S - \phi), \\ p_2^* &= -\frac{\phi(k + 2\phi) - 6t_S^2 + 4t_S\phi}{6t_S}, \\ l_2^{S,*} &= \frac{1}{6}(k + 4t_S - 4\phi), \\ l_2^{M,*} &= \frac{k}{2}. \end{aligned}$$

and the resulting platform profits for platform 1 and 2 are given by $\Pi_1^{nd,*} = \frac{2k^2 - 4\phi(k+t_S) + 4kt_S + 11t_S^2 - 7\phi^2}{18t_S}$ and $\Pi_2^{d,*} = \frac{13k^2 + 16k(\phi - t_S) + 2(t_S - \phi)(17t_S + \phi)}{36t_S}$. The total number of content providers on platform 1 are given as $n_1^* = \frac{2(k+t_S)+\phi}{6t_S}$ and on platform 2 is given by $n_2^* = \frac{k+\phi}{2t_S}$.

We get the following platform profit relations.

$$\Pi^{D,*} - \Pi_1^{nd,*} = \Pi_2^{d,*} - \Pi^{ND,*} = \frac{(k - 2t_S + 2\phi)^2}{9t_S} > 0.$$

Chapter 5

Conclusion

In this thesis, I presented three papers on industrial organizations. Chapter 2, analyzes the vertical relationship in presence of countervailing power as well as shopping costs. Competition is between large multi-product retailers and small specialized stores. The presence of these two retail formats along with consumers having heterogeneous shopping costs results in a dichotomy in consumer shopping behavior namely, onestop shopping and multistop shopping. One stop shoppers create buyer power for the large retailer. While multistop shoppers create incentives to price discriminate and extract profits larger than when it would be a monopolist. This result of profits being greater than monopoly stems from screening of consumers in to multistop shoppers and onestop shoppers. The supplier when setting wholesale prices can influence this proportion of multihomers and hence influence the profit of the large retailer. It is assumed that contracts between the supplier and large retailer are take it or leave it two-part tariff contracts. When the retailer does not have countervailing power (credible threat of demand side substitution), the supplier sets wholesale prices that are industry profit maximizing. The intuition here is that, since the supplier is the residual claimant of the large retailer's profit through fixed fees, it maximizes the total surplus while satisfying the participation constraint of the large retailer. On the other hand, when the large retailer does have countervailing power, wholesale prices are higher. The intuition for this result is that by increasing wholesale prices the supplier reduces screening and hence the outside option. This increase in wholesale prices also results in a fall in industry surplus as well as consumer welfare.

In Chapter 3, the main aim of this chapter is to provide clear cut policy implications of the recent debates on partial ownerships. The European commission has in recent years, in its staff working paper on merger control cited the anti-competitive impact of partial ownerships on effective merger control policy. This chapter adds to this debate on merger control and provide the tradeoffs between two remedies proposed namely, forward looking price test and the safeharbor rule, in this chapter. It focuses on the information learning of synergy aspect of partial ownerships. In our model, synergies are realized only ex-post and hence, the match value of synergies in the merger is also known only later. When going for a direct merger strategy, it creates a downside risk for the merging firms as well as consumers. Partial ownerships reduce this downside risk by allowing sequential merger through the acquisition of a partial ownership and learning the match value of synergies between the two firms in case of a merger. Further implications for a merger control approach to the PPO acquisitions are derived, where a forward looking price test and a safeharbor rule is examined. From a consumer surplus perspective, on the one hand, the price test is more restrictive and hence some consumer surplus enhancing mergers are rejected leading to type I errors. The safe harbor rule, on the other hand, is less restrictive compared to the consumer surplus standard and hence allows some consumer surplus reducing mergers resulting in type II errors. Moreover, from a social welfare perspective, merger control should be even more lenient, because every merger proposal increases producer surplus such that even mergers under the sneaky takeover strategies are socially desirable.

In Chapter 4, the focus is on the impact of two pricing regimes namely, discriminatory and non-discriminatory pricing regimes, on competition and consumer prices, in a competitive two-sided market where content providers can multi-home or single-home. The internet economy in recent times, has clearly demonstrated the importance of exclusive content on a platform. Towards modeling platform competition, a competitive bottleneck model is utilized. On the one side, consumers single-home, while on the other side, content providers can multi-home as well as single-home. Consumer prices rise when the share of single-homers increases in the non-discriminatory case, while they stay constant in the discriminatory pricing regime. A discriminatory pricing regime leads to higher platform profits than the non-discriminatory regime when the share of single-homers are relatively high. When the share of single-homers is relatively high (low), the discriminatory pricing regime leads to higher (lower) consumer surplus and social welfare when compared with the non-discriminatory regime. Furthermore, the robustness of our results are checked in many variations of our model.

Bibliography

Allain, M.-L. and Chambolle, C. (2011), Anticompetitive effects of resale-below-cost laws, International Journal of Industrial Organization 29, 373-385.

Armstrong, M. (2006), Competition in Two-Sided Markets, Rand Journal of Economics 37, 668-691.

Armstrong, M. and Wright, J. (2007), Two-Sided Markets, Competitive Bottlenecks and Exclusive Contracts, Economic Theory 32, 353-380.

Banal-Estañol, A., Heidhues, P., Nitsche, R., and Seldeslachts, J. (2010), Screening and Merger Activity, Journal of Industrial Economics 58, 794-817.

Barclay, M.J. and Holderness, C.G. (1991), Negotiated Block Trades and Corporate Control, Journal of Finance 46, 861-878.

Barney, J.B. (1988), Returns to Bidding Firms in Mergers and Acquisitions: Reconsidering the Relatedness Hypothesis, Strategic Management Journal 9, 71-78.

Bonnet, C., and Dubois, P. (2010), Inference on vertical contracts between manufacturers and retailers allowing for nonlinear pricing and resale price maintenance, RAND Journal of Economics 41, 139-164.

Bresnahan, T.F. and Salop, S.C. (1986), Quantifying the Competitive Effects of Production Joint Ventures, International Journal of Industrial Organization 4, 155-175.

Bresnahan, T., Orsini, J. and Yin, P. (2014), Platform Choice by Mobile App developers, Mimeo.

Cabral, L.M.B. (2003), Horizontal Mergers with Free-entry: Why Cost Efficiencies May be a Weak Defense and Asset Sales a Poor Remedy, International Journal of Industrial Organization 21, 607-623.

Caprice, S. (2006), Multilateral Vertical Contracting with an Alternative Supply: The Welfare Effects of a Ban on Price Discrimination, Review of Industrial Organization 28, 63-80.

Caprice, S., and Rey, P. (2015), Buyer power from joint listing decision, Economic Journal 125, 1677-1704.

Caprice, S., and von Schlippenbach, V. (2013), One-Stop Shopping as a Cause of Slotting Fees: A Rent-Shifting Mechanism, Journal of Economics and Management Strategy 22, 468-487.

Chemla, G. (2003), Downstream Competition, Foreclosure, and Vertical Integration, Journal of Economics and Management Strategy 12, 261–289.

Chen, Z. (2003), Dominant retailers and the countervailing-power hypothesis, RAND Journal of Economics 34, 612-625.

Chen, Z. (2007), Buyer power: Economic theory and antitrust policy, Zerbe R. O. and J. B. Kirkwood (Eds), Research in Law and Economics 22, 17-40.

Chen, Z., Ding, H., and Liu, Z. (2016), Downstream Competition and the Effects of Buyer Power, Review of Industrial Organization, 49, 1-23.

Chen, Z., and Rey, P. (2012), Loss leading as an exploitative practice, American Economic Review 102, 3462-3482.

Choi, J.P. (2010), Tying in Two-Sided Markets with Multi-Homing, The Journal of Industrial Economics 58, 607-626.

Christou, C., and Papadopoulos, K.G. (2015), The countervailing power hypothesis in the dominant firm-competitive fringe model, Economics Letters 126, 110-113.

Cosnita-Langlais, A. and Tropeano, J.-P. (2012), Do Remedies Affect the Efficiency Defense? An Optimal Merger-Control Analysis, International Journal of Industrial Organization 30, 58-66.

Dertwinkel-Kalt, M. and Wey, C. (2016), Merger Remedies in Oligopoly under a Consumer Welfare Standard, Journal of Law, Economics, and Organization 32, 150-179.

Dobson, P. W,.and Waterson, M. (1997), Countervailing power and consumer prices, Economic Journal 107, 418-430.

DOJ (2010), Horizontal Merger Guidelines, US Department of Justice and Federal Trade Commission, August 19, 2010, Washington, D.C.

Doyle, C. and Han, M. (2014), Cartelization through buyer groups, Review of Industrial Organization 44, 255-275.

EC (2013), Towards More Effective Merger Control, Commission Staff Working Document SWD(2013) 239 final, June 25, 2013, European Commission, Brussels.

EC (2014), White Paper: Towards More Effective EU Merger Control, European Commission, COM(2014) 449 final, Brussels.

Ellison, S. and Snyder, C. (2010), Countervailing power in wholesale pharmaceuticals, Journal of Industrial Economics, 58(1): 32-53.

European Commission (2011), Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal cooperation agreements, 2011/C 11/01, available at :http://eur-lex.europa.eu/legal-content/EN/TX
T/PDF/?uri=CELEX:52011XC0114(04)&from=EN.

Farrell, J. and Shapiro, C. (1990a), Asset Ownership and Market Structure in Oligopoly, Rand Journal of Economics 21, 275-292.

Farrell, J. and Shapiro, C. (1990b), Horizontal Mergers: An Equilibrium Analysis, American Economic Review 80, 107-126.

Farrell, J. and Shapiro, C. (2001), Scale Economies and Synergies in Horizontal Merger Analysis, Antitrust Law Journal 68, 685-710.

Farrell, J. and Shapiro, C. (2010), Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition, The B.E. Journal of Theoretical Economics, Policies and Perspectives 10, Article 9.

Federal Trade Commission (2001), Report on the Federal Trade Commission workshop on slotting allowances and other marketing practices in the grocery industry, available at: https://www.ftc.gov/sites/default/files/documents/reports
/report-federal-trade-commission-workshop-slotting-allowances-and-other-mar
keting-practices-grocery/slotting-allowancesreportfinal_0.pdf

Folta, T.B. and Miller, K.D. (2002), Real Options in Equity Partnerships, Strategic Management Journal 23, 77-88.

Foros, O., Kind, H.J., and Shaffer, G. (2011), Mergers and Partial Ownership, European Economic Review 55, 916-926.

Foros, O. and Kind, H. (2008), Do slotting allowances harm retail competition?, Scandinavian Journal of Economics 110, 367-384.

Galbraith, J. K. (1952), American capitalism: The concept of countervailing power, Boston: Houghton Mifflin.

Galbraith, J. K. (1954), Countervailing power, American Economic Review 44, 1-6.

Gaudet, G. and Salant, S.W. (1991), Increasing the Profits of a Subset of Firms in Oligopoly Models with Strategic Substitutes, American Economic Review 81, 658-665.

Gaudin G. (2017), Vertical bargaining and retail competition. What drives countervailing power?,
available at: https://papers.ssrn.com/sol3/papers2.cfm?abstract_id=2655726;

Ghosh, A. and Morita, H. (2015), Knowledge Transfer and Partial Equity Ownership, Mimeo. (available online at SSRN).

Gilo, D. (2000), The Anticompetitive Effect of Passive Investment, Michigan Law Review 99, 1-47.

Gilo, D., Moshe, Y., and Spiegel, Y. (2006), Partial Cross Ownership and Tacit Collusion, Rand Journal of Economics 37, 81-99.

Griffith, D.A., and Krampf, R.F. (1997), Emerging trends in U.S. retailing, Long Range Planning: International Journal of Strategic Management 30, 847-852.

Grossman, S.J. and Hart, O.D. (1980), Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation, Bell Journal of Economics 11, 42-64.

Gugler, K., Mueller, D.C., Yurtoglu, B.B., and Zulehner, C. (2003), The Effects of Mergers: An International Comparison, International Journal of Industrial Organization 21, 625-653.

ICN (2006), ICN Merger Guidelines Workbook, International Competition Network, Merger Working Group, Report Prepared for the Fifth Annual ICN Conference in Cape Town, April 2006.

Igami, M. (2011), Does big drive out small?, Review of Industrial Organization, 38(3): 1-21.

Inderst, R., and Shaffer, G. (2010), Market-share contracts as facilitating practices, RAND Journal of Economics 41, 709-729.

Inderst, R., and Shaffer, G. (2011), Wholesale Price Determination under the threat of Demand-Side Substitution, Working Paper University of Frankfurt, University of Rochester.

Inderst, R. and Valletti, T. (2011), Buyer power and the waterbed effect, Journal of Industrial Economics 59, 1-20.

Inderst, R., and Wey, C. (2003), Bargaining, Mergers, and Technology Choice in Bilaterally Oligopolistic Industries, RAND Journal of Economics 34, 1-19.

Inderst, R., and Wey, C. (2011), Countervailing power and dynamic efficiency, Journal of the European Economic Association 9, 702-720.

Iozzi, A., and Valletti, T. (2014), Vertical bargaining and countervailing power, American Economic Journal: Microeconomics 6, 106-35.

Jeitschko, T.D. and Tremblay, M.J. (2015), Platform Competition with Endogenous Homing, Mimeo.

Johansen, B. O., and Nilssen, T. (2016), The Economics of Retailing Formats: Competition versus Bargaining, Journal of Industrial Economics 64, 109-134.

Jovanovic, D. and Wey, C. (2014), Passive Partial Ownership, Sneaky Takeovers, and Merger Control, Economics Letters 125, 32-35.

Jullien, B. (2005), Two-Sided Markets and Electronic Intermediaries, CESifo Economic Studies 51, 233-260.

Katz, M. L. (1987), The welfare effects of third-degree price discrimination in intermediate good markets, American Economic Review 77, 154-167.

Lagerlöf, J.N.M. and Heidhues, P. (2005), On the Desirability of an Efficiency Defense in Merger Control, International Journal of Industrial Organization 23, 803-827.

Liu, Q. and Konstantinos, S. (2013), Price Discrimination in Two-Sided Markets, Journal of Economics and Management Strategy 22, 768-786.

Malueg, D.A. (1992), Collusive Behavior and Partial Ownership of Rivals, International Journal of Industrial Organization 10, 27-34.

Martin P. and Valletti, T.M. (2008), Content and Advertising in the Media: Pay-TV versus Free-to-air, International Journal of Industrial Organization 26, 949-965.

Matsushima, N., and Yoshida, S. (2016), the countervailing power hypothesis when dominant retailers function as sales promoters, Osaka University, Discussion Paper N° 981.

Milliou, C., and Petrakis, E. (2007), Upstream horizontal mergers, vertical contracts, and bargaining, International Journal of Industrial Organization 25, 963-987.

Mills, D. (2013), Countervailing power and chain stores, Review of Industrial Organization 42, 281-295.

Möller, M. (2007), The timing of contracting with externalities, Journal of Economic Theory 133, 484-503.

Münster, J., and Reisinger, M. (2015), Sequencing bilateral negotiations with externalities, mimeo.

Nocke, V. and Whinston, M.D. (2010), Dynamic Merger Review, Journal of Political Economy 118, 1201-1212.

O'Brien, D.P. and Salop, S.C. (2000), Competitive Effects of Partial Ownership: Financial Interest and Corporate Control, Antitrust Law Journal 67, 559-614.

OECD (2008), Policy Roundtables, Minority Shareholdings, OECD, Paris.

OFT (2010), Minority Interests in Competitors, Report commissioned by the Office of Fair Trading and prepared by Dotecon, March 2010 (OFT1218), London.

Povel, P. and Sertsios, G. (2014), Getting to Know Each Other: The Role of Toeholds in Acquisitions, Journal of Corporate Finance 26, 201-224.

Rasch, A. and Wenzel, T. (2013), Piracy in a Two-Sided Software Market, Journal of Economics Behavior and Organization 88, 78-89.

Reisinger, M. (2014), Two-Part Tariff Competition Between Two-Sided Platforms, European Economic Review, 68, 168-180.

Reynolds, R.J. and Snapp, B.R. (1986), The Competitive Effects of Partial Equity Interests and Joint Ventures, International Journal of Industrial Organization 4, 141-153.

Rey P., and Tirole, J. (2007), A primer on foreclosure, Handbook of Industrial Organization, Edited by Armstrong, M. and Porter, R. 3, 2145-2220.

Rochet, J.C. and Tirole, J. (2003), Platform Competition in Two-Sided Markets, Journal of the European Economic Association 1, 990-1029.

Rochet, J.C. and Tirole, J. (2006), Two-Sided Markets: A Progress Report, Rand Journal of Economics 37, 645-667.

Salant, S.W., Switzer, S., and Reynolds, R.J. (1983), Losses from Horizontal Merger: The Effects of an Exogenous Change in Industry Structure on Cournot-Nash Equilibrium, Quarterly Journal of Economics 98, 185-199.

Snyder C. (2005), Countervailing power, contribution to the New Palgrave Dictionary.

Suleymanova, I. and Wey, C. (2012), On the Role of Consumer Expectations in Markets with Network Effects, Journal of Economics 105, 101-127.

Thisse, J.F. and Vives, X. (1988), On The Strategic Choice of Spatial Price Policy, The American Economic Review, 78, 122-137.

Thomes, T.P. (2015), In-House Publishing and Competition in the Video Game Industry, Information Economics and Policy 32, 46-57.

Vieira-Montez, J. (2007), Downstream Concentration and Producer's Capacity Choice: Why Bake a Larger Pie when Getting a Smaller Slice, RAND Journal of Economics 38, 948-966.

Villas-Boas, S. B. (2007), Vertical Relationships between Manufacturers and Retailers: Inference with Limited Data, Review of Economic Studies 74, 625-652.

von Ungern-Sternberg, T. (1996), Countervailing power revisited, International Journal of Industrial Organization 14, 507-520.

Williamson, O.E. (1968), Economies as an Antitrust Defense: The Welfare Tradeoffs, American Economic Review 58, 407-426.

Xu, D., Zhou, C., and Phan, P.H. (2010), A Real Options Perspective on Sequential Acquisitions in China, Journal of International Business Studies 41, 166-174.

Eidesstattliche Versicherung

Ich, Shiva Shekhar, versichere an Eides statt, dass die vorliegende Dissertation von mir selbstständig, und ohne unzulässige fremde Hilfe, unter Beachtung der "Grundsätze zur Sicherung guter wissenschaftlicher Praxis an der Heinrich-Heine-Universität Düsseldorf" erstellt worden ist.

Düsseldorf, 12. Juni 2017

Shiva Shekhar

Unterschrift