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# One-Stop Shopping Behavior, Buyer Power and Upstream Merger Incentives*

Irina Baye† Vanessa von Schlippenbach‡ Christian Wey§

September 2017

**Abstract**

We analyze how consumer preferences for one-stop shopping affect the (Nash) bargaining relationships between a retailer and its suppliers. One-stop shopping preferences create 'demand complementarities' among otherwise independent products which lead to two opposing effects on upstream merger incentives: first a standard double mark-up problem and second a bargaining effect. The former creates merger incentives while the later induces suppliers to bargain separately. When buyer power becomes large enough, then suppliers stay separated which raises final good prices. We also show that our result can be obtained when wholesale prices are determined in a non-cooperative game, under two-part tariffs and when products are substitutable.

*JEL-Classification: L12, L22, L42*

*Keywords: One-Stop Shopping, Buyer Bower, Upstream Merger*

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# 1 Introduction

One-stop shopping is a pervasive phenomenon in retail markets. Many consumers prefer to concentrate a substantial part of their weekly grocery purchases with a single retailer. A survey conducted for the U.K. Competition Commission finds that '[t]he main factor and most likely influential determinant of store choice is the ability to one-stop shop. Seven [respondents] in ten regarded it as an important factor and it was considered the primary reason of store choice by more than twice the proportion of any other factor' (U.K. Competition Commission [2000, Appendix 4.2, p. 30]).[1] The same study reports that the respondents spend 85.3 percent of their overall expenditures on groceries at major supermarket chains. Parallel to the rise of consumer one-stop shopping behavior, the retail industry has gone through a strong consolidation process.[2] Meanwhile, large retailers are the essential intermediaries between manufacturers and consumers: unless manufacturers have passed 'the decision-making screen of a single dominant retailer' (FTC [2001]), their products are not sold to final consumers.[3] Both the importance of consumer one-stop shopping behavior and the ongoing concentration process in the retail industry have made suppliers more and more dependent on fewer and larger retailers.

We analyze how one-stop shopping affects retailer-supplier negotiations and we are interested in the question whether or not suppliers find it profitable to merge their businesses to counter buyer power.[4] We consider two manufacturers selling their goods to a common retailer for further distribution to final consumers. Delivery is based on bilateral negotiations about a linear wholesale price. The supplied goods are assumed to be inherently independent. The retailer faces two different consumer types: one-stop shoppers and single-item shoppers. While

[1] Consistent with the high importance of one-stop shopping, the U.K. Competition Commission [2000] reports that only 18 percent of the respondents selected 'price charged for groceries' as their main driver of store choice.

[2] Retail concentration has been sharply rising in Europe. The weighted average of the concentration ratio of the top-five retailers (CR 5) in the EU member states increased from about 40.7 percent in 1993 to 69 percent in 2002 (Dobson et al. [2003]).

[3] The 'gatekeeper' role of large retailers has become an issue in competition policy. For instance, the European Commission blocked the merger between the leading retail chains in Finland on the ground that it would further increase the existing gatekeeper power both retailers already had (see Kesko/Tuko COMP IV/M.784).

[4] The German Farmers Association, for example, recommended to consolidate activities of dairy processors as a way to counter retailer buyer power (*Milch und Rind*, 23 January, 2009).

a single-item shopper engages in frequent shopping and buys only one of the goods per shopping trip, a one-stop shopper bundles its purchases in a single shopping trip, and by that, economizes on shopping costs.[5] The buying decision of one-stop shoppers, therefore, depends on overall expenses rather than on individual product prices. This causes pricing externalities which are similar to the pricing of complementary goods.[6] Ceteris paribus, one-stop shopping behavior results in higher wholesale prices if suppliers operate separately. Correspondingly, consumer one-stop shopping behavior creates strong upstream merger incentives as a merged supplier internalizes the negative pricing externality, which increases the supplier's profit and leads to lower consumer prices.

Adding buyer power to this picture, the assessment of one-stop shopping changes dramatically. While suppliers are always better off by merging their businesses if the retailer is in a sufficiently weak bargaining position, suppliers counter increasing retailer bargaining power by negotiating separately. The underlying reason is a bargaining effect. To get the intuition, suppose suppliers stay independent. If the retailer fails to achieve an agreement with a single supplier, the supplier's product is no longer offered by the retailer.[7] This, in turn, diminishes the one-stop shoppers' ability to economize on their shopping costs implying a reduced demand for the remaining product. Hence, the sum of supplier profits when bargaining separately with the retailer is larger compared to the profit obtained when the suppliers are merged and, thus, bargain jointly with the retailer. As a supplier merger always leads to lower wholesale prices,

[5] According to Dubé [2005], single-item shoppers purchase only what they currently need, while one-stop shoppers are aware of future consumption needs in between their (weekly) shopping trips.

[6] Fixed costs per shopping trip change demand elasticities for single products as they create demand complementarities, i.e., a higher price of product $A$ tends to reduce the demand for product $B$, even though both products are inherently unrelated. The influence of shopping costs on multiproduct retailers' pricing decisions was analyzed in Klemperer [1992] and Beggs [1994]. Relatedly, the analysis of loss leading is based on shopping costs in Lal and Matutes [1994], DeGraba [2006], and Chen and Rey [2012]. A similar feature is obtained in the bundling literature (see, for instance, Matutes and Regibeau [1988]).

[7] In our model, disagreement is an off-equilibrium outcome which pins down the retailer-supplier Nash bargaining problem. Consumer responses to the stock-out of a product are studied intensively in the marketing literature. According to Sloot et al. [2005], 'out-of-stock is a regular phenomenon for grocery shoppers' and the resulting gross margin losses for retailers have been estimated by Anderson Consulting [1996] to lie between \$7 and \$12 billion per year in the United States.

excessive buyer power together with one-stop shopping preferences can induce an inefficiently fragmented supplier structure which is detrimental to consumers and overall social welfare. The overall assessment of buyer power, however, remains mixed. Ceteris paribus, modest buyer power tends to lower the suppliers' mark-up which is at least partially passed on to consumers. Only if buyer power becomes very large to trigger strategic separation on the suppliers' side, then it unfolds unambiguously negative effects on consumer and social welfare.

We examine two extensions of our basic model to show the robustness of our results. First, we present a simple non-cooperative price-setting game in which each party proposes an input price and one offer is selected randomly. Solving the entire game for the subgame-perfect Nash equilibrium leads to similar outcomes as in our main model. Second, we consider two-part tariffs and provide an extension with uncertain demand and an (infinitely) risk averse retailer (see Rey and Tirole [1986]). Such a setting gives rise to a double mark-up problem, which guarantees that our main results remain valid.

We contribute to the literature on horizontal (upstream) mergers in vertical structures. Most of that literature has been focusing on downstream mergers and the issue of buyer power through retail concentration (von Ungern-Sternberg [1996]; Dobson and Waterson [1997]). One-stop shopping has not been analyzed in that context so far. In a single model, we combine two opposing views on upstream merger incentives in the presence of demand complementarities. Since Cournot [1838], it is well known that firms selling complementary goods have strong incentives to merge to overcome the double mark-up problem. In contrast, Horn and Wolinsky [1988b] show that the complementary of products gives rise to incentives to stay independent in order to extract more rents from a common retailer.[8] In our model we obtain the 'Cournot' result whenever the retailer's bargaining power is relatively low. If, however, the retailer's bargaining power increases, we obtain the latter result of Horn and Wolinsky [1988b] such that suppliers prefer to stay independent.

Buyer power of large retail chains is a major concern in practical competition policy[9] and has

[8] A similar result is obtained in Horn and Wolinsky [1988a] for the case of competing supply chains and linear input prices.

[9] See, for example, studies conducted by the U.K. Competition Commission [2000, 2003 and 2008] and OECD [1998 and 2008]. Similar studies were conducted in the US and by the European Commission (see FTC [2001] and EC [1999], respectively) and more recently in Germany (see Bundeskartellamt [2014]).

become a focus area in the industrial organization literature. A major presumption is that buyer power adversely affects suppliers to the detriment of consumer welfare. Our paper contributes to this issue by offering a new theory of harm, which critically relies on one-stop shopping behavior. While the traditional monopsony analysis has assumed a perfectly competitive supply structure (neglecting the bargaining structure of intermediary goods markets), the more recent bargaining literature has either focused on the dynamic effects of rent-shifting or on the horizontal effects 'differential' buyer power may exert on smaller retailers.[10] To the best of our knowledge, none of the discussed theories of harm based on buyer power refers to one-stop shopping and the possibility of excessive supplier fragmentation as a strategic outcome to counter retailer buyer power.

By considering the supplier-retailer relationship explicitly, we extend the existing literature on one-stop shopping. Stahl [1982] is an early account of consumer shopping behavior and the therewith-associated feature of positive demand externalities. Beggs [1994] shows that one-stop shopping can explain retailers' preferences for malls, though forming supermarkets is a best non-cooperative response. Klemperer [1992] shows how shopping costs affect duopoly competition between multi-product firms. He points out that firms have incentives to compete 'head-to-head' (i.e., choosing the same product lines instead of differentiated assortments) to better exploit one-stop shoppers' lower demand elasticity.

The remainder of the paper is organized as follows. In Section 2 the model is specified. The game is solved in Section 3. Merger incentives for linear contracts are examined in Section 4. In Section 5, we provide three extensions of our basic model to show the robustness of our main results. Finally, Section 6 concludes.

[10]Both latter theories remain hotly debated. Even though buyer power should reduce suppliers' overall profits, their incentives to undertake investments may very well increase when the retail industry becomes more concentrated (see Inderst and Wey [2003]). The issue of differential buyer power relates to the issue of discrimination in intermediary goods markets and the possibility of a so-called 'waterbed effect' (Inderst and Valletti [2011]; for a survey, see Dobson and Inderst [2008]).

## 2 The Model

Consider two upstream manufacturers $M_i$, $i = 1, 2$, which produce each a good $i = 1, 2$ at constant marginal cost $c \geq 0$. We assume that goods 1 and 2 belong to different product categories and are, thus, independent. Both manufacturers sell their respective products to a common downstream retailer $R$ that transforms one unit of input into one unit of a final consumer good. Retailer's transformation and distribution costs are set to zero. Thus, the retailer bears no other costs than those of getting delivered by the upstream manufacturers. Delivery contracts are determined through bilateral negotiations. We assume that the retailer negotiates simultaneously with both manufacturers about a delivery contract that specifies a wholesale price $w_i$ the retailer has to pay for each unit of input.[11] We relax this assumption in Section 5, where we allow for non-linear tariffs in the retailer-supplier relationships. We analyze a three-stage game. In the first stage, the manufacturers decide whether to merge their businesses or not. If the upstream firms merge, they continue to produce both products. In the second stage, the retailer negotiates either with both suppliers separately or with the merged entity a wholesale price for each product. Finally, the retailer sets the prices in the final consumer market and consumers make their shopping decisions.

**Demand.** Consumers are uniformly distributed with density one along a line of infinite length. Their locations are denoted by $\theta \in (-\infty, \infty)$, while we assume that the retailer is located at $\theta^R = 0$. Since the retailer is a local monopolist for the goods 1 and 2, consumers must travel to the retailer's outlet to make their purchases of goods 1 and 2. Thereby consumers incur transportation costs $|\theta|\, t$, where $t$ is the transport cost parameter and $|\theta|$ is the distance between the consumer located at $\theta$ and the retailer's location. Each consumer buys at most one unit of each product. We assume that a share $\lambda \in [0, 1]$ of consumers are one-stop shoppers buying both

[11] The use of linear wholesale prices reflects the fact that contracts in vertical relations are not necessarily efficient. In particular, product nonspecifiability, demand uncertainty and unobservability of retail behavior may cause contracting problems in supplier-retailer relations (Iyer and Villas-Boas [2003]; Raskovich [2007]). Referring to a recent study of the U.K. Competition Commission [2008] on pricing in intermediate good markets, Inderst and Valletti [2011] conclude that powerful retailers often obtain price discounts at the margin which can be easily captured by the assumption of linear tariffs in intermediate good markets. They also point to the observation that particularly fresh products, bakery products and milk, are often delivered to retailers based on a perfectly linear contract.

products at the same time, while a share $1-\lambda$ of consumers are single-item shoppers buying product 1 and product 2 in different trips.[12]

Let $v > c$ stand for consumer willingness to pay for a unit of good $i = 1, 2$. The utility of a single-item shopper located at $\theta$ is then given by[13]

$$U_i^s(p_i) = \begin{cases} v - p_i - |\theta|\, t, & \text{if good } i = 1,2 \text{ is bought} \\ 0, & \text{otherwise,} \end{cases} \tag{1}$$

where $p_i$ indicates the price of good $i$ set by the retailer. Using (1), the location of the indifferent single-item shopper is

$$\theta_i^s(p_i) = \frac{v - p_i}{t}, \text{ if } p_i \leq v. \tag{2}$$

The demand of the single-item shoppers, thus, is given by

$$q_i^s(p_i) = \begin{cases} 2\theta_i^s(p_i), & \text{if } p_i \leq v \\ 0, & \text{if } p_i > v. \end{cases} \tag{3}$$

Likewise, the utility of a one-stop shopper located at $\theta$ is given by

$$U^o(p_1, p_2) = \begin{cases} 2v - \sum_{i=1}^{2} p_i - |\theta|\, t, & \text{if goods 1 and 2 are bought} \\ v - p_i - |\theta|\, t, & \text{if only good } i = 1,2 \text{ is bought} \\ 0, & \text{otherwise.} \end{cases} \tag{4}$$

That is, one-stop shoppers halve their transportation costs per product by bundling the purchases of goods 1 and 2.[14] Using (4), the location of the indifferent one-stop shopper is given

[12] Apparently, consumers reduce their shopping time by combining the purchases of products consumed today or in the future. The importance of one-stop shopping behavior is, therefore, increasing the more time constrained consumers are. Furthermore, one-stop shopping behavior may also occur in multi-person households, where the varying needs of the household members are satisfied in one single shopping trip. That is, one member is responsible for shopping and, thus, bundles all required purchases instead of all individual family members making purchases on their own.

[13] We denote the variables associated with single-item shoppers by '$s$.' Variables associated with one-stop shoppers are indexed by '$o$.'

[14] Note that we assume that one-stop shoppers become single-item shoppers when one good is not available (or, too expensive). Another specification would be that one-stop shoppers do not visit a shop if not the entire shopping basket is available (for a reasonable price) in a shop. Such a specification would increase the bargaining power of an independent supplier and would thus strengthen our result (see below) that buyer power tends to reduce upstream merger incentives. See also Campo et al. [2000] and Sloot et al. [2005] for marketing studies, which show that consumers respond differently to out-of-stock problems.

by

$$\theta^o(p_1,p_2) = \frac{1}{t}\left(2v - \sum_{i=1}^{2} p_i\right), \text{ if } p_i \leq v, \text{ for } i = 1,2. \tag{5}$$

If $p_i \leq v$ but $p_j > v$, then the indifferent location is given by $\theta_i^o(p_i) = (v - p_i)/t$, which is the same as the location of the indifferent single-item shopper, $\theta_i^s(p_i)$. We can then write the one-stop shopper demand for product $i$ as

$$q_i^o(p_1,p_2) = \begin{cases} 2\theta^o(p_1,p_2), & \text{if } p_i \leq v \text{ and } p_j \leq v \\ 2\theta_i^s(p_i), & \text{if } p_i \leq v \text{ and } p_j > v \\ 0, & \text{if } p_i > v. \end{cases} \tag{6}$$

Taking (3) and (6) together, the total demand the retailer faces for product $i = 1,2$ can be written as

$$Q_i(p_1,p_2) = \lambda q_i^o(p_1,p_2) + (1-\lambda) q_i^s(p_i). \tag{7}$$

Even though products are inherently independent, the demand for product $i$ depends not only on its own price but also on the price of the other product $j \neq i$. Precisely, $\partial Q_i(p_1,p_2)/\partial p_j \leq 0$ (with strict inequality if $\lambda > 0$), such that the overall demand for product $i$ is decreasing in the price of product $j$. The reason is the presence of one-stop shoppers who base their purchasing decisions on the sum of the products' prices.[15] While this feature is well-known in the context of complementary products, it also arises in the context of one-stop shopping behavior. A higher price for good $j$ results in a higher price for the overall shopping basket which determines the location of the indifferent one-stop shopper. As a consequence, fewer one-stop shoppers buy at the retailer, so that the demand for product $i$ is reduced when the price for product $j$ increases. Clearly, the single-item shopper's demand for good $i$ remains unaffected by the price of the other good $j$. Take finally the case that the retailer offers only one of the products, say product $i$, or sets the price for the other product too high with $p_j > v$. In this case all consumers (including one-stop shoppers) buy only product $i$ and total demand for that product is given by $Q_i(p_i) := q_i^s(p_i)$.

**Profits.** If the retailer sells both products, its profit can be written as

$$\pi(p_1,p_2) = \sum_{i=1}^{2} (p_i - w_i) Q_i(p_1,p_2). \tag{8}$$

[15] For an early account of these effects see Stahl [1982] and Beggs [1994].

Note that an increase in the share of one-stop shoppers implies a shift of the total demand since one-stop shopping lowers consumer transportation costs. If the retailer fails to achieve an agreement with supplier $i$ and, therefore, sells only product $j$, the retailer profit is given by

$$\pi_{-i}(p_j) = (p_j - w_j)\, Q_j(p_j), \text{ for } i, j = 1, 2,\ i \neq j. \tag{9}$$

In case of an upstream merger, the retailer bargains with the merged supplier about the delivery of both products instead of bargaining with both suppliers separately. Accordingly, the retailer's disagreement payoff is then equal to zero. Turning to the suppliers, the profit of each independent supplier $i$ is given by

$$\varphi_i\,(p_1, p_2) = (w_i - c)\, Q_i(p_1, p_2),$$

while the profit of a merged supplier is

$$\varphi^m\,(p_1, p_2) = \sum_{i=1}^{2} (w_i - c)\, Q_i(p_1, p_2).$$

# 3 Analysis

Using subgame-perfect Nash equilibrium as our equilibrium concept, we proceed by solving first for the equilibrium retail prices in stage three. We then move backwards to solve the bargaining stage.[16] Two cases must be considered. If the manufacturers decide to merge in the first stage of the game, an upstream monopolist sells two products to the downstream retailer. Otherwise, there is an upstream duopoly, such that the retailer negotiates with both suppliers separately.

**Downstream Prices.** In the last stage of the game, the retailer sets the prices for both products in the final consumer market. Using (8) and (7), focusing on interior solutions for $\theta_i^s\,(p_i)$ and $\theta^o\,(p_1, p_2)$ (given by (2) and (5), respectively) and assuming $w_1, w_2 \leq v$, we obtain

[16] Of course, we solve the bargaining problems axiomatically according to the Nash bargaining solution (thus, the second stage is not a non-cooperative game). In case of the two upstream firms each Nash bargaining product is maximized for a given bargaining outcome in the other bargaining pair. We then derive the 'Nash equilibrium' of the two Nash bargaining solutions. This approach has been widely used in, for instance, Horn and Wolinsky [1988a], Chipty and Snyder [1999] or more recently in Milliou and Petrakis [2007]. This approach neither specifies a non-cooperative bargaining game nor the problem of belief formation when there are externalities between the bargaining pairs. Below we provide a simple non-cooperative price-setting game, which gives rise to results which are qualitatively similar to the results we present in this section.

the equilibrium retail price $p_i^*(w_i) = (v+w_i)/2$, for $i = 1, 2$. That is, the retailer sets a monopoly price, which does not depend on the shares of the two consumer types.

Using the equilibrium retail price together with (8) and (9), we obtain the reduced profit functions of the retailer in the second stage of the game, namely, $\pi^*(w_i, w_j) := \pi\left(p_i^*(w_i), p_j^*(w_j)\right)$ and $\pi_{-i}^*(w_j) := \pi_{-i}(p_j^*(w_j))$. We denote the reduced profit function of an independent supplier $i$ by $\varphi_i^*(w_i, w_j) := \varphi_i\left(p_i^*(w_i), p_j^*(w_j)\right)$ and by $\varphi^{m*}(w_i, w_j) := \varphi^m\left(p_i^*(w_i), p_j^*(w_j)\right)$ of the merged firm.

**Bargaining in Input Markets.** Taking the upstream market structure as given, the retailer negotiates bilaterally with either the separate suppliers or the merged entity about a linear wholesale price $w_i$ for each product $i = 1, 2$. Negotiations take place simultaneously in the case of an upstream duopoly. Each retailer-supplier pair maximizes the Nash product to determine the wholesale price. The gains from trade are divided such that each party gets its disagreement payoff plus a share of the incremental gains from trade. We use the asymmetric Nash bargaining solution where the bargaining weight $\delta \in [0, 1]$ measures the bargaining power of the retailer. The value $1 - \delta$ represents the bargaining power of the supplier(s).[17] Thus, in the case of $\delta = 1$, the retailer makes take-it or leave-it offers to the suppliers, while the suppliers have the full bargaining power in the case of $\delta = 0$. If the retailer does not reach an agreement with supplier $i$, it can still sell product $j$ to final consumers earning $\pi_{-i}^*(w_j)$. In contrast, the manufacturers have no selling alternative, as the retailer is considered as a local gatekeeper of the final consumer market. We, therefore, set suppliers' disagreement payoffs to zero.

The pair $(w_1^*, w_2^*)$ is a Nash equilibrium of the bargaining stage if for $i, j = 1, 2$ and $i \neq j$ it holds that

$$w_i^* = \arg\max_{w_i \geq 0} \left\{ \left[\Delta\pi_i^*\left(w_i, w_j^*\right)\right]^{\delta} \cdot \left[\varphi_i^*\left(w_i, w_j^*\right)\right]^{1-\delta} \right\},$$

where

$$\Delta\pi_i^*(w_i, w_j) := \pi^*(w_i, w_j) - \pi_{-i}^*(w_j).$$

The equilibrium wholesale prices $w_i^*$ follow as solutions of the rearranged first-order conditions:

$$(1-\delta)\,\Delta\pi_i^*\left(w_i, w_j^*\right)\frac{\partial\varphi_i^*\left(w_i, w_j^*\right)}{\partial w_i} + \delta\varphi_i^*(w_i, w_j^*)\frac{\partial\pi^*\left(w_i, w_j^*\right)}{\partial w_i} = 0. \qquad (10)$$

[17] Note that we assume that a merger does not affect the exogenously given bargaining power of the suppliers.

Solving (10) and using symmetry, we obtain the equilibrium wholesale prices:

$$w^* := w_1^* = w_2^* = \frac{v(1-\delta)(1+\lambda)(1+2\lambda)+c\left[(1+\delta)(1+2\lambda)+2\delta\lambda^2\right]}{2+(5-\delta+2\lambda)\lambda}.$$

In the case of an upstream merger, we assume that the retailer and the merged supplier negotiate about the delivery of both products together. That is, neither the retailer nor the supplier have any trading alternative if no agreement is reached. The equilibrium wholesale prices $w_i^{m*}$, for $i, j = 1, 2$ and $i \neq j$, are then derived from maximizing the Nash product

$$\left[\pi^* \left(w_i, w_j\right)\right]^\delta \cdot \left[\varphi^{m*} \left(w_i, w_j\right)\right]^{1-\delta}$$

with respect to $w_1$ and $w_2$. The equilibrium wholesale prices $w_i^{m*}$ follow as solutions of the rearranged first-order conditions:

$$(1-\delta)\, \pi^*(w_i, w_j^{m*}) \frac{\partial \varphi^{m*}\left(w_i, w_j^{m*}\right)}{\partial w_i} + \delta \varphi^{m*}(w_i, w_j^{m*}) \frac{\partial \pi^*\left(w_i, w_j^{m*}\right)}{\partial w_i} = 0. \tag{11}$$

Solving (11) for $w_i$ and using symmetry, gives the equilibrium wholesale prices:

$$w^{m*} := w_1^{m*} = w_2^{m*} = \frac{v(1-\delta)+c(1+\delta)}{2}.$$

Comparing $w^*$ and $w^{m*}$, we get the following result.[18]

**Lemma 1.** *The wholesale price $w^*$ negotiated with an independent supplier always (weakly) exceeds the wholesale price $w^{m*}$ negotiated with a merged supplier, i.e., $w^* \geq w^{m*}$ (with equality holding for either $\lambda = 0$ or $\delta = 1$). Furthermore, both wholesale prices are decreasing in $\delta$, while $w^*$ is (weakly) increasing in $\lambda$ and $w^{m*}$ is independent of $\lambda$.*

Obviously, the negotiated wholesale prices $w^*$ and $w^{m*}$ are equal if all consumers act as single-item shoppers, with $\lambda = 0$ holding, or if the retailer makes take-it-or-leave-it offers to the suppliers, with $\delta = 1$ holding. In the former case, there are no positive demand externalities resulting from one-stop shopping behavior, which could be internalized by the merged supplier. In the latter case, the retailer offers the efficient wholesale price equal to the marginal cost $c$ independently of the upstream market structure.

However, if at least some consumers act as one-stop shoppers ($\lambda > 0$) and the manufacturers have some bargaining power ($\delta < 1$), the wholesale price negotiated with an independent supplier

[18] All proofs are relegated to the Appendix.

exceeds the wholesale price negotiated with a merged supplier, i.e., $w^* > w^{m*}$. To see this, we evaluate the first-order conditions in case of a merged supplier (11) at the equilibrium wholesale prices when the suppliers are independent, $w_1^* = w_2^* = w^*$, which fulfill first-order conditions (10).[19] Using symmetry, we get a negative expression:

$$\pi^*(w^*, w^*) \left. \frac{\partial \varphi_i^*(w^*, \cdot)}{\partial w_j} \right|_{w_j = w^*} + \left[ \pi^*(w^*, w^*) - 2\left( \pi^*(w^*, w^*) - \pi_{-i}^*(w^*) \right) \right] \left. \frac{\partial \varphi_i^*(\cdot, w^*)}{\partial w_i} \right|_{w_i = w^*} < 0.$$

In the first term of the sum, the derivative is negative because of demand complementarities. In the second term of the sum, the difference in the brackets stays for a bargaining effect. It says that, since the products are complements, the total punishment that a merged upstream firm can impose in case of a disagreement (that is $\pi^*$) is smaller than the sum of the punishments that separate firms can impose (that is $2(\pi^* - \pi_{-i}^*)$). Finally, the derivative in the second term is positive, because $w^*$ maximizes the Nash product and not only the manufacturer's profit. It then follows from the concavity of the Nash product that the wholesale prices negotiated with the separate suppliers are higher than those negotiated with the merged supplier, i.e., $w^* > w^{m*}$. Note that this also implies $p_i(w^*) > p_i(w^{m*})$, for $i = 1, 2$.

If the manufacturer's bargaining power increases ($\delta$ gets smaller), the manufacturers negotiate a higher wholesale price for their products both in the case when they are independent and when they are merged. If the share of one-stop shoppers increases, strategic complementarity between the wholesale prices $w_1$ and $w_2$ becomes stronger resulting in higher wholesale prices negotiated by the independent suppliers. In contrast, the wholesale prices negotiated by the merged supplier do not depend on the share of one-stop shoppers, because it always internalizes the positive externality of one wholesale price on the other independently of $\lambda$.

# 4 Merger Incentives

The upstream merger incentives are given by

$$\Psi := \varphi^{m*}(w^{m*}, w^{m*}) - \varphi_1^*(w^*, w^*) - \varphi_2^*(w^*, w^*), \tag{12}$$

where $\varphi^{m*}(w^{m*}, w^{m*})$ and $\varphi_i^*(w^*, w^*)$, for $i = 1, 2$, denote the equilibrium profit levels of the merged supplier and the independent suppliers, respectively. We assume that suppliers merge,

[19] We are grateful to an anonymous reviewer who suggested this line of reasoning.

whenever their merger incentives are non-negative. If all consumers are single-item shoppers, i.e., $\lambda = 0$, the wholesale prices do not depend on whether suppliers are independent or merged. Accordingly, suppliers are indifferent whether to merge their businesses or not. In turn, if at least some consumers have one-stop shopping preferences (and manufacturers have some bargaining power, i.e., $\delta < 1$), separate suppliers obtain a higher wholesale price than the merged supplier. In addition, the wholesale price negotiated with separate suppliers, $w^*$, is increasing in the share of one-stop shoppers, $\lambda$, while the wholesale price negotiated with a merged supplier, $w^{m*}$, does not depend on the share of one-stop shoppers. This implies the following trade-off suppliers have to deal with when considering a merger: increasing wholesale prices induce an increase of the suppliers' share of the total pie, while the total pie itself is decreasing at the same time. Suppliers, therefore, benefit from negotiating separately with the retailer as long as there are only few one-stop shoppers in the population.[20] In turn, if the share of one-stop shoppers in the population is sufficiently high, suppliers prefer to merge in order to counter the rising double mark-up problem. This is due to the fact that a merged supplier internalizes the positive demand externalities resulting from consumer one-stop shopping behavior.[21]

**Proposition 1.** *The manufacturers' merger incentives depend on the share of one-stop shoppers and the distribution of the bargaining power between them and the retailer.*

*i) For $\delta$ sufficiently low, there exists a unique threshold value $\lambda^c(\delta)$, such that an upstream merger is strictly profitable for all $\lambda > \lambda^c(\delta)$ implying $\Psi > 0$. Moreover, $\lambda^c(0) = 0$ and $\lambda^c(\delta)$ is monotonically increasing in $\delta$.*

*ii) The manufacturers are indifferent whether to merge their businesses if either $\lambda = 0$, or $\lambda = \lambda^c(\delta)$, or $\delta = 1$ hold yielding $\Psi = 0$.*

*iii) In all other cases $\Psi < 0$ holds and the manufacturers strictly prefer to remain independent.*

Our analysis is instructive for the assessment of the increasing buyer power of large retail chains. An increasing bargaining power of the retailer, i.e., $\delta$, tends to push wholesale prices down, softening the double mark-up problem in the case of independent suppliers. In other

[20] This is similar to the effect described in Horn and Wolinsky [1988a,b].

[21] As is well-known, overcoming the double mark-up problem gives rise to strong merger incentives. This effect is analyzed by Gaudet and Salant [1992] and Deneckere and Davidson [1985] for the case of complementary products.

words, if suppliers face a buyer endowed with a high level of bargaining power, the joint surplus of independent suppliers tends to become larger compared with the surplus that a single supplier can extract from the retailer. Buyer power, therefore, counters the upstream merger incentives caused by consumer one-stop shopping behavior. Buyer power is socially desirable as long as the upstream market structure does not change. If, in contrast, the increase in buyer power triggers a separation of suppliers, welfare is harmed because of the inevitable increase in wholesale prices.

**Proposition 2.** *An increase in the retailer's buyer power from $\delta'$ to $\delta''$ (with $\delta' < \delta''$) increases social welfare if the upstream structure remains the same. An increase in the retailer's buyer power reduces social welfare if it triggers a separation of suppliers, i.e., if $\lambda \geq \lambda^c(\delta')$ holds before and $\lambda < \lambda^c(\delta'')$ holds after the increase in buyer power.*

Proposition 2 uncovers a new channel through which buyer power can harm consumers and overall social welfare. While an increase in buyer power unambiguously reduces prices for a given market structure of the upstream firms in our model, the opposite becomes true when the upstream structure is endogenous. In particular, if buyer power increases beyond a certain threshold value (derived from $\lambda = \lambda^c(\delta)$, see Proposition 1), then the upstream firms prefer to disintegrate to bargain independently with the retailer. Such an increase of buyer power changes the upstream structure towards a more fragmented one, which leads to higher prices for final goods and lower social welfare.

## 5 Extensions and Discussion

In this section, we analyze the robustness of our main results. First, we show that our results can be derived in a non-cooperative price-setting game, which is in the spirit of the Nash bargaining solution. Second, we consider two-part tariffs and we show that our results remain valid if the retailer is risk averse and consumer demand is uncertain. Third, we consider the case of substitutable products, where we derive the share of one-stop shoppers endogenously. Our main results hold also in this case.

### 5.1 Non-Cooperative Price-Setting

In this extension we present a simple non-cooperative game to solve for the wholesale prices, which is in the spirit of a Nash bargaining solution. We change the bargaining stage as follows. All three players (the retailer and the two manufacturers) simultaneously choose the wholesale prices of products 1 and 2. Precisely, manufacturer $M_1$ and the retailer make their offers for the wholesale price of product 1, $w_1^M$ and $w_1^R$, respectively. At the same time, manufacturer $M_2$ and the retailer make their offers for product 2, $w_2^M$ and $w_2^R$, respectively. Next, one of the two offers for each input is realized with an exogenous probability. Let $P \in [0,1]$ be the probability with which the manufacturer's offer is selected and $1-P$ be the counter probability with which the retailer's offer is chosen. Thus, four outcomes are possible: first $(w_1^M, w_2^M)$ with probability $P^2$, second $(w_1^R, w_2^R)$ with probability $(1-P)^2$, and third $(w_1^M, w_2^R)$ and fourth $(w_1^R, w_2^M)$ each with probability $P(1-P)$. After one of the four outcomes is realized, the manufacturers and the retailer make their production decisions based on the selected wholesale prices. The manufacturers will always serve the retailer's demand, when the wholesale price does not fall short of their marginal production costs.[22]

We can interpret the probabilities $P$ and $(1-P)$ as representing the manufacturer's and the retailer's bargaining powers, respectively. A higher value of $P$ makes it more likely that the manufacturer's wholesale price is selected. As the manufacturer will always set a higher price than the one offered by the retailer, the expected price increases with $P$, which mirrors a higher manufacturer's bargaining power measured by the bargaining weight $1-\delta$ in the Nash product. As we will show, the expected profits of the manufacturers also increase with $P$.

In the first stage of the overall game manufacturers decide whether or not to merge. We assume that such a merger involves some fixed costs of $K > 0$.[23] Accordingly, the incentives

[22] Another specification would be to assume that participation in the bargaining game obliges the manufacturers to serve the retailer's demand for any non-negative wholesale price. We analyzed this case, and the results are similar to the results we present below. However, the analysis is more complicated because the retailer's optimal offers can depend on whether or not the manufacturers are merged. The analysis is available from the authors upon request.

[23] If there are no such fixed costs, then a merger is always profitable. A merger increases the total surplus while it does not affect the retailer's offers (it will always set the lowest possible wholesale price). It then follows that a merger also increases upstream firms' joint profit.

to merge are now measured by $\Psi - K$ ($\Psi$ is given in (12)). In case of a merger, it is the merged entity, which sets the wholesale prices for products 1 and 2. We assume that the merged manufacturer's offer is selected with probability $P$ and the retailer's offer is selected with the counter probability $1 - P$.

We solve the wholesale price-setting stage for a Nash equilibrium, such that the equilibrium wholesale offer of a player is the best response to the equilibrium offers of all the other players. All players are assumed to be risk neutral and maximize their expected profits. Consider first the case of the independent manufacturers. In equilibrium the retailer charges the lowest possible wholesale price for both inputs: $w^{R*} := w_i^{R*} = c$, for $i = 1, 2$.[24] Then manufacturer $i = 1, 2$ chooses $w_i^M$ to maximize the expected profit given by

$$E\varphi_i^* \left(w_i^M, w_j^M, w^{R*}, w^{R*}\right) = P \left(w_i^M - c\right) \left[\frac{P\left(v+\lambda v - w_i^M - \lambda w_j^M\right)}{t} + \frac{(1-P)\left(v+\lambda v - w_i^M - \lambda c\right)}{t}\right].$$

From the first-order condition and using symmetry, we get the equilibrium wholesale price proposed by the manufacturer $i = 1, 2$:[25]

$$w^{M*} := w_i^{M*} = \frac{c[1-\lambda(1-P)]+v(1+\lambda)}{2+P\lambda},$$

which yields the equilibrium expected profit of an independent manufacturer:[26]

$$E\varphi_i^* \left(w^{M*}, w^{M*}, w^{R*}, w^{R*}\right) = \frac{P(1+\lambda)^2(v-c)^2}{t(2+P\lambda)^2}, \text{ for } i = 1, 2. \tag{13}$$

In the case of an upstream merger, the retailer also chooses the lowest possible wholesale price for both inputs: $w^{Rm*} := w_i^{Rm*} = c$, for $i = 1, 2$. The merged entity proposes $w_i^M$, for $i = 1, 2$, to maximize the expected profit:

$$E\varphi^{m*} \left(w_1^M, w_2^M, w^{Rm*}, w^{Rm*}\right) = E\varphi_1^* \left(w_1^M, w_2^M, c, c\right) + E\varphi_2^* \left(w_1^M, w_2^M, c, c\right).$$

[24] Indeed, the derivative of the retailer's expected profit, $E\pi^* \left(w_1^M, w_2^M, w_1^R, w_2^R\right)$, with respect to $w_i^R$ is given by $\partial E\pi^* (\cdot) / \partial w_i^R = -(1-P) \left[v - w_i^R + \lambda \left(v - (1-P) w_j^R - P w_j^M\right)\right] / t \leq 0$, for $i = 1, 2$. The sign follows from $w_i^R, w_i^M \leq v$, which have to hold to guarantee $p_i^* (w_i) \leq v$, for $i = 1, 2$.

[25] For any $\lambda$ and $P$ it holds that $c < w^{M*} \leq v$. Note that the equilibrium expected wholesale price, $Ew^* := P w^{M*} + (1-P) w^{R*}$, increases in probability $P$: $\partial Ew^* / \partial P = 2(1+\lambda)(v-c) / \left[(2+P\lambda)^2\right] > 0$. This supports the intuition that $P$ can be interpreted as the manufacturer's bargaining power, similar to $1 - \delta$ in the main analysis.

[26] The equilibrium expected profit of an independent manufacturer increases in its bargaining power: $\partial E\varphi_i^* (\cdot) / \partial P = (2 - P\lambda)(1+\lambda)^2 (v-c)^2 / \left[t(2+P\lambda)^3\right] > 0$.

From the first-order condition and using symmetry we get the equilibrium wholesale price of product $i = 1, 2$ proposed by the merged manufacturer:

$$w^{Mm*} := w_i^{Mm*} = \frac{c[1-\lambda(1-2P)]+v(1+\lambda)}{2(1+P\lambda)},$$

which yields its equilibrium expected profits:[27]

$$E\varphi^{m*}\left(w^{Mm*}, w^{Mm*}, w^{Rm*}, w^{Rm*}\right) = \frac{P(1+\lambda)^2(v-c)^2}{2t(1+P\lambda)}. \tag{14}$$

The comparison of the profits (14) and (13) yields

$$\Psi - K = \frac{P^3\lambda^2(1+\lambda)^2(v-c)^2}{2t(1+P\lambda)(2+P\lambda)^2} - K.$$

The following proposition shows that the manufacturers' merger incentives are driven by the share of one-stop shoppers and the distribution of the bargaining power in a way which is qualitatively the same as in our main analysis (see Proposition 1).

**Proposition 3.** *Suppose a non-cooperative price-setting game in which all parties make their wholesale price offers simultaneously, while an offer of a manufacturer in a manufacturer-retailer pair is chosen with probability $P \in [0, 1]$. If the fixed merger costs are not too high, with $K \leq \widetilde{K} := (v-c)^2 / (9t)$ holding, there exists a critical value $\widetilde{P}(K) > 0$, such that an upstream merger is (weakly) profitable for any $P \geq \widetilde{P}(K)$ if the share of one-stop shoppers is large enough, with $\lambda \geq \widetilde{\lambda}(K, P) > 0$ holding. Moreover, $\widetilde{P}(K)$ is increasing in $K$, $\widetilde{P}\left(\widetilde{K}\right) = 1$ and $\lim_{K\to 0}\widetilde{P}(K) = 0$, while $\widetilde{\lambda}(K, P)$ is increasing in $K$ and decreasing in $P$, with $\lim_{K\to 0}\widetilde{\lambda}(K, P) = 0$ and $\widetilde{\lambda}\left(\widetilde{K}, \widetilde{P}\left(\widetilde{K}\right)\right) = 1$.*

A comparison of Propositions 1 and 3 shows the similarity of the non-cooperative model of price-setting with the Nash bargaining model of our main analysis. Since $P$ can be interpreted as the manufacturer's bargaining power similar to the Nash bargaining weight $1 - \delta$ in our main analysis, both models give the same qualitative result. Merger incentives are, ceteris paribus, larger the larger the share of one-stop shoppers and/or the larger the manufacturer's bargaining

[27] For any $\lambda$ and $P$ it holds that $c < w^{Mm*} \leq v$. Both the equilibrium expected wholesale price, $Ew^{m*} := Pw^{Mm*} + (1-P)\, w^{Rm*}$, and the equilibrium expected profit of the merged entity increase in probability $P$. We also get a mirror result of the main result of Lemma 1: the equilibrium expected wholesale price is larger when the manufacturers remain independent than when they are merged, i.e., $Ew^* \geq Ew^{m*}$ (with equality if either $P = 0$ or $\lambda = 0$ holds).

power (or, equivalently, the lower the buyer power) are. It is also straightforward that for the manufacturers to have incentives to merge, merger costs should not be too high.

To illustrate Proposition 3, in Table I we present the results of a numerical example with $\widetilde{K} = 900$. The table provides the critical value of the share of one-stop shoppers (multiplied by 100), $\widetilde{\lambda}(K, P)$, for different values of parameters $K$ and $P$. As a merger is profitable for all $\lambda \geq \widetilde{\lambda}(K, P)$, a lower value means that a merger is more likely. We see from Table I that $\widetilde{\lambda}(K, P)$ increases in $K$ and decreases in $P$. Thus, a merger becomes more likely, the larger the share of one-stop shoppers and the larger the supplier's bargaining power becomes, which mirrors the main result of our basic model.

| | | $P$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| $K$ | 3 | $n$ | 96 | 46 | 28 | 19 | 14 | 11 | 9 | 8 | 6 | 5 |
| | 20 | $n$ | $n$ | 96 | 63 | 45 | 35 | 28 | 23 | 20 | 16 | 14 |
| | 50 | $n$ | $n$ | $n$ | 90 | 67 | 50 | 40 | 35 | 30 | 26 | 22 |
| | 80 | $n$ | $n$ | $n$ | $n$ | 82 | 65 | 53 | 45 | 37 | 32 | 28 |
| | 130 | $n$ | $n$ | $n$ | $n$ | $n$ | 80 | 66 | 55 | 47 | 40 | 36 |
| | 220 | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | 84 | 71 | 61 | 54 | 47 |
| | 340 | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | 88 | 76 | 67 | 60 |
| | 460 | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | 88 | 78 | 70 |
| | 600 | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | 90 | 80 |
| | 800 | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | 94 |
| | 1000 | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ | $n$ |

Table I: Critical share of one-stop shoppers (multiplied by 100), $\widetilde{\lambda}(K, P)$; '$n$'= no merger

## 5.2 Two-Part Tariffs

With bargaining over two-part tariffs, the wholesale price is set equal to suppliers' marginal cost. This makes the retailer the residual claimant of the total profit of the vertical structure, which sets prices in the final consumer market to maximize it. The joint profit of each supplier-retailer pair is then divided by the fixed fee. That is, the retailer transfers rents to the upstream suppliers via a fixed fee. In this framework, one-stop shopping behavior does not trigger any merger incentives at the upstream level. Moreover, the efficiency of the vertical structure is independent of the upstream market structure.

We now assume demand uncertainty in association with risk aversion on the retailer side. We will show that these assumptions give rise to a double mark-up problem, which in turn implies that our main results (for linear contracts) remain qualitatively valid also under two-part tariffs. We build on Rey and Tirole [1986] who consider contracting between a risk neutral supplier and a risk averse retailer, when final demand is ex ante uncertain. Let parameter $v$ of the demand function be distributed over the interval $[\underline{v}, \overline{v}]$, with $\underline{v} > c$. Its realization is not known at the time when the contracts are signed. Let $v^e$ (with $\underline{v} < v^e < \overline{v}$) denote the expected value of $v$. To avoid making specific assumptions about the risk preference of the retailer, we follow Rey and Tirole and consider the extreme case of an infinitely risk averse agent. This assumption implies that the retailer only signs a contract, which guarantees a non-negative profit even in the worst possible case when the demand is smallest, with $v = \underline{v}$ holding.

A two-part tariff consists of a fixed fee $F \geq 0$ and a wholesale price $w \geq 0$. We assume the same non-cooperative price-setting game as in the previous subsection. The two manufacturers and the retailer make simultaneously their contract offers, which specify both $F$ and $w$. The retailer and manufacturer $i = 1, 2$ make their offers for product $i$. Then with probability $P \in [0, 1]$ the contract proposed by the manufacturer and with the counter probability $1 - P$ the contract proposed by the retailer is selected. After the contracts are chosen, all firms make their production decisions. We solve the game for a subgame-perfect Nash equilibrium.

Consider first the case of the independent suppliers. We start with the optimal contract of the retailer. Since both the fixed fee and the wholesale price constitute costs for the retailer, it sets them at the lowest possible levels, with $F^{R*} := F_i^{R*} = 0$ and $w^{R*} := w_i^{R*} = c$ holding, for $i = 1, 2$ (superscript $R$ refers to the retailer's offer). If the retailer's contracts are selected, then each manufacturer gets a profit of zero (assuming they serve the retailer's demand).

Every manufacturer chooses the contract which maximizes its expected profits under the constraint that the retailer gets a nonnegative profit even when $v = \underline{v}$ (see Rey and Tirole [1986, p. 925]) and taking the contracts of the other firms as given. In case that the contract offers of the manufacturers are selected for both products, the retailer participation constraint for the contract offer of supplier $i = 1, 2$ implies that

$$F_i^M \leq \pi^* \left(w_i^M, w_j^{M*}\right)\big|_{v=\underline{v}} - F_j^{M*}, \text{ for } j = 1, 2 \text{ and } j \neq i \tag{15}$$

(superscript $M$ refers to the contract offer of a manufacturer). In case that for product $i$ the contract of the manufacturer and for product $j$ the contract of the retailer are selected, this constraint takes the form:

$$F_i^M \leq \pi^* \left(w_i^M, w^{R*}\right)\big|_{v=\underline{v}} - F^{R*} = \pi^* \left(w_i^M, c\right)\big|_{v=\underline{v}}. \tag{16}$$

Under the assumption that $w_j^{M*} \geq c$ and $F_j^{M*} \geq 0$ (which hold in equilibrium), condition (15) is more restrictive than (16). Evaluating the retailer profit $\pi^* \left(w_i^M, w_j^{M*}\right)$ at $v = \underline{v}$ and substituting it into (15) yields

$$F_i^M \leq \frac{2(1+\lambda)\underline{v}(\underline{v}-w_i^M-w_j^{M*})+\left(w_i^M\right)^2+2\lambda w_i^M w_j^{M*}+\left(w_j^{M*}\right)^2}{2t} - F_j^{M*}. \tag{17}$$

Then every manufacturer $i = 1, 2$ chooses $w_i^M$ to maximize its expected profit under the constraint (17). Of course, $F_i^M$ is set at the maximal level, so that (17) binds. Thus, $w_i^{M*}$, for $i = 1, 2$, should maximize

$$P^2 E\varphi_i^* \left(w_i^M, w_j^{M*}\right) + P\left(1-P\right) E\varphi_i^* \left(w_i^M, w^{R*}\right) + P\, \pi^* \left(w_i^M, w_j^{M*}\right)\big|_{v=\underline{v}} - PF_j^{M*}. \tag{18}$$

Taking the derivative of (18) with respect to $w_i^M$ and imposing symmetry on the contract offers of the manufacturers, we get the equilibrium wholesale price charged by the independent manufacturers:[28]

$$w^{M*} := w_i^{M*} = c + \frac{(v^e-\underline{v})(1+\lambda)}{1-\lambda(1-P)} > c, \text{ for } i = 1, 2.$$

Imposing $w^{M*} \leq \underline{v}$, we get

$$\frac{\underline{v}-c}{v^e-\underline{v}} \geq \frac{1+\lambda}{1-\lambda(1-P)}, \tag{19}$$

which we assume to hold for the remainder of this subsection. Plugging $w_i^M = w^{M*}$ and $w_j^{M*} = w^{M*}$ into (17) and imposing symmetry, yields the equilibrium fixed fee offered by the

[28] First, note that $w^{M*}$ is defined if $P = 0$ and $\lambda = 1$ do not hold simultaneously. Second, while the equilibrium wholesale price of the manufacturer, $w^{M*}$, decreases in $P$, the expected wholesale price, $Ew^* := Pw^{M*} + (1-P)\,w^{R*}$, gets larger. The respective derivatives are $\partial w^{M*}/\partial P = -\lambda\left(1+\lambda\right)\left(v^e-\underline{v}\right)/\left[1-\lambda(1-P)\right]^2 \leq 0$ and $\partial Ew^*/\partial P = \left(1-\lambda^2\right)\left(v^e-\underline{v}\right)/\left[1-\lambda(1-P)\right]^2 \geq 0$.

manufacturer $i = 1, 2$:[29]

$$F^{M*} := F_i^{M*} = \frac{(1+\lambda)[(\underline{v}-c)(1-\lambda(1-P))-(v^e-\underline{v})(1+\lambda)]^2}{2t[1-\lambda(1-P)]^2} \geq 0.$$

Using $w^{M*}$ and $F^{M*}$, we can derive the sum of the manufacturers' expected equilibrium profits when they remain independent:

$$\begin{aligned} & P^2 \textstyle\sum_i E\varphi_i^* \left(w^{M*}, w^{M*}\right) + P\left(1-P\right) \textstyle\sum_i E\varphi_i^* \left(w^{M*}, w^{R*}\right) + 2PF^{M*} \qquad (20) \\ = \;& \frac{P(1+\lambda)\left[2(1-\lambda(1-P))-P\lambda^2(2-P)\right]}{t(1-\lambda(1-P))^2}\underline{v}^2 - \frac{P(1+\lambda)\left[2(1-\lambda)(c(1-\lambda(1-2P))+v^e(1+\lambda))+2cP^2\lambda^2\right]}{t(1-\lambda(1-P))^2}\underline{v} \\ & + \frac{P(1+\lambda)\left[c^2\left((1-\lambda)(1-\lambda(1-2P))+P^2\lambda^2\right)+(v^e)^2\left(1-\lambda^2\right)\right]}{t(1-\lambda(1-P))^2}. \end{aligned}$$

Suppose now that the suppliers are merged. The optimal contract offer of the retailer does not change: $F^{Rm*} := F_i^{Rm*} = 0$ and $w^{Rm*} := w_i^{Rm*} = c$, for $i = 1, 2$. Similar to the analysis above, fixed fees offered by the manufacturers must satisfy $F_1^{Mm*} + F_2^{Mm*} = \pi^* \left(w_i^{Mm*}, w_j^{Mm*}\right)\Big|_{v=\underline{v}}$. Then the merged manufacturer chooses the wholesale prices to maximize its expected profits:

$$P^2 \textstyle\sum_i E\varphi_i^* \left(w_i^M, w_j^M\right) + P\left(1-P\right) \textstyle\sum_i E\varphi_i^* \left(w_i^M, w_j^{Rm*}\right) + P\, \pi^* \left(w_i^M, w_j^M\right)\Big|_{v=\underline{v}}. \qquad (21)$$

Taking the derivative of (21) with respect to $w_i^M$ and imposing symmetry, yields the equilibrium wholesale price offered by the merged manufacturer:[30]

$$w^{Mm*} := w_i^{Mm*} = c + \frac{(v^e-\underline{v})(1+\lambda)}{1-\lambda(1-2P)} > c, \text{ for } i = 1, 2$$

and the equilibrium fixed fee:[31]

$$F^{Mm*} := F_i^{Mm*} = \frac{(1+\lambda)[(\underline{v}-c)(1-\lambda(1-2P))-(v^e-\underline{v})(1+\lambda)]^2}{2t[1-\lambda(1-2P)]^2} \geq 0, \text{ for } i = 1, 2.$$

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[29] If the manufacturer's bargaining power $P$ increases, then the fixed fee, $F^{M*}$, is optimally adjusted upwards, which must imply a downward adjustment of the wholesale price, $w^{M*}$, to fulfill the retailer's participation constraint. Because of assumption (19) we get that $\partial F^{M*}/\partial P = (v^e - \underline{v})\,\lambda\,(1+\lambda)^2\,[(\underline{v}-c)\,(1-\lambda\,(1-P)) - (v^e-\underline{v})\,(1+\lambda)] \,/\, \left[t\,(1-\lambda\,(1-P))^3\right] \geq 0$.

[30] Note that $w^{Mm*}$ is defined if $P = 0$ and $\lambda = 1$ do not hold simultaneously. Given (19), it holds that $w^{Mm*} \leq \underline{v}$. We also get that $w^{Mm*} - w^{M*} = -P\lambda\,(1+\lambda)\,(v^e-\underline{v})\,/\,[(1-\lambda(1-2P))\,(1-\lambda(1-P))] \leq 0$, which yields $w^{Mm*} \leq w^{M*}$. Hence, similar to the result of Lemma 1, the equilibrium expected wholesale price is larger when the manufacturers are independent than when they are merged: $Ew^* \geq Ew^{m*} := Pw^{Mm*} + (1-P)\,w^{Rm*}$, with equality if either $\lambda = 0$ or $P = 0$. The comparative statics of $w^{Mm*}$ and $Ew^{m*}$ with respect to $P$ are similar to those in the case of independent manufacturers.

[31] Similar to the case with the independent manufacturers, we have that $\partial F^{Mm*}/\partial P \geq 0$, because of assumption (19).

Using $w^{Mm*}$ and $F^{Mm*}$, we can calculate the equilibrium expected profit of the merged manufacturer:

$$\begin{aligned} & P^2 \sum_i E\varphi_i^* \left(w^{Mm*}, w^{Mm*}\right) + P\left(1-P\right) \sum_i E\varphi_i^* \left(w^{Mm*}, w^{Rm*}\right) + 2PF^{Mm*} \\ = & \frac{(1+\lambda)P\left[2\underline{v}^2(1+P\lambda) - 2\underline{v}(c(1-\lambda(1-2P)) + v^e(1+\lambda)) + (v^e)^2(1+\lambda) + c^2(1-\lambda(1-2P))\right]}{t[1-\lambda(1-2P)]}. \end{aligned} \tag{22}$$

The manufacturers prefer to merge if the difference between the profits (22) and (20), while taking fixed merger costs $K$ into account, is non-negative, i.e.,

$$\Psi - K = \frac{P^3\lambda^2(1+\lambda)^2(v^e-\underline{v})^2}{t[1-\lambda(1-P)]^2[1-\lambda(1-2P)]} - K \geq 0.$$

The following proposition summarizes our results on the upstream merger incentives depending on parameters $K$, $P$ and $\lambda$.

**Proposition 4.** *Assume two-part tariffs, uncertain demand and an infinitely risk averse retailer. If the merger costs are not too high, $K \leq \widehat{K} := 2\left(v^e - \underline{v}\right)^2 / t$, then for any $P > 0$ there exists a critical value of the share of one-stop shoppers, $\widehat{\lambda}\left(K, P\right) > 0$, such that an upstream merger is (weakly) profitable for any $\lambda \geq \widehat{\lambda}\left(K, P\right)$. Moreover, $\widehat{\lambda}\left(K, P\right)$ is increasing in $K$ and decreasing in $P$, $\widehat{\lambda}\left(\widehat{K}, 1\right) = 1$ and $\lim_{K\to 0} \widehat{\lambda}\left(K, P\right) = 0$.*

Proposition 4 shows that upstream merger incentives do not necessarily disappear under two-part tariffs. If the retailer is risk averse and faces demand uncertainty, then the equilibrium merger incentives of the manufacturers are analogous to the incentives in our main analysis where the players (Nash) bargain over linear contracts. Precisely, merger incentives increase the larger the share of one-stop shoppers and the larger the probability that the manufacturer's offer is chosen. In contrast, larger buyer power, ceteris paribus, makes it more likely that suppliers counter buyer power through staying independent.

The reason why merger incentives are present with two-part tariffs is the risk aversion of the retailer, which imposes a binding constraint on the maximal fixed fee the manufacturer can charge. It then follows that the manufacturer sets a wholesale price above the marginal cost to extract rents from the retailer when the demand is large. As under linear contracts, independent manufacturers do not internalize the negative external effect of a wholesale price increase on the other manufacturer's demand and profit. This problem becomes the more serious the larger the demand complementarity caused by one-stop shopping behavior. A merged manufacturer internalizes the externality and thus charges lower wholesale prices. This results in a larger total surplus and higher joint profits than under independent manufacturers. As a consequence, a merger becomes profitable when the fixed merger costs are not too large, while this incentive increases in the share of one-stop shoppers and decreases in buyer power, $1 - P$.

In the following we consider a numerical example to illustrate our results. We set $\widehat{K} = 200$. In Table II we present the critical value of the share of one-stop shoppers (multiplied by 100), $\widehat{\lambda}(K, P)$, for different values of $K$ and $P$. We see that keeping merger costs $K$ fixed, this share decreases when the manufacturer's bargaining power gets larger, which relaxes the constraint $\lambda \geq \widehat{\lambda}(K, P)$ and makes a merger more likely. Similarly, fixing the bargaining power $P$, we observe that a higher value of merger fixed costs can only be sustained under a larger share of one-stop shoppers implying that a merger becomes less likely. These results support the conclusion of our main analysis that the manufacturers have stronger incentives to merge when the share of one-stop shoppers and/or their bargaining power are sufficiently large.

| | | $P$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| $K$ | 1 | $n$ | 62 | 44 | 33 | 26 | 21 | 17 | 15 | 13 | 11 | 10 |
| | 4 | $n$ | 75 | 59 | 49 | 41 | 35 | 30 | 26 | 23 | 21 | 18 |
| | 10 | $n$ | 82 | 70 | 60 | 53 | 47 | 42 | 37 | 34 | 31 | 28 |
| | 20 | $n$ | 88 | 78 | 70 | 63 | 57 | 52 | 48 | 44 | 41 | 38 |
| | 35 | $n$ | 91 | 84 | 77 | 72 | 67 | 62 | 58 | 55 | 52 | 49 |
| | 50 | $n$ | 93 | 87 | 82 | 77 | 73 | 69 | 66 | 62 | 59 | 57 |
| | 80 | $n$ | 96 | 92 | 88 | 85 | 82 | 79 | 76 | 74 | 71 | 69 |
| | 110 | $n$ | 97 | 95 | 93 | 90 | 88 | 86 | 84 | 82 | 80 | 79 |
| | 150 | $n$ | 99 | 98 | 96 | 95 | 94 | 93 | 92 | 91 | 90 | 89 |

Table II: Critical share of one-stop shoppers (multiplied by 100), $\widehat{\lambda}(K, P)$; '$n$'= no merger

### 5.3 Substitutable Products

In this subsection, we consider substitutable products by incorporating a Hotelling-type dimension of horizontal product differentiation into our basic model. This also allows us to derive endogenously the shares of one-stop and single-item shoppers.

To extend our model in a parsimonious way, we assume that the additional utility of consuming a second unit of the same product is zero. In contrast, if a consumer decides to buy not only one product but also the other one, she still receives the full utility of consuming the other product. Thus, in equilibrium consumers either buy one of the products, buy both products or none. In the former case consumers are single-item shoppers and in the latter case they are one-stop shoppers buying both variants of the same product category. While the assumption of zero additional utility of the second unit of the same product is strong, we can think of situations in which such a setting is realistic. To provide an example, consider the situation of buying a movie DVD in a media store. Suppose there are only two different movies available. If a consumer has a strong preference for one of the movies, she will buy just the preferred DVD. Buying the other movie as well (or, only the other movie) cannot be optimal as a strong preference for one of the products implies a weak preference for the other one. If, however, the consumer is rather indifferent between the two movies, she may very well buy both of them given low enough prices. This suggests that the share of one-stop shoppers is larger the less differentiated the products are, which turns out to be true in our extended model.

We, therefore, depart from our basic setting in which a consumer is characterized only by the location $\theta$. In addition, each consumer is now also characterized by her address $x$ on the unit interval $[0, 1]$, which is the ideal product variant of the consumer. We assume that product 1 is located at the left end, $x_1 = 0$, and product 2 is located at the right end of the unit interval, $x_2 = 1$.[32] If a consumer does not buy her ideal product, she incurs linear utility costs proportional to the distance between her own and the firm's address. Denote by $\tau > 0$ the product differentiation parameter. Then, the disutility of a consumer with address $x$ from buying firm $i$'s product is given by $\tau |x - x_i|$, with $i = 1, 2$.

We consider the case where both one-stop and single-item shoppers coexist in equilibrium, which requires that[33]

$$p_1 + p_2 \leq 2v - \tau \text{ and } p_i \geq v - \tau, \text{ for } i = 1, 2. \tag{23}$$

[32] Consumers indexed by $(\theta, x)$ are uniformly distributed over the area $(-\infty, +\infty) \times [0, 1]$.

[33] See Appendix for the derivation of these conditions and of the demand functions.

The single-item shoppers' demand for product $i = 1, 2$ is given by

$$q_i^s(p_1, p_2) = 2\left(1 - \frac{v-p_j}{\tau}\right)\left(\frac{v-p_i}{t} + \frac{v-\tau-p_j}{2t}\right), \text{ with } j = 1, 2 \text{ and } j \neq i, \tag{24}$$

and the demand of the one-stop shoppers is given by

$$q_i^o(p_1, p_2) = \frac{2(2v-\tau-p_1-p_2)^2}{t\tau}. \tag{25}$$

Adding the demands (24) and (25), we obtain the total demand for product $i = 1, 2$:

$$Q_i(p_1, p_2) = 2\left(1 - \frac{v-p_j}{\tau}\right)\left(\frac{v-p_i}{t} + \frac{v-\tau-p_j}{2t}\right) + \frac{2(2v-\tau-p_i-p_j)^2}{t\tau}, \text{ with } j = 1, 2 \text{ and } j \neq i.$$

As in the main analysis, this demand is strictly downward sloping in its own price and exhibits complementarities ($\partial Q_i(\cdot)/\partial p_j \leq 0$, for $i, j = 1, 2$ and $i \neq j$, because of assumption (23)). To understand the demand complementarity, consider a price increase of product 2, $p_2$. Such a price increase induces some single-item shoppers of product 2 to leave the market, while none of them becomes a one-stop shopper. Similarly, some one-stop shoppers do not buy anymore, while some of them become single-item shoppers of product 1. Thus, an increase of $p_2$ must reduce the total demand for product 1, because some one-stop shoppers leave the market.

In the main analysis we showed, how the upstream merger incentives depend on the share of one-stop shoppers, $\lambda$, and the bargaining power of the retailer, $\delta$. In this extension, where consumers can choose between buying both products, just one of them or none, we cannot vary the share of one-stop shoppers exogenously. We can instead vary parameter $\tau$, which changes the share of one-stop shoppers. Define the share of one-stop shoppers by $\lambda_i(p_i, p_j) := q_i^o(\cdot)/Q_i(\cdot)$, for $i = 1, 2$. We then get the following derivative:[34]

$$\frac{\partial \lambda_i(\cdot)}{\partial \tau} = \frac{4(v-p_i)^2(\tau-2v+p_i+p_j)}{\left(5v^2-4v\tau-6vp_i-4vp_j+\tau^2+2\tau p_i+2\tau p_j+2p_i^2+2p_ip_j+p_j^2\right)^2} \leq 0.$$

Ceteris paribus, a larger value of $\tau$ leads to a lower value of $\lambda_i(\cdot)$: When the degree of product differentiation increases, less consumers prefer to buy both products.

However, a change of the product differentiation parameter $\tau$ not only affects the share of one-stop shoppers, but it also the demand functions. As a higher value of $\tau$ implies less

[34] The sign of the inequality follows from assumption (23), which implies that the second term in parentheses in the numerator is non-positive.

gross utility for all consumers, less consumers buy the products (demand decreases along the $\theta$ dimension). In fact, calculating the respective derivative, we get[35]

$$\frac{\partial Q_i(\cdot)}{\partial \tau} = -\frac{5v^2 - 6vp_i - 4vp_j + 2p_i^2 + 2p_ip_j + p_j^2 - \tau^2}{t\tau^2} \leq 0,$$

so that a higher degree of product differentiation reduces each product's demand.

As the demand is a quadratic function of prices, we cannot derive an analytical solution of the game for the parameter range under consideration. However, we provide some numerical examples, which support the main results of our basic analysis.[36] We consider three different values of parameter $v$: 5, 10 and 15. We also vary the degree of product differentiation, $\tau$. For each $v$ we consider two (or three) different values of $\tau$, which we set to be not very different from $v$, such that both groups of consumers coexist in equilibrium (condition (23) is fulfilled). For each combination of parameters $v$ and $\tau$ we analyze the manufacturers' merger incentives under different values of the bargaining power parameter, $\delta$. In all calculations we set the transport cost parameter $t$ equal to one and the marginal cost $c$ equal to zero.

In Table III, $\lambda_i^*$ and $Q_i^*$ ($\lambda_i^{m*}$ and $Q_i^{m*}$), for $i = 1, 2$, denote the equilibrium share of one-stop shoppers and total quantity of product $i$, when the manufacturers are independent (are merged). Notice that changing $\tau$ (in the table we consider a 'high' value of $\tau = 5$ and a 'low' value of $\tau = 4$, while $v = 5$) exhibits the expected effects on the share of one-stop shoppers and total quantities. Precisely, reducing the value of $\tau$ from 5 to 4 increases both the equilibrium share of one-stop shoppers and the equilibrium output levels independently of the bargaining power parameter $\delta$. Take, for example $\delta = 0.4$ and assume that the manufacturers are independent. Then the equilibrium share of one-stop shoppers is 30 percent for $\tau = 5$, while it increases to 67 percent for $\tau = 4$. Similarly, total quantity of product $i$ in equilibrium (multiplied by 100) increases from 234 to 358.[37]

[35] Note that from assumption (23) it follows that $\tau^2 \leq (2v - p_i - p_j)^2$. Hence, $5v^2 - 6vp_i - 4vp_j + 2p_i^2 + 2p_ip_j + p_j^2 - \tau^2 \geq 5v^2 - 6vp_i - 4vp_j + 2p_i^2 + 2p_ip_j + p_j^2 - (2v - p_i - p_j)^2 = (v - p_i)^2 \geq 0$, which explains the sign of the derivative.

[36] All calculation are presented in the Appendix.

[37] Similar tables are derived for $v = 10$ and $v = 15$ in the Appendix.

| | $\delta$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| | $\tau = 5$ ('high' product differentiation) | | | | | | | | | | |
| $100 * \lambda_i^*$ | 10 | 13 | 17 | 23 | 30 | 36 | 43 | 49 | 54 | 60 | 65 |
| $100 * \lambda_i^{m*}$ | 20 | 23 | 27 | 32 | 37 | 42 | 47 | 52 | 56 | 61 | 65 |
| $100 * Q_i^*$ | 167 | 176 | 190 | 210 | 234 | 261 | 290 | 321 | 355 | 391 | 430 |
| $100 * Q_i^{m*}$ | 200 | 212 | 226 | 244 | 265 | 288 | 313 | 340 | 369 | 399 | 430 |
| | $\tau = 4$ ('low' product differentiation) | | | | | | | | | | |
| $100 * \lambda_i^*$ | 40 | 47 | 54 | 61 | 67 | 72 | 77 | 82 | 86 | 90 | 94 |
| $100 * \lambda_i^{m*}$ | 57 | 61 | 66 | 70 | 74 | 78 | 82 | 85 | 88 | 91 | 94 |
| $100 * Q_i^*$ | 223 | 252 | 284 | 320 | 358 | 399 | 444 | 493 | 546 | 604 | 668 |
| $100 * Q_i^{m*}$ | 296 | 323 | 353 | 385 | 420 | 456 | 495 | 536 | 578 | 622 | 668 |

Table III: Equilibrium shares $\lambda_i$ and equilibrium quantity $Q_i$ (multiplied by 100); $v = 5$

Table III also shows that a larger degree of buyer power increases the share of one-stop shoppers. Buyer power reduces the input prices and thus also the final good prices, which in turn makes it more attractive for consumers to buy both products.

We now examine suppliers' merger incentives according to (12). Table IV presents the critical values of the retailer's bargaining power (Nash weight), $\widetilde{\delta}$, at which the suppliers are indifferent between merging and staying independent. As in our main model, a merger is profitable for $\delta \leq \widetilde{\delta}$, i.e., when buyer power is small enough, while staying independent is optimal when the retailer's bargaining power becomes sufficiently large (see Proposition 1). As one can see from the table, a smaller value of the product differentiation parameter reduces the critical value $\widetilde{\delta}$. For instance, take $v = 5$. Then, for $\tau = 4$ (i.e., 'low' product differentiation) a merger is profitable if the retailer's bargaining power is smaller than 0.12. If product differentiation is somehow larger (with $\tau = 5$), then an upstream merger becomes profitable for retailer's bargaining powers smaller than 0.15, which is obviously less restrictive.

| | | $\tau$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 8 | 9 | 10 | 12 | 14 | 15 |
| | 5 | 0.12 | 0.15 | | | | | | |
| $v$ | 10 | | | 0.12 | 0.13 | 0.15 | | | |
| | 15 | | | | | | 0.12 | 0.13 | 0.15 |

Table IV: Critical values of the retailer's bargaining power, $\widetilde{\delta}$

To understand this result, two effects of a change in the product differentiation parameter have to be considered. First, a smaller value of $\tau$ increases the share of one-stop shoppers, which makes a merger more attractive because of the negative pricing externalities due to product complementarity. Second, a smaller value of $\tau$ increases the equilibrium output levels, which is favorable for remaining independent because of the higher input prices under separation. It turns out that the second effect dominates the first one, so that a lower value of $\tau$ reduces the critical value $\widetilde{\delta}$, such that it becomes more likely that the suppliers stay independent. While the reasoning of Proposition 2 remains valid (namely, an increase of buyer power can induce suppliers to favor separation over integration), this result is reassuring for our analysis. In our main model, a larger share of (exogenously given) one-stop shoppers tends to reduce the range of bargaining power parameters that support a no-merger outcome, the opposite holds in our extended model. Considering substitutable products and an endogenously derived share of one-stop shoppers, we obtain the result that a larger share of one-stop shoppers is now associated with a larger range of bargaining power parameters that support a no-merger outcome. Overall, these results show that suppliers may very well strategically separate for bargaining power reasons even in markets characterized by both a high share of one-stop shoppers and a high degree of retailer's bargaining power.[38]

[38] In our main model such a constellation is less likely because of the positive relationship between the critical bargaining power value $\widetilde{\delta}$ and the share of one-stop shoppers $\lambda$ (see Proposition 1).

# 6 Conclusion

In this paper we have examined the bargaining relationship between a retailer and two suppliers, assuming the specific environment of today's retail markets. First, the retailer enjoys monopoly power vis-à-vis consumers. Second, delivery contracts and wholesale prices are determined in bilateral negotiations where the retailer may have substantial bargaining power. Third, consumers benefit from a larger assortment because of their preferences for one-stop shopping.

We have shown that shopping behavior may have important implications for both the supplier-retailer relationship and upstream merger decisions. If consumers prefer to bundle their purchases in order to economize on their shopping time, two kinds of complementarities arise. First, inherently independent goods become complementary, which creates pricing externalities and excessive mark-ups. Second, formerly independent bilateral bargaining relations also become complementary, which weakens the retailer's disagreement payoff, and hence, improves the bargaining position of an independent supplier.

The first effect creates incentives to merge, which are known since Cournot [1838]. The second effect works in the opposite direction such that staying independent becomes more attractive; a phenomenon known from models of wage bargaining between a firm and complementary unions (Horn and Wolinsky [1988a,b]). We find that the second effect unambiguously increases when buyer power becomes more pronounced. If buyer power is sufficiently large, then suppliers always stay separated because of bargaining reasons.

We have also shown that upstream mergers imply lower wholesale prices such that they are always socially beneficial. Therefore, competition authorities are well advised to take a retailer's countervailing power into account when deciding about mergers between upstream suppliers. With regard to the assessment of the increasing buyer power of large retail chains, our analysis gives a mixed picture. For a given upstream market structure increasing buyer power tends to lower wholesale prices which is desirable both from a consumer and a social welfare perspective. However, if buyer power becomes sufficiently large, then suppliers may respond by separating their businesses to counter buyer power. This logic provides a new channel through which large buyer power can harm consumers and social welfare. With increasing buyer power, bargaining power considerations become more and more important at the suppliers' side, which may induce them to stay separated even though this creates excessive mark-ups.

Finally, we considered three extensions which show that our main results remain valid under a non-cooperative price-setting game, under two-part tariffs (in association with uncertain demand and a risk-avers retailer), and when goods are substitutable.

# Appendix

**Proof of Lemma 1.** Comparing $w^*$ and $w^{m*}$ we get

$$w^* - w^{m*} = \frac{\lambda(1-\delta)(1+\delta+2\lambda)(v-c)}{4+2\lambda(5-\delta+2\lambda)} \geq 0,$$

with equality holding if either $\lambda = 0$ or $\delta = 1$. Turning to comparative statics, $w^{m*}$ is obviously decreasing in $\delta$ and independent of $\lambda$. In turn, the comparative statics of $w^*$ in $\lambda$ and $\delta$ are given by

$$\begin{aligned} \frac{\partial w^*}{\partial \lambda} &= \frac{(1-\delta)(v-c)\left[1+2(2-\delta)\lambda^2+4\lambda+\delta\right]}{[2+\lambda(5-\delta+2\lambda)]^2} \geq 0 \text{ and} \\ \frac{\partial w^*}{\partial \delta} &= -\frac{2(1+\lambda)^3(1+2\lambda)(v-c)}{[2+\lambda(5-\delta+2\lambda)]^2} < 0. \end{aligned}$$

**Proof of Proposition 1.** Employing (12) we get

$$\Psi(\lambda,\delta) = -\frac{\lambda(1+\lambda)(1-\delta)(c-v)^2\Omega(\lambda,\delta)}{2t[2+\lambda(5-\delta+2\lambda)]^2}, \tag{26}$$

with

$$\Omega(\lambda,\delta) = -4\lambda^3(1-3\delta) + 4\lambda^2\left(\delta^2+6\delta-1\right) + \lambda\left[\delta^2(9-\delta)+17\delta-1\right] + 4\delta(1+\delta).$$

Consider the function $\Omega(\cdot)$. If $\delta = 1/3$, then $\Omega(\lambda, 1/3) > 0$ for any $\lambda$. If $\delta \neq 1/3$, then $\Omega(\cdot)$ can be stated as

$$\Omega(\lambda,\delta) = -2(1-3\delta)(1+2\lambda+\delta)\left[\lambda - \frac{1-(10-\delta)\delta+\psi}{4(3\delta-1)}\right]\left[\lambda - \frac{1-(10-\delta)\delta-\psi}{4(3\delta-1)}\right], \tag{27}$$

with $\psi := \sqrt{1+\delta\left[12+\delta\left(6-20\delta+\delta^2\right)\right]}$. Note that for any $\delta$ it holds that

$$\frac{1-(10-\delta)\delta+\psi}{4(3\delta-1)} < 0,$$

such that the first bracket on the right-hand side of (27) is always (strictly) positive. Similarly, $1+2\lambda+\delta > 0$ holds for any $\lambda$ and $\delta$. We introduce now $\lambda^c(\delta) := [1-(10-\delta)\delta-\psi]/[4(3\delta-1)]$.

If $\delta < 1/3$, then $\lambda^c(\delta)$ monotonically increases in $\delta$ with $\lambda^c(0) = 0$ and $\lambda^c(10 - \sqrt{97}) = 1$. If $\delta > 1/3$, then $\lambda^c(\delta) < 0$ and for any $\lambda$ we get $\lambda - \lambda^c(\delta) > 0$. We can now conclude that $\Omega(\cdot) = 0$ if $\lambda = \lambda^c(\delta)$, $\Omega(\cdot) < 0$ if $\lambda > \lambda^c(\delta)$ (such $\lambda$ exist if $\delta < 10 - \sqrt{97} \approx 0.15$) and $\Omega(\cdot) > 0$ for all other $\lambda$ and $\delta$.

Coming back to the function $\Psi(\cdot)$ in (26), note first that $2 + \lambda(5 - \delta + 2\lambda) > 0$ for any $\lambda$ and $\delta$. We observe that $\Psi(\cdot) = 0$ if either $\lambda = 0$, or $\delta = 1$, or $\lambda = \lambda^c(\delta)$ (in which case $\Omega(\cdot) = 0$ holds), implying that the manufacturers are indifferent whether to merge or not in these cases. If $\lambda > \lambda^c(\delta)$, then $\Psi(\cdot) > 0$ (in which case $\Omega(\cdot) < 0$ holds) and the manufacturers strictly prefer a merger in this case. For all other $\lambda$ and $\delta$ it holds that $\Psi(\cdot) < 0$ (in which case $\Omega(\cdot) > 0$ holds) and the manufacturers strictly prefer to stay independent.

**Proof of Proposition 3.** The manufacturers' merger incentives are given by

$$\Psi(P, \lambda) - K = \frac{P^3\lambda^2(1+\lambda)^2(v-c)^2}{2t(1+P\lambda)(2+P\lambda)^2} - K. \tag{28}$$

Taking the derivative of (28) with respect to $P$ we get

$$\frac{\partial\Psi(\cdot)}{\partial P} = \frac{P^2\lambda^2(1+\lambda)^2(v-c)^2(6+5P\lambda)}{2t(1+P\lambda)^2(2+P\lambda)^3} \geq 0, \tag{29}$$

for any $\lambda$ and $P$. Taking the derivative of (28) with respect to $\lambda$ we get

$$\frac{\partial\Psi(\cdot)}{\partial\lambda} = \frac{P^3\lambda(1+\lambda)(v-c)^2\left(P^2\lambda^3 - P^2\lambda^2 + 8P\lambda^2 + 2P\lambda + 8\lambda + 4\right)}{2t(1+P\lambda)^2(2+P\lambda)^3} \geq 0, \tag{30}$$

for any $\lambda$ and $P$. We introduce now merger costs $\widetilde{K}$:

$$\widetilde{K} := \Psi(1, 1) = \frac{(v-c)^2}{9t}. \tag{31}$$

At a next step for any $K \leq \widetilde{K}$ we implicitly define $\widetilde{P}(K)$ as a probability at which $\Psi\left(\widetilde{P}(K), 1\right) = K$ holds:

$$\frac{2\widetilde{P}^3(K)(v-c)^2}{t\left[1+\widetilde{P}(K)\right]\left[2+\widetilde{P}(K)\right]^2} = K. \tag{32}$$

We show next that such a $\widetilde{P}(K) \in (0, 1]$ exists. If $P = 0$, then $\Psi(0, 1) - K = -K < 0$ for any $K \leq \widetilde{K}$. If $P = 1$, then

$$\Psi(1, 1) - K = \widetilde{K} - K \geq 0, \text{ for any } K \leq \widetilde{K}.$$

Combining the results that for any $K \leq \widetilde{K}$ it holds that $\Psi(0, 1) - K < 0$ and $\Psi(1, 1) - K \geq 0$ with the fact that $\Psi(P, 1)$ is a continuous function of $P$, we conclude that there exists $P \in (0, 1]$, such that $\Psi(P,1) - K = 0$. Moreover, such a $P$ is unique, which follows from the fact that $\Psi(\cdot)$ strictly increases in $P$ if $P > 0$ and $\lambda = 1$ (see (29)). We refer to this $P$ as $\widetilde{P}(K)$, which is a function. We derive next some properties of $\widetilde{P}(K)$. First, if $K = \widetilde{K}$, then $\widetilde{P}\left(\widetilde{K}\right) = 1$. Indeed, evaluating (32) at $K = \widetilde{K}$ we get

$$\frac{2P^3(v-c)^2}{t(1+P)(2+P)^2} = \frac{(v-c)^2}{9t},$$

which yields $P = 1$. Second, as is straightforward from (32),

$$\lim_{K \to 0} \widetilde{P}(K) = 0.$$

Third, from (32) we get that

$$\frac{\partial \widetilde{P}(K)}{\partial K} = \frac{1}{\partial \Psi(P,1)/\partial P|_{P=\widetilde{P}(K)}} > 0, \text{ because } \widetilde{P}(K) > 0.$$

At a next step for any $K \leq \widetilde{K}$ and $P \geq \widetilde{P}(K)$ we implicitly define $\widetilde{\lambda}(K,P)$, which solves the equation:

$$\Psi\left(P, \widetilde{\lambda}(K,P)\right) = K. \tag{33}$$

We next show that such a $\widetilde{\lambda}(\cdot) \in (0,1]$ exists. Note that if $\lambda = 0$, then for any $K \leq \widetilde{K}$ and $P$ it holds that $\Psi(P,0) - K = -K < 0$. If $\lambda = 1$, then for any $K \leq \widetilde{K}$ and $P \geq \widetilde{P}(K)$ we get

$$\Psi(P,1) - K = \frac{2P^3(v-c)^2}{t(1+P)(2+P)^2} - K \geq \frac{2\widetilde{P}^3(K)(v-c)^2}{t\left[1+\widetilde{P}(K)\right]\left[2+\widetilde{P}(K)\right]^2} - K = 0,$$

where the inequality sign follows from the fact that $\Psi(\cdot)$ increases in $P$ (see (29)) and the last equality sign follows from the definition of $\widetilde{P}(K)$ (see (32)). Using $\Psi(P,0) - K < 0$, $\Psi(P,1) - K \geq 0$ and the fact that $\Psi(\cdot)$ is a continuous function of $\lambda$ for any $P$ and $\lambda$, we conclude that there exists $\lambda \in (0,1]$, such that $\Psi(\cdot) - K = 0$. Moreover, such a value is unique, which follows from the fact that $\Psi(\cdot)$ strictly increases in $\lambda$ if $\lambda > 0$ and $P > 0$ (see (30)). We refer to this $\lambda$ as $\widetilde{\lambda}(K,P)$, which is a function. We next derive some properties of $\widetilde{\lambda}(\cdot)$. First, from (33) we get that

$$\begin{aligned}
\frac{\partial \widetilde{\lambda}(\cdot)}{\partial K} &= \frac{1}{\partial \Psi(\cdot)/\partial \lambda|_{\lambda=\widetilde{\lambda}(\cdot)}} > 0 \text{ and} \\
\frac{\partial \widetilde{\lambda}(\cdot)}{\partial P} &= -\frac{\partial \Psi(\cdot)/\partial P|_{\lambda=\widetilde{\lambda}(\cdot)}}{\partial \Psi(\cdot)/\partial \lambda|_{\lambda=\widetilde{\lambda}(\cdot)}} < 0,
\end{aligned}$$

where strict inequalities follow from $P \geq \widetilde{P}(K) > 0$ and $\widetilde{\lambda}(\cdot) > 0$. Second, if $K = \widetilde{K}$ and $P = \widetilde{P}\left(\widetilde{K}\right) = 1$, then $\widetilde{\lambda}\left(\widetilde{K}, \widetilde{P}\left(\widetilde{K}\right)\right) = 1$. Indeed, solving $\Psi(1,\lambda) = \widetilde{K}$ we get

$$\frac{\lambda^2(1+\lambda)(v-c)^2}{2t(2+\lambda)^2} = \frac{(v-c)^2}{9t},$$

which yields $\lambda = 1$. Third, $\lim_{K\to 0} \widetilde{\lambda}(K, P) = 0$, as is straightforward from (28).

From (30) it follows that for any $K \leq \widetilde{K}$, $P \geq \widetilde{P}(K)$ and $\lambda \geq \widetilde{\lambda}(\cdot)$ it holds that

$$\Psi(P, \lambda) - K \geq \Psi\left(P, \widetilde{\lambda}(\cdot)\right) - K = 0,$$

which implies upward merger incentives. Note also that for any $P$, $\lambda$ and $K > \widetilde{K}$ it holds that

$$\Psi(P, \lambda) - K < \Psi(P, \lambda) - \widetilde{K} \leq \Psi(1, 1) - \widetilde{K} = 0,$$

such that the manufacturers do not merge. Similarly, for any $K \leq \widetilde{K}$, $P < \widetilde{P}(K)$ and $\lambda$ it holds that

$$\Psi(P, \lambda) - K \leq \Psi(P, 1) - K < \Psi\left(\widetilde{P}(K), 1\right) - K = 0,$$

which implies that there are no upstream merger incentives. Finally, for any $K \leq \widetilde{K}$, $P \geq \widetilde{P}(K)$ and $\lambda < \widetilde{\lambda}(\cdot)$ it holds that

$$\Psi(P, \lambda) - K < \Psi\left(P, \widetilde{\lambda}(\cdot)\right) - K = 0,$$

such that there are no upstream merger incentives. We conclude that the manufacturers merge if and only if $K \leq \widetilde{K}$, $P \geq \widetilde{P}(K)$ and $\lambda \geq \widetilde{\lambda}(\cdot)$ hold together.

**Proof of Proposition 4.** The manufacturers' merger incentives depend on the sign of the expression:

$$\Psi(P, \lambda) - K = \tfrac{P^3\lambda^2(\lambda+1)^2(v^e-\underline{v})^2}{t(P\lambda+1-\lambda)^2(2P\lambda-\lambda+1)} - K. \tag{34}$$

Note that for any $P$ and $\lambda$ it holds that

$$\begin{aligned} \tfrac{\partial\Psi(\cdot)}{\partial P} &= \tfrac{P^2\lambda^2(1-\lambda)(\lambda+1)^2(v^e-\underline{v})^2(5P\lambda+3(1-\lambda))}{t(P\lambda+1-\lambda)^3(2P\lambda-\lambda+1)^2} \geq 0 \text{ and} \\ \tfrac{\partial\Psi(\cdot)}{\partial \lambda} &= \tfrac{P^3\lambda(\lambda+1)(v^e-\underline{v})^2\left[2P^2\lambda^3 P\lambda^2(11-3\lambda-2P)+2P\lambda+\lambda^3-6\lambda^2+3\lambda+2\right]}{t(P\lambda+1-\lambda)^3(2P\lambda-\lambda+1)^2} \geq 0, \end{aligned} \tag{35}$$

where the sign of the latter derivative follows from $\min_{\lambda\in[0,1]}\left\{\lambda^3 - 6\lambda^2 + 3\lambda + 2\right\} = 0$. We introduce $\widehat{K}$:

$$\widehat{K} := \Psi(1, 1) = \tfrac{2(v^e-\underline{v})^2}{t}.$$

Note that no merger incentives exist for any $P$, $\lambda$ and $K > \widehat{K}$, because $\Psi(P, \lambda) - K \leq \Psi(1, 1) - K < \Psi(1, 1) - \widehat{K} = 0$, which follows from the fact that $\Psi(\cdot)$ increases in $P$ and $\lambda$ (see (35)). In the following we consider $K \leq \widehat{K}$. Note that if $P = 0$, then no merger takes place for any $\lambda$:

$$\Psi(0, \lambda) - K = -K < 0, \text{ for any } K \leq \widehat{K}.$$

We next consider only $P > 0$. For any $K \leq \widehat{K}$ and $P > 0$ we implicitly define $\widehat{\lambda}(K, P)$, such that

$$\Psi\left(P, \widehat{\lambda}(K, P)\right) - K = 0. \tag{36}$$

We prove next that such a $\widehat{\lambda}(\cdot) \in (0, 1]$ exists. If $\lambda = 0$, then for any $P > 0$ and $K \leq \widehat{K}$ it holds that

$$\Psi(P, 0) - K = -K < 0.$$

If $\lambda = 1$, then

$$\Psi(P, 1) - K = \tfrac{2(v^e - \underline{v})^2}{t} - K = \widehat{K} - K \geq 0,$$

for any $P > 0$ and $K \leq \widehat{K}$. Then there exists $\lambda \in (0, 1]$, such that $\Psi(P, \lambda) - K = 0$, because $\Psi(\cdot)$ is a continuous function. Moreover, such a value is unique, because $\Psi(\cdot)$ strictly increases in $\lambda$ if $\lambda > 0$ and $P > 0$ (see (35)). Note that $\widehat{\lambda}(\cdot)$ is a function. Then for any $K \leq \widehat{K}$, $P > 0$ and $\lambda \geq \widehat{\lambda}(\cdot)$ using the definition of $\widehat{\lambda}(\cdot)$ in (36) we get that

$$\Psi(P, \lambda) - K \geq \Psi\left(P, \widehat{\lambda}(K, P)\right) - K = 0,$$

which implies that the manufacturers prefer to merge.

We finally derive some properties of $\widehat{\lambda}(\cdot)$. First, from (36) we get that

$$\begin{aligned} \tfrac{\partial \widehat{\lambda}(\cdot)}{\partial P} &= -\tfrac{\partial \Psi(\cdot)/\partial P|_{\lambda=\widehat{\lambda}(\cdot)}}{\partial \Psi(\cdot)/\partial \lambda|_{\lambda=\widehat{\lambda}(\cdot)}} < 0 \text{ and} \\ \tfrac{\partial \widehat{\lambda}(\cdot)}{\partial K} &= \tfrac{1}{\partial \Psi(\cdot)/\partial \lambda|_{\lambda=\widehat{\lambda}(\cdot)}} > 0, \end{aligned}$$

where strict inequalities follow from $P > 0$ and $\widehat{\lambda}(\cdot) > 0$. Second, if $P = 1$ and $K = \widehat{K}$, then $\widehat{\lambda}\left(\widehat{K}, 1\right) = 1$. Indeed, from (36) we get that

$$\Psi(1, \lambda) - \widehat{K} = \tfrac{\lambda^2(1+\lambda)(v^e - \underline{v})^2}{t} - \tfrac{2(v^e - \underline{v})^2}{t} = 0,$$

which yields $\lambda = 1$. Third, as is straightforward from (34), $\lim_{K \to 0} \widehat{\lambda}(K, P) = 0$.

**Derivation of Demands in Subsection 5.3 (Substitutable Products).** Consider first one-stop shoppers. These are the consumers for whom the following three conditions are satisfied. First,

$$2v - \tau - t|\theta| - p_1 - p_2 \geq 0, \tag{37}$$

such that a consumer gets a non-negative utility from buying both products. Second,

$$2v - \tau - t|\theta| - p_1 - p_2 \geq v - t|\theta| - \tau x - p_1, \tag{38}$$

implying that buying both products is preferred to buying only product 1. And third,

$$2v - \tau - t\,|\theta| - p_1 - p_2 \geq v - t\,|\theta| - \tau\,(1-x) - p_2, \tag{39}$$

which states that a consumer prefers to buy both products rather than buying only product 2. Condition (38) yields the following constraint on consumer addresses:

$$x \geq 1 - \tfrac{v-p_2}{\tau},$$

while condition (39) can be rewritten as

$$x \leq \tfrac{v-p_1}{\tau}.$$

For a group of one-stop shoppers to exist, we have to require that

$$1 - \tfrac{v-p_2}{\tau} \leq \tfrac{v-p_1}{\tau},\ 1 - \tfrac{v-p_2}{\tau} \leq 1 \text{ and } \tfrac{v-p_1}{\tau} \geq 0,$$

which yield the three conditions on firms' prices:

$$p_1 + p_2 \leq 2v - \tau \text{ and } p_i \leq v, \text{ for } i = 1, 2. \tag{40}$$

Then the addresses of one-stop shoppers are given by

$$\max\left\{1 - \tfrac{v-p_2}{\tau}; 0\right\} \leq x \leq \min\left\{\tfrac{v-p_1}{\tau}; 1\right\}. \tag{41}$$

Consider now single-item shoppers of product 1. For these consumers, the following three conditions must be satisfied. First,

$$v - t|\theta| - \tau x - p_1 \geq 0, \tag{42}$$

which implies that a consumer prefers to buy product 1 rather than not buying at all. Second, buying product 1 is preferred to buying product 2 if

$$v - t|\theta| - \tau x - p_1 \geq v - t|\theta| - \tau\,(1-x) - p_2 \tag{43}$$

holds. Third, buying product 1 gives higher utility than buying both products if

$$v - t|\theta| - \tau x - p_1 \geq 2v - t|\theta| - \tau - p_1 - p_2 \tag{44}$$

holds. Condition (43) yields the following constraint on consumer addresses:

$$x \leq \tfrac{1}{2} + \tfrac{p_2-p_1}{2\tau} \tag{45}$$

and condition (44) can be rewritten as

$$x \leq 1 - \tfrac{v-p_2}{\tau}. \tag{46}$$

Note that $p_1 + p_2 \leq 2v - \tau$ in (40) implies that

$$1 - \tfrac{v-p_2}{\tau} \leq \tfrac{1}{2} + \tfrac{p_2-p_1}{2\tau},$$

such that (46) is a stricter constraint than (45) and, hence, defines the addresses of single-item shoppers of product 1. For this group to be non-empty, we have to require that $1-(v-p_2)/\tau \geq 0$ holds, which yields

$$p_2 \geq v - \tau. \tag{47}$$

Symmetrically, single-item shoppers of product 2 have the addresses $x \geq (v - p_1)/\tau$, provided

$$p_1 \geq v - \tau \tag{48}$$

holds. Given conditions (47) and (48), we can rewrite the inequality (41) as

$$1 - \tfrac{v-p_2}{\tau} \leq x \leq \tfrac{v-p_1}{\tau}, \tag{49}$$

which gives the addresses of one-stop shoppers.

Finally, note that the constraints $p_1+p_2 \leq 2v-\tau$ and $p_i \geq v-\tau$, for $i = 1, 2$, together imply that $p_i \leq v$. Hence, conditions (40), (47) and (48) can be summarized as

$$p_1 + p_2 \leq 2v - \tau \text{ and } p_i \geq v - \tau, \text{ for } i = 1, 2, \tag{50}$$

which are the necessary and sufficient conditions for all consumer groups (one-stop shoppers and single-item shoppers of products 1 and 2) to exist. We assume that firms' prices satisfy (50).

From (37) we can calculate the location of the indifferent one-stop shopper:

$$\theta^o (p_1, p_2) = \tfrac{2v-\tau-p_1-p_2}{t}.$$

Note that under the first condition in (50), it holds that $\theta^o (\cdot) \geq 0$. Integrating the location $\theta^o (\cdot)$ over the addresses in (49), we get the demand of one-stop shoppers for product 1:

$$q_1^o (p_1, p_2) = 2 \int_{1-\frac{v-p_2}{\tau}}^{\frac{v-p_1}{\tau}} \theta^o (p_1, p_2)\, dx = \tfrac{2(2v-\tau-p_1-p_2)^2}{t\tau}.$$

From (42) we can calculate the location of the indifferent single-item shopper of product 1:

$$\theta_1^s\left(p_1, x\right) = \tfrac{v-\tau x-p_1}{t}.$$

Note that (46) together with the first condition in (50) imply that $\theta_1^s\left(\cdot\right) \geq 0$. Integrating $\theta_1^s\left(\cdot\right)$ over the addresses (46), we get the demand of single-item shoppers for product 1:

$$q_1^s\left(p_1, p_2\right) = 2\int_0^{1-\frac{v-p_2}{\tau}} \theta_1^s\left(p_1, x\right) dx = 2\left(1-\tfrac{v-p_2}{\tau}\right)\left(\tfrac{v-p_1}{t}+\tfrac{v-\tau-p_2}{2t}\right).$$

Summing up $q_1^o\left(\cdot\right)$ and $q_1^s\left(\cdot\right)$ yields the total demand for product 1:

$$Q_1\left(p_1, p_2\right) = \tfrac{2(2v-\tau-p_1-p_2)^2}{t\tau} + 2\left(1-\tfrac{v-p_2}{\tau}\right)\left(\tfrac{v-p_1}{t}+\tfrac{v-\tau-p_2}{2t}\right).$$

The total demand for product 2 can be derived symmetrically.

The demand for product $i = 1, 2$ decreases in its own price:

$$\tfrac{\partial Q_i(\cdot)}{\partial p_i} = \tfrac{2(\tau-3v+2p_i+p_j)}{t\tau} \leq 0, \text{ for } j = 1, 2 \text{ and } j \neq i, \quad (51)$$

where the sign of the derivative follows from (50), which, as we mentioned above, implies that $p_i \leq v$. Indeed, $p_i + p_j \leq 2v - \tau \leq 2v - \tau + (v - p_i)$ yielding $2p_i + p_j \leq 3v - \tau$. The demand functions exhibit complementarities:

$$\tfrac{\partial Q_i(\cdot)}{\partial p_j} = \tfrac{2(\tau-2v+p_i+p_j)}{t\tau} \leq 0,$$

where the sign of the derivative follows from the first condition in (50).

**Calculation of Numerical Example in Subsection 5.3.** For the whole analysis we set $t = 1$ and $c = 0$. We consider three values of parameter $v$: 5, 10 and 15. For each value of $v$ we consider two (or three) values of parameter $\tau$, such that the following conditions hold:

$$p_1 + p_2 \leq 2v - \tau \text{ and } p_i \geq v - \tau, \text{ for } i = 1, 2, \quad (52)$$

which guarantee that both single-item and one-stop shoppers coexist in the market. We provide a detailed analysis of the manufacturers' merger incentives for the parameter combination $(v, \tau) = (5, 5)$. Since for other parameter combinations we follow the same analysis, we only provide the main results of our calculations in those cases.

**Case 1:** $(v,\tau) = (5,5)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$p^*, p^{m*} \leq 2.5. \tag{53}$$

We start with deriving the optimal retail prices for products 1 and 2 depending on the wholesale prices $w_1$ and $w_2$. Taking the derivatives of the retailer's profit with respect to $p_1$ and $p_2$, we get two first-order conditions, which are quadratic in both retail prices:[39]

$$\begin{aligned}\frac{\partial\pi(\cdot)}{\partial p_1} &= \frac{6p_1^2}{5}+\left(\frac{6p_2}{5}-\frac{4w_1}{5}-\frac{2w_2}{5}-8\right)p_1+4w_1-4p_2+2w_2+\frac{3p_2^2}{5}-\frac{2p_2w_1}{5}-\frac{2p_2w_2}{5}+10 \text{ and}\\ \frac{\partial\pi(\cdot)}{\partial p_2} &= \frac{3p_1^2}{5}+\left(\frac{6p_2}{5}-\frac{2w_1}{5}-\frac{2w_2}{5}-4\right)p_1+\frac{6p_2^2}{5}-\left(\frac{2w_1}{5}+\frac{4w_2}{5}+8\right)p_2+2w_1+4w_2+10.\end{aligned}$$

Second-order conditions require that $\partial^2\pi(\cdot)/(\partial p_i)^2 < 0$, for $i = 1,2$, when evaluated at the equilibrium prices. Since both first-order conditions are quadratic functions, which open upwards, for second-order conditions to be fulfilled, we need to use the smaller root of each function. The other second-order condition, $\left[\partial^2\pi(\cdot)/(\partial p_1)^2\right]\left[\partial^2\pi(\cdot)/(\partial p_2)^2\right]-\left[\partial^2\pi(\cdot)/(\partial p_1\partial p_2)\right]^2 > 0$, when evaluated at the equilibrium prices, is also fulfilled. Solving both first-order conditions for $p_1$ and choosing the smaller root of each condition we get:

$$\begin{aligned}p_1^1(p_2) &= \frac{1}{6}\left(20-3p_2+2w_1+w_2-\sqrt{100-9p_2^2-40w_1+4w_1^2-20w_2+6p_2w_2+4w_1w_2+w_2^2}\right) \text{ and}\\ p_1^2(p_2) &= \frac{1}{3}\left(10-3p_2+w_1+w_2-\sqrt{-50+60p_2-9p_2^2-10w_1+w_1^2-40w_2+6p_2w_2+2w_1w_2+w_2^2}\right).\end{aligned}$$

To guarantee the uniqueness of the optimal price, we equate the prices $p_1^1(p_2)$ and $p_1^2(p_2)$ and solve this equation for the equilibrium price $p_2$ as a function of the wholesale prices $w_1$ and $w_2$. While there are four different functions $p_2(w_1,w_2)$, which solve $p_1^1(p_2) = p_1^2(p_2)$, there is only one yielding the feasible equilibrium wholesale prices, to which we refer as $p_2^*(w_1,w_2)$.[40] Plugging this price in either $p_1^1(p_2)$ or $p_1^2(p_2)$, we get the equilibrium retail price of product 1, $p_1^*(w_1,w_2)$.

At the next step, we consider different values of the retailer's bargaining power parameter, $\delta$, and for each value we derive the equilibrium wholesale prices and the manufacturers' profits when they are independent and when they are merged. The comparison of these profits allows to conclude, whether the manufacturers remain independent in equilibrium.

[39] All the calculations presented in the Appendix are performed using Wolfram Mathematica 7.0.

[40] We do not provide the expression for $p_2^*(w_1,w_2)$ here, because it is too long.

To solve the bargaining problems when manufacturers are independent, we have to derive the outside options of the retailer in the case when its negotiations with a given manufacturer break down. Consider negotiations with the manufacturer of product 2. If no agreement is reached, then all consumers choose between single-item shopping (of product 1) and not buying at all. Those consumers buy, which get a non-negative utility:

$$v - t\,|\theta| - \tau x - p_1 \geq 0,$$

yielding the location of the indifferent consumer:

$$\theta_1^s\,(p_1, x) = \tfrac{v - \tau x - p_1}{t}. \tag{54}$$

From (54) we get the addresses of consumers who buy (only) product 1:

$$x \leq \tfrac{v-p_1}{\tau}, \text{ provided } 0 \leq \tfrac{v-p_1}{\tau} \leq 1.$$

As a result, the demand the retailer faces in the case when its negotiations with manufacturer 2 break down is given by

$$Q_1(p_1) = 2 \int\limits_0^{\frac{v-p_1}{\tau}} \theta_1^s\,(p_1, x)\,dx = \tfrac{(v-p_1)^2}{t\tau},$$

provided that the price $p_1$ satisfies the condition:

$$v - \tau \leq p_1 \leq v.$$

The case when the negotiations between the retailer and manufacturer 1 break down is solved symmetrically.

In Tables 1-3 we present the equilibrium levels (rounded to three decimal places) of the wholesale and retail prices, produced quantity, the share of one-stop shoppers and the manufacturers' profits for different values of the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Our calculations show that the equilibrium wage rates $w^*$ and $w^{m*}$ fulfill second-order conditions and, hence, indeed maximize the Nash product. Note that all the equilibrium prices $p^*$ and $p^{m*}$ in the tables satisfy condition (53).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.01 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 |
| $w^*$ | 1.163 | 1.16 | 1.152 | 1.144 | 1.135 | 1.124 | 1.119 |
| $p^*$ | 2.184 | 2.179 | 2.169 | 2.159 | 2.147 | 2.135 | 2.128 |
| $Q^*$ | 1.666 | 1.674 | 1.69 | 1.708 | 1.727 | 1.748 | 1.76 |
| $\lambda^*$ | 0.096 | 0.098 | 0.104 | 0.109 | 0.115 | 0.122 | 0.126 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **3.876** | **3.882** | **3.894** | **3.906** | **3.919** | **3.932** | **3.938** |
| $w^{m*}$ | 1.00 | 0.995 | 0.984 | 0.973 | 0.962 | 0.949 | 0.943 |
| $p^{m*}$ | 2.00 | 1.995 | 1.984 | 1.974 | 1.962 | 1.95 | 1.944 |
| $Q^{m*}$ | 2.00 | 2.01 | 2.031 | 2.054 | 2.077 | 2.102 | 2.115 |
| $\lambda^{m*}$ | 0.20 | 0.203 | 0.209 | 0.216 | 0.223 | 0.23 | 0.234 |
| $\boldsymbol{\varphi}^{m**}$ | **4.0** | **4.0** | **3.999** | **3.997** | **3.994** | **3.99** | **3.987** |

Table 1: Equilibrium values with and w/o a merger; $(v, \tau) = (5, 5)$, $\delta \leq 0.1$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.12 | 0.13 | 0.14 | 0.15 | 0.20 | 0.30 | 0.40 |
| $w^*$ | 1.107 | 1.10 | 1.094 | 1.087 | 1.048 | 0.949 | 0.831 |
| $p^*$ | 2.115 | 2.107 | 2.10 | 2.092 | 2.049 | 1.951 | 1.842 |
| $Q^*$ | 1.784 | 1.797 | 1.811 | 1.825 | 1.904 | 2.101 | 2.341 |
| $\lambda^*$ | 0.133 | 0.137 | 0.142 | 0.146 | 0.171 | 0.23 | 0.296 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **3.95** | **3.956** | **3.962** | **3.968** | **3.99** | **3.989** | **3.892** |
| $w^{m*}$ | 0.93 | 0.923 | 0.916 | 0.909 | 0.871 | 0.784 | 0.686 |
| $p^{m*}$ | 1.932 | 1.925 | 1.919 | 1.912 | 1.877 | 1.80 | 1.717 |
| $Q^{m*}$ | 2.141 | 2.155 | 2.17 | 2.183 | 2.26 | 2.438 | 2.645 |
| $\lambda^{m*}$ | 0.241 | 0.245 | 0.249 | 0.253 | 0.274 | 0.321 | 0.371 |
| $\boldsymbol{\varphi}^{m**}$ | **3.981** | **3.977** | **3.973** | **3.968** | **3.936** | **3.824** | **3.63** |

Table 2: Equilibrium values with and w/o a merger; $(v, \tau) = (5, 5)$, $0.12 \leq \delta \leq 0.4$

| | $\delta$ | | | | | |
|---|---|---|---|---|---|---|
| | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 |
| $w^*$ | 0.703 | 0.569 | 0.432 | 0.292 | 0.148 | 0.00 |
| $p^*$ | 1.731 | 1.621 | 1.512 | 1.403 | 1.294 | 1.184 |
| $Q^*$ | 2.609 | 2.90 | 3.213 | 3.549 | 3.91 | 4.30 |
| $\lambda^*$ | 0.362 | 0.426 | 0.486 | 0.542 | 0.595 | 0.645 |
| $\sum_i \varphi_i^{**}$ | **3.669** | **3.303** | **2.778** | **2.073** | **1.159** | **0.00** |
| $w^{m*}$ | 0.58 | 0.468 | 0.353 | 0.236 | 0.118 | 0.00 |
| $p^{m*}$ | 1.63 | 1.54 | 1.45 | 1.36 | 1.272 | 1.184 |
| $Q^{m*}$ | 2.877 | 3.13 | 3.40 | 0.387 | 3.987 | 4.30 |
| $\lambda^{m*}$ | 0.42 | 0.47 | 0.518 | 0.563 | 0.605 | 0.645 |
| $\varphi^{m**}$ | **3.337** | **2.93** | **2.40** | **1.742** | **0.943** | **0.00** |

Table 3: Equilibrium values with and w/o a merger; $(v, \tau) = (5, 5)$, $\delta \geq 0.5$

Comparing the manufacturers' equilibrium profits when they are independent, $\sum_i \varphi_i^{**}$, and when they are merged, $\varphi^{m**}$, we observe that for any $\delta \leq 0.15$ it holds that $\varphi^{m**} \geq \sum_i \varphi_i^{**}$ (with an opposite inequality otherwise). We conclude that when $(v, \tau) = (5, 5)$, the manufacturers merge in equilibrium when the retailer's bargaining power is relatively low, with $\delta \leq 0.15$.

**Case 2:** $(v, \tau) = (5, 4)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$1 \leq p^*, p^{m*} \leq 3. \tag{55}$$

In Tables 3-6 we present the equilibrium levels (rounded to three decimal places) of the wholesale and retail prices, produced quantity, the share of one-stop shoppers and the manufacturers' profits for different values of the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Note that all the equilibrium prices $p^*$ and $p^{m*}$ in the tables satisfy condition (55).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 | 0.12 |
| $w^*$ | 1.496 | 1.458 | 1.433 | 1.407 | 1.38 | 1.367 | 1.341 |
| $p^*$ | 2.33 | 2.30 | 2.279 | 2.258 | 2.237 | 2.227 | 2.206 |
| $Q^*$ | 2.231 | 2.314 | 2.371 | 2.43 | 2.49 | 2.521 | 2.583 |
| $\lambda^*$ | 0.402 | 0.424 | 0.439 | 0.453 | 0.467 | 0.474 | 0.488 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **6.675** | **6.75** | **6.8** | **6.837** | **6.876** | **6.893** | **6.925** |
| $w^{m*}$ | 1.184 | 1.153 | 1.132 | 1.111 | 1.089 | 1.078 | 1.056 |
| $p^{m*}$ | 2.085 | 2.061 | 2.045 | 2.029 | 2.013 | 2.005 | 1.989 |
| $Q^{m*}$ | 2.961 | 3.04 | 3.093 | 3.148 | 3.204 | 3.233 | 3.29 |
| $\lambda^{m*}$ | 0.565 | 0.58 | 0.59 | 0.599 | 0.608 | 0.613 | 0.622 |
| $\boldsymbol{\varphi}^{m**}$ | **7.014** | **7.01** | **7.003** | **6.993** | **6.979** | **6.97** | **6.95** |

Table 4: Equilibrium values with and w/o a merger; $(v, \tau) = (5, 4)$, $\delta \leq 0.12$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.13 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 |
| $w^*$ | 1.327 | 1.30 | 1.232 | 1.092 | 0.95 | 0.803 | 0.653 |
| $p^*$ | 2.195 | 2.174 | 2.122 | 2.016 | 1.909 | 1.8 | 1.694 |
| $Q^*$ | 2.614 | 2.678 | 2.843 | 3.2 | 3.577 | 3.99 | 4.438 |
| $\lambda^*$ | 0.495 | 0.509 | 0.543 | 0.606 | 0.665 | 0.719 | 0.769 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **6.94** | **6.965** | **7.005** | **6.981** | **6.793** | **6.411** | **5.799** |
| $w^{m*}$ | 1.045 | 1.023 | 0.966 | 0.851 | 0.733 | 0.613 | 0.491 |
| $p^{m*}$ | 1.98 | 1.964 | 1.922 | 1.837 | 1.751 | 1.665 | 1.578 |
| $Q^{m*}$ | 3.32 | 3.379 | 3.531 | 3.853 | 4.198 | 4.564 | 4.95 |
| $\lambda^{m*}$ | 0.627 | 0.636 | 0.658 | 0.702 | 0.743 | 0.781 | 0.817 |
| $\boldsymbol{\varphi}^{m**}$ | **6.938** | **6.911** | **6.824** | **6.558** | **6.152** | **5.592** | **4.863** |

Table 5: Equilibrium values with and w/o a merger; $(v, \tau) = (5, 4)$, $0.13 \leq \delta \leq 0.6$

| | $\delta$ | | | |
|---|---|---|---|---|
| | 0.70 | 0.80 | 0.90 | 1.00 |
| $w^*$ | 0.499 | 0.339 | 0.173 | 0.00 |
| $p^*$ | 1.583 | 1.47 | 1.353 | 1.232 |
| $Q^*$ | 4.926 | 0.858 | 6.048 | 6.577 |
| $\lambda^*$ | 0.815 | 0.88 | 0.899 | 0.937 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **4.914** | **3.7** | **2.09** | **0.00** |
| $w^{m*}$ | 0.369 | 0.246 | 0.123 | 0.00 |
| $p^{m*}$ | 1.491 | 1.404 | 1.318 | 1.232 |
| $Q^{m*}$ | 5.355 | 5.778 | 6.219 | 6.677 |
| $\lambda^{m*}$ | 0.85 | 0.811 | 0.91 | 0.937 |
| $\boldsymbol{\varphi}^{m**}$ | **3.951** | **2.845** | **1.532** | **0.00** |

Table 6: Equilibrium values with and w/o a merger; $(v, \tau) = (5, 4)$, $\delta \geq 0.7$

Comparing the manufacturers' equilibrium profits when they are independent, $\sum_i \varphi_i^{**}$, and when they are merged, $\varphi^{m**}$, we observe that for any $\delta \leq 0.12$ it holds that $\varphi^{m**} \geq \sum_i \varphi_i^{**}$ (with an opposite inequality otherwise). We conclude that the manufacturers merge in equilibrium when the retailer's bargaining power is relatively low, with $\delta \leq 0.12$.

Tables 7 and 8 provide the equilibrium total quantity of each product, $Q^*$ ($Q^{m*}$), and the equilibrium share of one-stop shoppers of each product, $\lambda^*$ ($\lambda^{m*}$), when the manufacturers remain independent (are merged) for cases 1 and 2. We observe that all four variables ($Q^*$, $Q^{m*}$, $\lambda^*$ and $\lambda^{m*}$) are larger in case 2 when the product differentiation parameter $\tau$ is smaller. While a larger share of one-stop shoppers strengthens merger incentives, a larger total output weakens them. As the second effect dominates, upstream merger incentives get weaker (the critical bargaining power parameter decreases from $\widetilde{\delta} = 0.15$ to $\widetilde{\delta} = 0.12$) when products become less differentiated, i.e., $\tau$ decreases.

| | $\delta$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.00 | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 |
| | Case 1: $\tau = 5$ ('high' product differentiation) | | | | | | | |
| $100 * Q^*$ | 167 | 171 | 176 | 183 | 190 | 210 | 234 | 261 |
| $100 * Q^{m*}$ | 200 | 205 | 212 | 218 | 226 | 244 | 265 | 288 |
| $100 * \lambda^*$ | 10 | 11 | 13 | 15 | 17 | 23 | 30 | 36 |
| $100 * \lambda^{m*}$ | 20 | 22 | 23 | 25 | 27 | 32 | 37 | 42 |
| | Case 2: $\tau = 4$ ('low' product differentiation) | | | | | | | |
| $100 * Q^*$ | 223 | 237 | 252 | 268 | 284 | 320 | 358 | 399 |
| $100 * Q^{m*}$ | 296 | 309 | 323 | 338 | 353 | 385 | 420 | 456 |
| $100 * \lambda^*$ | 40 | 44 | 47 | 51 | 54 | 61 | 67 | 72 |
| $100 * \lambda^{m*}$ | 57 | 59 | 61 | 64 | 66 | 70 | 74 | 78 |

Table 7: Equilibrium values (multiplied by 100) with and w/o a merger; $v = 5$, $\delta \leq 0.5$

| | $\delta$ | | | | |
|---|---|---|---|---|---|
| | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 |
| | Case 1: $\tau = 5$ ('high' product differentiation) | | | | |
| $100 * Q^*$ | 290 | 321 | 355 | 391 | 430 |
| $100 * Q^{m*}$ | 313 | 340 | 387 | 399 | 430 |
| $100 * \lambda^*$ | 43 | 49 | 54 | 60 | 65 |
| $100 * \lambda^{m*}$ | 47 | 52 | 56 | 61 | 65 |
| | Case 2: $\tau = 4$ ('low' product differentiation) | | | | |
| $100 * Q^*$ | 444 | 493 | 86 | 604 | 668 |
| $100 * Q^{m*}$ | 495 | 536 | 578 | 622 | 668 |
| $100 * \lambda^*$ | 77 | 82 | 88 | 90 | 94 |
| $100 * \lambda^{m*}$ | 82 | 85 | 81 | 91 | 94 |

Table 8: Equilibrium values (multiplied by 100) with and w/o a merger; $v = 5$ and $\delta \geq 0.6$

**Case 3:** $(v, \tau) = (10, 10)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$p^*, p^{m*} \leq 5. \tag{56}$$

In Tables 9-11 we present the equilibrium levels (rounded to three decimal places) of the wholesale and retail prices, produced quantity, the share of one-stop shoppers and the suppliers' profits for different values of the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Note that all the equilibrium prices $p^*$ and $p^{m*}$ in the tables satisfy condition (56).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 | 0.12 |
| $w^*$ | 2.326 | 2.304 | 2.288 | 2.269 | 2.249 | 2.238 | 2.214 |
| $p^*$ | 4.367 | 4.339 | 4.318 | 4.295 | 4.27 | 4.257 | 4.229 |
| $Q^*$ | 3.333 | 3.38 | 3.415 | 4.454 | 3.497 | 3.519 | 3.568 |
| $\lambda^*$ | 0.096 | 0.104 | 0.109 | 0.115 | 0.122 | 0.126 | 0.133 |
| $\sum_i \varphi_i^{**}$ | **7.752** | **15.576** | **15.626** | **15.676** | **15.727** | **15.752** | **15.801** |
| $w^{m*}$ | 2.00 | 1.969 | 1.946 | 1.923 | 1.898 | 1.886 | 1.859 |
| $p^{m*}$ | 4.00 | 3.969 | 3.947 | 3.924 | 3.901 | 3.889 | 3.863 |
| $Q^{m*}$ | 4.00 | 4.063 | 4.107 | 4.154 | 4.20 | 4.299 | 4.28 |
| $\lambda^{m*}$ | 0.20 | 0.209 | 0.216 | 0.223 | 0.23 | 0.234 | 0.241 |
| $\varphi^{m**}$ | **16.00** | **15.996** | **15.989** | **15.977** | **15.96** | **15.949** | **15.923** |

Table 9: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 10)$, $\delta \leq 0.12$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.13 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 |
| $w^*$ | 2.202 | 2.174 | 2.096 | 1.899 | 1.662 | 1.406 | 1.139 |
| $p^*$ | 4.214 | 4.184 | 4.099 | 3.901 | 3.684 | 3.463 | 3.243 |
| $Q^*$ | 3.594 | 3.649 | 3.807 | 4.203 | 4.682 | 5.219 | 5.801 |
| $\lambda^*$ | 0.137 | 0.146 | 0.171 | 0.23 | 0.296 | 0.362 | 0.426 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **15.825** | **15.871** | **15.962** | **15.96** | **15.567** | **14.674** | **13.213** |
| $w^{m*}$ | 1.845 | 1.817 | 1.741 | 1.568 | 1.372 | 1.16 | 0.936 |
| $p^{m*}$ | 3.851 | 3.824 | 3.755 | 3.601 | 3.435 | 3.26 | 3.081 |
| $Q^{m*}$ | 4.31 | 4.367 | 4.521 | 4.877 | 5.29 | 5.754 | 6.26 |
| $\lambda^{m*}$ | 0.245 | 0.253 | 0.274 | 0.321 | 0.371 | 0.421 | 0.471 |
| $\boldsymbol{\varphi}^{m**}$ | **15.907** | **15.871** | **15.744** | **15.296** | **14.521** | **13.348** | **11.724** |

Table 10: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 10)$, $0.13 \leq \delta \leq 0.6$

| | $\delta$ | | | |
|---|---|---|---|---|
| | 0.70 | 0.80 | 0.90 | 0.10 |
| $w^*$ | 0.865 | 0.584 | 0.296 | 0.00 |
| $p^*$ | 3.025 | 2.807 | 2.588 | 2.367 |
| $Q^*$ | 6.427 | 7.098 | 7.82 | 8.599 |
| $\lambda^*$ | 0.486 | 0.542 | 0.6 | 0.645 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **11.114** | **8.291** | **4.634** | **0.00** |
| $w^{m*}$ | 0.706 | 0.472 | 0.237 | 0.00 |
| $p^{m*}$ | 2.901 | 2.722 | 2.543 | 2.367 |
| $Q^{m*}$ | 6.801 | 7.374 | 7.974 | 8.599 |
| $\lambda^{m*}$ | 0.518 | 0.563 | 0.605 | 0.645 |
| $\boldsymbol{\varphi}^{m**}$ | **9.608** | **6.967** | **3.773** | **0.00** |

Table 11: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 10)$, $\delta \geq 0.7$

Comparing the manufacturers' equilibrium profits when they are independent, $\sum_i \varphi_i^{**}$, and when they are merged, $\varphi^{m**}$, we observe that $\varphi^{m**} \geq \sum_i \varphi_i^{**}$ holds if $\delta \leq 0.15$ (with an opposite inequality otherwise). We conclude that the suppliers merge in equilibrium when the bargaining power of the retailer is relatively low, with $\delta \leq 0.15$.

**Case 4:** $(v, \tau) = (10, 9)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$1 \leq p^*, p^{m*} \leq 5.5. \tag{57}$$

In Tables 12-14 we present the equilibrium values (rounded to three decimal places) of the wholesale and retail prices, the share of one-stop shoppers and the suppliers' profits for different values of the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Note that all the equilibrium prices $p^*$ and $p^{m*}$ in the tables satisfy condition (57).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 | 0.12 |
| $w^*$ | 2.734 | 2.68 | 2.641 | 2.601 | 2.559 | 2.537 | 2.493 |
| $p^*$ | 4.535 | 4.483 | 4.447 | 4.41 | 4.41 | 4.352 | 4.312 |
| $Q^*$ | 3.733 | 3.841 | 3.919 | 4.001 | 4.086 | 4.13 | 4.221 |
| $\lambda^*$ | 0.222 | 0.239 | 0.251 | 0.264 | 0.277 | 0.284 | 0.297 |
| $\sum_i \varphi_i^{**}$ | **20.408** | **20.586** | **20.7** | **20.808** | **20.909** | **20.956** | **21.043** |
| $w^{m*}$ | 2.226 | 2.175 | 2.14 | 2.104 | 2.067 | 2.048 | 2.011 |
| $p^{m*}$ | 4.083 | 4.041 | 4.012 | 3.983 | 3.953 | 3.938 | 3.907 |
| $Q^{m*}$ | 4.782 | 4.892 | 4.968 | 5.047 | 5.127 | 5.169 | 5.253 |
| $\lambda^{m*}$ | 0.373 | 0.387 | 0.396 | 0.406 | 0.415 | 0.42 | 0.429 |
| $\varphi^{m**}$ | **21.285** | **21.276** | **21.26** | **21.234** | **21.198** | **21.176** | **21.123** |

Table 12: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 9)$, $\delta \leq 0.12$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.13 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 |
| $w^*$ | 2.47 | 2.424 | 2.303 | 2.047 | 1.778 | 1.502 | 1.218 |
| $p^*$ | 4.292 | 4.252 | 4.148 | 3.936 | 3.722 | 3.508 | 3.293 |
| $Q^*$ | 4.268 | 4.364 | 4.617 | 5.172 | 5.784 | 6.447 | 7.163 |
| $\lambda^*$ | 0.304 | 0.317 | 0.352 | 0.42 | 0.486 | 0.547 | 0.604 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **21.082** | **21.152** | **21.265** | **21.174** | **20.571** | **19.362** | **17.452** |
| $w^{m*}$ | 1.991 | 1.952 | 1.852 | 1.641 | 1.419 | 1.19 | 0.956 |
| $p^{m*}$ | 4.292 | 3.86 | 3.78 | 3.615 | 3.445 | 3.272 | 3.098 |
| $Q^{m*}$ | 5.30 | 5.384 | 5.613 | 6.109 | 6.651 | 7.236 | 7.858 |
| $\lambda^{m*}$ | 0.434 | 0.444 | 0.468 | 0.517 | 0.564 | 0.61 | 0.653 |
| $\boldsymbol{\varphi}^{m**}$ | **21.093** | **21.022** | **20.79** | **20.048** | **18.879** | **17.222** | **15.027** |

Table 13: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 9)$, $0.13 \leq \delta \leq 0.6$

| | $\delta$ | | | |
|---|---|---|---|---|
| | 0.70 | 0.80 | 0.90 | 1.00 |
| $w^*$ | 0.928 | 0.629 | 0.32 | 0.00 |
| $p^*$ | 3.077 | 2.857 | 2.633 | 2.404 |
| $Q^*$ | 7.936 | 8.772 | 9.681 | 10.673 |
| $\lambda^*$ | 0.658 | 0.708 | 0.754 | 0.799 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **14.723** | **11.031** | **6.198** | **0.00** |
| $w^{m*}$ | 0.719 | 0.48 | 0.24 | 0.00 |
| $p^{m*}$ | 2.923 | 2.749 | 2.576 | 2.404 |
| $Q^{m*}$ | 8.515 | 9.204 | 9.924 | 10.673 |
| $\lambda^{m*}$ | 0.693 | 0.731 | 0.766 | 0.799 |
| $\boldsymbol{\varphi}^{m**}$ | **12.246** | **8.84** | **4.769** | **0.00** |

Table 14: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 9)$, $\delta \geq 0.7$

Comparing the manufacturers' equilibrium profits when they are independent, $\sum_i \varphi_i^{**}$, and when they are merged, $\varphi^{m**}$, we observe that $\sum_i \varphi_i^{**} \leq \varphi^{m**}$ holds for any $\delta \leq 0.13$ ( with an opposite inequality otherwise). We conclude that the manufacturers merge in equilibrium when the bargaining power of the retailer is weak enough, with $\delta \leq 0.13$.

**Case 5:** $(v, \tau) = (10, 8)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$2 \leq p^*, p^{m*} \leq 6. \tag{58}$$

In Tables 15-17 we present the equilibrium values (rounded to three decimal places) of the wholesale and retail prices, the share of one-stop shoppers and the suppliers' profits for different values of the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Note that all the equilibrium prices $p^*$ and $p^{m*}$ in the tables satisfy condition (58).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 | 0.12 |
| $w^*$ | 2.992 | 2.917 | 2.866 | 2.814 | 2.76 | 2.735 | 2.682 |
| $p^*$ | 4.66 | 4.599 | 4.558 | 4.516 | 4.474 | 4.454 | 4.412 |
| $Q^*$ | 4.462 | 4.628 | 4.743 | 4.86 | 4.98 | 5.04 | 5.165 |
| $\lambda^*$ | 0.402 | 0.424 | 0.439 | 0.446 | 0.467 | 0.474 | 0.488 |
| $\sum_i \varphi_i^{**}$ | **26.7** | **26.999** | **27.181** | **27.35** | **27.5** | **27.573** | **27.7** |
| $w^{m*}$ | 2.369 | 2.306 | 2.264 | 2.221 | 2.178 | 2.156 | 2.112 |
| $p^{m*}$ | 4.17 | 4.123 | 4.09 | 4.059 | 4.026 | 4.01 | 3.977 |
| $Q^{m*}$ | 5.922 | 6.079 | 6.187 | 6.297 | 6.409 | 6.466 | 6.581 |
| $\lambda^{m*}$ | 0.565 | 0.58 | 0.589 | 0.599 | 0.608 | 0.613 | 0.622 |
| $\varphi^{m**}$ | **28.055** | **28.04** | **28.013** | **27.971** | **27.914** | **27.88** | **27.799** |

Table 15: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 8)$ and $\delta \leq 0.12$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.13 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 |
| $w^*$ | 2.655 | 2.60 | 2.464 | 2.185 | 1.899 | 1.607 | 1.307 |
| $p^*$ | 4.391 | 4.349 | 4.243 | 4.031 | 3.819 | 3.605 | 3.388 |
| $Q^*$ | 5.228 | 5.356 | 5.686 | 6.391 | 7.154 | 7.98 | 8.877 |
| $\lambda^*$ | 0.495 | 0.509 | 0.543 | 0.606 | 0.665 | 0.719 | 0.769 |
| $\sum_i \varphi_i^{**}$ | **27.758** | **27.859** | **28.022** | **27.925** | **27.172** | **25.644** | **23.197** |
| $w^{m*}$ | 2.09 | 2.045 | 1.933 | 1.702 | 1.465 | 1.225 | 0.982 |
| $p^{m*}$ | 3.961 | 3.927 | 3.844 | 3.674 | 3.502 | 3.329 | 3.156 |
| $Q^{m*}$ | 6.639 | 6.757 | 7.062 | 7.707 | 8.397 | 9.129 | 9.90 |
| $\lambda^{m*}$ | 0.627 | 0.636 | 0.658 | 0.702 | 0.743 | 0.781 | 0.817 |
| $\varphi^{m**}$ | **27.752** | **27.645** | **27.297** | **26.23** | **24.608** | **22.368** | **19.451** |

Table 16: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 8)$, $0.13 \leq \delta \leq 0.6$

| | $\delta$ | | | |
|---|---|---|---|---|
| | 0.70 | 0.80 | 0.90 | 1.00 |
| $w^*$ | 0.998 | 0.678 | 0.346 | 0.00 |
| $p^*$ | 3.167 | 2.94 | 2.706 | 2.463 |
| $Q^*$ | 9.851 | 10.913 | 12.076 | 13.354 |
| $\lambda^*$ | 0.815 | 0.858 | 0.899 | 0.937 |
| $\sum_i \varphi_i^{**}$ | **19.655** | **14.8** | **8.361** | **0.00** |
| $w^{m*}$ | 0.738 | 0.492 | 0.246 | 0.00 |
| $p^{m*}$ | 2.982 | 2.809 | 2.636 | 2.463 |
| $Q^{m*}$ | 10.71 | 11.557 | 12.438 | 13.354 |
| $\lambda^{m*}$ | 0.85 | 0.881 | 0.91 | 0.937 |
| $\varphi^{m**}$ | **15.806** | **11.38** | **6.127** | **0.00** |

Table 17: Equilibrium values with and w/o a merger; $(v, \tau) = (10, 8)$, $\delta \geq 0.7$

Comparing the equilibrium profits of the manufacturers when they are independent, $\sum_i \varphi_i^{**}$, and when they are merged, $\varphi^{m**}$, we observe that $\sum_i \varphi_i^{**} \leq \varphi^{m**}$ holds for $\delta \leq 0.12$ (with an opposite inequality otherwise). We conclude that the suppliers merge in equilibrium when the retailer's bargaining power is low enough, with $\delta \leq 0.12$.

In Tables 18 and 19 we provide the equilibrium total quantity of each product, $Q^*$ ($Q^{m*}$), and the equilibrium share of one-stop shoppers of each product, $\lambda^*$ ($\lambda^{m*}$), when the manufacturers remain independent (are merged) for cases 3-5. We observe that for any value of the retailer's bargaining power parameter, $\delta$, all four variables ($Q^*$, $Q^{m*}$, $\lambda^*$ and $\lambda^{m*}$) increase when products become less differentiated. Precisely, for any $\delta$ they are the largest if $\tau = 8$, the smallest if $\tau = 10$ and take intermediate values if $\tau = 9$.

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.15 | 0.20 |
| | Case 3: $\tau = 10$ ('high' product differentiation) | | | | | | |
| $100 * Q^*$ | 333 | 338 | 342 | 345 | 350 | 365 | 381 |
| $100 * Q^{m*}$ | 400 | 406 | 411 | 415 | 420 | 437 | 452 |
| $100 * \lambda^*$ | 10 | 10 | 11 | 11 | 12 | 15 | 17 |
| $100 * \lambda^{m*}$ | 20 | 21 | 22 | 22 | 23 | 25 | 27 |
| | Case 4: $\tau = 9$ ('medium' product differentiation) | | | | | | |
| $100 * Q^*$ | 373 | 384 | 392 | 400 | 409 | 436 | 462 |
| $100 * Q^{m*}$ | 478 | 489 | 497 | 505 | 513 | 538 | 561 |
| $100 * \lambda^*$ | 22 | 24 | 25 | 26 | 28 | 32 | 35 |
| $100 * \lambda^{m*}$ | 37 | 39 | 40 | 41 | 42 | 44 | 47 |
| | Case 5: $\tau = 8$ ('low' product differentiation) | | | | | | |
| $100 * Q^*$ | 446 | 463 | 474 | 486 | 498 | 536 | 569 |
| $100 * Q^{m*}$ | 592 | 608 | 619 | 630 | 641 | 676 | 706 |
| $100 * \lambda^*$ | 40 | 42 | 44 | 45 | 47 | 51 | 54 |
| $100 * \lambda^{m*}$ | 57 | 58 | 59 | 60 | 61 | 64 | 66 |

Table 18: Equilibrium values with and w/o a merger (multiplied by 100); $v = 10$, $\delta \leq 0.2$

| | $\delta$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 |
| | Case 3: $\tau = 10$ ('high' product differentiation) | | | | | | | |
| $100 * Q^{*}$ | 420 | 468 | 522 | 580 | 643 | 710 | 782 | 860 |
| $100 * Q^{m*}$ | 488 | 529 | 575 | 626 | 680 | 737 | 797 | 860 |
| $100 * \lambda^{*}$ | 23 | 30 | 36 | 43 | 49 | 54 | 60 | 65 |
| $100 * \lambda^{m*}$ | 32 | 37 | 42 | 47 | 52 | 56 | 61 | 65 |
| | Case 4: $\tau = 9$ ('medium' product differentiation) | | | | | | | |
| $100 * Q^{*}$ | 517 | 578 | 645 | 716 | 794 | 877 | 968 | 1067 |
| $100 * Q^{m*}$ | 611 | 665 | 724 | 786 | 852 | 920 | 992 | 1067 |
| $100 * \lambda^{*}$ | 42 | 49 | 55 | 60 | 66 | 71 | 75 | 80 |
| $100 * \lambda^{m*}$ | 52 | 56 | 61 | 65 | 69 | 73 | 77 | 80 |
| | Case 5: $\tau = 8$ ('low' product differentiation) | | | | | | | |
| $100 * Q^{*}$ | 639 | 715 | 798 | 888 | 985 | 109 | 121 | 134 |
| $100 * Q^{m*}$ | 771 | 840 | 913 | 990 | 107 | 116 | 124 | 134 |
| $100 * \lambda^{*}$ | 61 | 67 | 72 | 77 | 82 | 86 | 90 | 94 |
| $100 * \lambda^{m*}$ | 70 | 74 | 78 | 82 | 85 | 88 | 91 | 94 |

Table 19: Equilibrium values with and w/o a merger (multiplied by 100); $v = 10$, $\delta \geq 0.3$

**Case 6:** $(v, \tau) = (15, 15)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$p^{*}, p^{m*} \leq 7.5. \tag{59}$$

In Tables 20-22 we present the equilibrium values (rounded to three decimal places) of the wholesale and retail prices, the share of one-stop shoppers and the suppliers' profits depending on the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Note that all the equilibrium prices $p^{*}$ and $p^{m*}$ in the tables satisfy condition (59).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 | 0.12 |
| $w^*$ | 3.489 | 3.456 | 3.431 | 3.404 | 3.373 | 3.357 | 3.321 |
| $p^*$ | 6.551 | 6.508 | 6.476 | 6.442 | 6.405 | 6.385 | 6.344 |
| $Q^*$ | 4.999 | 5.07 | 5.123 | 5.181 | 5.245 | 5.279 | 5.352 |
| $\lambda^*$ | 0.096 | 0.104 | 0.109 | 0.115 | 0.122 | 0.126 | 0.133 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **34.885** | **35.046** | **35.158** | **35.271** | **35.385** | **35.442** | **35.553** |
| $w^{m*}$ | 3.00 | 2.953 | 2.92 | 2.885 | 2.848 | 2.828 | 2.789 |
| $p^{m*}$ | 6.00 | 5.953 | 5.921 | 5.887 | 5.851 | 5.833 | 5.795 |
| $Q^{m*}$ | 6.00 | 6.094 | 6.161 | 6.231 | 6.305 | 6.344 | 6.423 |
| $\lambda^{m*}$ | 0.20 | 0.209 | 0.216 | 0.223 | 0.23 | 0.234 | 0.241 |
| $\boldsymbol{\varphi}^{m**}$ | **36.00** | **35.991** | **35.975** | **35.948** | **35.909** | **35.885** | **35.826** |

Table 20: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 15)$, $\delta \leq 0.12$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.13 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 |
| $w^*$ | 3.302 | 3.262 | 3.144 | 2.848 | 2.494 | 2.109 | 1.708 |
| $p^*$ | 6.322 | 6.276 | 6.148 | 5.852 | 5.526 | 5.194 | 4.864 |
| $Q^*$ | 5.391 | 5.474 | 5.711 | 6.304 | 7.023 | 7.828 | 8.702 |
| $\lambda^*$ | 0.137 | 0.146 | 0.171 | 0.23 | 0.296 | 0.362 | 0.426 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **35.607** | **35.709** | **35.914** | **35.91** | **35.026** | **33.017** | **29.729** |
| $w^{m*}$ | 2.768 | 2.726 | 2.612 | 2.352 | 2.059 | 1.74 | 1.405 |
| $p^{m*}$ | 5.776 | 5.736 | 5.632 | 5.402 | 5.152 | 4.89 | 4.622 |
| $Q^{m*}$ | 6.465 | 6.55 | 6.781 | 7.315 | 7.936 | 8.632 | 9.39 |
| $\lambda^{m*}$ | 0.245 | 0.253 | 0.274 | 0.321 | 0.371 | 0.421 | 0.471 |
| $\boldsymbol{\varphi}^{m**}$ | **35.791** | **35.709** | **35.423** | **34.416** | **32.672** | **30.033** | **26.379** |

Table 21: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 15)$, $0.13 \leq \delta \leq 0.6$

| | $\delta$ | | | |
|---|---|---|---|---|
| | 0.70 | 0.80 | 0.90 | 1.00 |
| $w^*$ | 1.297 | 0.876 | 0.444 | 0.00 |
| $p^*$ | 4.537 | 4.21 | 3.883 | 3.551 |
| $Q^*$ | 9.64 | 10.647 | 11.73 | 12.899 |
| $\lambda^*$ | 0.486 | 0.542 | 0.595 | 0.645 |
| $\sum_i \varphi_i^{**}$ | **25.006** | **18.655** | **10.427** | **0.00** |
| $w^{m*}$ | 1.059 | 0.709 | 0.355 | 0.00 |
| $p^{m*}$ | 4.352 | 4.082 | 3.815 | 3.551 |
| $Q^{m*}$ | 10.202 | 11.061 | 11.961 | 12.899 |
| $\lambda^{m*}$ | 0.518 | 0.563 | 0.605 | 0.645 |
| $\varphi^{m**}$ | **21.618** | **15.676** | **8.489** | **0.00** |

Table 22: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 15)$, $\delta \geq 0.7$

We observe from Tables 20-22 that $\varphi^{m**} \geq \sum_i \varphi_i^{**}$ holds for $\delta \leq 0.15$ (with an opposite inequality otherwise), such that the manufacturers merge in equilibrium if the bargaining power of the retailer is sufficiently low, with $\delta \leq 0.15$.

**Case 7:** $(v, \tau) = (15, 14)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$2 \leq p^*, p^{m*} \leq 8. \tag{60}$$

In Tables 23-25 we present the equilibrium values (rounded to three decimal places) of the wholesale and retail prices, the share of one-stop shoppers and the suppliers' profits depending on the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Note that all the equilibrium prices $p^*$ and $p^{m*}$ in the tables satisfy condition (60).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 | 0.12 |
| $w^*$ | 3.929 | 3.864 | 3.816 | 3.765 | 3.711 | 3.683 | 3.624 |
| $p^*$ | 6.733 | 6.664 | 6.616 | 6.565 | 6.512 | 6.485 | 6.429 |
| $Q^*$ | 5.341 | 5.473 | 5.568 | 5.67 | 5.778 | 5.834 | 5.952 |
| $\lambda^*$ | 0.172 | 0.186 | 0.197 | 0.207 | 0.219 | 0.225 | 0.237 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **41.974** | **42.289** | **42.495** | **42.695** | **42.885** | **42.975** | **43.143** |
| $w^{m*}$ | 3.246 | 3.178 | 3.131 | 3.082 | 3.032 | 3.006 | 2.954 |
| $p^{m*}$ | 6.086 | 6.027 | 5.986 | 5.944 | 5.901 | 5.88 | 5.836 |
| $Q^{m*}$ | 6.722 | 6.864 | 6.963 | 7.065 | 7.171 | 7.226 | 7.337 |
| $\lambda^{m*}$ | 0.311 | 0.324 | 0.333 | 0.342 | 0.351 | 0.356 | 0.365 |
| $\boldsymbol{\varphi}^{m**}$ | **43.643** | **43.627** | **43.597** | **43.55** | **43.483** | **43.442** | **43.345** |

Table 23: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 14)$, $\delta \leq 0.12$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.13 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 |
| $w^*$ | 3.594 | 3.532 | 3.365 | 3.0 | 2.609 | 2.203 | 1.786 |
| $p^*$ | 6.40 | 6.343 | 6.191 | 5.875 | 5.552 | 5.228 | 4.905 |
| $Q^*$ | 6.012 | 6.138 | 6.477 | 7.237 | 8.088 | 9.015 | 10.015 |
| $\lambda^*$ | 0.243 | 0.256 | 0.289 | 0.356 | 0.423 | 0.487 | 0.546 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **43.221** | **43.359** | **43.594** | **43.433** | **42.209** | **39.72** | **35.771** |
| $w^{m*}$ | 2.927 | 2.873 | 2.732 | 2.429 | 2.106 | 1.769 | 1.423 |
| $p^{m*}$ | 5.813 | 5.768 | 5.652 | 5.407 | 5.153 | 4.893 | 4.63 |
| $Q^{m*}$ | 7.394 | 7.511 | 7.818 | 8.493 | 9.242 | 10.055 | 10.926 |
| $\lambda^{m*}$ | 0.37 | 0.379 | 0.403 | 0.452 | 0.501 | 0.549 | 0.594 |
| $\boldsymbol{\varphi}^{m**}$ | **43.288** | **43.155** | **42.712** | **41.264** | **38.935** | **35.586** | **31.1** |

Table 24: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 14)$, $0.13 \leq \delta \leq 0.6$

| | $\delta$ | | | |
|---|---|---|---|---|
| | 0.70 | 0.80 | 0.90 | 1.00 |
| $w^*$ | 1.359 | 0.92 | 0.468 | 0.00 |
| $p^*$ | 4.581 | 4.254 | 3.922 | 3.583 |
| $Q^*$ | 11.093 | 12.256 | 13.516 | 14.887 |
| $\lambda^*$ | 0.602 | 0.654 | 0.703 | 0.749 |
| $\sum_i \varphi_i^{**}$ | **30.139** | **22.547** | **12.646** | **0.00** |
| $w^{m*}$ | 1.071 | 0.716 | 0.358 | 0.00 |
| $p^{m*}$ | 4.367 | 4.104 | 3.842 | 3.583 |
| $Q^{m*}$ | 11.848 | 12.818 | 13.831 | 14.887 |
| $\lambda^{m*}$ | 0.637 | 0.677 | 0.714 | 0.749 |
| $\varphi^{m**}$ | **25.382** | **18.344** | **9.907** | **0.00** |

Table 25: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 14)$, $\delta \geq 0.7$

From Tables 23-25 we observe that $\varphi^{m**} \geq \sum_i \varphi_i^{**}$ holds for any $\delta \leq 0.13$ (with an opposite inequality otherwise), such that the manufacturers merge in equilibrium if the bargaining power of the retailer is sufficiently low, with $\delta \leq 0.13$.

**Case 8:** $(v, \tau) = (15, 12)$. Condition (52) requires that in the symmetric equilibrium (with or without an upstream merger) the retail price of each product is such that

$$3 \leq p^*, p^{m*} \leq 9. \tag{61}$$

In Tables 26-28 we present the equilibrium values (rounded to three decimal places) of the wholesale and retail prices, the share of one-stop shoppers and the suppliers' profits depending on the retailer's bargaining power parameter, $\delta$. We consider both the independent and the merged manufacturers. Note that all the equilibrium prices $p^*$ and $p^{m*}$ in the tables satisfy condition (61).

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.10 | 0.12 |
| $w^*$ | 4.488 | 4.375 | 4.298 | 4.221 | 4.142 | 4.102 | 4.022 |
| $p^*$ | 6.99 | 6.898 | 6.836 | 6.774 | 6.712 | 6.68 | 6.617 |
| $Q^*$ | 6.693 | 6.942 | 7.114 | 7.29 | 7.47 | 7.562 | 7.748 |
| $\lambda^*$ | 0.402 | 0.424 | 0.439 | 0.453 | 0.467 | 0.474 | 0.488 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **60.076** | **60.747** | **61.158** | **61.537** | **61.881** | **62.04** | **62.327** |
| $w^{m*}$ | 3.553 | 3.459 | 3.296 | 3.332 | 3.267 | 3.234 | 3.168 |
| $p^{m*}$ | 6.256 | 6.184 | 6.136 | 6.088 | 6.039 | 6.015 | 5.966 |
| $Q^{m*}$ | 8.883 | 9.119 | 9.28 | 9.445 | 9.613 | 9.698 | 9.871 |
| $\lambda^{m*}$ | 0.565 | 0.58 | 0.589 | 0.599 | 0.608 | 0.613 | 0.622 |
| $\boldsymbol{\varphi}^{m**}$ | **63.124** | **63.081** | **63.03** | **62.936** | **62.807** | **62.73** | **62.547** |

Table 26: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 12)$, $\delta \leq 0.12$

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.13 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 |
| $w^*$ | 3.982 | 3.901 | 3.696 | 3.277 | 2.849 | 2.41 | 1.96 |
| $p^*$ | 6.586 | 6.509 | 6.365 | 6.047 | 5.728 | 5.407 | 5.082 |
| $Q^*$ | 7.842 | 8.034 | 8.529 | 9.586 | 10.731 | 11.971 | 13.315 |
| $\lambda^*$ | 0.495 | 0.509 | 0.543 | 0.606 | 0.665 | 0.719 | 0.769 |
| $\sum_i \boldsymbol{\varphi}_i^{**}$ | **62.456** | **62.682** | **63.049** | **62.83** | **61.137** | **57.7** | **52.193** |
| $w^{m*}$ | 3.135 | 3.068 | 2.899 | 2.553 | 2.198 | 1.838 | 1.474 |
| $p^{m*}$ | 5.941 | 5.891 | 5.766 | 5.511 | 5.254 | 4.994 | 4.734 |
| $Q^{m*}$ | 9.959 | 10.136 | 10.593 | 11.56 | 12.595 | 13.693 | 14.851 |
| $\lambda^{m*}$ | 0.627 | 0.636 | 0.658 | 0.702 | 0.743 | 0.781 | 0.817 |
| $\boldsymbol{\varphi}^{m**}$ | **62.441** | **62.2** | **61.419** | **59.018** | **55.368** | **50.327** | **43.766** |

Table 27: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 12)$, $0.13 \leq \delta \leq 0.6$

| | $\delta$ | | | |
|---|---|---|---|---|
| | 0.70 | 0.80 | 0.90 | 1.00 |
| $w^*$ | 1.496 | 1.017 | 0.519 | 0.00 |
| $p^*$ | 4.75 | 4.41 | 4.059 | 3.695 |
| $Q^*$ | 14.777 | 16.37 | 18.114 | 20.03 |
| $\lambda^*$ | 0.815 | 0.86 | 0.899 | 0.937 |
| $\sum_i \varphi_i^{**}$ | **44.223** | **33.3** | **18.812** | **0.00** |
| $w^{m*}$ | 1.107 | 0.739 | 0.369 | 0.00 |
| $p^{m*}$ | 4.473 | 4.213 | 3.954 | 3.695 |
| $Q^{m*}$ | 16.065 | 17.335 | 18.657 | 20.03 |
| $\lambda^{m*}$ | 0.85 | 0.881 | 0.91 | 0.937 |
| $\varphi^{m**}$ | **35.563** | **25.606** | **13.786** | **0.00** |

Table 28: Equilibrium values with and w/o a merger; $(v, \tau) = (15, 12)$, $\delta \geq 0.7$

Comparing the equilibrium profits of the manufacturers with and without a merger ($\varphi^{m**}$ and $\sum_i \varphi_i^{**}$, respectively) for different values of the bargaining parameter $\delta$, we observe that $\varphi^{m**} \geq \sum_i \varphi_i^{**}$ holds for any $\delta \leq 0.12$ (with an opposite inequality otherwise). We conclude that the manufacturers merge in equilibrium when the bargaining power of the retailer is sufficiently low, with $\delta \leq 0.12$.

In Tables 29 and 30 we provide the equilibrium total quantity of each product, $Q^*$ ($Q^{m*}$), and the equilibrium share of one-stop shoppers of each product, $\lambda^*$ ($\lambda^{m*}$), when the manufacturers remain independent (are merged) for cases 6-8. We observe that for any value of the retailer's bargaining power parameter $\delta$, all the four variables ($Q^*$, $Q^{m*}$, $\lambda^*$ and $\lambda^{m*}$) increase when products become less differentiated, i.e., $\tau$ decreases.

| | $\delta$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.00 | 0.03 | 0.05 | 0.07 | 0.09 | 0.15 | 0.20 |
| | Case 6: $\tau = 15$ ('high' product differentiation) | | | | | | |
| $100 * Q^*$ | 500 | 507 | 512 | 518 | 525 | 547 | 571 |
| $100 * Q^{m*}$ | 600 | 609 | 616 | 623 | 631 | 655 | 678 |
| $100 * \lambda^*$ | 10 | 10 | 11 | 12 | 12 | 15 | 17 |
| $100 * \lambda^{m*}$ | 20 | 21 | 22 | 22 | 23 | 25 | 27 |
| | Case 7: $\tau = 14$ ('medium' product differentiation) | | | | | | |
| $100 * Q^*$ | 534 | 547 | 557 | 567 | 578 | 614 | 648 |
| $100 * Q^{m*}$ | 672 | 686 | 696 | 707 | 717 | 751 | 782 |
| $100 * \lambda^*$ | 17 | 19 | 20 | 21 | 22 | 26 | 29 |
| $100 * \lambda^{m*}$ | 31 | 32 | 33 | 34 | 35 | 38 | 40 |
| | Case 8: $\tau = 12$ ('low' product differentiation) | | | | | | |
| $100 * Q^*$ | 669 | 694 | 711 | 729 | 747 | 803 | 853 |
| $100 * Q^{m*}$ | 883 | 912 | 928 | 945 | 961 | 1014 | 1059 |
| $100 * \lambda^*$ | 40 | 42 | 44 | 45 | 47 | 51 | 54 |
| $100 * \lambda^{m*}$ | 57 | 58 | 59 | 60 | 61 | 64 | 66 |

Table 29: Equilibrium values with and w/o a merger (multiplied by 100); $v = 15$, $\delta \leq 0.2$

| | $\delta$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 |
| | Case 6: $\tau = 15$ ('high' product differentiation) | | | | | | | |
| $100 * Q^*$ | 630 | 702 | 783 | 870 | 964 | 106 | 117 | 129 |
| $100 * Q^{m*}$ | 732 | 794 | 863 | 939 | 102 | 111 | 120 | 65 |
| $100 * \lambda^*$ | 23 | 30 | 36 | 43 | 49 | 54 | 60 | 129 |
| $100 * \lambda^{m*}$ | 32 | 37 | 42 | 47 | 52 | 56 | 61 | 65 |
| | Case 7: $\tau = 14$ ('medium' product differentiation) | | | | | | | |
| $100 * Q^*$ | 724 | 809 | 902 | 100 | 111 | 123 | 135 | 149 |
| $100 * Q^{m*}$ | 849 | 924 | 101 | 109 | 118 | 128 | 138 | 149 |
| $100 * \lambda^*$ | 36 | 42 | 49 | 55 | 60 | 65 | 70 | 75 |
| $100 * \lambda^{m*}$ | 45 | 50 | 55 | 59 | 64 | 68 | 71 | 75 |
| | Case 8: $\tau = 12$ ('low' product differentiation) | | | | | | | |
| $100 * Q^*$ | 959 | 1073 | 1197 | 1332 | 1478 | 1637 | 1811 | 2003 |
| $100 * Q^{m*}$ | 1156 | 1260 | 1369 | 1485 | 1607 | 1734 | 1866 | 2003 |
| $100 * \lambda^*$ | 61 | 67 | 72 | 77 | 82 | 86 | 90 | 94 |
| $100 * \lambda^{m*}$ | 70 | 74 | 78 | 82 | 85 | 88 | 91 | 94 |

Table 30: Equilibrium values with and w/o a merger (multiplied by 100); $v = 15$, $\delta \geq 0.3$

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