Bundled Negotiations and Line Extensions as Manufacturer Strategies

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Abstract

We show how manufacturers can benefit from contracts that incentivize retailers to purchase multiple products from the same manufacturer. We isolate two effects: first, under standard contractual inefficiencies, which give rise to double-marginalization, such contracts can increase channel profits (the "improved contractual efficiency" effect); second, when a weaker product is tied to a particularly strong "must-stock" product, such contracts can also reduce a retailer's position and shift rent to the manufacturer (the "increased rent-extraction" effect). To harness these effects, we show that it can even be profitable for the manufacturer to introduce a weak product that ultimately has the effect of foreclosing a rival's more efficient substitute. Nevertheless, unless the strong product is sufficiently strong, the overall effect on welfare can still be positive, providing manufacturers with an efficiency rationale against common concerns held by antitrust agencies against such practices.

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1 Introduction

Manufacturers face increasing pressure from retailers. In their negotiations, retailers leverage not only their ever-increasing size,[1] but also various other strategies. Notably, in food retailing, the share of private labels has increased considerably and in some countries dramatically over the last two decades, making it easier for retailers to obtain concessions.[2] In addition, the breadth of stocked products, next to private labels, supports retailers' arguments that their shelf space for branded products is limited (too many products and not enough space), which further allows them to squeeze the manufacturers' profits.[3]

One strategy that manufacturers can use to mitigate this squeeze is to double down on their investments in advertising and innovation, to ensure that they remain in the driver's seat at least with respect to their top brands. In this contribution, we show how manufacturers can in addition, or alternatively, use bundled negotiations to shore up their profits, notably when they possess a particularly strong ("must-stock") product. In particular, we show that it can be profitable for a manufacturer to bundle his negotiations across products so as to tie the purchase of a weak product (either one that he is already producing, or one that he introduces just for this purpose) to the purchase of a strong product, even if the weak product is inferior to comparable products offered by competitors.

We characterize a manufacturer's optimal negotiations strategy and isolate two ways in which he can benefit from bundled negotiations. First, we find that when there is double marginalization, tying a weak product to a strong product can improve contractual

[1] This consolidation, notably in food retailing, has been observed across many countries, as witnessed by various sector inquiries performed by antitrust agencies over the last two decades and the increasing hostility to mergers. Examples in Europe include Germany's sector inquiry in 2014 and the initial prohibition of a takeover of a failing national retailer (Tengelmann) in 2015, the UK's sector inquiry in 2008 and subsequent merger investigations (cf. for a recent account https://www.competitionpolicyinternational.com/competition-issues-in-uk-grocery-retailing/), and the European Commission's large-scale inquiry into food retailing and innovation in 2014. Given this hostility, many retailers have turned to employing more inward-looking strategies such as organic growth.

[2] The concessions often take the form of lower wholesale prices (cf. Raju et al, 1995; Narashimhan and Wilcox, 1998; Chintagunta et al, 2002; and Meza and Sudhir, 2010). There are two reasons for this. One is that the manufacturers' demand elasticities may be adversely affected by the private label sales, causing them to respond by lowering their wholesale prices. The other, which is the one we will focus on in this paper, is that the existence of the private labels strengthen the retailers' bargaining positions by making their threats of delistment more credible, again allowing retailers to obtain concessions. Both reasons have been recognized in a by now considerable literature (for an early account, cf. Mills, 1995, and Bergès-Sennou et al., 2004). Though this literature has also identified various (other) determinants of the private-label growth, recent contributions suggest that macroeconomic conditions, such as recessions, may play only a limited role (cf. Dubé et al, 2018, for the U.S. and Calogero et al, 2022, for the Netherlands).

[3] The limited shelf space in food retailing and its implications for the distribution of surplus is well documented. See, for example, the reports prepared by the U.S. Federal Trade Commission (cf. U.S. Federal Trade Commission, 2001, 2003), the Norwegian Competition Authority (2005), and Shaffer (2013).

efficiency, leading to an increase in overall channel profits — which can then be captured by the manufacturer. The efficiency gains arise because bundling the negotiations gives the manufacturer more flexibility in choosing his terms and allows him to engage in something akin to Ramsey pricing.[4] Second, we find that if the manufacturer's strong product is sufficiently strong, tying the weak and strong product may also have the effect of weakening the retailer's position, allowing the manufacturer to extract more rent. In the first case, channel profits and welfare are higher, the manufacturer is better off, and the retailer is no worse off. In the second case, however, the manufacturer's profits are higher, but channel profits and welfare are lower. Third parties may also be adversely affected in the sense that the bundled negotiations (effectively requiring the retailer to buy both the weak and the strong product) may inadvertently exclude potentially more efficient competitors. Nevertheless, we find that the overall gain to society may still be positive in many instances.

It should be noted that the precise contractual terms negotiated in distribution channels are rarely observed directly by researchers. This applies in particular to those set between manufacturers and retailers, which are often treated as commercial secrets. Nevertheless, from our experience, and from what is known from public documents, manufacturers that bundle their negotiations generally do so in a variety of ways, both formally and informally. For example, the bundling may be explicit in the form of aggregate rebates that tie a retailer's purchases across brands, or of special conditions that are contingent upon the procurement of the manufacturer's weaker products. Or, the bundling may be implicit in that the agreed-upon contractual terms would be different if during negotiations the retailer would not agree to stock also a manufacturer's weaker products or, more generally, if the retailer were instead to delist some of the products that the manufacturer offers.

For the most part, manufacturer-retailer negotiations that tie the retailer's purchase terms across two or more of the manufacturer's products do not typically receive scrutiny from antitrust authorities unless the manufacturer is deemed to have significant market power in at least one of the products.[5] Occasionally though it makes news, particularly when the tying product is alleged to be a "must stock" product. One such instance where bundled negotiations have been made public is that of the antitrust proceeding of the European Commission against The Coca-Cola Company (TCCC).[6] This case focused on the

[4] Ramsey-pricing is well known in the theory of optimal taxation and regulation of public utilities.

[5] Tying is subject to an effects-based approach under U.S. antitrust law. A necessary requirement is that the manufacturer have sufficient market power over the tying product, and that the tie-in affects a not insubstantial amount of commerce in the tied product market (cf. American Bar Association, 2007).

[6] Case COMP/A.39.116/B2 *Coca-Cola* (2005).

complaint that TCCC had made the supply of its strongest "must-stock" products (e.g., carbonated soft drinks like Coca-Cola or Fanta Orange) conditional upon the purchase of other, weak products (e.g., bottled water of the brand Bonaqua). Evidence of bundled negotiations exists notably also for various other (non-FMCG) industries. In the U.S., for example, it is a matter of public record that Cablevision complained against Viacom's bundling strategy, which forced Cablevision to distribute Viacom's less popular channels in order to obtain access to Viacom's popular channels.[7] And in Europe, it has been scrutinized for both postal services and tire sales to distributors.[8] In each of these instances, a particularly strong service or product was paired with a much weaker product. As in these settings, in our setting, the asymmetry between tied products will also be crucial.

At the heart of our model is an assumption of inefficient contracting between manufacturers and retailers, which plays a crucial role in opening the door for efficiency gains through bundled negotiations over more than one product. As is standard practice, we model such inefficiencies by assuming that contracts are linear, which gives rise to double-marginalization. In light of the importance of this assumption for our analysis, it is useful to reflect briefly on its application in the literature, its (real-world) relevance, and how it can be regarded as an approximation of various inefficiencies that characterize real-world negotiations. To this end, we note that linear wholesale prices feature prominently in much of the channels literature, from different aspects of channel management (cf. Spengler, 1950; Gerstner and Hess, 1995; Iyer and Villas-Boas, 2003; Dukes et al, 2006; Cui et al, 2007) to price discrimination (cf. Katz, 1987; DeGraba, 1990; Inderst and Valletti, 2009; O'Brien, 2014), to product-line design (cf. Villas-Boas, 1998; Liu and Cui, 2010), and to returns policies (cf. Padmanabhan and Png, 1997; Wang, 2004; Bandyopadhyay and Paul, 2010; Gumus et al, 2013; Jerath et al, 2017), among others. It is also a key assumption in the vast majority of structural models of (negotiated) wholesale price determination in empirical research, which by their very nature try to capture observable patterns (such as pass-on rates). And its real-world relevance has been documented in various industry studies, which have unveiled explicit cases where linear contracts prevail, such as between hospitals and medical device suppliers (Grennan, 2013, 2014), hospitals and insurers (Ho and Lee, 2017), and book publishers and their resellers (Gilbert, 2015).

[7] Case No. 13 Civ. 1278 *Viacom* (2014). In *Viacom's* case, as in the *Coca Cola* case cited above, the salient feature is that the seller tied its weak products to its especially strong products. The effects we identify hold whether the products are independent, substitutes, or even complements in final demand.

[8] See Commission v. 5.12.2001, COMP/37.859 – La Poste and EuG, Urt. v. 30.9.2003, T-203/01 – Michelin II.

We acknowledge, however, that in many instances wholesale contracts are more complicated than prescribed by a uniform per-unit price (and, indeed, our case of bundled negotiations exhibits such greater complexity). Nevertheless, what is ultimately crucial for our analysis is not whether contracts may contain non-linear terms, but whether the bilateral contracting that exists between firms exhausts all possible efficiencies and thus leads to full surplus maximization (i.e., whether there is sufficient flexibility in designing the terms to disentangle this objective from that of appropriating a larger share of the surplus). If not, then there will be some form of double marginalization, which we capture in a tractable way with our assumption of linear contracts. That double marginalization is important in practice has also been confirmed indirectly through its explicit recognition in antitrust guidelines as a source of efficiency in vertical mergers and other agreements.[9] Indeed, the elimination of double markups is alleged to be the primary driver behind many vertical mergers, which would not have been necessary in the absence of impediments.

In our model, we distinguish between a manufacturer's strong product and a weak product that it potentially introduces as well. When the two products' terms of supply are not tied, the manufacturer either does not supply the weak product (which occurs when the retailer has a more attractive alternative), or its wholesale price on the weak product is determined by the constraint to match the retailer's outside option. The retailer's outside option derives from the profits it would realize by using its limited shelf space to sell a private label, an alternative though potentially inferior substitute, or another independent product. Our results do not depend on the specific interpretation. Similarly, the manufacturer's wholesale price on the strong product is also constrained by the retailer's outside option when it is not sufficiently attractive (or, likewise, when it is not sufficiently strong). In this case (when both the weak and the strong products' wholesale prices are constrained by the retailer's respective outside options), the sole effect of bundling the supply of the two products is to enhance contractual efficiency and thereby increase channel profits. But when the manufacturer's strong product is sufficiently strong (akin to a "must-stock" product), tying also allows the manufacturer to extract from the retailer more rent, which the manufacturer must leave the retailer under separate contracting due to the double-marginalization problem. Thus, tying leads to two different effects: on the one hand, it can lead to more efficient contracting; but on the other hand, it can allow for more rent extraction from the retailer, which pushes up both wholesale and retail prices.

[9] See the *Vertical Merger Guidelines* U.S. Department of Justice and U.S. Federal Trade Commission, June 30, 2020, and the European Commission's new *Guidelines on Vertical Restraints*, May 10, 2022.

Both effects increase the manufacturer's profit. They can also be sufficiently attractive as to make it profitable for the manufacturer to introduce a new brand to its product line (line extension) that, on its own, is inferior to a rival's product. However, the two effects work in different directions from an industry profits and welfare (and thus also antitrust) perspective. How the two identified effects of tied contracting then balance depends crucially on whether the manufacturer owns a sufficiently strong product. The stronger it is (relative to the retailer's alternatives), the more likely the rent-extraction effect will dominate. Importantly, however, the positive effects of tying may still dominate even when the bundled negotiations essentially foreclose a more efficient, stand-alone rival.

Our analysis contributes to several literatures. First, it contributes to the debate over how brand manufacturers should respond when faced with the dual threats of private labels on the one hand and limited shelf space on the other (cf. the report by the U.S. Federal Trade Commission, 2001, and the interviews contained therein, and the chapters in Kumar, 2007, about brand manufacturers being under attack and the need to rethink strategy). Should they throw in the towel or fight back? The consensus seems to be that they should fight back, e.g., by investing increasing amounts into advertising and innovation, with the idea of the former being to cement the brand loyalty of their consumers and the idea of the latter being to ensure that their best products remain unique and different. Nasser et al. (2013) take this a step further and suggest some other possibilities as well: namely adopt an accommodation strategy (i.e., reposition one's products); adopt a displacement strategy (i.e., offer to supply the private labels yourself); or adopt a buffering strategy (i.e., introduce a fighting brand to compete head on). To this, we suggest that instead of accommodating, displacing, or buffering, or engaging in other costly activities, the manufacturer might try bundling his negotiations. While this may be seen as upping the ante, when coupled with a strong product, it can lead to a sizeable increase in its profit.

Second, the realization of efficiency gains in our model is closely linked to our consideration of bundled negotiations in distribution channels, rather than with respect to final consumers, which has been largely the focus of the bundling and tying literature. There, faced with different consumers, and when first-order price discrimination is not possible, tying and bundling allows manufacturers to price discriminate and extract more consumer surplus (cf. Adams and Yellen, 1976; McAfee et al., 1989; Venkatesh and Kamakura, 2003; Bakos and Brynjolfsson, 1999), which may then also have the effect of (credibly) foreclosing a more efficient single-product supplier (Whinston, 1990; Nalebuff, 2004). To the extent that bundling has been considered in distribution channels, the concerns have mostly fo-

cused on the bundling of different manufacturers' products by a retailer (cf. Bhargava, 2012; Cao et al, 2015), and whether a manufacturer might want to take steps to prevent a retailer from undoing his bundles (Girju et al, 2013). Here, the bundling is over the retailer's procurement terms, and both products are produced by the same manufacturer.

Next, our contribution ties into a large literature on vertical contracting and channel management. As we have already noted, a feature of our analysis is that we assume contractual inefficiencies, which we capture with linear contracts. In contrast, O'Brien and Shaffer (2005), building on Shaffer (1991), show that when the manufacturer supplies substitute products, a restriction to separate offers can be inefficient even with non-linear contracts, as the manufacturer can then profitably distort each individual contract so as to negatively affect the retailer's outside options (cf. also Verge, 2001; Dertwinkel-Kalt and Wey, 2020). The idea in these papers is that bundled offers are needed because, with substitute products, retailers may otherwise be emboldened to drop a manufacturer's product knowing that they can use the manufacturer's other product to capture some of the lost sales (in effect playing the manufacturers' products off against each other). This reasoning is very different from the reasons why bundled negotiations arise here. To isolate the novel effects of our analysis, and thus to emphasize our differences, we therefore focus in what follows on the case where the manufacturer's products are independent, so that the effects they identify are not present (i.e. with independent products in demand, there is no sense in which a retailer can make up for the lost sales of one product by only selling the other). Moreover, we also differ from the above research in that we bring together the two themes of increasing surplus by contracting more efficiently and that of extracting more surplus from the retailers in a tractable model of tying with double-marginalization.

We also contribute to the literature on product-line design and length in a distribution channel (cf. Villas-Boas, 1998; Liu and Cui, 2010; Wong et al, 2021). There it is found that manufacturers may want to distort their product offerings and increase their line length in order to induce their retailers to serve all market segments and to mitigate the high prices that may arise due to double marginalization. It is also known that a manufacturer may choose its product line with an eye towards deterring entry (cf. Bayus and Putsis, 1999). Here, the line extension to a weak product may end up foreclosing a rival's more efficient substitute product, but if so, it is incidental to its primary purpose of allowing for more efficient contracting and rent shifting from the retailer. There is no sense in which the manufacturer is trying to get the retailer to cover all market segments, and moreover, the gains he is trying to achieve go hand in hand with being able to bundle his contract terms

across products, something that is explicitly not allowed in the aforementioned literature.

As mentioned previously, our bundled negotiations give the manufacturer more flexibility in choosing his terms, allowing him to engage in Ramsey-like pricing (sometimes also referred to as Boiteux-Ramsey pricing, cf. Ramsey, 1927; Boiteux, 1956; and Dierker, 1991). Thus, another tie-in is with the literature on Ramsey pricing. Under traditional Ramsey-pricing, a social planner chooses its per-unit taxes to maximize social welfare subject to obtaining a fixed tax revenue. Ramsey pricing is also relevant for the optimal (regulated) pricing of multi-product utilities (cf. Armstrong and Vickers, 2018), where the goal of the social planner is to choose its prices to maximize social welfare subject to covering the utilities' fixed costs. The relevance in our context arises because (i) the manufacturer is selling multiple products which have downward-sloping demand, (ii) bundling means that the retailer cannot pick and choose which of these products to sell, (iii) the manufacturer is maximizing a single function (here, his profits), and (iv) the maximization is subject to the fixed constraint that the retailer earn no more than the value of his shelf space. Under traditional Ramsey pricing, the optimal per-unit taxes are inverse to the respective price elasticities of demand. In our context, the ratio of the wholesale price margins are inverse to the derived elasticities demand — when the constraints are binding.

Last, our findings contribute to the law and economics literature on bundled rebates, loyalty discounts, tying, and other conditional pricing practices (cf. Kobayashi, 2005; Lambert, 2005; Hovenkamp, 2006; Elhauge, 2009). Such practices are generally found to be legal unless they result in an undue foreclosure of competition on the merits, which essentially boils down to whether or not they would lead to (or have already led to) the exclusion of an "equally efficient competitor" (i.e., one with the same costs and scale economies). For this, various tests have been devised (cf. Greenlee and Reitman, 2005; Salop, 2017; Fumagalli and Motta, 2017). Our findings suggest, however, that regardless of which test is used, a manufacturer's bundled negotiations can improve efficiency and lead to higher overall welfare even if they foreclose a more efficient (single-product) rival.

The unexpectedness of this last result arises because our rationale for why the manufacturer is engaging in bundled negotiations is new. For the most part, the law and economics literature on bundling and tying has focused on price discrimination and the exclusion of competitors as the two main themes, with the former having ambiguous consequences for welfare and the latter being anti-competitive. Our results thus contribute by providing a powerful counterargument. There is no price discrimination in the model, no heterogeneous values to exploit, and the bundled negotiations may or may not lead to exclusion.

And if (more efficient) competitors are excluded as a result, it is not necessarily the case that welfare will be lower. Whether it will be lower or higher will depend in general on the strength of the manufacturer's "must stock" product. The stronger it is, the more likely it is that the potential contracting efficiencies will be outweighed by the anti-competitive effects, and vice versa. Having too narrow a mindset, and focusing only on the potential harm to the excluded firm, will not be sufficient to establish this, one way or the other.

The rest of the paper is organized as follows. Section 2 introduces the model. Section 3 derives the equilibrium under both separate and tied contracting. Sections 4 and 5 isolate and balance the two effects of bundled negotiations. Section 6 analyzes a manufacturer's incentive to introduce weak product even if it is less efficient than a rival's substitute product. Section 7 summarizes our main findings and points to future research avenues.

2 The Model

To make our points in the simplest way possible, we conceive of a single strategic manufacturer offering to supply two different products, indexed by $n = A, B$, which are produced at constant unit costs c_n. The manufacturer must sell his products through a monopolistic retailer who then resells to final consumers. As discussed in the Introduction, we stipulate that final demands for the two products are fully independent, as this allows us to abstract from other reasons why a manufacturer might want to offer multiple products and make the delivery of one product or its price to the retailer contingent on the terms of the other. For this reason, we assume demand for product n, $D_n(p_n)$, only depends on the price p_n.

Throughout our analysis, we will also restrict attention to linear contracts w_n. As discussed in the Introduction, the resulting double-marginalization problem is our key source of contractual inefficiency. There, we also argued that such inefficiencies are of practical relevance. We distinguish between two types of contracting. Under separate contracting (offers), the manufacturer cannot make the condition for the supply of one product contingent on the retailer's procurement of the other product. In the second scenario of tied contracting (offers), the manufacturer ties together the conditions for the supply of the two products. As will be evident in what follows, we can restrict attention to a tied offer (w_A, w_B) under which the retailer can procure the respective product n at a per-unit price w_n, while the manufacturer makes separate procurement of only product A or B sufficiently unattractive. For instance, compared to when procuring only one product, the offer (w_A, w_B) could come at a sufficiently large (cross-products or bundled) rebate.

In our contracting game, the manufacturer makes a take-it-or-leave-it offer to the retailer, for which, depending on the subsequently discussed antitrust regime, he can either offer only separate contracts or both separate and tied contracts. The retailer can accept or reject the manufacturer's offer. In the latter case he procures from his alternative sources. After that, the retailer sets the respective prices p_n and sales are made to final consumers.

The manufacturer's offer must respect the retailer's outside options. These options may consist of filling the respective shelf space with a substitute product, or with another, unrelated product. For the moment, we capture the respective values of doing so by the variable π_n^o. Subsequently, we will impose more structure on this variable where necessary for our interpretation. Overall, we intentionally keep the model as simple as possible.

Preliminary Analysis. If the retailer accepts the manufacturer's offer of w_n and thus buys from the manufacturer, he can realize a profit on product n of

$$\pi_n(w_n) = \max_{p_n}[D_n(p_n)(p_n - w_n)],$$

where we have used the fact that the independence of A and B implies that the pricing strategy of the retailer for one product is independent of the wholesale price of the other product – or whether he even purchases this product (or alternatively from other suppliers).

It is convenient to stipulate that the respective maximization problems are well-behaved in the sense that the objective functions are strictly quasi-concave (where positive). In the latter case, given the manufacturer's offer, we denote the retailer's optimal price by $p_n(w_n)$ and the thereby realized quantity sold by $q_n(w_n)$ (where we sometimes drop the dependency on w_n). The manufacturer's profit is denoted by capital letters and given by

$$\Pi_n(w_n) = q_n(w_n)(w_n - c_n).$$

Assuming the retailer purchases both products from the manufacturer, we abbreviate the retailer's total profits by $\pi = \pi_A + \pi_B$ and the manufacturer's total profits by $\Pi = \Pi_A + \Pi_B$.

3 A First Look at Separate and Tied Contracting

In this Section, we solve for the equilibrium under both separate and tied contracting. In the process, we will show that the wholesale prices w_n that arise when tied contracting is feasible are generically different than the wholesale prices w_n that arise when it is not, implying that tied contracting will be profitable when feasible. Presently, our maintained

assumption is that the retailer's outside options are inferior:

$$\pi_n(w_n = c_n) > \pi_n^o. \tag{1}$$

Hence, it follows for now that under both separate and tied contracting, the manufacturer will always be supplying both products in equilibrium. Later, we will relax this assumption.

Separate Contracting. To set the stage, it is useful to begin by considering the case in which the manufacturer can use only separate contracting. In this case, the manufacturer's wholesale prices must be set independently. Under our maintained assumption that the retailer's alternatives are weakly inferior, it is then easy to see that the manufacturer's optimal choice of w_n maximizes $\Pi_n(w_n)$ subject to the retailer's participation constraint

$$\pi_n(w_n) \geq \pi_n^o. \tag{2}$$

To characterize the solution, we first ignore the retailer's respective outside option and denote the manufacturer's unconstrained optimal choice of wholesale price w_n by

$$\overline{w}_n = \arg\max_{w_n} \Pi_n(w_n). \tag{3}$$

Once again, we suppose that the objective is strictly quasi-concave, which implies that $\overline{w}_n$ is unique. It also implies that for all $w_n < \overline{w}_n$, the manufacturer can increase his profit by raising his wholesale price, while for all $w_n > \overline{w}_n$, the resulting reduction in the retailer's indirect demand dominates, and the manufacturer is better off lowering his wholesale price. On the other side, it is straightforward to see that the retailer's profit, $\pi_n(w_n)$, is everywhere decreasing in the manufacturer's wholesale price (precisely, $d\pi_n/dw_n = -q_n < 0$) We thus have two regimes to consider, depending on whether the retailer's participation constraint binds or does not bind.

Lemma 1 *Suppose the manufacturer offers both products but is constrained to use separate contracts. Then, there exists a threshold value of the retailer's outside option, $\widehat{\pi}_n^o$, such that for $\pi_n^o < \widehat{\pi}_n^o$ the retailer's participation constraint (2) is slack and $w_n^s = \overline{w}_n$ (Case 1) while for $\pi_n^o \geq \widehat{\pi}_n^o$ the retailer's participation constraint (2) binds and $w_n^s < \overline{w}_n$ (Case 2).*

In what follows, we will focus on the case where product B represents the manufacturer's "weak" product, so that Case 2 applies and the retailer's outside option always binds. Instead, for product A, which represents the manufacturer's "strong" product, we will distinguish between Cases 1 and 2. Below we will also offer an interpretation of this in terms of each product's distance to its closest substitute, where the respective substitutes are offered by, for instance, a competitive fringe or consists of a private-label product.

Tied Contracting. Recall that under a tied offer (w_A, w_B), the manufacturer either commits not to supply only one product, or he makes the choice of only one product sufficiently unattractive (in which case the tied offer must be sufficiently rebated). Either way, there is thus only a single, joint participation constraint to consider for the retailer:

$$\pi_A(w_A) + \pi_B(w_B) \geq \pi_A^o + \pi_B^o. \tag{4}$$

This collapsing of the individual participation constraints into one joint participation constraint has the effect of relaxing the manufacturer's overall maximization problem (across the two products) and potentially incentivizes him to choose a different pair of wholesale prices than he would have chosen under separate contracting. Since the latter is still feasible, if he does choose a different pair, then he must be better off. As we will now show, the manufacturer's optimal wholesale prices will indeed be generically different under tying.

To see this, note that under tied contracting, the manufacturer's problem is to maximize his total profit Π subject to the joint participation constraint (4). If (4) does not bind, then the optimal tied offer, which we denote by w_n^t, satisfies $w_n^t = \overline{w}_n$ for both A and B, as given by (3), an outcome that does not arise under separate contracting given our assumption that Case 2 applies for product B. More interesting is what happens if (4) binds, because then even though demands are independent, the optimal choice of wholesale prices will be interrelated through the binding constraint. Setting up the Lagrangian

$$\mathcal{L} = \Pi_A + \Pi_B + \lambda \left(\pi_A + \pi_B - \pi_A^o - \pi_B^o \right), \tag{5}$$

the first-order requirement reads

$$\frac{d\Pi_A/dw_A}{d\pi_A/dw_A} = \frac{d\Pi_B/dw_B}{d\pi_B/dw_B}. \tag{6}$$

Or, in other words, the marginal rate of substitution between the manufacturer's and the retailer's profit must be the same for the two products in equilibrium. Substituting $d\Pi_n/dw_n = q_n + (w_n - c_n)dq_n/dw_n$ and $d\pi_n/dw_n = -q_n$ into the above expression yields

$$\frac{dq_A}{dw_A}\frac{(w_A - c_A)}{q_A} = \frac{dq_B}{dw_B}\frac{(w_B - c_B)}{q_B}.$$

Noting that q_n represents the derived demand function and $\eta_n = (dq_n/dw_n)(w_n/q_n)$ its elasticity, we ultimately have that under the manufacturer's optimal offer it must be that

$$\frac{(w_A - c_A)/w_A}{(w_B - c_B)/w_B} = \frac{\eta_B}{\eta_A}. \tag{7}$$

Here, the ratio of the respective (percentage) margins equals the inverse ratio of the respective elasticities of the derived demand functions. Intuitively, when the elasticity of the derived demand is higher for one product, then under the optimal tied offer the manufacturer accepts a lower (percentage) margin on this product. The manufacturer thus follows a Ramsey-pricing-like rule (also called more descriptively an "inverse elasticity rule").[10] This observation formalizes the insight that when (4) binds, the manufacturer optimally extracts surplus from the retailer in the most efficient way (in terms of industry profit), which mirrors the use of Ramsey prices in many other contexts (such as optimal taxation).

Which of the two cases, i.e., that with a binding joint participation constraint (4) or that without, arises depends on the attractiveness of the retailer's alternatives. We will make this dependency more explicit in the next section, where we analyze the profit and welfare implications of tying. For now, we can summarize the preceding findings as follows:

Lemma 2 *Suppose the manufacturer offers both products and can tie the respective terms of supply. If (4) is slack, the manufacturer sets* $w_n^t = \overline{w}_n$ *(the unconstrained wholesale price) for both products. Otherwise, the choice of* w_n^t *follows the Ramsey pricing rule (7).*

Before continuing to the next section, it is useful to point out that the mapping between the cases in Lemma 1 and the possibilities in Lemma 2 can take one of three forms. If the retailer's participation constraint on product A (the manufacturer's strong product) binds under separate contracting (Case 2 holds), then the joint participation constraint (4) will also necessarily bind under tied contracting.[11] This is one possibility. However, if the retailer's participation constraint on product A does not bind under separate contracting (Case 1 holds), then the joint participation constraint (4) may bind under tied contracting (a second possibility) or may not (the third possibility).[12] From these possibilities, we can identify two distinct effects of tied contracting, which we will isolate and discuss next.

[10] The inverse elasticity rule is a special case of the Ramsey pricing rule and only applies when, as in our case, cross-price elasticities are zero.

[11] If this were not true, then, from Lemma 2, the manufacturer would optimally set $w_n^t = \overline{w}_n$ on both products and a slack participation constraint (4) would imply that $\pi_A(\overline{w}_A) + \pi_B(\overline{w}_B) > \pi_A^o + \pi_B^o$. But this would mean that either $\pi_A(\overline{w}_A) > \pi_A^o$, $\pi_B(\overline{w}_B) > \pi_B^o$, or both, which contradicts the supposition.

[12] Our assumption that product B is weak excludes the case where the manufacturer is unconstrained on both products. If this were to hold, so that Case 1 of Lemma 1 applied for both of the manufacturer's products, then the joint participation constraint would also not bind and there would be no effect of tying.

4 Isolating and Balancing the Effects of Tied Contracting

In this Section, we first isolate two effects that arise from the transition to tied contracting. Both effects work in the same direction in that they increase the manufacturer's profits. But in terms of a potential conflict with the retailer, they have opposite implications. Also, their implications differ with respect to total industry profits and ultimately welfare, which is relevant from a managerial perspective as it can affect the presumed legality of the practice. In what follows, we then analyze in detail the interaction of these two effects.

We let total industry profits be the sum of the manufacturer's and the retailer's profit, i.e., the sum of $(p_n - c_n)q_n$ for $n = A, B$. In light of our subsequent analysis, we also introduce the consumer surplus realized with product n, $CS_n = \int_0^{q_n}[P_n(s) - p_n]ds$, and define total welfare W_n as the sum of industry profits and consumer surplus for $n = A, B$.

4.1 Improved Contractual Efficiency under Tied Contracting

To isolate the first effect of tied contracting, we consider what the effects of Ramsey pricing would be in the absence of any added rent extraction. Specifically, we fix the retailer's total profit to be the same as it would be under separate contracting and denote it by $\pi^s = \pi_A(w_A^s) + \pi_B(w_B^s)$. We then consider an auxiliary problem in which the manufacturer maximizes his profit Π subject to promising the retailer a profit of at least π^s. In this case, it is easy to see that the manufacturer's optimal wholesale prices satisfy the Ramsey pricing rule (7), and that they generically differ from his optimal offer under separate contracting (which generally does not satisfy (7)). The fact that they differ, even though he could have chosen the same prices, implies that the manufacturer will be strictly better off under the auxiliary problem than he would be under separate contracting. Given that the retailer's profit is the same in both cases, it also implies that industry profits will be higher as well.

We can formally state this "improved contractual efficiency" effect of tying as follows:

Proposition 1 *Consider an auxiliary problem in which the manufacturer maximizes his profit* Π *subject to the retailer earning a profit of at least* π^s*. Then, total industry profits are generically strictly higher (and always so if under separate contracting the manufacturer is unconstrained on its strong product) under tied contracting than under separate contracting.*

Proof of Proposition 1. Under the auxiliary problem with tying, the manufacturer maximizes Π subject to $\pi \geq \pi^s$. Arguing to a contradiction, we first show that in the

auxiliary problem, the retailer's participation constraint must bind, so that the manufacturer's respective wholesale prices must satisfy condition (7). In fact, if the retailer's (auxiliary) participation constraint did not bind, the manufacturer would set $w_n^t = \overline{w}_n$ for both products. But then, from $w_B^s < \overline{w}_B$, the retailer's profits would be strictly lower than under separate contracting, a contradiction. Suppose now that pricing for product A is not constrained under separate contracting. Then, the first-order condition for w_A^s requires that $(w_A - c_A)/w_A = 1/\eta_A$, while $w_B^s < \overline{w}_B$ implies that $(w_B - c_B)/w_B \neq 1/\eta_B$, which does not satisfy condition (7). In this case, the solutions do not coincide.[13] If instead the pricing for product A is constrained under separate contracting, then $w_n^s < \overline{w}_n$ for both products and the wholesale prices will generically be different under the auxiliary problem than under separate contracting. It follows from this that we know that the manufacturer's profit (and therefore total industry profits) will thus be generically strictly higher. **Q.E.D.**

By tying together the contractual terms for the strong and weak products, the manufacturer is able to satisfy more efficiently the retailer's fixed participation constraint. Specifically, tied contracting benefits the manufacturer in this case because it gives him more flexibility in choosing his wholesale prices. It allows him, for example, to increase his profit by lowering his wholesale price on the product on which he is initially less constrained and raising his wholesale price on the product on which he is initially more constrained, all the while continuing to keep the retailer's profit the same. Having two contractual instruments at his disposal, the manufacturer can thus better reconcile the conflicting objectives of maximizing overall profit and extracting the respective surplus.

Comparative Analysis of Wholesale Prices. Note that Proposition 1 does not make any prediction as to which wholesale price will increase under tying and which will decrease. To shed light on this, recall from (6) that the marginal rate of substitution between profits must be equal for the two products whenever the joint participation constraint binds. In some instances, it is easy to see how the wholesale prices must adjust to make this happen. In other instances, however, it is less straightforward. Consider first the case of $w_A^s = \overline{w}_A$ and $w_B^s < \overline{w}_B$. Then, by optimality, $d\Pi_A/dw_A = 0$ (implying that $d\Pi_A/d\pi_A = 0$ under

[13] A more intuitive way of understanding why the solutions do not coincide is to notice that in this case, from the envelope theorem, a marginal reduction of the wholesale price for product A, where $w_A^s = \overline{w}_A$, does not have a first-order impact on the manufacturer's profit, but it strictly increases the retailer's profit and thereby relaxes his participation constraint. This in turn allows the manufacturer to marginally increase the wholesale price of the weak product, which from $w_B^s < \overline{w}_B$, strictly increases his profit.

separate contracting) and $d\Pi_B/dw_B > 0$ (implying that $d\Pi_B/d\pi_B < 0$ under separate contracting). Since in this case transferring marginally higher profit to the retailer by lowering the price on product A has a zero first-order effect on the manufacturer's profit, while transferring marginally higher profit to the retailer by lowering the price on product B has a negative first-order effect on the manufacturer's profit, it should be clear that under the manufacturer's optimal tied contract, the manufacturer will necessarily be specifying a lower wholesale price on his product A and a higher wholesale price on his product B.[14]

Things are more nuanced, however, in the case of $w_A^s < \overline{w}_A$ and $w_B^s < \overline{w}_B$, as then transferring marginally higher profit to the retailer via a lower wholesale price always results in a first-order loss to the manufacturer. Writing out explicitly the marginal rate of substitution between the manufacturer's and the retailer's profit for product n, we have

$$\frac{d\Pi_n}{d\pi_n} = -1 - \frac{w_n - c_n}{q_n}\frac{dq_n}{dw_n},$$

which is equal to minus one at $w_n = c_n$, zero at $w_n = \overline{w}_n$, and bounded between minus one and zero for all other values of w_n between c_n and $\overline{w}_n$. If we further assume, as seems reasonable, that $d\Pi_n/d\pi_n$ is (at least weakly) increasing (and in absolute terms decreasing) in w_n, and if this property holds for both products, then the prediction as to how wholesale prices would change in the auxiliary problem can be found simply by comparing the respective marginal rates of substitution at the wholesale prices prevailing under separate contracting: To equalize the marginal rates of substitution under tied contracting, the wholesale price of the product with a marginal rate of substitution that was previously closer to zero must decrease and that of the other product must increase.[15]

The case of $w_A^s < \overline{w}_A$ and $w_B^s < \overline{w}_B$ is of special interest, because when it holds, the joint participation constraint under tied contracting must be binding (cf. footnote 4). The auxiliary problem in Proposition 1 then exactly coincides with the manufacturer's true maximization problem, and the only effect of tying in this case would be the one that we have identified here – that of improved contractual efficiency. The outcome can be very different, however, when the manufacturer's strong product is sufficiently strong that the retailer's outside option for it does not constrain the manufacturer under separate

[14] If the opposite were true, the manufacturer would see his profit on both products decrease, which would make him strictly worse off under tied contracting than under separate contracting, a contradiction.

[15] There is a technical reason to suppose that this property of a (at least weakly) decreasing marginal rate of substitution holds generally for the considered demand functions. If this were not the case, there would be a region where Π_n as a function of π_n would cease to be (at least weakly) concave. Then profits could be transferred more efficiently between the two firms by involving lotteries over wholesale contracts. In technical terms, this would convexify the (efficiency) boundary of the set of feasible pairs (π_n, Π_n).

contracting. When this is the case, whether or not the joint participation constraint (4) would be binding under tying, there is a second effect at work, which we analyze next.

4.2 Increased Rent Extraction under Tied Contracting

To illustrate the second effect of tied contracting, that of increased rent extraction, we focus on the case where under separate contracting, the manufacturer leaves the retailer with a positive rent on the strong product. This would be the case, for example, whenever Case 1 of Lemma 1 applies. Leaving rent with the retailer when Case 1 applies is optimal, if not ideal, for the manufacturer, because although he could reduce the retailer's profit by increasing his wholesale price above $w_A^s = \overline{w}_A$ in this case without infringing on the retailer's participation constraint, he would also be reducing his own profit, which is not in his interest to do. Given this, the retailer's realized overall profit, π^s, from the two products will be strictly higher than the sum of his respective two outside options, $\pi_A^o + \pi_B^o$.

Tying can help in this instance. By tying his two offers together, the manufacturer can "tap into" the respective rent that the retailer would realize under separate contracting. This can be seen by marginally adjusting upwards the separate wholesale price for product B, starting from w_B^s. Under separate contracting, the retailer would not accept such a higher wholesale price for product B. But when the two offers are tied together, the retailer accepts it, because otherwise he would lose the rent that he earns from product A. We can formally state this "increased rent extraction" effect of tying as follows:

Proposition 2 *Suppose the manufacturer's strong product A is sufficiently strong that the retailer's outside option for it does not bind under separate contracting. Then, under tied contracting, the retailer's profit strictly decreases and the manufacturer's profit increases.*

Proof of Proposition 2. Take the characterization of tied contracting in Lemma 2, where two cases are distinguished. When the joint participation constraint of the retailer binds, the retailer's profits under tied contracting are necessarily strictly lower than his profits under separate contracting, as there $\pi^s > \pi_A^o + \pi_B^o$. In the second case, the manufacturer offers the two unconstrained optimal contracts, $w_n^t = w_n^m$, so that the assertion follows immediately from $w_B^s < \overline{w}_B$ under separating contracting (while $w_A^s = w_A^t = \overline{w}_A$). **Q.E.D.**

Note that the rent-extraction effect decreases channel profits (the manufacturer's gain is more than offset by the retailer's loss) all else equal – because it leads to weakly higher wholesale prices which render the problem of double marginalization more severe. This

can be most clearly seen in the case in which neither the retailer's participation constraint on product A under separate contracting nor the retailer's joint participation constraint under tied contracting binds. In this case, the manufacturer's optimal wholesale prices under separate contracting are $w_A^s = \overline{w}_A$ and $w_B^s < \overline{w}_B$, respectively, whereas his optimal wholesale prices under tied contracting are $w_A^t = \overline{w}_A$ and $w_B^t = \overline{w}_B$, respectively, which implies that there will be an increase in the wholesale price of product B (and therefore worse double marginalization on this product) with no change in the wholesale price of product A. The only effect of the tied contracting in this case is the increased-rent-extraction effect. Though the manufacturer will be better off, the retailer will be worse off, consumers will be worse off, overall profits will be lower, and welfare will be lower.

Things differ in the companion case of interest, where the participation constraint on product A under separate contracting is slack, but the joint participation constraint under tied contracting binds. In this instance, both effects of tied contracting will be operating, with the overall effect depending on which one dominates. To see this, it is useful to start from this case's initial setting of $w_A^s = \overline{w}_A$ and $w_B^s < \overline{w}_B$, and then to decompose the overall change that would arise in the wholesale prices from tied contracting into the change in the wholesale prices that would arise in moving from non-Ramsey pricing to Ramsey pricing while fixing the retailer's profit at π^s (the "improved-contractual-efficiency" effect) plus the change in the wholesale prices that would arise from reducing the retailer's profit from π^s to $\pi_A^o + \pi_B^o$ (the "increased-rent-extraction" effect). In the first part of the decomposition, we know that the adjustment will lead to a *decrease* in the wholesale price of product A and an *increase* in the wholesale price of product B (cf. the first paragraph in the discussion on the Comparative Analysis of Wholesale Prices in the previous section), whereas in the second part of the decomposition (assuming the marginal rate of substitution between the manufacturer's and the retailer's profit is increasing in w_n for both products),[16] we know that both wholesale prices will *increase*.[17] On net, this means that whereas product B's wholesale price will increase as a result of the tied contracting, the change in product A's wholesale price could go either way. It is thus not possible to say in general what the overall effect on double marginalization, industry profits, and welfare will be when the improved contractual efficiency and increased rent extraction effects are both operating.

[16] See footnote 15 and the accompanying text it refers to.

[17] They cannot both decrease, because this would increase the retailer's profit instead of decreasing it, and it is not possible for one to increase and the other to decrease, because then the marginal rates of substitution between the manufacturer's and the retailer's profit on A and B would no longer be the same.

5 Balancing of Effects

We have shown that when the manufacturer's strong product is sufficiently strong that the retailr's joint participation constraint does not bind under tying, then only the increased-rent-extraction effect of tying is present. The retailer is worse off and industry profits decrease: The wholesale and hence retail price of product B will be higher with no change in product A's price. We have also shown that if instead all participation constraints are binding, both pre and post tying, then only the improved-contractual-efficiency effect of tying is present and total channel profits strictly increase. As the Ramsey-pricing-like formula in (7) relies on the elasticities of derived demand, which reflect the respective properties of final demand, it is then also suggestive that welfare increases (which we will establish in this section): The tied-contracting allows the manufacturer to better manage the allocative distortions that arise across products due to the wholesale price mark-ups.

The more nuanced case occurs when *both* effects are jointly present. To make progress, we begin by putting more structure on the retailer's outside options. Now, as well as in the extensions analyzed subsequently, we suppose that the retailer's alternative to product n is to stock a substitute product on the limited shelf space. For simplicity, we focus on the case where this alternative is produced and supplied (competitively) at a higher per-unit cost (cf., however the next section, where this assumpton is relaxed), denoted by c_n^o.[18] Given this, the retailer's outside option on product n is now obtained from

$$\pi_n^o = \max_{p_n}[D_n(p_n)(p_n - c_n^o)],$$

which may be zero when c_n^o is above the price of demand at which the quantity demanded is zero. This also allows us to express the threshold $\widehat{\pi}_n^o$ in Lemma 1 in terms of a threshold $\hat{c}_B^o$, so that the retailer's participation constraint binds when $c_n^o \leq \hat{c}_B^o$, in which case $w_n^s = \hat{c}_B^o$.

Introducing Linear Demand. Our subsequent results are derived for linear demand. To keep the example as simple and as illustrative as possible, we let $D(p_n) = a - bp_n$. We also stipulate symmetry in the manufacturer's unit costs, $c_A = c_B$, which are set to zero.

Given this, it is straightforward to show that the prices and quantities that maximize the retailer's profit as a function of w_n are $p_n(w_n) = (a+bw_n)/2b$ and $q_n(w_n) = (a-bw_n)/2$, respectively. With this, retailer profits are $\pi_n = (a - bw_n)^2/4b$ and consumer surplus is

[18] All of our results would hold if we were to suppose instead that the manufacturer has alternatively an advantage, at least for product A, in terms of quality or consumer loyalty. For instance, with some parameter $d > 0$, the retailer's demand under the alternative supplier's variant could be $D_n(p_n + d)$.

$CS_n = \int_0^{q_n} (a-q)/b dq - p_n q_n$ which, after some substitutions, simplifies to $(a - bw_n)^2/8b$. It follows that $CS_n = \pi_n/2$ and, after aggregating over both products, $CS = \pi/2$. We can thus conclude that with linear demands, consumer surplus is a linear function of the retailer's profits. It remains unchanged, increases, or decreases if the same holds for the retailer's profits, a useful feature that will allow us to streamline the subsequent exposition.

The further solution, namely the manufacturer's wholesale prices under both separate and tied contracting, and derivation of all relevant expressions is given in the Appendix. Figure 1 is representative. It depicts wholesale prices in the special case of $a = b = 1$, $c_n = 0$, and $c_B^o = 1/3$. Wholesale prices are on the vertical axis, and the attractiveness of the retailer's outside option for product A, as measured by c_A^o, is on the horizontal axis.

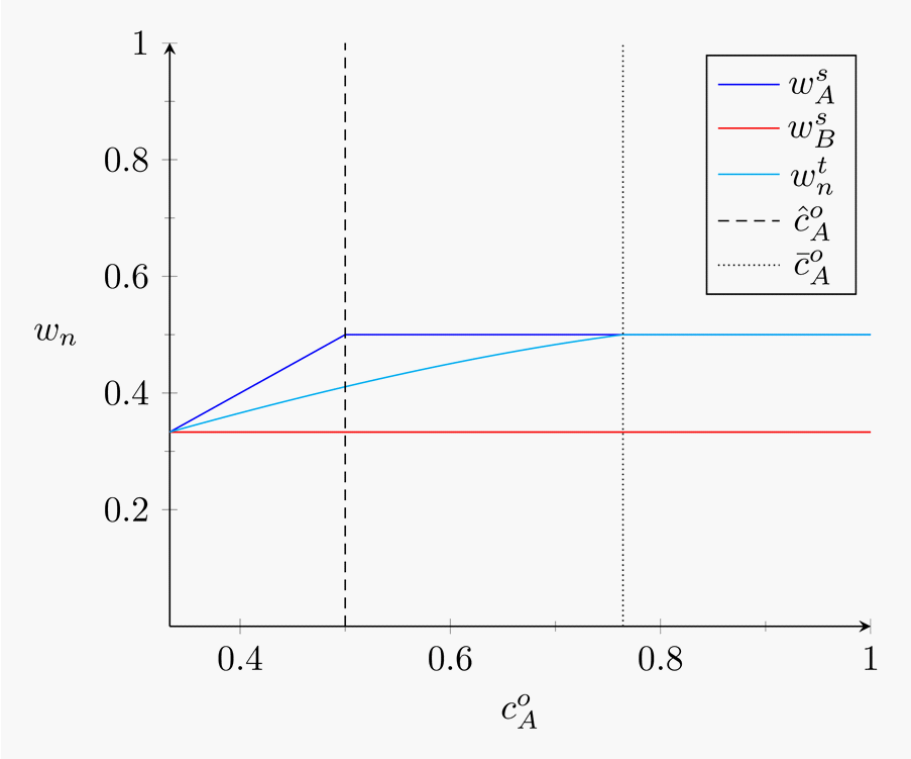

Figure 1: Wholesale prices under linear demand (with $a = b = 1$, $c_n = 0$, $c_B^o = 1/3$).

What we find is that when $c_A^o = c_B^o$, tied contracting has no effect: it neither enhances contractual efficiency or increases rent extraction. Instead, tied contracting is only effective when there is some degree of asymmetry, as when the cost of the retailer's alternative for product A begins to increase. When this is sufficiently small, so that $c_A^o - c_B^o$ is sufficiently small, the retailer's participation constraints will continue to bind under separate contracting (and thus also under tied contracting) and only the positive efficiency effect of tying is present. In the case of Figure 1, it can be seen that under separate contracting, w_B^s

is constrained to equal $c_B^o = 1/3$, whereas for all $c_A^o \leq \hat{c}_A^o$, w_A^s is constrained to equal c_A^o, which is increasing along the horizontal axis. In contrast, under tied contracting, Ramsey pricing requires that both wholesale prices w_n^t be the same (given that demands and the manufacturer's unit costs are symmetric). With linear demands, this necessarily results in an increase in both industry profits and total welfare. Compared to separate contracting, the wholesale price of product A decreases while that of the weaker product B increases.

For increases in c_A^o beyond $\hat{c}_A^o$ (i.e., the threshold at which the manufacturer is no longer constrained on its pricing of product A under separate contracting), the second effect of tying kicks in, with a resulting negative effect on efficiency. In the case of Figure 1, this occurs when under separate contracting, $w_B^s = 1/3$ and $w_A^s = \overline{w}_A = 1/2$ is now at its unconstrained upper bound. Although it is still the case that Ramsey pricing requires that both wholesale prices w_n^t be the same in this region, the decrease in w_n^t relative to w_A^s flattens as one moves from left to right, even as the increase in w_n^t relative to w_B^s widens.

When the retailer's respective rent under separate contracting is however still small, this negative effect of tying remains muted. While the retailer is worse off, industry profits and also welfare are still strictly higher. The positive effect of enhanced contractual efficiency is thus still dominant. At some point, though, the increased-rent-extraction effect of tying begins to gain the upper hand, which occurs when the retailer's alternative option for product A is sufficiently unattractive. In fact, further increases in c_A^o beyond a second cutoff, $\bar{c}_A^o$, can be seen to cause even the retailer's joint participation constraint under tying to be slack, in which case the manufacturer optimally sets $w_n^t = \overline{w}_n$ on *both* products. Retailer profits, overall channel profits, and welfare in this case are all unambiguously lower. Only the manufacturer's profit increases under tied contracting for all parameters.

Summarizing our findings, we have the following results with linear demand:

Proposition 3 *Consider the case of linear demand. As the manufacturer's product A becomes increasingly stronger (captured by increasing the cost c_A^o for the retailer's alternative supply), channel profits decrease and at some point become strictly lower under tied-contracting than they would be under separate contracting. A similar cutoff applies to welfare, which is higher under tied-contracting if and only if c_A^o remains sufficiently low.*

Proposition 3 illustrates the trade off between the two effects of tying. Depending on c_A^o, there are clear implications for how this trade off plays out for both industry profits and welfare. When the manufacturer's competitive advantage on his strong product is sufficiently small, tied contracting will increase both industry profits and welfare. When

the manufacturer's competitive advantage is large but not too large, i.e., when c_A^o takes on intermediate values, tied-contracting will still increase industry profits but reduce welfare. And when the manufacturer's competitive advantage is sufficiently large, tied contracting will ultimately decrease both industry profits and welfare. In fact, as noted above, consumers suffer proportionally to retailers when tied-contracting shifts rents to the manufacturer, pushing up wholesale prices and aggravating the double-marginalization problem.

We choose to illustrate Proposition 3 in terms of the comparative analysis of welfare (rather than channel profits), as this serves also as a point of reference for our subsequent discussion of how manufacturers can defend tied-contracting when this practice is challenged by antitrust authorities. In Figure 2 it can be seen that the change in welfare is positive and increasing in the leftmost region, decreasing and eventually turning negative in the middle region, and then remaining negative and leveling off in the rightmost region.

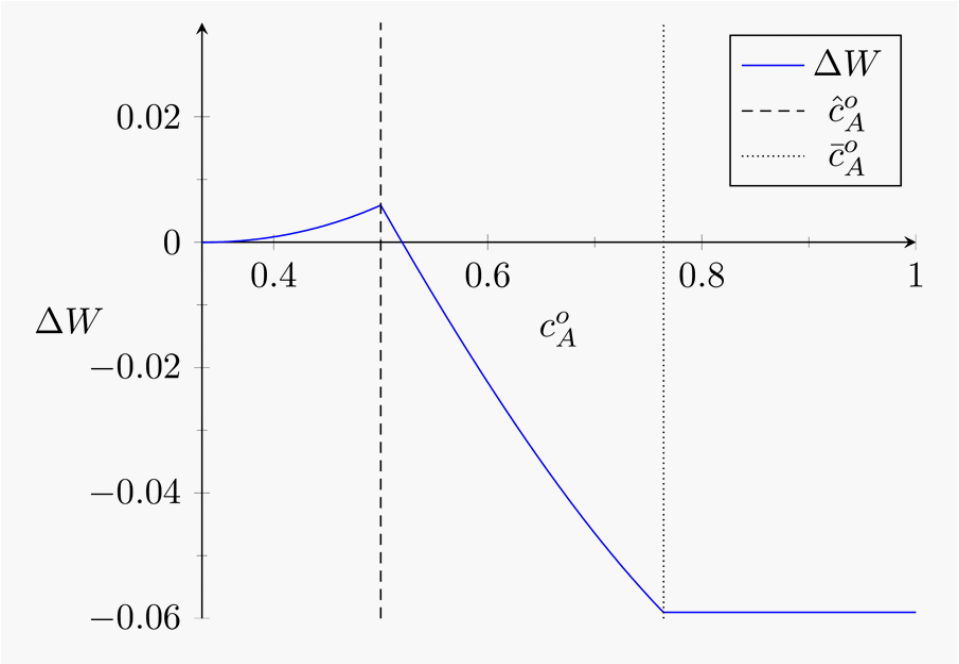

Figure 2: Difference in welfare under linear demand (with $a = b = 1$, $c_n = 0$, $c_B^o = 1/3$).

6 Strategic Incentives for the Introduction of a Weak Product

Our focus up to now has been on cases in which under separate contracting industry profits are higher when the retailer sells both the manufacturer's strong and weak product, rather than using his limited shelf space for other products, including potentially (inferior)

substitutes. This was useful for two reasons. First, it meant that we did not need to check whether supplying both products was indeed optimal for the manufacturer, and second, it meant that we could better isolate the two effects of improved contractual efficiency and rent extraction. We now extend the analysis to consider the case where the manufacturer's (potential) product B is inferior in the sense that on a stand-alone basis, industry profits would be higher if the retailer used his shelf space differently, realizing π_B^o. We ask, first, whether and when the introduction of such a weak product is optimal for the manufacturer, and second, how the resulting foreclosure would again affect industry profits and welfare.

6.1 The Manufacturer's Optimal Strategy

For comparison with the previous section, it is again useful to suppose that the retailer's outside option to the manufacturer's product B is to stock a substitute procured competitively at a per-unit cost of c_B^o. When the manufacturer can supply product B as efficiently, so that $c_B = c_B^o$, we know that he strictly prefers to offer both products as long as he can tie his weak product B to his strong product A. We now imagine an increase in c_B that makes the manufacturer less efficient. Then, clearly, under separate contracting the manufacturer would strictly prefer not to produce and supply product B at the same terms as the others, as this would result in losses. Hence, his maximum profit under separate contracting, Π^s, will equal his profit on product A alone, Π_A^s, and any further increases in c_B will have no impact. This is different when the manufacturer supplies both products under tied contracting, as there his profits, which we denote by Π^t, strictly decrease with c_B. Together with the continuity of profits in costs, we thus have the following result:

Proposition 4 *Suppose the supply of product B is inefficient compared to the retailer's alternatives. Then, the manufacturer will never produce and supply product B under separate contracting, but may, depending on how inefficient he is, supply product B under tied contracting: There exists a threshold c_{Ex} that exceeds the other suppliers' costs, c_B^o, such that the manufacturer will supply product B under tied contracting as long as $c_B < c_{Ex}$.*

Proof of Proposition 4. Denote the maximum manufacturer profit under tied contracting by Π^t, where Π^t is obtained by maximizing $\Pi = \Pi_A + \Pi_B$ subject to (4). Because the solution to this program is assumed to be unique, we have that Π^t is continuous and strictly decreasing in c_B as long as $q_B > 0$. Denote the maximum manufacturer profit from supplying only product A under separate contracting by Π^s, where Π^s is obtained by maximizing Π_A subject to (2) for product A. As the program for Π^t constrains the

manufacturer to satisfy the joint participation constraint of the retailer (whether or not product B is offered), and as $q_B = 0$ for sufficiently high c_B, it follows that $\Pi^t < \Pi^s$ for such c_B when $\pi_B^o > 0$. To obtain a unique cutoff $c_{Ex} > c_B$ where $\Pi^t = \Pi^s$, it thus remains to show that the converse holds at $c_B = c_B^o$. As the manufacturer's profit from offering product B when $w_B = c_B = c_B^o$ is zero, the claim follows immediately when the optimal tied wholesale prices differ from $(w_A^s, w_B = c_B^o)$, which follows from Lemma 2. **Q.E.D.**

Proposition 4 implies that the manufacturer may have an incentive to expand his product offerings and supply a weak product even when he cannot supply it as efficiently as his competitors. For products that are independent in demand (as we have assumed here), this might mean the introduction of a weak product in a different product category, i.e., other than the manufacturer's core category (of product A). But even within a given category, demand for different products can often be independent, which may be the case with the offering of Coca Cola and Bonaqua, as discussed in the Introduction.[19] Moreover, as we noted in the Introduction, the two effects of tying that we have identified do not depend on demands being independent, but would be expected to hold even with substitution. It then follows from the same logic that manufacturers of strong brands may have incentives to extend their product line (line extensions) to weak, substitute products, even if their new offerings would not otherwise be competitive on a stand-alone basis.

We now show that the manufacturer's incentive for such a seemingly over-extension of his offerings/product line is especially high the stronger is his core product A. This holds for two reasons. First, as the distance between his product and his competitors' products increases, via an increase in c_A^o, a constrained manufacturer's optimal stand-alone wholesale price w_A^s under separate contracting increases, and with it so does the double-marginalization inefficiency. This can be mitigated by balancing the wholesale price of the strong product A with that of the weaker product B. Second, in settings in which product A is particularly strong, the manufacturer cannot fully exploit his advantage relative to his competitors under linear contracting, and the retailer necessarily realizes a rent. The introduction of even an inefficiently supplied weak product then helps by generating a second instrument to extract this rent. Together, the two reasons imply the following:

Proposition 5 *Ceteris paribus, the threshold c_{Ex} up to which the manufacturer will supply product B despite an increasing cost disadvantage is strictly increasing in the strength of product A, as given by the distance to competitors (i.e., c_{Ex} is strictly increasing in c_A^o).*

[19] In fact, in many categories the different products supplied by leading brand manufacturers are not strong substitutes, e.g., the different milk-based products in the dairy category or various tinned products.

Proof of Proposition 5. Recall from the proof of Proposition 4 that $\Pi^t - \Pi^s = 0$ at $c_B = c_{Ex}$, where Π^s is the maximum profit that can be obtained by supplying only product A. We note that Π^s is independent of c_B. From implicit differentiation we have that

$$\frac{dc_{Ex}}{dc_A^o} = - \left. \frac{d\Pi^t/dc_A^o - d\Pi^s/dc_A^o}{d\Pi^t/dc_B} \right|_{c_B = c_{Ex}}.$$

Because we have already established that $d\Pi^t/dc_B < 0$ when $c_B < c_{Ex}$ (as then $q_B > 0$), it remains only to prove that $d\Pi^t/dc_A^o > d\Pi^s/dc_A^o$. To this end, we note that at $c_B = c_{Ex}$ the joint participation constraint (4) must bind under tied contracting (because otherwise $\Pi^t > \Pi^s$). This implies that $d\Pi^t/dc_A^o > 0$. The claim then follows immediately when the participation constraint does not bind under separate contracting for the strong product A. This captures formally the second of the two rationales described in the main text.

We now consider the case where the retailer's participation constraint for product A does bind. In this case, the respective comparison of outcomes coincides with the discussion of the auxiliary problem in Proposition 1. Consider first $d\Pi^s/dc_A^o$. It is useful to rewrite this as $[d\Pi_A/d\pi_A^o]/[d\pi_A^o/dc_A^o]$. As the effect on the participation constraint is the same under tied contracting, $d\Pi^t/dc_A^o > d\Pi^s/dc_A^o$ holds whenever $d\Pi^t/d\pi^o > d\Pi_A/d\pi_A^o$ (both strictly negative), where $\pi^o = \pi_A^o + \pi_B^o$. This captures formally the first rationale described in the text. For this it is sufficient to suppose that as a response to an increase in π^o the manufacturer only adjusts w_A also under tied contracting. Then the result follows when $d\Pi_A/d\pi_A$ is lower in absolute terms with the wholesale price under tied contracting, which, given assumed monotonicity of the marginal rate of substitution, holds if $w_A^t > w_A^s$ is lower under tied contracting than under separate contracting. But this inequality follows immediately as we analyze the outcome at $\Pi^t - \Pi^s = 0$, and thus at $c_B = c_{Ex} > c_B^o$, because otherwise tying the inefficiently provided product B would not have been optimal. **Q.E.D.**

Proposition 5 implies that the stronger is the manufacturer's core product relative to the retailer's outside options, the greater will be the manufacturer's incentive to tie it to a weak product, even one that is inefficiently supplied. When the latter happens, one or more other suppliers will be foreclosed. How this would affect welfare is our next topic.

6.2 Implications for the Presumed Legality and Antitrust

Throughout our analysis we showed that while the manufacturer is always better off with it, tied contracting can, under some circumstances, lower retailer and channel profits as well as welfare. Our focus on the latter is of managerial interest in the sense that when employed

by manufacturers with particularly strong products, the respective practice is likely to be scrutinized by antitrust authorities. Consequently, managers may want to undertake an ex-ante legal assessment with this in mind. And when confronted with an investigation, our analysis provides them with an argument as to why under an effects-based approach, as practiced by antitrust authorities on both sides of the Atlantic, tied-contracting may enhance (consumer) welfare. This is important in particular for the current case where through tied-contracting, but not without it, a more efficient product may be foreclosed.

The introduction of an inefficiently supplied product naturally raises the concern that welfare may be reduced, all else being equal, by the higher costs of production. Focusing only on the inefficient production, however, would be a mistake as it would ignore the positive effects of tying on contractual efficiency. There is thus a trade-off to consider, and all else will not in general be equal. In fact, as we will show next, as long as the manufacturer's core product A is not too strong, the manufacturer will have an incentive to introduce his inefficiently supplied weak product B only when it increases total industry profits (and when demand is linear, also consumer welfare). In this case, contrary to what one may have thought, the exclusion of the more efficient suppliers of product B can actually lead to higher overall efficiency. But, as we will also show, this conclusion need not hold when there is also an increased amount of rent shifting going on. In that case, the manufacturer has another incentive to introduce the weak product (beyond contractual efficiency), which only serves the purpose of transferring (but not increasing) joint surplus.

Proposition 6 *Suppose the manufacturer cannot supply his weak product as efficiently as his competitors. If under separate contracting the manufacturer would be constrained on product A, then the manufacturer will introduce the weak product B only when this increases industry profit (and, when demand is linear, also total welfare). This need not be the case, however, when the introduction of the weak product B also serves to extract rent from the retailer. In that case, the manufacturer's incentive to introduce the weak product B is too high under tied contracting compared to the social optimum (formally, $W^t < W^s$ at $c_B = c_{Ex}$), and inefficient exclusion can prevail, at least when c_B is sufficiently high.*

Proof of Proposition 6. We know that the retailer's profit under tied contracting (given that the manufacturer is maximizing $\Pi = \Pi_A + \Pi_B$ subject to (4)) will be the same as his profit under separate contracting when the participation constraint for product A is binding. In both cases, the retailer will earn a profit of $\pi_A^o + \pi_B^o$. We also know that consumer surplus will be unaffected in this case if demand is linear (per our discussion

in Section 4). Together with the fact that $\Pi^t = \Pi^s$ at $c_B = c_{Ex}$, this establishes the first claim. To show the second claim, note that if the retailer's participation constraint for product A does not bind under separate contracting, then the retailer's profit under separate contracting (and also consumer surplus if demand is linear) will be strictly greater than his profit under tying (because of the increased-rent-extraction effect). Once again together with $\Pi^t = \Pi^s$ at $c_B = c_{Ex}$, this establishes that $W^t < W^s$ at $c_B = c_{Ex}$. **Q.E.D.**

To understand the intuition for this, note that when only the improved-contractual-efficiency effect of tying is present, the manufacturer fully internalizes the higher costs of the inefficient production when deciding whether to introduce his weak product B. This is because the retailer is indifferent in both cases. In the absence of tying, the retailer buys from the alternative suppliers of product B at cost $c_B^o < c_B$, but pays a relatively high per-unit markup to obtain product A from the manufacturer, whereas in the optimal offer when the manufacturer introduces his inefficient product and ties it to product A, the retailer is required to pay a higher per-unit price on product B, but then realizes an offsetting lower per-unit price on product A. What is lost on the former is gained on the latter. In effect, the retailer (and society) benefits from the existence of the efficient alternative suppliers of product B, whether or not the retailer actually buys from them.

In contrast, when both effects of tying are present, or when only the increased-rent-extraction effect of tying is present, the retailer's profit under tying will be strictly less than what he would earn under separate contracting. In these cases, the manufacturer does not have to lower his wholesale price on product A by as much, if at all, in order to get the retailer to accept his tied offer, and as a result, the retailer may be stuck paying more for the two products than would be optimal from his (and society's) perspective.

A Final Note on Consumer Welfare. Following much of the literature, when going beyond industry profits, our measure was that of total welfare, comprising of industry profits and consumer surplus. However, antitrust agencies frequently (also) resort to consumer welfare when evaluating potentially harmful practices. As shown above, in the linear case the derived proportionality of retailer profits and consumer welfare allows us to immediately deduce from the preceding analysis the presumed legality of the manufacturer's tied-contracting (bundled negotiations) under a consumer welfare standard: It should be vetoed by an antitrust agency precisely when it would meet resistance from the retailer.

7 Conclusion

We have analyzed the practice of tying the contractual terms of different products in distribution channels. This practice essentially constrains a retailer who might otherwise have purchased from different manufacturers to purchase from the same manufacturer. In the process, we isolated two effects of the practice, with both effects originating from the same underlying contractual inefficiency of double-marginalization. On the one hand, we found that such tying of contractual terms may allow surplus to be shared more efficiently (the improved-contractual-efficiency effect of tying), as wholesale prices can then be set according to a Ramsey-pricing-like rule. On the other hand, we found that when one of the manufacturer's products is sufficiently strong, tying it together with the supply of a weaker product allows the manufacturer to extract more rent from the retailer (the increased-rent-extraction effect of tying). Both effects increase the manufacturer's profits, but again due to double-marginalization, the latter effect reduces not only retailer profits but also efficiency. Although either effect can dominate, we found that the overall effect on channel profits and ultimately welfare is more likely to be negative when the manufacturer has a particularly strong product, so that the retailer's alternatives are much inferior.

We showed that in order to reap the benefits of tied-contracting, a manufacturer may have an incentive to introduce a weak product even when the retailer could more profitably stock an alternative product instead. Again, the implications for channel profits and welfare are generally ambiguous, although a reduction in both is more likely if the weak product is tied to a particularly strong product, as then the rent extraction effect of tying dominates the contractual efficiency effect of tying. As we discussed in the Introduction, cases where antitrust authorities have taken an issue with such tied contracting often involve intermediate markets. A side result of our analysis is thus to provide manufacturers with a new argument in an effects-based analysis of such practices: They can be (consumer) welfare improving even when they result in the foreclosure of a more efficient supplier.

Although the focus of our contribution lies on normative (managerial) implications, we conclude with some remarks of how future work could also derive additional positive implications, beyond providing a rationale for why manufacturers with particularly strong brands may wish to extend their product lines by introducing even very weak products. One set of such positive implications could relate to an analysis of cost pass-through even across independent products and product categories. For this, consider, as outlined in the Introduction, the negotiations between TCCC and a retailer over the supply of TCCC's

strong brand (Coca-Cola) and a weak product (Bonaqua). The specific cost shock may affect the sugar price or that of another specific ingredient of Coca-Cola, but not that of the production of the bottled water Bonaqua. Standard theory would predict that in this case only the wholesale and retail price of product A would be affected, but not those of product B. However, it is straightforward to see that this is no longer the case under tied contracting. For instance, in the characterized case of Ramsey-like pricing, holding all else constant, we would expect the wholesale price of Coca-Cola to increase and that of bottled water to decrease. In a full-fledged analysis, however, we would also expect the increasing cost of sugar to negatively affect the retailer's outside options with other softdrink suppliers. Interestingly, under tied contracting, a change in the retailer's outside option for one product would also have repercussions for the wholesale prices of the other product, even when the manufacturer's two products are independent in final demand.

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Appendix: Derivations for the Case of Linear Demand

The following derivation for the case of linear demand serves two purposes. First, it serves to prove Proposition 3 as well as the latter part of Proposition 6. Second, we thereby obtain the expressions that are needed for the numerical example.

Separate Contracting. If unconstrained, the manufacturer's optimal wholesale price, maximizing $q_n(w_n)(w_n - c_n)$, is $\overline{w}_n = (a + bc_n)/2b$, which simplifies to $\overline{w} = a/2b$ when $c_n = 0$. Profits for the manufacturer and the retailer are then $\pi_n = a^2/16b$ and $\Pi_n = a^2/8b$, respectively. If instead the manufacturer sets $w_n^s = c_n^o$ under separate contracting, profits are $\pi_n = \pi_n^o = (a - bc_n^o)^2/4b$ and $\Pi_n = (a - bc_n^o)c_n^o/2$, respectively, again using $c_n = 0$. It follows that the manufacturer is not constrained on product A if $c_A^o \geq \hat{c}_n^o = a/2b$.

Tied Contracting. We can now make use of the above expressions to set up the more complex program under tied contracting:

$$\begin{aligned} \max_{w_A, w_B} \quad & \frac{(a - bw_A)w_A + (a - bw_B)w_B}{2} \\ \text{s.t.} \quad & \frac{(a - bw_A)^2 + (a - bw_B)^2}{4b} \geq \frac{(a - bc_A^o)^2 + (a - bc_B^o)^2}{4b}. \end{aligned}$$

When the joint participation constraint binds, given the Ramsey pricing rule (7) and symmetric demand, it must hold that $w_A^t = w_B^t$. Plugging this into the binding joint participation constraint, we thus have

$$w_A^t = w_B^t = c_B^o + \frac{2a(c_A^o - c_B^o) - b\left[(c_A^o)^2 - (c_B^o)^2\right]}{2(a - bc_B^o) + \sqrt{2\left[(a - bc_A^o)^2 + (a - bc_B^o)^2\right]}}.$$

The retailer profits in this case are given by the binding participation constraint, $\pi^t = [(a - bc_A^o)^2 + (a - bc_B^o)^2]/4b$. Substitution yields for the manufacturer's profits

$$\Pi^t = \frac{a\sqrt{2\left[(a - bc_A^o)^2 + (a - bc_B^o)^2\right]} - (a - bc_A^o)^2 - (a - bc_B^o)^2}{2b}.$$

Finally, we need to determine which case applies under tied contracting. Using the respective retailer profits, we need to solve for the cutoff $\bar{c}_A^o$ at which the retailer's profit under the assumption that the joint participation constraint binds equals its profit under the assumption that it does not bind: $\left[(a - b\bar{c}_A^o)^2 + (a - bc_B^o)^2\right]/4b = a^2/8b$. This yields

$$\bar{c}_A^o = \frac{a}{b} - \sqrt{\frac{(bc_B^o)^2 - \left(a - 2bc_B^o\right)^2}{2b^2}}.$$

Industry Profits and Welfare under Separate Contracting. When the manufacturer is constrained for both products under separate contracting, the retailer realizes a profit of $\pi^s = [(a - bc_A^o)^2 + (a - bc_B^o)^2]/4b$ and the manufacturer realizes a profit of $\Pi^s = [((a - bc_A^o)c_A^o + (a - bc_B^o)c_B^o]/2$, so that industry profits are

$$PS^s = \frac{2a^2 - b^2\left[(c_A^o)^2 + (c_B^o)^2\right]}{4b}.$$

Recall further that then $w_n^s = c_n^o$ and with this $q_n^s = (a - bc_n^o)/2$ and $p_n^s = (a + bc_n^o)/2b$. Consequently, consumer surplus is

$$CS^s = \int_0^{q_A^s} \frac{a - q_A}{b} dq_A - p_A^s q_A^s + \int_0^{q_B^s} \frac{a - q_B}{b} dq_B - p_B^s q_B^s = \frac{(a - bc_A^o)^2 + (a - bc_B^o)^2}{8b}.$$

Aggregating both industry profits and consumer surplus yields total welfare:

$$W^s = \frac{6a^2 - 2ab\left(c_A^o + c_B^o\right) - b^2\left[(c_A^o)^2 + (c_B^o)^2\right]}{8b}.$$

We turn next to the case where the manufacturer is not constrained on his strong product A, so that $w_A^s = w_A^m$. This case applies when $c_A^o \geq \hat{c}_A^o = w_A^m$, i.e., when $c_A^o \geq a/2b$. Aggregating the previously derived profits yields

$$\Pi^s = \frac{a^2 + 4abc_B^o - 4b^2(c_B^o)^2}{8b} \text{ and } \pi^s = \frac{5a^2 - 8abc_B^o + 4b^2(c_B^o)^2}{16b},$$

so that total industry profits are now

$$PS^s = \frac{7a^2 - 4b^2(c_B^o)^2}{16b}.$$

Substituting the derived wholesale prices yields $p_A^s = 3a/4b$ and $p_B^s = (a + bc_B^o)/2b$, so that $q_A^s = a/4$ and $q_B^s = (a - bc_B^o)/2$. This yields for consumer surplus and total welfare

$$\begin{aligned} CS^s &= \frac{5a^2 - 8abc_B^o + 4b^2(c_B^o)^2}{32b}, \\ W^s &= \frac{19a^2 - 8abc_B^o - 4b^2(c_B^o)^2}{32b}. \end{aligned}$$

Industry Profits and Welfare under Tied Contracting. We suppose first that the joint participation constraint binds. In that case $\pi^t = [(a - bc_A^o)^2 + (a - bc_B^o)^2]/4b$, and after the substitution of w_n^t for the manufacturer, we obtain

$$\Pi^t = \frac{a\sqrt{2\left[(a - bc_A^o)^2 + (a - bc_B^o)^2\right]} - (a - bc_A^o)^2 - (a - bc_B^o)^2}{2b},$$

so that industry profits are

$$PS^t = \frac{2a\sqrt{2\left[(a-bc_A^o)^2+(a-bc_B^o)^2\right]}-(a-bc_A^o)^2-(a-bc_B^o)^2}{4b}.$$

Substituting the wholesale prices, we have for the retail prices and quantities

$$q_A^t = q_B^t = \frac{\sqrt{2\left[(a-bc_A^o)^2+(a-bc_B^o)^2\right]}}{4},$$
$$p_A^t = p_B^t = \frac{a}{b} - \frac{\sqrt{2\left[(a-bc_A^o)^2+(a-bc_B^o)^2\right]}}{4b},$$

so that

$$CS^t = 2\left[\int_0^{q_n^t} \frac{a-q}{b}dq - p_n^t q_n^t\right] = \frac{(a-bc_A^o)^2+(a-bc_B^o)^2}{8b},$$

and total welfare is thus

$$W^t = \frac{4a\sqrt{2\left[(a-bc_A^o)^2+(a-bc_B^o)^2\right]}-(a-bc_A^o)^2-(a-bc_B^o)^2}{8b}.$$

We now suppose that the joint participation constraint is slack. As then $w_n^t = w_n^t$, it is immediate that $\Pi^t = a^2/4b$, $\pi^t = a^2/8b$, and thus $PS^t = 2a^2/8b$. With $p_n^t = 3a/4b$ and $q_n^t = a/4$, consumer surplus equals $CS^t = a^2/16b$ and total welfare is thus $W^t = 7a^2/16b$.

Comparison of Industry Profits and Welfare (Proposition 3) Based on the derived expressions we can now turn to the proof of Proposition 3. We consider first the difference in welfare, $\Delta W = W^t - W^s$. Starting from $c_A^o = c_B^o$, as c_A^o increases, thereby making the manufacturer's product A stronger, we claim that there exists $c_W > \hat{c}_A^o$ such that $\Delta W > 0$ if $c_A^o < c_W$ and $\Delta W < 0$ if $c_A^o > c_W$.

To see this, consider first the range of costs up to $c_A^o \leq \hat{c}_A^o$. We note here that by definition $\pi^s = \pi^t$, so that together with $\Pi^t > \Pi^s$, we thus have that $PS^t > PS^s$. With linear demand, we have from inspection of the respective derivations that $CS^s = \pi^s/2$ and $CS^t = \pi^t/2$, so that also $CS^s = CS^t$. Together with $PS^t > PS^s$, we thus have that $W^t > W^s$. Next, we turn to the other extreme, where $c_A^o \geq \bar{c}_A^o$. In this case, $W^t < W^s$ follows immediately from $w_A^t = w_A^s$ and $w_B^t > w_B^s$. In what follows, we thus deal with the intermediate case $\hat{c}_A^o < c_A^o < \bar{c}_A^o$.

In this intermediate case, the joint participation constraint binds under tied contracting, and with separate contracting, the participation constraint binds only for product B. Importantly, in this case, wholesale prices under separate contracting do not depend on c_A^o, so that profits Π^s and welfare W^s are unaffected by a change in c_A^o. This is not the case

under tied contracting, where wholesale prices do depend on c_A^o. There, for example, as the joint participation constraint binds, π^t is strictly decreasing in c_A^o. In terms of how total welfare W^t changes in c_A^o, we note that the derivative with respect to the term $(a - bc_A^o)^2$ in W^t can change sign at most once. It follows that $W^t > W^s$ at $c_A^o = \hat{c}_A^o$ and $W^t < W^s$ at $c_A^o = \bar{c}_A^o$, together with continuity, establishes the existence of the unique threshold c_W.

Industry profits are given by the sum of the manufacturer's and the retailer's profits. Recall the proportionality result that with linear demand, $CS = \pi/2$, so that industry profit is $\Pi + \pi$ and welfare can be written as $W = \Pi + \frac{3}{2}\pi$. This allows to apply the preceding arguments also for a comparative analysis of welfare, giving rise again to a cutoff threshold for now industry profits, c_{IP}. It is also immediate that $c_{IP} > c_W$: There exists an intermediate interval for c_A^o, capturing the relative strength of product A, in which industry profits are still higher under tied-contracting, but welfare is strictly lower.