Softening Upstream Competition through Vertical Restraints

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Abstract

This paper studies the competitive effects of a variety of observable non-linear contracts and vertical restraints in the equilibrium of a bargaining model of successive duopolies in which both downstream retailers deal with both upstream suppliers. I show that non-exclusive contracts that reference rivals (e.g. market-share discounts) and quantity-forcing contracts (e.g. all-units discounts) lead to higher equilibrium prices than two-part tariffs, although banning only quantity-forcing provisions and not market-share requirements may have unintended welfare consequences. I also study competition for exclusives and show that, while retailers may benefit from committing to exclusivity, consumers are generally harmed by it.

Keywords: Successive oligopolies, bargaining, market-share discounts, all-units discounts, competition for exclusives.

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1 Introduction

In many industries it is common for competing downstream firms with some buyer power to negotiate vertical contracts with more than one supplier of substitutable inputs. Examples include retail distribution, in which competing retailers often carry the products of more than one manufacturer; the health care industry, in which competing insurers typically offer their subscribers a choice among a number of different health care providers; and computer hardware or other durable goods, in which competing OEMs often offer their customers a choice among different makes of components. The contracts resulting from those negotiations often contain non-linear pricing and vertical restraints that may enhance the efficiency of supply relationships, but may also harm consumers by softening competition. In this paper I focus on the latter aspect and analyze the effects of different types of vertical contracts on the intensity of upstream and downstream competition in a model of successive duopolies. I study both delegated common agency equilibria in which each competing downstream firm chooses to deal with more than one supplier and equilibria in which downstream firms encourage instead suppliers to compete for exclusives.

In particular, after having characterized the benchmark case in which firms are only allowed to negotiate standard two-part tariffs contracts without vertical restraints, I study the competitive effects of a number of more complex contracts: contracts that reference rivals (CRRs henceforth) and contracts containing all-units discounts. Non-exclusive CRRs may take different forms, but often contain provisions that discourage or prohibit downstream firms from steering a significant portion of business from the supplier offering the contract to a rival supplier.[1] One example of such provisions is the Non-Discrimination Rules (NDRs) in the contracts between major credit card networks and merchants. NDRs prevent merchants from offering consumers better prices for purchases made with credit cards issued by other networks. In a recent enforcement action the U.S. Department of Justice challenged these restraints alleging that they reduce the incentives of credit card networks to compete at the point of sale by lowering the fees they charge merchants, and ultimately lead to higher merchant fees and retail prices.[2] Another common form of CRRs is contracts with loyalty or market-share discounts, which require a downstream firm to purchase a

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[1] For a discussion of CRRs and of their implications for antitrust enforcement, see Scott-Morton (2012).

[2] While MasterCard and Visa settled the law suit with DOJ in October 2010, the case against American Express is ongoing at the time of writing (see Civil Action No. CV-10-4496). Another relevant example is a case brought in 2008 by the U.K. OFT against a group of tobacco manufacturers and retailers, in which the challenged practices involved the fixing of the relative retail prices of different brands of cigarettes at the point of sale (see Case CE/2596–03, 'Tobacco').

minimum share of its needs from a given supplier in order to obtain a favorable price from that supplier. Although market-share requirements do not constrain relative retail prices directly, they do so indirectly by preventing a downstream firm from steering too much business towards rival suppliers and have therefore competitive effects analogous to the NDRs discussed above.[3] Loyalty and market-share discounts often take the form of all-units discounts, i.e. of discounts that are calculated on all the units purchased by a customer. All-units discounts have recently attracted considerable antitrust scrutiny, since they have the potential to impose significant penalties on a customer that fails to meet certain volume or share thresholds by causing a large upward jump in the average effective price paid by that customer. Although the primary concern in cases involving CRRs and/or all-units discounts is often that they may be used by dominant firms to weaken or exclude smaller rivals, in this paper I show that they can also soften competition regardless of any effect they may have on the costs or presence in the market of rivals. These contracts can thus have anticompetitive effects even in settings with symmetric firms and no major exclusionary concerns, such as in the DOJ enforcement action against credit card companies discussed above.[4]

In order to study the effects of the vertical contracts discussed above, I present a model in which two upstream suppliers negotiate such contracts with two firms that compete in the downstream market. In this model, suppliers always charge equilibrium wholesale prices that are above their marginal cost to prevent excessive dissipation of industry profits through downstream competition. In light of this, in any delegated common agency equilibrium of the model in which downstream firms choose to represent both suppliers each supplier has an incentive to steal profitable marginal sales from the other supplier, thus imposing a competitive externality on that supplier. I derive conditions under which delegated common agency equilibria with these features exist and study how different types of vertical contracts exacerbate or mitigate the competitive externalities that arise in those equilibria, ultimately affecting equilibrium prices and consumer welfare.

From a methodological point of view, the main innovation of this paper is to present a model of

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[3]In some cases a supplier may not only require a minimum share from downstream firms, but may also impose explicit restrictions on the relative retail prices that those firms can charge for the products of rival suppliers. This was, for example, the case in a recent case before the Supreme Court involving the market-share rebates and other vertical restraints imposed by a manufacturer of transmissions for heavy-duty trucks (Eaton Corp. v. ZF Meritor). Market-share rebates have recently been the subject of a number of high-profile government and private enforcement actions in the U.S. and in Europe, including the actions brought by AMD and by the U.S. FTC against Intel.

[4]For analyses of the exclusionary use of vertical contracts by a dominant firm see Rasmusen, Ramseyer and Wiley (1991), Whinston and Segal (2000), and subsequent contributions. The focus of the present paper is quite different from that of that literature, since I mostly study the effects of vertical contracts on competition for marginal sales in non-exclusive equilibria and, even when I analyze equilibria with exclusive contracts in Section 6, I do so in a context of competition for exclusives between two equally situated firms.

imperfect upstream and downstream competition with non-linear vertical contracts in which there exist common agency equilibria for a broad (and intuitive) range of parameters. The existence of common agency equilibria overcomes a serious modeling difficulty that has so far hindered progress on the topic (see, for example, the discussion in Miklós-Thal, Rey and Vergé (2010) and Inderst and Shaffer (2010)),[5] and makes it possible to analyze the effects of a broad range of contracts, including two-part tariffs, CRRs, and all-units discounts, in a setting that captures the essential features of many industries. The modeling difficulty arises from the fact that, for a model with upstream and downstream imperfect competition to have delegated common agency equilibria (i.e. equilibria in which both downstream firms choose to represent both suppliers), downstream firms must retain some of the surplus generated by the product of each supplier. If the suppliers could extract all the surplus they generate through fixed fees, as would be the case if they made take-it-or-leave-it offers involving a single non-linear contract, a retailer would be indifferent between representing both suppliers or only one of them, with the consequence that either supplier could always nudge that retailer into dropping the product of the other supplier with a small discount. Such a deviation would always be profitable, since it would result in a significant increase in the sales of the deviating supplier in the presence of positive upstream profit margins. In order to generate more realistic predictions, in this paper I assume that downstream firms have some intrinsic bargaining power and can thus appropriate a share of the incremental profits generated by the product of each supplier. When the distribution of bargaining power between retailers and suppliers is sufficiently symmetric and the suppliers' products are sufficiently differentiated, dropping one of the two suppliers would be too costly for a retailer, which makes a deviation to exclusivity unprofitable for the suppliers and thus ensures the existence of common agency equilibria.[6]

When common agency equilibria exist, suppliers earn positive profit margins in those equilibria and have therefore incentives to steal marginal sales from each other. The implications of this for prices and welfare depend crucially on the type of admissible contracts. While with two-part tariffs the only way for a supplier to steal marginal sales from rival suppliers is to cut its wholesale price, with CRRs each supplier has instead the ability and the incentives to induce retailers to raise

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[5]I review related literature in the second part of this introduction.

[6]Another possible approach to ensuring the existence of common agency equilibria in a model like mine is to assume that suppliers have all the bargaining power (e.g. they make take-it-or-leave-it offers) but can offer menus of contracts with particularly attractive off-equilibrium offers for exclusivity. For an application of this approach in models with only one supplier or only one buyer see Miklós-Thal, Rey and Vergé (2011), Rey and Whinston (2013), and Calzolari and Denicolò (2013). I discuss this approach, which is compatible with, and possibly complementary to, the one I adopt in this paper, further in Appendix B.1.

the retail price of rival products by effectively "taxing" the retailers' sales of those products. This leads to higher equilibrium prices and lower welfare than those that would prevail in an equilibrium with two-part tariffs and even in a hypothetical monopoly outcome in which total industry profits are maximized. I also show that, when minimum volume requirements enforced through all-units discounts or other discontinuities in pricing schedules are admissible, each supplier can use them to mitigate the rival supplier's ability and incentives to steal marginal sales. The implications of this for prices and welfare depend again crucially on the type of admissible contracts. If CRRs are banned, the adoption of minimum volume requirements in common agency equilibria effectively amounts to a facilitating practice that reduces the rival supplier's incentives to compete by cutting prices, leading to higher equilibrium prices and industry profits and lower welfare. Minimum volume requirements have instead beneficial effects when they are used in a second-best world in which CRRs are also admitted, since in that case they limit the scope for excessive double marginalization and lead to lower equilibrium prices and higher welfare.

Besides providing a natural framework for studying the effects of non-exclusive contracts on price competition in common agency equilibria, my model can also be used to study competition for exclusives when exclusive contracts are admitted. Since competition for exclusives lowers the profits of both suppliers relative to common agency equilibria, an equilibrium in which both suppliers offer exclusive contracts can arise only when suppliers fail to coordinate their actions or, more plausibly, when downstream firms benefit from such competition and thus decide to promote it by committing ex-ante to accepting only exclusive offers. The latter is the case when downstream firms have limited intrinsic bargaining power in common agency equilibria and exclusive arrangements do not lower industry profits excessively. The fact that downstream firms may benefit from competition for exclusives does not, however, mean that the benefits are passed through to final consumers. On the contrary, when the direct buyers are downstream firms and supply contracts can specify fixed fees, competition for exclusives leads to lower fixed fees but does not necessarily put downward pressure on wholesale and retail prices and thus is very likely to harm final consumers through loss of variety relative to competition with two-part tariffs.

Related literature – Rey and Vergé (2010) analyze a model of "interlocking relationships" with the same market structure as mine, but assume that suppliers have all the bargaining power (and cannot offer menus of contracts). Although their model has a common agency equilibrium that maximizes industry profits when suppliers can use resale price maintenance, it does not have delegated common agency equilibria when suppliers can only use two-part tariffs or other

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contracts in which suppliers can soften downstream competition only by charging input prices above marginal cost. In contrast, by allowing retailers to have some bargaining power, my model ensures the existence of such equilibria and makes it possible to study the competitive effects of a number of important vertical contracts, such as two-part tariffs, CRRs and all-units discounts.[7]

Most of the existing literature considers models in which either side of the market has only one player with some market power. Bernheim and Whinston (1998) and O'Brien and Shaffer (1997) study the case in which two suppliers make offers to a monopolistic retailer in the presence of complete information. Calzolari and Denicolò (2013) study the competitive implications of market-share and exclusive contracts in a model in which two suppliers make take-it-or-leave-it offers of menus of contracts, including both non-exclusive and exclusive contracts, to a single buyer in the presence of incomplete information about that buyer's demand. Notwithstanding the significant differences between Calzolari and Denicolò's model and mine, we reach similar conclusions regarding the welfare effects of non-exclusive CRRs (see Section 5). The presence of downstream competition in my model causes, however, our conclusions regarding the welfare effects of competition for exclusives to differ (see Section 6).

Another strand of the literature has instead considered models in which multiple competing downstream firms deal with a single supplier. Shaffer (1991), O'Brien and Shaffer (1992), McAfee and Schwartz (1994), and Segal (1999) study how a monopolistic supplier can use vertical contracts to affect downstream competition, with particular emphasis on the role played by the observability of contracts. Inderst and Shaffer (2010) extend this literature by analyzing a model in which a single supplier with market power can use market-share requirements and all-units discounts to soften downstream competition and maximize industry profits when downstream firms can substitute to another input supplied at marginal cost by a perfectly competitive upstream fringe. As discussed in further detail in Sections 4 and 5, this model provides helpful insights but cannot be used to study strategic upstream competition between suppliers with market power, since it does not give

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[7]A setting analogous to that of Rey and Vergé is studied also by Dobson and Waterson (2007), who, however, limit their attention to linear pricing. This is a strong assumption for supply contracts, since linear pricing is a bilaterally inefficient contractual arrangement and standard forms of non-linear pricing, such as two-part tariffs, are generally legal. Models with multiple upstream and downstream firms have also been studied by a number of other authors: Katz (1989) and Kühn (1997) assume that each downstream firm represents exclusively only one upstream supplier. Prat and Rustichini (2003) consider a model in which downstream firms represent more than one supplier but do not compete with one another. Rey and Stiglitz (1988, 1995) study the role of exclusive territories in a model with imperfect upstream competition and perfect downstream competition. Finally, Nocke and Rey (2012) focus on the effects of vertical integration, rather than on the effects of vertical restraints, in a model of multilateral relationships with unobservable vertical contracts and homogeneous retailers.

rise to competitive externalities in the upstream market.[8] Martimort and Stole (2003), Miklós-Thal, Rey and Vergé (2011) and Rey and Whinston (2013) explore models in which two competing downstream firms make-take-it-or-leave-it offers of menus of contracts to a monopolistic upstream supplier.[9] Of particular interest for the analysis of all-units discounts in Section 4 of the present paper is their discussion of the facilitating effects of pricing schedules that entail "drastic" reactions to attempts by the agent to steer business between the principals offering the contracts.[10]

Structure of the paper – The remainder of the paper is organized as follows. Section 2 presents the formal model. Section 3 explores the existence and properties of a delegated common agency equilibrium with two-part tariff contracts, while Section 4 shows that all-units discounts with minimum volume requirements introduce additional, less competitive common agency equilibria. Section 5 studies common agency equilibria in the presence of non-exclusive CRRs with and without minimum volume requirements. Section 6 allows for exclusive contracts and explores the consequences of competition for exclusives. Section 7 discusses policy implications and concludes. Appendix A contains the most important proofs, while Appendix B (for online publication) contains the remainder of the proofs, as well as a detailed discussion of assumptions and a number of derivations.

2 The model

2.1 Market structure and demand

There are two imperfectly substitutable products, s and s', each produced by a different upstream supplier with the same constant marginal cost c. The two products are distributed by two differentiated retailers, r and r', that do not have to bear any additional costs besides the payments to suppliers.[11] When both retailers sell both products, consumers can effectively choose between four differentiated products, corresponding to the four different supplier-retailer combinations. Let $\mathbf{p} = (p_{sr}, p_{s'r}, p_{sr'}, p_{s'r'})$ be the vector of the retail prices of those four products, where p_{ij} is the price charged by retailer j for product i, and the demand system be symmetric, with

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[8]Innes and Hamilton (2009) study a model with the same market structure as in Inderst and Shaffer (2010), but with one-stop shopping and without CRRs.

[9]Marx and Shaffer (2007) consider a model in which retailers can offer only a single contract instead of menus of contracts. This always leads to exclusion of one of the retailers for the reasons discussed above.

[10]See also Fershtman, Judd and Kalai (1991) for a model in which principals can induce less competitive outcomes by offering their (exclusive) agents discontinuous "target compensation functions".

[11]For ease of exposition, throughout the paper I refer to downstream firms as retailers, although it should be apparent that the analysis applies also to any other type of downstream firms (including manufacturing and service firms) that procure substitutable inputs from competing suppliers and compete with one another in the downstream market.

$q_{sr} = D(p_{sr}, p_{s'r}, p_{sr'}, p_{s'r'})$ denoting demand for product s at retailer r, where $D\left(\cdot\right)$ is continuous and twice differentiable in all its arguments. The demand for each product decreases with the price of that product, $\partial_1 D < 0$, increases with the price of other products, $\partial_i D > 0$, $i = 2, 3, 4$, and decreases with an increase in the price of all products, $\sum_{i=1}^{4} \partial_i D < 0$.[12] I also assume that the demand system is invertible and denote the inverse demand for product s sold by retail r by $p_{sr} = P(q_{sr}, q_{s'r}, q_{sr'}, q_{s'r'})$, with $\partial_i P < 0$, $i = 1, 2, 3, 4$.[13] For illustrative purposes, in Section 3.5 I present an example with linear demand that satisfies these assumptions.

Denote the total vertical profits earned on the sales of both products made by retailer r by

$$V_r\left(\mathbf{p}\right) = \left(p_{sr} - c\right) q_{sr}\left(\mathbf{p}\right) + \left(p_{s'r} - c\right) q_{s'r}\left(\mathbf{p}\right). \tag{1}$$

These vertical profits are split between the two suppliers and retailer r, with each supplier s earning Π_{sr} and retailer r earning Π_r, so that

$$\Pi_{sr} + \Pi_{s'r} + \Pi_r = V_r\left(\mathbf{p}\right). \tag{2}$$

Total industry profits are equal to the sum of the vertical profits at the two retailers

$$V\left(\mathbf{p}\right) = \sum_{r,r'} V_r\left(\mathbf{p}\right). \tag{3}$$

I assume that $V\left(\mathbf{p}\right)$ has a unique maximum $\mathbf{p}^m$ at which both retailers sell positive quantities of both products and is strictly concave in each retail price. That is

$$\frac{\partial V\left(\mathbf{p}^m\right)}{\partial p_{sr}} = 0 \quad \text{and} \quad \frac{\partial^2 V\left(\mathbf{p}\right)}{\partial p_{sr}^2} < 0. \tag{4}$$

for all s and r and all $\mathbf{p}$. Symmetry of demand and costs implies that all the elements of $\mathbf{p}^m$ are equal, i.e. $p_{sr}^m = p^m$ for all s and r. In the rest of the paper I refer to $\mathbf{p}^m$ as the vector of industry monopoly retail prices and denote the quantities associated with these prices by $\mathbf{q}^m$.

2.2 Contracting and downstream competition

I study competition in this market by means of a two-stage model. In the first stage suppliers and retailers negotiate publicly observable supply contracts and in the second stage retailers compete in the downstream market given those contracts. The details and assumptions of this two-stage game are laid out in this section and discussed in further detail in online Appendix B.1.

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[12]In keeping with the notation in Rey and Vergé (2010), I use $\partial_i f$ to denote the partial first derivative of f with respect to its *ith* argument. Analogously $\partial_{ik}^2 f$ denotes the partial second derivative of f with respect to its *ith* and *kth* arguments. For example, $\partial_1 D = \partial q_{sr}/\partial p_{sr}$ and $\partial_{12}^2 D = \partial^2 q_{sr}/\partial p_{sr}\partial p_{s'r}$.

[13]Invertibility of demand makes it possible to solve the model also for the case of differentiated Cournot downstream competition, besides the case of differentiated Bertrand downstream competition.

Stage 1: Contracting – A contract C_{sr} between supplier s and retailer r specifies a fixed fee F_{sr}, a unit wholesale price w_{sr}, and possibly one or more vertical restraints.[14] Contracts are negotiated as follows: in *Stage 1(a)* each supplier s simultaneously offers a wholesale price w_{sr} and possibly a set of vertical restraints to each retailer r, taking as given the contracts offered by supplier s'. Once made, these contract offers are binding and observed by all suppliers and retailers, which prevents opportunism by suppliers (see O'Brien and Shaffer (1992), McAfee and Schwartz (1994), Nocke and Rey (2012) and the discussion in online Appendix B.1). Given these public and binding offers, in *Stage 1(b)* each supplier-retailer pair sr shares the surplus (i.e. the incremental profits) generated by their contract by bargaining over the fixed fee F_{sr}, with the supplier appropriating a share β and the retailer a share $(1 - \beta)$ of that surplus.[15] As explained in the introduction and in further detail in online Appendix B.1, this bargaining framework ensures that, when the suppliers' bargaining power is not too great (i.e. when β is not too large), there exist delegated common agency equilibria in which retailers represent both suppliers even in the absence of menus of contracts. To simplify the analysis, I also make the following assumption:

Assumption 1 *A supplier can be active if and only if it distributes its product at both retailers.*[16]

As discussed in further detail in online Appendix B.1, this assumption entails relatively little loss of generality, since the model remains fundamentally one of *delegated* common agency, and has the advantage of simplifying the bargaining game significantly and of making the outside options of a retailer vis-à-vis a supplier independent of the contract offered by that supplier to the other retailer. This implies that a supplier always offers a retailer a contract that maximizes their joint surplus and allows me to abstract from rent-shifting motives.

Stage 2: Downstream competition – When the negotiation of all supply contracts ends (with all supplier-retailer pairs having either signed a contract or disagreed), retailers compete in the

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[14]When a contract includes vertical restraints, it may specify more than one wholesale price, with the wholesale price that applies in any given situation being determined by whether the retailer has complied or not with the restraints. However, since in the particular type of contracts with vertical restraints that I study in this paper all but one of the wholesale prices are prohibitive, for ease of notation I use w_{sr} to denote only the non-prohibitive wholesale price that applies when the retailer complies with the restraints.

[15]Note that, in this model, having suppliers offer wholesale prices in stage 1(a) and then negotiate fixed fees with retailers in stage 1(b) is only a convenient expositional device. Given Assumption 1 (introduced below) and the fact that bilateral bargaining is efficient, each supplier chooses wholesale prices that maximize the joint supplier-retailer surplus in any bilateral negotiation. Since retailers appropriate an exogenously given share of that surplus, they would offer the same wholesale price as the suppliers if they were called to do so in stage 1(a).

[16]This assumption is, for example, satisfied when retailers are sufficiently differentiated and suppliers have fixed costs within a certain intermediate range, so that a supplier would not be able to cover its fixed costs by selling only at one retailer but could do so by selling at both retailers.

downstream market. I assume that for each profile **w** of wholesale prices and for each set of vertical restraints there always exists a unique downstream equilibrium and consider both the case of Bertrand and Cournot downstream competition. Under reasonable regularity conditions on demand (introduced in Assumption 2 further below and derived in online Appendix B.2) these two modes of downstream competition yield similar conclusions. As will become clear, this is because the equilibrium of the upstream game played by suppliers in stage one does not depend on the retailers' actions (i.e. retail prices or quantities) being strategic complements, but only on the derived demand faced by the upstream suppliers having reasonable properties, such as negative own-price derivatives and positive cross-price derivatives in the absence of vertical restraints.

3 Two-part tariffs

In this section I study the equilibrium of the model outlined above for the case in which suppliers can only use two-part tariffs without vertical restraints. Note that, although two-part tariffs are an important type of "own-quantity contracts" (i.e. of contracts that cannot be made contingent on the quantity purchased from rival suppliers), they are not the only possible type of such contracts. In principle, suppliers could offer own-quantity contracts in which the marginal input price paid by a retailer is not constant but depends instead on the volume purchased by that retailer, as is for example the case with the quantity-forcing contracts with all-units discounts that I study in Section 4 below. Contrary to the conclusions reached by Inderst and Shaffer (2010) in a model without strategic upstream competition, in a model with strategic upstream competition like mine the restriction of the set of admissible own-quantity contracts to two-part tariffs matters, since more complex own-quantity contracts would affect equilibrium outcomes. The reasons for the difference between my results and those of Inderst and Shaffer (2010) are discussed in some detail in Section 4.

The remainder of this section solves the game starting from stage 2 and working backward. In Section 3.1, I characterize the properties of the equilibrium of the downstream duopoly game played in stage 2 by the two multiproduct retailers for any given profile of wholesale prices offered by the suppliers in Stage 1. Given the prices, quantities and profits resulting from this downstream game, in Section 3.2 I characterize the division of surplus between suppliers and retailers through bargaining over fixed fees in Stage 1(b) for any market configuration in which both retailers sell positive quantities of both products (i.e. for any common agency market configuration). In Section 3.3, using the results of the previous sections and assuming temporarily that there does not exist

any profitable deviation to exclusivity, I characterize the wholesale prices offered in Stage 1(a), and the resulting retail prices and quantities in stage 2, in any common agency equilibrium with two-part tariffs. In Section 3.4, I derive the conditions under which there exists no profitable deviation to exclusivity and, therefore, under which the candidate common agency equilibrium characterized in the previous section is indeed an equilibrium of the model. Finally, in Section 3.5 I provide an illustration of the general results of this section by analyzing a concrete example with linear demand and Bertrand downstream competition, and performing some helpful comparative statics with respect to key parameters.

3.1 Downstream competition

In stage 2, for any given pair of wholesale prices w_{sr} and $w_{s'r}$ offered by the two suppliers and any given pair of prices $p_{sr'}$ and $p_{s'r'}$ (in the Bertrand case) or quantities $q_{sr'}$ and $q_{s'r'}$ (in the Cournot case) chosen by its rival, each retailer r chooses a pair of prices p_{sr} and $p_{s'r}$ (in the Bertrand case) or quantities q_{sr} and $q_{s'r}$ (in the Cournot case) that maximize its profits. In light of this, a change in any of the wholesale prices offered in Stage 1 by either supplier to a given retailer affects the equilibrium value of all four retail prices and quantities by affecting *directly* the choices of that retailer and *indirectly* the choices of the other retailer. Since the symmetry of the demand system implies that each supplier always finds it optimal to charge both retailers the same wholesale price for its product when the other supplier also does so (see Section 3.3 below and online Appendix B.2), one can restrict attention to situations with $w_{ir} = w_{ir'} = w_i$ and thus $p_{ir} = p_{ir'} = p_i$ and $q_{ir} = q_{ir'} = q_i$, for $i = s, s'$. Moreover, to ensure that retail prices and quantities respond in sensible ways to changes in wholesale prices around a symmetric equilibrium with $w_s = w_{s'}$, I impose the following regularity conditions on the primitives of the demand system.

Assumption 2 *The demand system satisfies conditions (B-7) and (B-11) in Appendix B.2 (for the case of Bertrand competition) and condition (B-14) in Appendix B.2 (for the case of Cournot competition). In the absence of vertical restraints, these conditions imply*[17]

$$\frac{dq_s}{dw_s} < 0 < \frac{dq_{s'}}{dw_s}, \quad \frac{dq_s}{dw_s} + \frac{dq_{s'}}{dw_s} < 0, \quad and \quad \frac{dp_s}{dw_s} + \frac{dp_{s'}}{dw_s} > 0.$$

These regularity conditions, which for the case of Bertrand competition are the same as those imposed by Rey and Vergé (2010), are fairly mild, as they amount to requiring that the derived

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[17]Online Appendix B.2 provides a detailed derivation of the restrictions on the primitive of the demand system that give rise to these comparative statics.

demand for a product decreases with the wholesale price of that product and increases with the wholesale price of the rival product, and that, around a symmetric equilibrium, the average retail price of all products increases and the average quantity of all products falls with the wholesale price of any product. These regularity conditions are always satisfied in the linear demand example that I introduce in Section 3.5.

3.2 Bargaining and division of surplus

This section studies how, for any given profile $\mathbf{w}$ of wholesale prices offered by the suppliers in Stage 1(a), each supplier-retailer pair shares the surplus resulting from their contract by bargaining over fixed fees in Stage 1(b). One can write the surplus resulting from the contract between supplier s and retailer r as

$$S_{sr} = (V_r - \Pi_{s'r} + \Pi_{sr'}) - \left(V_{r\backslash s} - \Pi_{s'r\backslash s}\right), \tag{5}$$

where $V_{r\backslash s}$ denotes the overall vertical profits on the sales made by retailer r when that retailer sells only product s' and $\Pi_{s'r\backslash s}$ the profits earned by supplier s' in that case (throughout the paper I use the notation $\backslash s$ or $\backslash s'$ to indicate that a retailer does not sell product s or s', respectively); while V_r, $\Pi_{s'r}$ and $\Pi_{sr'}$ are defined on page 7. Intuitively, this surplus is given by the overall profits $(V_r - \Pi_{s'r} + \Pi_{sr'})$ earned by s and r on all of their contracts when they agree to the contract that they are negotiating minus the profits $\left(V_{r\backslash s} - \Pi_{s'r\backslash s}\right)$ that retailer r would earn if it were to sell only product s' given the equilibrium contracts offered by supplier s' (note that, by Assumption 1, the outside option of supplier s is equal to zero). Note that the surplus is calculated taking into account the effects of a contract between s and r not only on the profits generated directly by that contract, but also on the profits earned by s and r on *all* of their other contracts. For example, supplier s must take into account that, by agreeing to a contract with retailer r, it displaces some of its own sales through retailer r', hence the term $\Pi_{sr'}$ in (5).

Nash bargaining over fixed fees implies that the payoff of supplier s in its negotiation with each retailer is equal to the supplier's outside option, which is equal to zero because of Assumption 1, plus a share β of the joint surplus:

$$\Pi_{sr} + \Pi_{sr'} = \beta S_{sr}, \tag{6}$$

$$\Pi_{sr} + \Pi_{sr'} = \beta S_{sr'}. \tag{7}$$

Since the surplus over which each negotiation takes place includes the effects of that negotiation on the total profits earned by each party from all sources, the corresponding payoffs to supplier s

from each negotiation in the left hand sides of (6) and (7) must also include the profits earned by that supplier on all of its contracts, i.e. they must be equal to $\Pi_{sr} + \Pi_{sr'}$. Including only Π_{sr} in the left hand side of (6) or only $\Pi_{sr'}$ in the left hand side of (7) would be incorrect and violate the adding up constraint for vertical profits in (2), since it would attribute too much surplus to each supplier.

Adding (6) and (7), and solving for the total profits $\Pi_s = \Pi_{sr} + \Pi_{sr'}$ earned by supplier s on its two contracts, one obtains[18]

$$\Pi_s\left(\mathbf{w}\right) = \frac{\beta}{2-\beta} \left\{ \left[V\left(\mathbf{w}\right) - \Pi_{s'}\left(\mathbf{w}\right)\right] - \left[V_{\backslash s}\left(\mathbf{w}_{\backslash s}\right) - \Pi_{s'\backslash s}\left(\mathbf{w}_{\backslash s}\right)\right] \right\}, \tag{8}$$

where the notation reminds the reader that profits in a common agency setting depend on the profile $\mathbf{w}$ of all wholesale prices, while profits when either retailer does not carry product s depend only on the wholesale prices charged by supplier s', i.e. on $\mathbf{w}_{\backslash s} = (\infty, w_{s'r}, \infty, w_{s'r'})$.[19] Intuitively, in any common agency configuration each supplier appropriates a share $\beta/\left(2-\beta\right)$ of the incremental profits generated by its presence in the market, with the remaining share going to the retailers.

3.3 Wholesale prices in common agency equilibrium

Let w^t, p^t and q^t denote the equilibrium value of wholesale prices, retail prices and quantities in a symmetric common agency equilibrium with two-part tariffs. In any such equilibrium each supplier s offers wholesale prices w_{sr} and $w_{sr'}$ that maximize its total profits Π_s in (8), given the wholesale prices $w_{s'r} = w_{s'r'} = w^t$ offered by its rival s'. Since demand and costs are symmetric, supplier s always finds it optimal to offer the same wholesale price to both retailers and chooses therefore $w_{sr} = w_{sr'} = w_s$ to solve the following first order condition[20]

$$\frac{d\Pi_s\left(\mathbf{w}^t\right)}{dw_s} = \underbrace{\frac{dV\left(\mathbf{w}^t\right)}{dw_s}}_{\substack{\text{Effect on industry} \\ \text{profits}}} - \underbrace{\frac{d\Pi_{s'}\left(\mathbf{w}^t\right)}{dw_s}}_{\substack{\text{Competitive} \\ \text{externality}}} = 0. \tag{9}$$

As shown in (9), one can distinguish between two effects of a small change in w_s on Π_s: an effect on industry profits, dV/dw_s, and a competitive externality, $d\Pi_{s'}/dw_s$. These combine to

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[18]Note that Π_{sr} and $\Pi_{sr'}$ enter also the right hand sides of (6) and (7) through S_{sr} and $S_{s'r}$; see (5).

[19]By Assumption 1, supplier s exits the market even if only one of the two retailers drops its product. Therefore, whenever at least one of the retailers carries only product s', product s becomes effectively irrelevant at both retailers and the relevant profile of wholesale prices is $\mathbf{w}_{\backslash s} = (\infty, w_{s'r}, \infty, w_{s'r'})$.

[20]I assume that the Hessian of $\Pi_s\left(\mathbf{w}\right)$ satisfies the second order conditions and that $\Pi_s\left(\mathbf{w}\right)$ is everywhere concave in w_{sr} and $w_{sr'}$, so that it has a unique maximum. These conditions hold in the linear demand example that I analyze in Section 3.5.

yield the following result, which is a restatement of Proposition 1 in Rey and Vergé (2010).[21]

Lemma 1 *In any symmetric common agency equilibrium with two-part tariffs it must be $c < w^t < w^m$, where w^m is the wholesale price that implements the industry monopoly outcome.*

Intuitively, starting from a situation in which all wholesale prices are $w^t \leq c$, a small increase in w_s would always be profitable for supplier s because it would increase industry profits without increasing the profits of supplier s'. As shown formally in the proof of Lemma 1, an increase in w_s above c affects *industry profits* through two channels: it *softens downstream competition*, inducing both retailers to raise their prices and/or reduce their quantities, and it causes *double marginalization*. When $w_s \leq c$, however, a small increase in w_s does not cause double marginalization and thus always increases industry profits by softening downstream competition. As for the *competitive externality*, when $w_{s'} = w^t \leq c$, i.e. when the margins earned by the rival supplier are non-positive, an increase in w_s does not increase $\Pi_{s'}$ since, by Assumption 2, $dq_{s'}/dw_s > 0$. This establishes that in any common agency equilibrium it must be $w^t > c$. It also implies that it must be $w^t < w^m$, since, starting from any $w^t \geq w^m$, a small reduction in w_s does not reduce industry profits (which are, by definition, maximized at w^m) and imposes a negative externality on supplier s', given the fact that that supplier earns positive margins $w^t - c > 0$ and, by Assumption 2, $dq_{s'}/dw_s > 0$. One can therefore conclude that, when a common agency equilibrium with two-part tariffs exists, upstream competition limits, but does not completely eliminate, the ability of differentiated suppliers to soften downstream competition and raise overall industry profits.

3.4 Existence of common agency equilibrium

A symmetric delegated common agency equilibrium in which both retailers represent both suppliers exists whenever the profits that each supplier earns in such an equilibrium are greater than the maximum profits that the same supplier could earn by deviating to different contracts that would induce exclusivity.[22] Using (8), the total profits earned by each supplier s in a symmetric common

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[21] In order to emphasize the distinction between the effects of changes in wholesale prices on total industry profits and on the profits of the rival supplier, in Appendix A I prove this result slightly differently from Rey and Vergé (2010).

[22] Note that, since a supplier and a retailer each appropriate a fixed share of the incremental profits (if any) from a deviation to exclusivity, their interests are aligned in any such deviation (i.e. the deviation is profitable for the supplier whenever it is profitable for the retailers and vice versa). For ease of exposition, in what follows I therefore focus only on the profitability of deviations for suppliers.

agency equilibrium can be re-written as

$$\Pi_s^t = \frac{\beta}{2-\beta} \left[\left(V^t - \Pi_{s'}^t \right) - \left(\widehat{V}_{\backslash s}^t - \widehat{\Pi}_{s'\backslash s}^t \right) \right] \tag{10}$$

where V^t and $\Pi_{s'}^t$ denote, respectively, the total industry profits and the profits of supplier s' in a symmetric common agency equilibrium with two-part tariffs; while $\widehat{V}_{\backslash s}^t$ and $\widehat{\Pi}_{s'\backslash s}^t$ denote the same variables in the (off-equilibrium) case in which both retailers sold only product s', given the equilibrium wholesale prices $w_{s'r} = w_{s'r'} = w^t$ for that product. The profits Π_s^t should be compared to the maximum profits, Π_s^e, that supplier s can obtain by deviating in Stage 1(a) to different two-part tariff contracts that would induce the retailers to carry exclusively product s.[23] In the most profitable deviation to exclusivity supplier s offers both retailers the wholesale price $w_{s\backslash s'}^e$ that maximizes its profits when supplier s' is not in the market, which results in industry profits equal to $V_{\backslash s'}^e$. One can thus write the total profits of supplier s in the most profitable deviation to exclusivity starting from a candidate symmetric equilibrium with two-part tariffs as[24]

$$\Pi_s^e = \frac{\beta}{2-\beta} \left[V_{\backslash s'}^e - \left(\widehat{V}_{\backslash s}^t - \widehat{\Pi}_{s'\backslash s}^t \right) \right] \tag{11}$$

where the retailer's outside option, $\left(\widehat{V}_{\backslash s}^t - \widehat{\Pi}_{s'\backslash s}^t \right)$, is the same as its outside option when receiving an equilibrium contract offer from the same supplier (see (10) above). The profitability of a deviation from a candidate symmetric common agency equilibrium to exclusivity can then be assessed by considering the difference between the profits of supplier s in (11) and in (10)

$$\Delta\Pi_s = \Pi_s^e - \Pi_s^t = \frac{\beta}{2-\beta} \left[\left(V_{\backslash s'}^e - V^t \right) + \Pi_{s'}^t \right] \tag{12}$$

The gains $\Delta\Pi_s$ from a deviation to exclusivity by supplier s are proportional to the sum of the change in total industry profits caused by such a deviation, $\left(V_{\backslash s'}^e - V^t \right)$, and the negative externality imposed on supplier s', which corresponds to the profits $\Pi_{s'}^t$ that that supplier would lose if it were excluded. The implications of (12) for the existence of symmetric equilibria with two-part tariffs are summarized, together with the results in Lemma 1, in the following proposition.

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[23] Given that in this section the set of admissible contracts is restricted to two-part tariffs, a deviation to exclusive representation cannot entail explicit exclusive contracts, but only different two-part tariff contracts. These two-part tariff contracts would specify new wholesale price $w_{s\backslash s'}^e$ and fixed fee $F_{s\backslash s'}^e$ that would make it unprofitable for the retailers to pay the fixed fees $F_{s'}^t$ charged by the rival supplier s' in the candidate common agency equilibrium with two-part tariffs and would thus induce the retailers to drop product s'. Since an explicit exclusivity requirement would not improve the profitability of such a deviation to *de facto* exclusivity, the restriction to two-part tariffs is without consequences for the analysis in this section.

[24] For a derivation of this expression see the proof of Proposition 1 in Appendix A.

Proposition 1 *When products are sufficiently differentiated and Assumptions 1 and 2 hold, there exists a threshold $\tilde{\beta}^t < 1$ such that for $\beta \leq \tilde{\beta}^t$ there exists a symmetric delegated common agency equilibrium with two-part tariffs. In this equilibrium, $c < w^t < w^m$, which leads to $p^o < p^t < p^m$ and $q^m < q^t < q^o$, where p^o and q^o are the equilibrium retail prices and quantities when $w = c$.*

Although a formal proof of Proposition 1 is provided in Appendix A, its most important aspects can be grasped from an intuitive interpretation of (12). Note, first, that, since $\Pi_{s'}^t \geq 0$, a necessary condition for a common agency equilibrium to exist is that $\left(V_{\backslash s'}^e - V^t \right) < 0$, i.e. that a deviation to exclusivity reduces total industry profits. If this were not the case, the deviating supplier could always impose a negative externality on the other supplier without reducing total industry profits and would thus always do so. Unless the retailers are completely independent in demand (a limit case that I discuss briefly further below), this condition is satisfied only if the products are sufficiently differentiated. Intuitively, if products were close substitutes a deviation to exclusivity would increase industry profits, since, by eliminating competition at the margin between suppliers, it would make it possible to raise wholesale prices and soften downstream competition while entailing little loss of product variety. If instead products were highly differentiated exclusivity would reduce industry profits, since it would not significantly increase upstream market power and would entail a significant loss of product variety. Product differentiation, though necessary, is not sufficient for the existence of common agency equilibria, as existence also requires retailers to have sufficient bargaining power. As explained above, if retailers had little bargaining power, i.e. if β were high, the incremental profits that they would earn from distributing any single product would be low, and it would thus be easy for either supplier to induce the retailer to drop the rival product. Deviations to exclusivity would, however, be more costly, and thus less profitable, for low levels of β, with the consequence that delegated common agency equilibria exist when β is sufficiently low.[25] Finally, note that if retailers were instead completely independent in demand, which would follow from changing the assumption that $\partial_3 D, \partial_4 D > 0$ to $\partial_3 D = \partial_4 D = 0$, the standard result that there always exists a unique common agency equilibrium with $w^t = c$ and $p^t = p^m$ would obtain for any value of β (including $\beta = 1$), since $w^t = c$ would imply that there are no externalities between suppliers.

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[25] As discussed in Appendix B.1, if Assumption 1 did not hold one of the two retailers would be excluded for very low values of β. A common agency equilibrium with both retailers being active would, however, still exist even without Assumption 1 for intermediate values of β (i.e. for a fairly symmetric distribution of bargaining power between suppliers and retailers) and for sufficient product and retailer differentiation.

3.5 An example with linear demand

By way of example, I now discuss the solution of the model for the case of symmetric linear demand and Bertrand downstream competition.[26] This example provides a helpful illustration of the results derived above and makes a number of interesting comparative static exercises possible. In particular, I assume that demand for product s at retailer r is given by:

$$q_{sr}\left(\mathbf{p}\right) = m - p_{sr} + a\left(p_{s'r} - p_{sr}\right) + b\left(p_{sr'} - p_{sr}\right) + ab\left(p_{s'r'} - p_{sr}\right), \tag{13}$$

for all s and r, with $a, b > 0$ and $m > c$. The greater a, the more substitutable the two products; and the greater b, the more substitutable the two retailers. It can be verified that this linear demand system satisfies the regularity conditions imposed on demand so far.[27]

Figure 1 confirms that a delegated common agency equilibrium exists when the retailers have sufficient bargaining power (i.e. β is low) and products and retailers are sufficiently differentiated (i.e. a and b are low).

Figure 2 shows instead prices in a symmetric common agency equilibrium with two-part tariffs, when this exists. In particular, the lighter solid line represents the symmetric equilibrium wholesale prices, w^t, and the darker solid line represents the symmetric equilibrium retail prices, p^t, for different values of a and b. The dashed lines represent, instead, the monopoly retail prices p^m that maximize industry profits and the wholesale prices w^m that would yield such an outcome conditional on retailers competing à la Bertrand in stage 2 (w^m is the wholesale price that the two suppliers would choose if they could collude in Stage 1). The left panel shows that, when the products become closer substitutes (i.e. when a increases), more intense upstream competition causes w^t and p^t to fall and to diverge further from their monopoly levels. The right panel shows that, not surprisingly, p^t falls as the retailers become closer substitutes. However, it also shows that w^t first increase and then decrease as b increases. The increasing part of the graph is explained

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[26]The calculations for the linear demand example underlying this and other figures in the paper are complex and performed in a Mathematica code enclosed with this submission. Online Appendix B.4 presents the results for the case of Cournot downstream competition.

[27]In this demand system, which is a particular version of that introduced by Shubik and Levitan (1980), changes in a and b affect the substitutability of products and retailers but do not shift the demand curves when all prices are equal, which is helpful when performing comparative statics around a symmetric equilibrium. Another desirable property of the demand system in (13) is that the inverse demand system associated with it is well-defined, in the sense that prices are decreasing in all quantities, which makes it possible to solve the example also for the case of Cournot downstream competition (see Section B.4 of online Appendix B). This, as pointed out by Rey and Vergé (2010), is instead not the case with the linear demand systems or inverse demand systems used in a similar context by Dobson and Waterson (2007), Inderst and Shaffer (2010), and Rey and Vergé (2010).
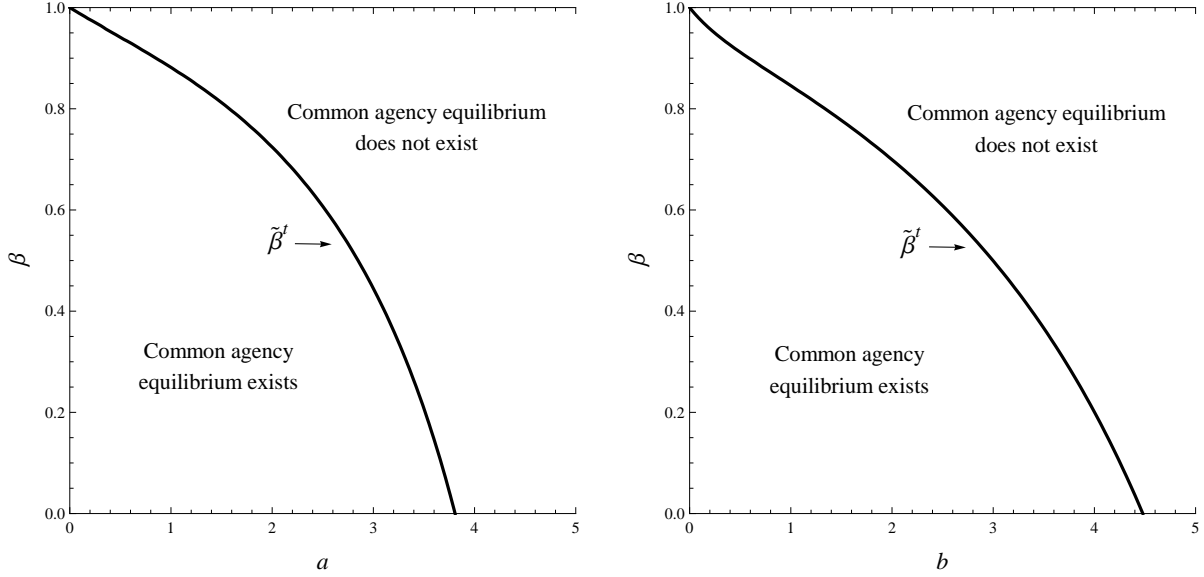
Figure 1: Existence of common agency equilibrium with two-part tariffs.

by the fact that, as downstream competition intensifies, the gains from softening such competition through higher wholesale prices increase while the costs associated with double marginalization decrease. The decreasing portion of the graph is due to the fact that, in the particular linear demand specification adopted in this section, an increase in b also increases the substitutability between any "product" sr and the "product" that its furthest away from it, $s'r'$.
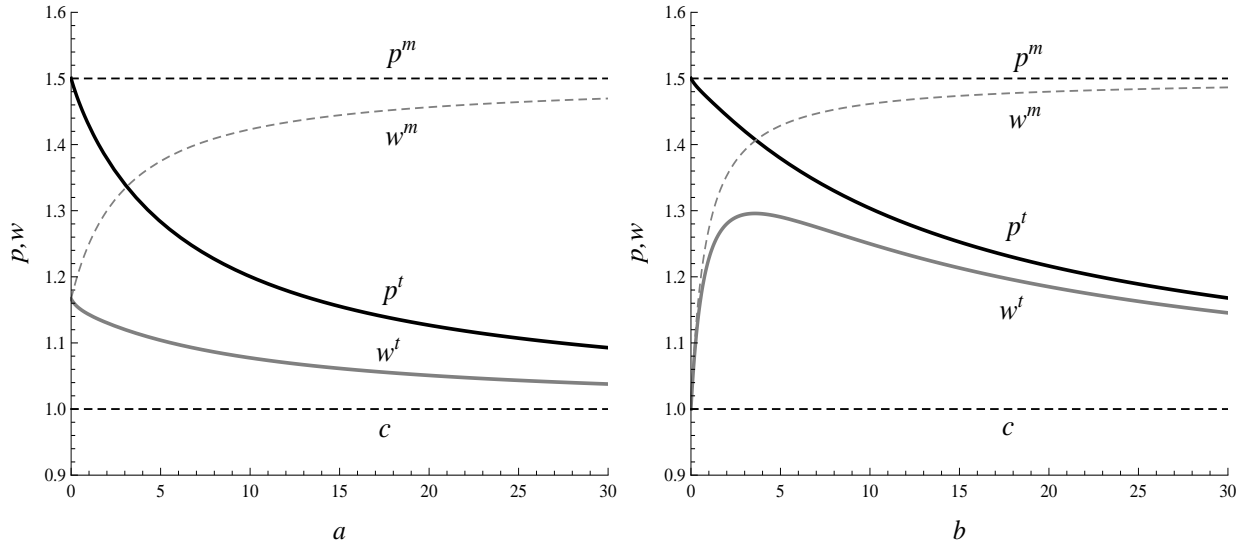

Figure 2: Two-part tariff equilibrium with Bertrand downstream competition.

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4 Quantity forcing through all-units discounts

In this section I continue to limit the analysis to "own-quantity" contracts (i.e. to contracts that can only be made contingent on the quantity purchased from the supplier that offers the contract and cannot thus reference rivals), but I expand the set of these contracts to include contracts, such as all-units discounts, that require a retailer to purchase a minimum volume $\underline{q}_s$ from supplier s in order to qualify for a non-prohibitive wholesale price w_s. Since these contracts effectively force a retailer to purchase a minimum quantity or nothing at all from a supplier, in the remainder of this section I refer to them as quantity-forcing contracts.

As established in Proposition 2 below, when adopted by both suppliers, quantity-forcing contracts can have significant effects on equilibrium outcomes, by making it possible to sustain a large number (a continuum, in fact) of additional common agency equilibria. All of these additional equilibria are less competitive, and thus more profitable, than the equilibrium that can be sustained with two-part tariffs. This also implies that these equilibria exist under a broader range of parameters, e.g. for greater values of β, than with two-part tariffs, with the extent to which this is the case depending on the particular equilibrium one selects.[28]

Proposition 2 *When quantity-forcing contracts are admissible and Assumptions 1 and 2 hold:*

1. *If $\beta \leq \widetilde{\beta}^t$ (i.e. if there exists a common agency equilibrium with two-part tariffs) any $w^v \in [w^t, w^m]$, with associated $p^v \in [p^t, p^m]$ and $q^v \in [q^m, q^t]$, can be sustained as a symmetric common agency equilibrium with quantity-forcing contracts.*

2. *If $\beta > \widetilde{\beta}^t$, there exist jointly determined $\widetilde{\beta}^v > \widetilde{\beta}^t$ and $\widetilde{w}^v \in (w^t, w^m)$, such that for $\beta \leq \widetilde{\beta}^v$ any $w^v \in [\widetilde{w}^v, w^m]$, with associated $p^v \in [\widetilde{p}^v, p^m]$ and $q^v \in [q^m, \widetilde{q}^v]$, can be sustained as a symmetric common agency equilibrium with quantity-forcing contracts.*

While a rigorous proof of Proposition 2 is given in online Appendix B.3, here I discuss the intuition for its results, with particular emphasis on the reasons for their divergence from the

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[28]Note that, in addition to the common agency equilibria discussed in the proposition, with all-units discounts there may also exist equilibria with *effective* exclusion, even when *explicit* exclusive contracts are not allowed. In such equilibria both suppliers offer contracts with minimum volume requirements that are so large as to induce a retailer to find it optimal to accept only one of the two contracts. These types of equilibria with effective exclusion are discussed by Bernheim and Whinston (1998, Section IV.C) in a different model with one retailer and cost externalities between suppliers. They show that these equilibria are less efficient than equilibria sustained by explicit exclusion, since they entail production of an excessive quantity by the excluding supplier. Since the main focus of my paper is on competition in common agency equilibria, and since I already study the properties of an exclusionary equilibrium sustained with explicit exclusive contracts in Section 6, in this section I limit the analysis to common agency equilibria.

results obtained by Inderst and Shaffer (2010), who conclude that own-quantity all-units discounts have no effect on equilibrium outcomes when they can be adopted by only one supplier.

Just as in Inderst and Shaffer (2010), also in my model supplier s can induce any level of retail prices p_s and sales q_s by using only two-part tariff contracts with appropriately chosen wholesale prices w_s. Supplier s cannot increase its profits by adding a quantity-forcing requirement to a two-part tariff contract, although doing so would not reduce its profits either and would thus be a (weak) best response. In this sense, and only in this sense, quantity-forcing requirements do not matter in my model either. However, contrary to Inderst and Shaffer (2010), in my model the adoption of quantity-forcing contracts by supplier s affects the profit maximization problem of rival supplier s' and, through this channel, equilibrium outcomes.[29] In particular, when faced with the minimum volume requirements imposed by supplier s, supplier s' must decide whether to induce the retailers to drop product s altogether or to accept instead common agency by the retailers. When a deviation to exclusivity is unprofitable (i.e. when β is sufficiently low and/or w^v is sufficiently close to w^m; see Proposition 2 for the exact conditions), it is optimal for supplier s' to accept a common agency outcome in which the retailers do not reduce q_s in response to small cuts in $w_{s'}$. Starting from any $w_{s'} = w^v \leq w^m$, this eliminates any incentive for supplier s' to cut $w_{s'}$, since such a price cut would reduce total industry profits without shifting any profits away from supplier s.[30] Therefore, when quantity-forcing contracts are offered by both suppliers, no supplier has an incentive to cut prices starting from any equilibrium with $w^v \in [w^t, w^m]$. In other words, by allowing each supplier to reduce the other supplier's incentives to compete for marginal sales, quantity-forcing contracts can have a facilitating effects and move the equilibrium outcome closer to the one that maximizes total industry profits. The reason that this cannot happen in Inderst and Shaffer's (2010) model is that in that model there are no competitive externalities in the upstream market: supplier s cannot impose any externality on the competitive fringe producing product s', since that fringe earns zero profit margins; and the competitive fringe does not have the market power to impose any externality on supplier s, even though the existence of positive profit margins on product s would make that profitable.

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[29]For the reasons discussed in Klemperer and Meyer (1989), the results in this section may not be robust to the introduction of uncertainty (see the discussion on page B-3 in online Appendix B.1). This feature is, however, not specific to my analysis, as it is shared by other contributions to the literature on the topic, such as Inderst and Shaffer (2010), and by virtually every applied antitrust analysis of all-units discounts.

[30]Note that, as shown in the proof of Proposition 2, supplier s' has no incentive to raise its wholesale price either, since doing so would benefit supplier s. This is the reason for the multiplicity of equilibria in this section. Price increases become, however, profitable for supplier s' when that supplier can adopt the CRRs considered in Section 5.

5   Non-exclusive Contracts that Reference Rivals

In this section I study common agency equilibria in the presence of non-exclusive CRRs, i.e. of supply contracts that do not require complete exclusivity but nevertheless condition explicitly the terms offered to a retailer on that retailer's decisions regarding the retail price or volume of sales of rival products. Equilibria with exclusive contracts are instead studied in Section 6. As discussed in the introduction, non-exclusive CRRs can restrict a retailer's ability to sell and price rival products in various ways. Two common types of restraints in CRRs are market-share requirements, that require a retailer r to purchase a minimum share σ_{sr} of its total volume from supplier s, i.e. $q_{sr}/(q_{sr} + q_{s'r}) \geq \sigma_{sr}$, and merchant restraints, such as non-discrimination rules (NDRs), that prohibit a retailer r from lowering the price of a rival product s' below some multiple of the price of product s, i.e. $p_{s'r} \geq \nu_{sr}p_{sr}$. In Section 5.1, after having established that these two types of restraints are equivalent in terms of their competitive implications, I study symmetric common agency equilibria in which both suppliers find it optimal to offer CRRs with these restraints and retailers deal with both suppliers. As in Section 4, I assume that these restraints are embedded in all-units discount contracts in which a retailer can procure product s at a non-prohibitive wholesale price w_s only if it complies with the market-share or NDR restraints imposed by supplier s, otherwise the only option left to the retailer is not to purchase anything from supplier s and to deal exclusively with supplier s'. In Section 5.1 I show that, contrary to two-part tariffs, non-exclusive CRRs without minimum volume requirements induce retailers to respond to increases in the wholesale price of any one product by reducing the quantities of *both* products by the same amount. This encourages both suppliers to raise their wholesale price in order to impose a negative externality on their rival and, absent minimum volume requirements, leads to higher prices and lower equilibrium quantities than in the industry monopoly outcome. In Section 5.2 I then show that the inclusion of minimum volume requirements (i.e. quantity-forcing) in non-exclusive CRRs can mitigate, but not necessarily eliminate, externalities between suppliers and thus reduce the tendency of those contracts to cause high prices and inferior welfare outcomes.

5.1   CRRs without minimum volume requirements

In this section I study the adoption of market-share requirements and NDRs by both suppliers in symmetric common agency equilibria in which retailers carry both products.[31] For these restraints

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[31]Since, as in previous sections, the symmetry of the model implies that each supplier offers the same wholesale price and restraints to both retailers, in what follows I drop the subscript r for ease of notation.

to be consistent with common agency, it must be $\sigma_s + \sigma_{s'} \leq 1$ in the case of market-share re-quirements and $\nu_s \nu_{s'} \leq 1$ in the case of NDRs. In light of this, in any symmetric common agency equilibrium with binding constraints it must be $\sigma_s = 1/2$ and $\nu_s = 1$ for all s.[32] Market-share requirements and NDRs have very similar implications for the equilibrium of the model, since both constrain the prices charged by retailers (directly in the case of NDRs and indirectly in the case of market-share requirements). In fact, when one considers symmetric restraints, as I do in this section, the two types of contracts are exactly equivalent. This follows from the fact that a symmetric market-share requirement is equivalent to requiring $q_s = q_{s'}$ and that, with symmetric demand, this can be the case if and only if $p_{s'} = p_s$.[33] In light of this, I analyze both types of restraints within the same framework and refer to them as restraints that reference rivals. For the time being, I assume that the contracts do not specify any minimum volume requirement.

In any common agency equilibrium in which both suppliers offer symmetric non-exclusive CRRs, the retailers cannot respond to changes in either of the wholesale prices by altering the relative retail prices or quantities of the two products, since they must ensure that $p_s = p_{s'}$ (or, alternatively, that $q_s = q_{s'}$). In particular, following an increase in w_s above $w_{s'}$, it is the restraint $p_{s'} \geq p_s$ (or, equivalently, $q_{s'} \leq q_s$) imposed by s that becomes binding and prevents the retailers from changing the relative prices and quantities of the two products; while following a reduction in w_s below $w_{s'}$ the binding restraint is that imposed by supplier s', i.e. $p_s \geq p_{s'}$ (or, equivalently, $q_s \leq q_{s'}$). This implies the following result, which drives all the other results in this section.

Lemma 2 *Under the restrictions on demand introduced in Assumption 2, symmetric non-exclusive CRRs imply*

$$\frac{dq_{s'}}{dw_s} = \frac{dq_s}{dw_s} < 0.$$

While in the absence of vertical restraints, and under the restrictions on the primitives of demand introduced in Assumption 2, the (endogenous) cross-derivatives of the derived demand for the two products are positive, i.e. $dq_{s'}/dw_s > 0$, with CRRs these (endogenous) cross-derivatives become negative, i.e. $dq_{s'}/dw_s < 0$. This is because, with CRRs, the retailers can no longer steer consumers towards product s' in response to an increase in w_s but can only pass through

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[32]I study the exclusive equilibria that arise when $\sigma_s + \sigma_{s'} > 1$ or $\nu_s \nu_{s'} > 1$ in Section 6.

[33]When the restraints offered by the two suppliers are binding but not symmetric (e.g. $\nu_s \nu_{s'} = 1$ with $\nu_s > 1$ and $\nu_{s'} < 1$, or $\sigma_s + \sigma_{s'} = 1$ with $\sigma_s > 1/2$ and $\sigma_{s'} < 1/2$), unless demand is linear, they have similar, but not exactly equivalent, implications on the equilibrium of the model. The details of this are discussed in a technical note available from the author upon request.

the *average* increase in their overall marginal cost, $(w_s + w_{s'})/2$, by raising the retail prices and reducing the quantities of *both* products in the same proportion. In other words, as explained by Calzolari and Denicolò (2013), with non-exclusive CRRs retailers behave *as if* the products were perfect complements, regardless of their actual degree of substitutability in demand. This leads to a variant of the well-known problem of Cournot complements: with CRRs the fact that $dq_{s'}/dw_s < 0$ gives supplier s incentives to impose a negative externality on supplier s' by raising w_s, which leads to "overprovision" of wholesale price increases (from the point of view of total industry profits). In the case of two-part tariffs without vertical restraints analyzed in Section 3 the maximization of industry profits is instead prevented by exactly the opposite problem: the fact that $dq_{s'}/dw_s > 0$ gives supplier s incentives to impose a negative externality on supplier s' by lowering, instead of raising, w_s, which leads to "overprovision" of wholesale price cuts (from the point of view of total industry profits). In other words, the adoption of restraints that reference rivals changes the sign of the competitive externality between suppliers. This, as discussed below, has important consequences for the equilibrium of the model.

In the absence of CRRs, the optimal wholesale price chosen by either supplier is bound by upstream competition: if supplier s were to increase w_s above that optimal level, it would lose too much volume to supplier s' and to the outside good and thus refrains from doing so. However, if the competitive externality had the opposite sign, as is the case in the presence of non-exclusive CRRs (see Lemma 2), a small increase in w_s would be profitable, as it would make it possible to soften downstream competition further without losing volume to the rival supplier. Therefore, when non-exclusive CRRs are admitted, each supplier can increase its profits by adopting them while at the same time raising its wholesale price. Intuitively, a supplier that is given the opportunity to reduce, at no cost, the cross-derivative of the derived demand for its product, possibly making it negative, would always take that opportunity. This result is summarized in the following lemma.

Lemma 3 *When non-exclusive CRRs are admissible, it is a dominant strategy for every supplier to adopt them.*

The implications of Lemmas 2 and 3 for equilibrium prices and quantities are characterized in the following lemma, in which the superscript c stands for CRRs.

Lemma 4 *In any symmetric common agency equilibrium with non-exclusive CRRs and no minimum volume requirements, wholesale prices w^c are above the level that maximizes total industry profits, i.e. $w^c > w^m > w^t$, which implies $p^c > p^m > p^t$ and $q^c < q^m < q^t$.*

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Proof: If $w^c \leq w^m$, a small increase in w_s above w^c would not decrease total industry profits, V, (since these are maximized at w^m) and, as a consequence of the binding restraint that reference rivals imposed by supplier s, would strictly decrease the sales, $q_{s'}$, and profits, $\Pi_{s'}$, of supplier s' (see Lemma 2). Such an increase is therefore always strictly profitable for supplier s, since $\Pi_s = \beta/(2 - \beta)(V - \Pi_{s'})$. ∎

The following proposition completes the characterization of the symmetric common agency equilibrium with non-exclusive CRRs by laying out the conditions under which such an equilibrium is immune to deviations to exclusivity and, thus, exists.

Proposition 3 *When non-exclusive CRRs without minimum volume requirements are admissible, Assumptions 1 and 2 hold, and $V^e - V^c < 0$, there exists a $\tilde{\beta}^c < 1$ such that for $\beta \leq \tilde{\beta}^c$ there exists a unique symmetric common agency equilibrium with $w^c > w^m > w^t$, $p^c > p^m > p^t$ and $q^c < q^m < q^t$.*

Note that, contrary to the case of two-part tariffs characterized in Proposition 1, with non-exclusive CRRs one cannot conclude unambiguously that the necessary condition $(V^e - V^c) < 0$ is always satisfied when the products are sufficiently differentiated. This is because with non-exclusive CRRs the retailers always act as if the products were perfect complements regardless of the actual degree of product substitutability, which implies that the resulting pricing inefficiencies persist even when the products are completely independent in demand. When this is the case, one can only conclude that $V^c < 2V^e$, which is not sufficient to sign the difference $(V^e - V^c)$ unambiguously. One should, however, note that when the products are highly differentiated the loss in variety from a deviation to exclusivity is significant, which tends to make V^e small relative to V^c and thus the necessary condition more likely to hold. The linear demand example discussed at the end of this section confirms this intuition.

Welfare and profits – Non-exclusive CRRs always reduce consumer and overall welfare relative to two-part tariffs, since they lead to higher equilibrium prices and lower equilibrium quantities. Moreover, and perhaps more surprisingly, in the absence of minimum volume requirements they can, at least in principle, also lead to lower equilibrium industry profits than two-part tariffs. To see this note that, in the absence of minimum volume requirements, both non-exclusive CRRs and two-part tariffs fail to implement the outcome that maximizes total industry profits, and that the shortfall of CRRs can be greater than that of two-part tariffs. However, when products are

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close substitutes, profits in an equilibrium with two-part tariffs are low due to intense upstream competition and non-exclusive CRRs lead to an increase in those profits by softening such competition. This intuition is confirmed by the linear demand example introduced in Section 3.5 (see the discussion below and panel (b) of Figure 4). Moreover, as shown in Section 5.2 below, the profitability of CRRs can be increased by imposing minimum volume requirements on retailers.

Linear demand example – The results of this section can be illustrated with the linear demand example introduced in Section 3.5. Figure 3 shows the wholesale and retail prices in a common agency equilibrium with non-exclusive CRRs, w^c and p^c, when such an equilibrium exists.
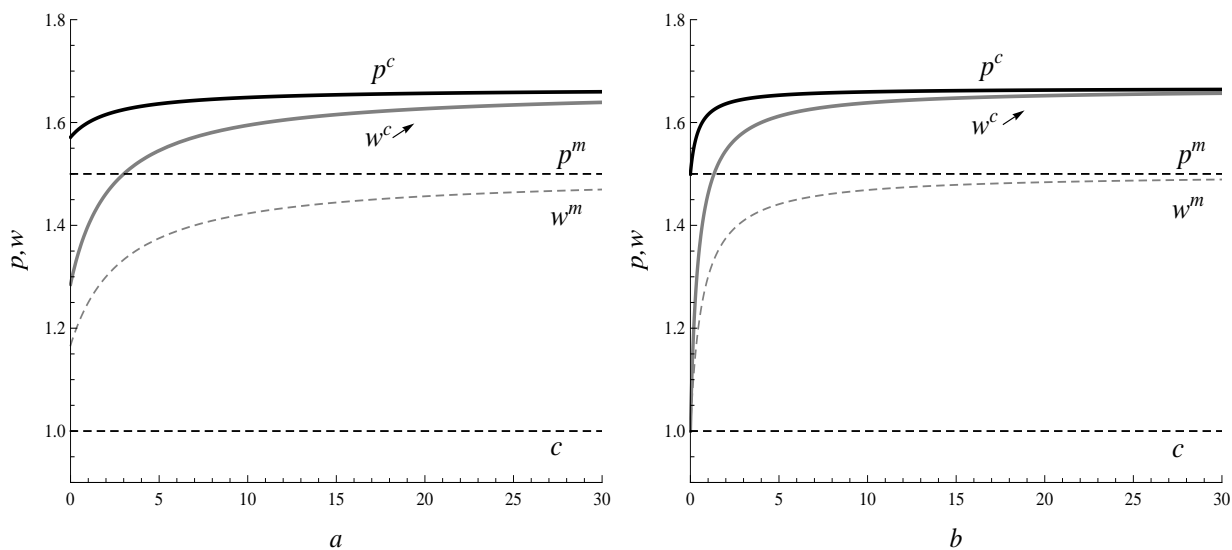

Figure 3: Equilibrium prices with non-exclusive CRRs.

Note that w^c and p^c are not only higher than in a common agency equilibrium with two-part tariffs but also than their industry monopoly levels, w^m and p^m. Note also that, as shown in the right panel, when retailers become closer substitutes, i.e. when the downstream market becomes more competitive, the optimal response of suppliers is to increase the wholesale prices w^c. This is because an increase in wholesale prices can partly mitigate the dissipation of industry profits resulting from increased downstream competition and causes a smaller double marginalization distortion when downstream margins are lower.[34]

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[34]The fact that w^c increases with the intensity of downstream competition may provide a possible explanation, among others, for some recent empirical findings in the literature on bargaining between hospitals and health insurance companies. For example, Ho and Lee (2013) and other articles cited by these authors find evidence that the reimbursement rates charged by hospitals to health insurers (which correspond to wholesale prices in my model) increase in some markets when (downstream) competition between insurers increases. These authors, who assume linear prices and no steering (i.e. CRRs) in their bargaining model,

The linear demand example can also shed some light on the existence of delegated common agency equilibria and on the profitability of such equilibria. The left panel of Figure 4 shows that, as conjectured in the discussion following Proposition 3, with linear demand the necessary condition for the existence of a common agency equilibrium with non-exclusive CRRs, $(V^e - V^c) < 0$, is satisfied for sufficiently low values of a and b, i.e. for sufficient product and retailer differentiation. The right panel, instead, shows that profits are higher in a common agency equilibrium with CRRs than in a common agency equilibrium with two-part tariffs when products and retailers are close substitutes. As explained above, this is because, although CRRs introduce pricing inefficiencies due to the Cournot complements problem, they also eliminate competition at the margin between suppliers. When products are close substitutes (i.e. when a is high) this competition would lower profits significantly with two-part tariffs.
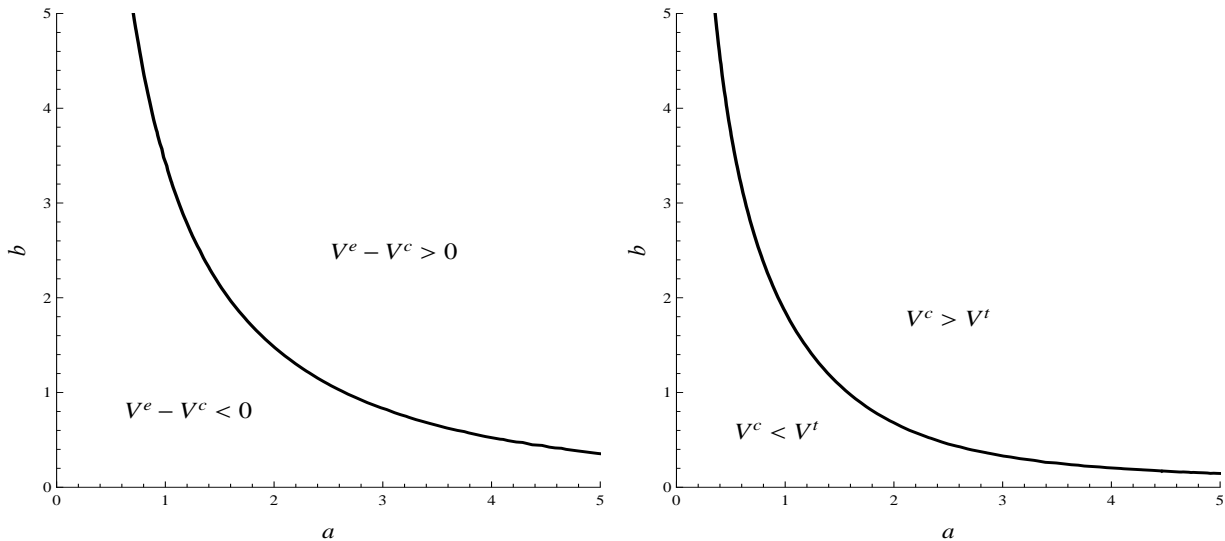

Figure 4: Left panel: Necessary condition for existence with CRRs. Right panel: Industry profits with CRRs v. two-part tariffs.

explain this finding by arguing that increased competition in the insurance market reduces the insurers outside options and thus, all else equal, allows hospitals to charge higher prices. As shown in the present paper, however, an additional explanation for this finding is that, in the presence of more intense competition between insurers, the optimal reimbursement contract specifies higher marginal reimbursement rates (i.e. input prices) in order to mitigate profit dissipation by insurers. In fact, if hospitals and insurers can adopt non-linear reimbursement contracts, changes in *marginal* reimbursement rates can be explained *only* by the strategic effects studied in the present paper, since changes in the outside options of the insurers can affect only fixed fees, and thus *average* reimbursement rates, but not *marginal* reimbursement rates.

5.2 CRRs with minimum volume requirements

The tendency of the CRRs studied above to lead to equilibrium prices that are excessive, not only from the point of view of consumer welfare but possibly also from the point of view of total industry profits, follows from the fact that these contracts give suppliers instruments to impose negative externalities on each other by raising wholesale prices. By a logic analogous to that studied in Section 4 for the case of own-quantity contracts, suppliers can, however, defend themselves from the imposition of such externalities by including minimum volume requirements in their contracts and committing to drastic reactions if the retailers do not meet those requirements. While in Section 4 minimum volume requirements discouraged price cutting by rival suppliers, this section shows that, with non-exclusive CRRs, minimum volume requirements discourage excessive price hiking by rival suppliers. In both cases minimum volume requirements, by reducing the scope for suppliers to impose externalities on each other, move the equilibrium closer to the jointly optimal outcome that maximizes total industry profits.

To see this, consider the same contracts studied above, but with the requirement that, in addition to complying with the restraints that reference rivals, both retailers must also comply with minimum volume requirements $\underline{q}_s$ and $\underline{q}_{s'}$. In the presence of non-exclusive CRRs, the requirement $q_{s'} \geq \underline{q}_{s'}$ imposed by supplier s' reduces the profitability of small increases in w_s by supplier s (and vice versa) and thus discourages such price increases. In particular, when $q_{s'} \geq \underline{q}_{s'}$ is binding, starting from any $w^{cv} \geq w^m$ (where cv denotes variables in an equilibrium with non-exclusive CRRs *and* minimum volume requirements) a small increase in w_s above w^{cv} such that the retailers continue to carry both products would reduce (or, at best, leave unchanged) industry profits, V, and have no effect on $\Pi_{s'}$, since, by Lemma 2, the retailer would like to reduce $q_{s'}$ but is prevented from doing so by the minimum volume requirement imposed by supplier s'. Moreover, when β is sufficiently low and the products are sufficiently differentiated, a deviation to exclusivity, i.e. a deviation that induces $q_{s'} = 0$, is also unprofitable for reasons analogous to those discussed in previous sections. These observations are summarized in the following proposition, which shows that minimum volume requirements can expand considerably the set of the common agency equilibria that can be sustained with non-exclusive CRRs.

Proposition 4 *When non-exclusive CRRs with minimum volume requirements are admissible, Assumptions 1 and 2 hold, and $(V^e - V^{cv}) < 0$:*

1. *If $\beta \leq \widetilde{\beta}^c$ (i.e. if there exists a common agency equilibrium with non-exclusive CRRs without*

minimum volume requirements) any $w^{cv} \in [w^m, w^c]$ can be sustained as a symmetric common agency equilibrium.

2. *If $\beta > \widetilde{\beta}^c$, there exist jointly determined $\widetilde{\beta}^{cv} > \widetilde{\beta}^c$ and $\widetilde{w}^{cv} \in (w^m, w^c)$, such that for $\beta \leq \widetilde{\beta}^{cv}$ any $w^{cv} \in [w^m, \widetilde{w}^{cv}]$ can be sustained as a symmetric common agency equilibrium.*

Welfare and profits – When non-exclusive CRRs are admissible, all the additional common agency equilibria made possible by the adoption of minimum volume requirements have lower prices and greater quantities than the common agency equilibrium without those requirements and thus Pareto-dominate that equilibrium, both from the point of view of consumer and overall welfare and from the point of view of industry profits. As explained above, the reason for this is that minimum volume requirements reduce the scope for the imposition of externalities between suppliers and thus move the equilibrium closer to the joint optimum for suppliers and retailers and benefit consumers by leading to lower retail prices and greater output. Therefore, contrary to what happens in a first-best world without CRRs, in a second-best world with CRRs a ban on minimum volume requirements can have the unintended effect of reducing consumer and overall welfare.

6 Competition for exclusives

Besides providing a natural framework for studying the use of non-exclusive CRRs in common agency equilibria, the model presented in this paper can also be used to study equilibria in which suppliers compete by offering exclusive contracts. With the notable exception of Calzolari and Denicolò (2013), which I discuss in further detail at the end of this section, the economics literature has devoted significantly less attention to competition for exclusives between existing suppliers than to the use of exclusive contracts by an incumbent supplier to exclude potential entrants when those potential entrants cannot offer their own contracts.[35] In this section I show that, when retailers have some buyer power and compete in the downstream market, competition for exclusives reduces supplier profits but does not necessarily benefit retailers and is very likely to harm final consumers.

The fact that in an equilibrium with exclusive contracts suppliers earn lower profits than in a common agency equilibrium with non-exclusive contracts raises the question of how likely these exclusive equilibria are to arise in reality. Although coordination failures between suppliers are a possible explanation, in industries with a limited number of large suppliers such coordination

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[35]For models of naked exclusion by incumbents see Rasmusen, Ramseyer and Wiley (1991), Segal and Whinston (2000), and subsequent contributions.

failures are unlikely to be pervasive and persistent. A more convincing explanation is, therefore, that retailers may want to promote competition for exclusives by committing ex-ante (i.e. before stage 1(a) in my model) to carrying only one product when such commitment increases their profits.[36] In this section I derive the conditions under which it is profitable for retailers to do so. I also show that, even when competition for exclusives increases the profits of retailers, it does not necessarily put downward pressure on wholesale and retail prices and is thus likely to harm consumers through loss of variety. These results are summarized in the following proposition.

Proposition 5 *When exclusive dealing is admissible, there always exists an equilibrium in which both suppliers offer exclusive contracts and, in any symmetric equilibrium,*

1. *Both suppliers offer wholesale prices w^e that maximize total industry profits under exclusive representation and earn zero profits, as competition leads to fixed fees $F^e = -(w^e - c) q^e < 0$.*

2. *Retailers appropriate all industry profits, i.e. $\Pi_r^e = V_r^e$. If retailers have sufficient intrinsic bargaining power (i.e. if β is sufficiently low) they can be worse off in an equilibrium with exclusive dealing than in a common agency equilibrium with two-part tariffs or with non-exclusive CRRs, when these common agency equilibria exist.*

3. *Consumers can be worse off in an equilibrium with exclusive contracts than in a common agency equilibrium with two-part tariffs or with non-exclusive CRRs, when these common agency equilibria exist. In the linear demand example of Section 3.5, consumers are always worse off than in an equilibrium with two-part tariffs, and worse off than in an equilibrium with non-exclusive CRRs if products and retailers are sufficiently differentiated.*

As shown in more rigorous detail in the proof in on-lie Appendix B.3, when competing for exclusives, suppliers have incentives to offer the wholesale price w^e that yields the highest joint profits for the supplier and the retailers, as this maximizes their chances of winning exclusive rights. However, when both suppliers offer exclusive contracts with w^e, in the symmetric context of this model their mutually exclusive offers are completely undifferentiated in the eyes of retailers. This implies that no supplier provides the retailers with positive surplus relative to the other supplier

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[36]See Klein and Murphy (2008) for a non-technical discussion of this potential explanation and O'Brien and Shaffer (1997) for an analyis of this issue in a model with a monopolisitic retailer without intrinsic bargaining power.

and thus that in stage 1(b) the retailers can appropriate the entire industry profits by negotiating low (in fact negative) fixed fees.[37]

Since, all else equal, exclusivity reduces total industry profits by eliminating product variety, retailers with some intrinsic bargaining power do not necessarily gain from it. In particular, although retailers appropriate all industry profits in an exclusive equilibrium, when they have significant intrinsic bargaining power they can appropriate a large share of the (higher) industry profits also in a common agency equilibrium. This implies that, when β is sufficiently low and the equilibrium with exclusive contracts entails significantly lower industry profits than a common agency equilibrium, retailers can be worse off in the former than in the latter equilibrium and have therefore no incentive to instigate competition for exclusives between suppliers. This result is illustrated in Figure 5 using the linear demand example introduced in Section 3.5.
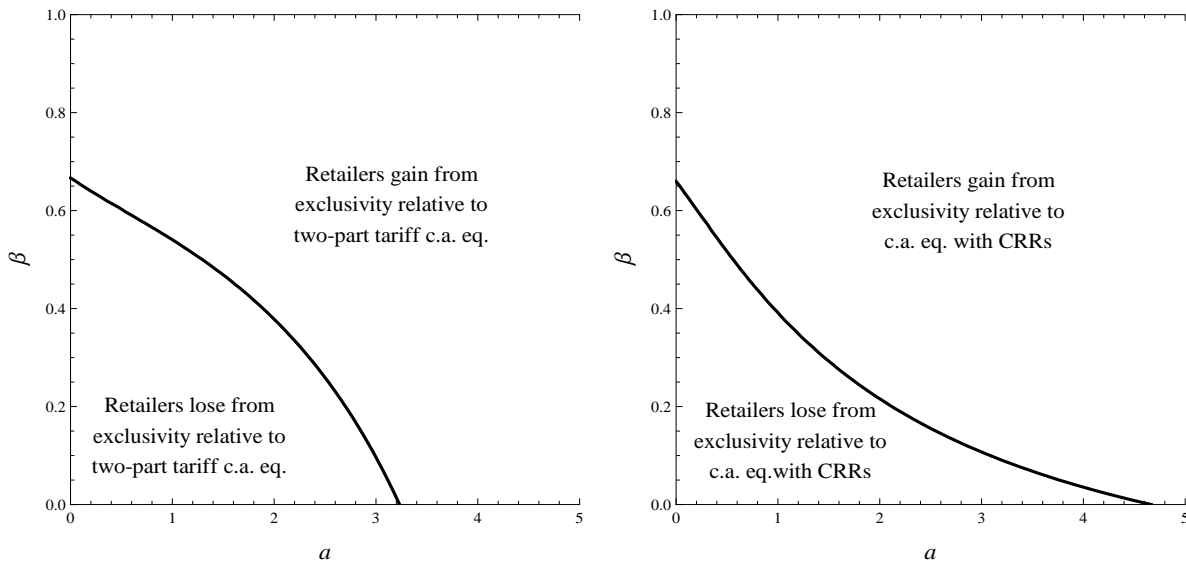

Figure 5: Retailers' profits in exclusive and common agency equilibria.

The left panel shows that retailer profits are lower in an equilibrium with exclusive contracts than in a common agency equilibrium with two-part tariffs whenever β is low (i.e. retailers have significant bargaining power) and a is low (i.e. products are highly differentiated). The right panel illustrates a similar conclusion for the case in which the equilibrium with exclusive contracts is compared to a symmetric common agency equilibrium with non-exclusive CRRs.

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[37]See the proof in the appendix for a discussion of asymmetric equilibria in which suppliers offer exclusive contracts with different wholesale prices. In such equilibria at least one supplier offers w^e (and w^e is always the wholesale price in the contract that is selected), while the other supplier offers any wholesale price. These asymmetric equilibria are equivalent to the symmetric equilibria characterized in Proposition 5 in terms of retail prices, total industry profits, and consumer and social welfare; the only difference being in the distribution of profits between the winning supplier and the retailers.

As for consumer welfare, note that the retail prices p^e paid by final consumers in an equilibrium with exclusive contracts depend only on the wholesale prices w^e, not on the fixed fees F^e, charged by suppliers in that equilibrium. Competition for exclusives does not necessarily put downward pressure on wholesale prices but simply induces suppliers to vie for a retailer's business by lowering fixed fees. In fact, all else equal, the lack of competition at the margin between suppliers tends to yield wholesale prices w^e, and thus retail prices p^e, that are higher than the wholesale prices w^t and retail prices p^t in a common agency equilibrium with two-part tariffs. Since a supplier that has succeeded in obtaining exclusive representation may have incentives to serve a broader customer base with less intense preferences for its product than in a common agency equilibrium in which customers sort themselves across products, one cannot rule out special cases in which w^e is lower than w^t.[38] However, even in those cases, the fact that $w^e < w^t$ would be due to a change in demand mix rather than to downward competitive pressure and needs to be balanced against the loss of variety suffered by final consumers. The linear demand example introduced in Section 3.5 makes it possible to reach more definite conclusions and shows that consumers are always worse-off in an equilibrium with exclusive contracts than in a common agency equilibrium with two-part tariffs.[39] As shown in Figure 6 below, the conclusion is, however, quite different when one compares an equilibrium with exclusive contracts to an equilibrium with non-exclusive CRRs, since, unless products and retailers are highly differentiated, consumers are better-off in the former than in the latter equilibrium. This follows from the fact that exclusive contracts eliminate the pricing inefficiencies associated with the Cournot complements problem discussed in Section 5.

Competition for exclusives has also been studied in a different setting by Calzolari and Denicolò (2013), who analyze a model with incomplete information and no downstream competition in which suppliers offer menus of contracts that include both exclusive and non-exclusive offers. Although the main focus of their paper is on the implications of exclusive contracts for the outside options of buyers, and thus for the prices paid by those buyers in common agency equilibria in which exclusive

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[38] As demonstrated by Chen and Riordan (2008), it is indeed possible that a firm charges lower prices when it is a monopolist than when it competes with the sellers of other differentiated products, and that consumer welfare is higher in the former than in the latter case under certain distributions of consumer preferences. The reason for this is that, with competition between differentiated sellers, consumers sort themselves across sellers and sellers can better extract the value that consumers attach to their product.

[39] The issues discussed in this section have also been addressed in a non-technical paper by Klein and Murphy (2008). Based on the assumption that suppliers can only compete for exclusives by lowering marginal wholesale prices, Klein and Murphy conclude that competition for exclusives necessarily leads to lower wholesale prices. In light of the analysis above it is, however, difficult to see how the linear pricing assumption is without loss of generality, as claimed by Klein and Murphy, and how their conclusions can be valid in an environment where firms have access to more sophisticated contracts.
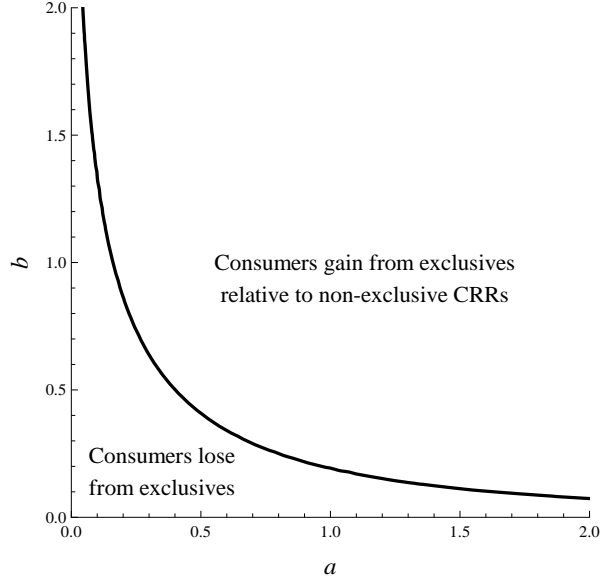
Figure 6: Consumer welfare: Exclusive equilibrium $v.$ equilibrium with non-exclusive CRRs.

contracts are not selected, they also briefly discuss the case in which exclusive contracts are selected in equilibrium (see their section 2.2). In that case, which is the most directly comparable to the analysis in this section, our models yield similar predictions regarding the effects of exclusive contracts on direct buyers but possibly different predictions regarding the effects of those contracts on marginal input prices and, thus, on consumer welfare. In particular, in both models direct buyers that have the ability to obtain large surpluses in a common agency equilibrium are worse off in an equilibrium with exclusive contracts. Those buyers are high-type buyers in Calzolari and Denicolò's incomplete information model and buyers with high intrinsic bargaining power in my complete information bargaining model.[40] With regard to marginal input prices and consumer welfare, while in Calzolari and Denicolò's model competition for exclusives always leads to lower marginal prices, this is not necessarily the case in my model. The key difference is that in my model the presence of downstream competition induces suppliers to charge wholesale prices above marginal cost even when they vie for exclusivity, whereas this is not the case when exclusive contracts are selected by the buyer in the equilibrium of Calzolari and Denicolò's model.

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[40]Exclusive contracts make instead all buyers better off when they are offered but not selected in the equilibrium of Calzolari and Denicolò's model. A similar result would obtain also in my model if I allowed suppliers to offer menus of contracts, with the difference that in my model off-equilibrium exclusive contracts would only lead to a reduction in fixed fees (and to an expansion of the parameters range for which common agency equilibria exist), not to a fall in marginal prices, as is instead the case in Calzolari and Denicolò.

7 Policy implications and conclusions

This paper has shown that vertical restraints, such as CRRs and quantity-forcing provisions, can soften upstream competition even when they do not have exclusionary effects. With a few notable exceptions, this source of potential competitive harm has received relatively little attention in the existing literature. This relative lack of attention may have been due, at least in part, to the difficulties associated with ensuring the existence of common agency equilibria in models with multiple upstream and downstream firms and non-linear pricing. In this paper I overcome those difficulties by adopting a realistic framework in which suppliers and retailers bilaterally negotiate vertical contracts and both sides have some bargaining power. When bargaining power is distributed fairly symmetrically between suppliers and retailers and products are sufficiently differentiated, there exist common agency equilibria in which both retailers represent both suppliers. The fact that in such equilibria suppliers earn positive unit margins in order to soften downstream competition gives rise to upstream competition for marginal sales. By showing how different types of vertical contracts affect the intensity of this competition and, ultimately, welfare, this paper has provided guidance for antitrust policy and enforcement.

In particular, absent significant efficiency justifications, non-exclusive CRRs lead to lower consumer and overall welfare than two-part tariffs because they force retailers to respond to increases in the wholesale price of any given product by raising, instead of lowering, the retail price of rival products. The increase in the retail price of rival products effectively reduces the elasticity of the residual derived demand for the first product and therefore induces the supplier selling that product to charge higher wholesale prices. This leads to higher equilibrium wholesale and retail prices, lower consumer welfare, and, when the products are close substitutes in demand, higher supplier profits than in an equilibrium in which only two-part tariffs are allowed.

This paper has also shed some light on the competitive effects of quantity-forcing provisions, such as minimum volume requirements implemented through all-units discounts. In a model in which both suppliers have some market power and earn positive unit margins, quantity-forcing provisions can be used by the suppliers to defend themselves from business stealing attempts by their rivals. Whether this is good or bad for welfare depends on the set of admissible contracts in the counterfactual world. When evaluated against a benchmark in which only two-part tariffs are allowed, all-units discounts may reduce consumer and social welfare by making it possible for suppliers to sustain less competitive outcomes. However, when evaluated against a counterfactual

world in which firms can use non-exclusive CRRs, all-units discounts may increase consumer and social welfare, as well as supplier profits, by reducing the suppliers' incentives to "tax" their rivals' products and mitigating the pricing inefficiencies resulting from those incentives.

In light of this, when called upon to rule on the legality of non-exclusive CRRs and quantity-forcing provisions in settings similar to the one analyzed in this paper, courts and antitrust agencies would be well advised to strike down both types of contracts, unless they have convincing evidence of sufficient efficiency justifications. The same courts and agencies should, however, be careful not to condemn quantity-forcing provisions while at the same time allowing CRRs, since such a partial ban may have unintended welfare effects. In relation to antitrust enforcement, one should also note that, notwithstanding the significant consumer harm that it may cause, the type of conduct studied in this paper is unlikely to give rise to many private antitrust actions, or at least to be the central theory of harm in such actions, since, by softening competition and increasing the profits in the entire vertical chain, it typically benefits all (or, at least, most) upstream and downstream firms in the market at the expense of consumers.[41] Since the interests of consumers are typically diffused and difficult to organize, enforcement against these practices, when warranted, may therefore require government intervention or an appropriate legal framework for class actions.

Finally, when exclusive contracts are permitted, the framework developed in this paper can also be used to study the welfare effects of retailer-induced competition for exclusives. When retailers have low intrinsic bargaining power and products are not highly differentiated, retailers can gain from committing to exclusivity and encouraging competition for exclusives between suppliers. Such competition does not, however, necessarily put downward pressure on unit wholesale and retail prices, and, in light also of the loss of variety that it entails, is very likely to harm final consumers. This conclusion casts significant doubts on the often-heard arguments in defense of competition for exclusives or "competition for the market" as an adequate substitute for competition at the margin or "competition in the market", at least in markets in which non-linear supply contracts are common and there is little evidence of significant efficiency justifications.

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[41]This is, instead, not the case when the same contracts are used by a dominant firm to exclude or weaken a smaller rival, since in that case the smaller rival and possibly some uncompensated downstream firms typically have the incentives and the means to complain. See, however, Asker and Bar-Isaac (2013) for a model of exclusion in which downstream firms may have incentives to help an upstream monopolist exclude a potential upstream entrant when they can appropriate some of the resulting monopoly profits through various vertical practices.

APPENDIX A

Proof of Lemma 1: I first provide a proof for the case of Bertrand downstream competition and then an abbreviated proof for the case of Cournot downstream competition (the logic and results are very similar in the two cases).

Bertrand downstream competition – Given the expression for V resulting from (1) and (3), the first part (effects on industry profits) of the first order condition in (9) can be written as

$$\frac{dV\left(\mathbf{w}^t\right)}{dw_s} = 2\left[q^t + \left(p^t - c\right)\sum_{i=1}^4 \partial_i D\right]\left(\frac{dp_s}{dw_s} + \frac{dp_{s'}}{dw_s}\right) \tag{A-1}$$

In a symmetric equilibrium, the first order condition of either retailer with respect to the price of either product implies

$$q^t = -\left(p^t - w^t\right)\left(\partial_1 D + \partial_2 D\right) \tag{A-2}$$

Since $\left(p^t - c\right) = \left(p^t - w^t\right) + \left(w^t - c\right)$, one can use (A-2) to eliminate q^t and rewrite (A-1) as

$$\frac{dV\left(\mathbf{w}^t\right)}{dw_s} = \underbrace{\left[\left(p^t - w^t\right)\left(\partial_3 D + \partial_4 D\right)}_{\substack{\text{Softening of downstream} \\ \text{competition}}} + \underbrace{\left(w^t - c\right)\sum_{i=1}^4 \partial_i D\right]}_{\text{Double marginalization}}\left(\frac{dp_s}{dw_s} + \frac{dp_{s'}}{dw_s}\right) \tag{A-3}$$

Given the restrictions on demand introduced in Assumption 2, $\left(dp_s/dw_s + dp_{s'}/dw_s\right) > 0$; i.e. around a symmetric equilibrium an increase in w_s induces each retailer to raise the sum of the prices that it charges for the two products, $\left(p_s + p_{s'}\right)$. This, in turn, affects total industry profits through two channels: it softens downstream competition (this effect is measured by the diversion of sales between the two retailers, $\left(\partial_3 D + \partial_4 D\right) > 0$, evaluated at the retail unit profit margins, $\left(p^t - w^t\right)$) and it causes double marginalization (this effect is evaluated by the loss of total sales to the outside good, $\sum_{i=1}^4 \partial_i D < 0$, evaluated at the upstream unit margins, $\left(w^t - c\right)$).

The second part (competitive externality) of (9) can instead be written as

$$\frac{d\Pi_{s'}\left(\mathbf{w}^t\right)}{dw_s} = 2\left(w^t - c\right)\frac{dq_{s'}}{dw_s} \tag{A-4}$$

One can use (A-3) and (A-4) to prove that, in any symmetric common agency equilibrium with two-part tariffs, it cannot be $w^t \leq c$ or $w^t \geq w^m$, and it must thus be $c < w^t < w^m$. If $w^t \leq c$, (A-3) and (A-2), together with Assumption 2, imply that

$$\left.\frac{dV\left(\mathbf{w}^t\right)}{dw_s}\right|_{\mathbf{w}^t \leq c} = -q^t \frac{\partial_1 D + \partial_2 D}{\partial_3 D + \partial_4 D}\left(\frac{dp_s}{dw_s} + \frac{dp_{s'}}{dw_s}\right) > 0,$$

while (A-4) and Assumption 2 imply that $d\Pi_{s'}\left(\mathbf{w}^t\right)/dw_s \leq 0$. Together these two results imply

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that $d\Pi_s\left(\mathbf{w}^t\right)/dw_s > 0$ and thus that $w^t \leq c$ cannot be an equilibrium. If instead $w^t \geq w^m$, then $p^t \geq p^m$ and, given that V is single-peaked and maximized at p^m, the expression in square brackets in (A-1) (or in (A-3), which is the same) is non-positive. Since, by Assumption 2, $(dp_s/dw_s + dp_{s'}/dw_s) > 0$, this implies that $dV\left(\mathbf{w}^t\right)/dw_s \leq 0$. The competitive externality term in (A-4) is instead strictly positive, i.e. $d\Pi_{s'}\left(\mathbf{w}^t\right)/dw_s > 0$. Together these results imply that $d\Pi_s\left(\mathbf{w}^t\right)/dw_s < 0$ and thus that $w^t \geq w^m$ cannot be an equilibrium either.

Cournot downstream competition – By a sequence of steps similar to that for the case of Bertrand competition, one obtains the following equation, which is analogous to (A-3)

$$\frac{dV\left(\mathbf{w}^t\right)}{dw_s} = \underbrace{\left[q^t\left(\partial_3 P + \partial_4 P\right)\right.}_{\substack{\text{Softening of downstream} \\ \text{competition}}} + \underbrace{\left(w^t - c\right)\right]}_{\text{Double marginalization}} \left(\frac{dq_s}{dw_s} + \frac{dq_{s'}}{dw_s}\right), \qquad \text{(A-5)}$$

while the expression for the competitive externality remains the same as in (A-4). As above, these can be used to show that for $w^t \leq c$ it would be $d\Pi_s\left(\mathbf{w}^t\right)/dw_s > 0$, while for $w^t \geq w^m$ it would be $d\Pi_s\left(\mathbf{w}^t\right)/dw_s < 0$. $\blacksquare$

Proof of Proposition 1: Since Π_s is assumed to be maximized at w^t and everywhere strictly concave, there exists no profitable deviation to a two-part tariff contract with $w \neq w^t$ that also yields common agency. The only possible profitable deviation is therefore a deviation to exclusivity.

The profit earned by supplier s in a symmetric common agency equilibrium with two-part tariffs, Π_s^t, is given in (10), while maximum profit that the same supplier could earn in a deviation to exclusivity, Π_s^e, is given in (11) and obtained as follows. The joint surplus for supplier s and retailer r from a deviation to exclusivity is

$$S_{sr\backslash s'} = \left[\left(V_{r\backslash s'} + \Pi_{sr'\backslash s'}\right) - \left(V_{r\backslash s} - \Pi_{s'r\backslash s}\right)\right] \qquad \text{(A-6)}$$

Note that, by Assumption 1, this deviation would cause supplier s' to exit the market altogether and thus force also retailer r' to sell only product s. The division of the incremental profits (if any) resulting from this deviation between supplier s and the two retailers can be found by solving the following system for $\Pi_{s\backslash s'} = \Pi_{sr\backslash s'} + \Pi_{sr'\backslash s'}$ (note that $\Pi_{sr\backslash s'}$ and $\Pi_{sr'\backslash s'}$ enter also the expressions for $S_{sr\backslash s'}$ and $S_{sr'\backslash s'}$ in the right hand side.)

$$\Pi_{sr\backslash s'} + \Pi_{sr'\backslash s'} = \beta S_{sr\backslash s'} = \beta S_{sr'\backslash s'}, \qquad \text{(A-7)}$$

which yields

$$\Pi_{s \backslash s'} = \frac{\beta}{2 - \beta} \left\{ V_{\backslash s'} \left(\mathbf{w}_{\backslash s'} \right) - \left[V_{\backslash s} \left(\mathbf{w}_{\backslash s} \right) - \Pi_{s' \backslash s} \left(\mathbf{w}_{\backslash s} \right) \right] \right\} \qquad \text{(A-8)}$$

In the most profitable deviation to exclusivity supplier s offers both retailers a wholesale price w_s^e that maximizes the symmetric function in (A-8). The maximum of this function is given by (11) in the main text, where $\widehat{V}_{\backslash s}^t$ and $\widehat{\Pi}_{s' \backslash s}^t$ are, respectively, the values of $V_{\backslash s}$ and $\Pi_{s' \backslash s}$ for $w_{s'} = w^t$. By subtracting the expression for Π_s^t from that for Π_s^e one obtains the expression in (12) for the profitability of a deviation to exclusivity, $\Delta \Pi_s$, on which I focus for the remainder of the proof.

Note that, since $\Pi_{s'}^t \geq 0$, a necessary condition for $\Delta \Pi_s \leq 0$ is that $V_{\backslash s'}^e - V^t < 0$ (as I show further below, this necessary condition needs to hold with strict inequality only in order to prove that a common agency equilibrium exists for $\beta > 0$; for a common agency equilibrium to exist when $\beta = 0$ the necessary condition $V_{\backslash s'}^e - V^t \leq 0$ is enough). This necessary condition is satisfied only if products are sufficiently differentiated. To see this, assume that the demand system can be parametrized so that substitutability between products (e.g. cross-price derivatives) is increasing continuously in the parameter $a \in [0, \infty)$. If $a \to \infty$ (i.e. the products are perfect substitutes), in a common agency equilibrium with two-part tariffs $w^t = c$, while the most profitable contract under exclusivity has $w^e > c$. In this case, exclusivity increases industry profits, since it makes it possible to soften downstream competition by raising wholesale prices above marginal cost without entailing any loss in product variety. If instead $a = 0$ (i.e. the products are completely independent in demand) exclusive representation lowers industry profits, since it entails a loss in product variety without increasing market power (i.e. the ability to use wholesale prices to soften downstream competition). Formally, when $a = 0$ one has $w^t = w^e$, which, given symmetry, implies that $V^t = 2V_{\backslash s'}^e > V_{\backslash s'}^e$ and thus that $V_{\backslash s'}^e - V^t = V_{\backslash s'}^e < 0$. Given these two limit cases and given that cross-derivatives are continuous and monotonically increasing in a, by a continuity argument there exists an $\widetilde{a}$ such that $V_{\backslash s'}^e - V^t < 0$ for $a < \widetilde{a}$.

Next, I assume that the necessary condition $V_{\backslash s'}^e - V^t < 0$ is satisfied and I prove that there exists a unique $\widetilde{\beta}^t$, with $0 < \widetilde{\beta}^t < 1$, such that for $\beta \leq \widetilde{\beta}^t$ there exists a common agency equilibrium and for $\beta > \widetilde{\beta}^t$ such an equilibrium does not exist. I do so by showing that $\Delta \Pi_s \to 0^-$ for $\beta \to 0$, that $\Delta \Pi_s > 0$ for $\beta = 1$, and that $\Delta \Pi_s$ is everywhere quasi-convex in β. This requires a number of preliminary steps. Note that, since $\Pi_s^t / 2 = F^t + \left(w^t - c \right) q^t$ and $\widehat{\Pi}_s^t / 2 = F^t + \left(w^t - c \right) \widehat{q}^t$, one can write the equivalent of (10) for supplier s' as

$$\Pi_{s'}^t = \frac{\beta}{2 - \beta} \left[\left(V^t - \widehat{V}^t \right) + 2 \left(w^t - c \right) \left(\widehat{q}^t - q^t \right) \right] \geq 0 \qquad \text{(A-9)}$$

where the term within square brackets does not depend on β. Substituting (A-9) into (12) and setting $\beta = 0$ one obtains $\Delta\Pi_{s,\beta=0} = 0$, while setting $\beta = 1$ one obtains

$$\Delta\Pi_{s,\beta=1} = \left[\left(V^e - \widehat{V}^t\right) + 2\left(w^t - c\right)\left(\widehat{q}^t - q^t\right)\right] > 0 \tag{A-10}$$

The expression in (A-10) has an intuitive interpretation and can be signed in a straightforward manner. The term $2\left(w^t - c\right)\left(\widehat{q}^t - q^t\right)$ represents the increase in profits that the deviating supplier can achieve, for given wholesale prices w^t, by displacing the sales of the other supplier. This term is always positive, since, as established in Lemma 1, $\left(w^t - c\right) > 0$ and, given that the products are substitute in demand, $\widehat{q}^t > q^t$. The term $\left(V^e - \widehat{V}^t\right)$ represents instead that part of the gains from a deviation to exclusivity that can be attributed to the ability to adjust wholesale prices from w^t, which is not optimal for a configuration in which retailers represent only one supplier, to w^e, which is instead optimal for such a configuration. This term is always positive. Consider next the first and second order derivatives of $\Delta\Pi_s$ with respect to β

$$\frac{\partial\Delta\Pi_s}{\partial\beta} = \frac{2}{(2-\beta)^2}\left(V^e_{\backslash s'} - V^t + 2\Pi^t_{s'}\right) \tag{A-11}$$

$$\frac{\partial^2\Delta\Pi_s}{\partial\beta^2} = \frac{4}{(2-\beta)^3}\left(V^e_{\backslash s'} - V^t + 2\frac{1+\beta}{\beta}\Pi^t_{s'}\right) \tag{A-12}$$

From (A-9) and (A-11) one can conclude that the first derivative of $\Delta\Pi_s$ with respect to β at $\beta = 0$ is equal to $V^e_{\backslash s'} - V^t$ and thus negative when the necessary condition is satisfied. Given that $\Delta\Pi_{s,\beta=0} = 0$ this implies that there exists values of β in an interval to the right of zero for which $\Delta\Pi_s < 0$. Moreover, the fact that $\Delta\Pi_s$ is continuous in β and that $\Delta\Pi_{s,\beta=1} > 0$ implies that $\Delta\Pi_s$ must be increasing over some interval of $\beta \in [0,1]$. Finally, since $\Pi^t_{s'} \geq 0$, inspection of (A-11) and (A-12) shows that, whenever the first derivative is positive, the second derivative is also positive, which implies quasiconvexity of $\Delta\Pi_s$. This proves that, when the necessary condition $V^e_{\backslash s'} - V^t < 0$ is satisfied, there exists a unique $\widetilde{\beta}^t$ such that $\Delta\Pi_s < 0$ for $\beta < \widetilde{\beta}^t$ and $\Delta\Pi_s > 0$ for $\beta > \widetilde{\beta}^t$. ∎

Proof of Lemma 2: *Bertrand downstream competition* – Given wholesale prices w_s and $w_{s'}$ and the retail prices charged by the other retailer, the first order condition with respect to either price for a retailer facing the constraint $p_s = p_{s'}$ is

$$\left(q_s + q_{s'}\right) + \left(p_s - w_s\right)\left(\partial_1 D + \partial_2 D\right) + \left(p_{s'} - w_{s'}\right)\left(\partial_1 D + \partial_2 D\right) = 0. \tag{A-13}$$

Note that, in a symmetric equilibrium with $w_s = w_{s'}$, this first order condition is the same as that for the case of two-part tariffs without vertical restraints (see (B-1) in online Appendix B.2), since in a symmetric equilibrium the constraint $p_s = p_{s'}$ is just binding. The comparative

statics of equilibrium retail prices and quantities with respect to wholesale prices implied by (A-13) are, however, very different from those implied by (B-1) for the case of two-part tariffs. Totally differentiating (A-13) with respect to w_s and $p_s = p_{s'}$ and rearranging one obtains

$$\frac{dp_s}{dw_s} = \frac{dp_{s'}}{dw_s} = \frac{(\partial_1 D + \partial_2 D)}{A + B} > 0, \tag{A-14}$$

where A and B are defined in (B-5) and (B-6) in online Appendix B.2 and the sign follows from the fact that $(\partial_1 D + \partial_2 D) < 0$ and, when Assumption 2 holds, $A + B < 0$. An equal increase in all prices around a symmetric equilibrium causes an equal decrease in all quantities

$$\frac{dq_s}{dw_s} = \frac{dq_{s'}}{dw_s} = (\partial_1 D + \partial_2 D + \partial_3 D + \partial_4 D) \frac{dp_s}{dw_s} < 0, \tag{A-15}$$

where the sign follows from $(\partial_1 D + \partial_2 D + \partial_3 D + \partial_4 D) < 0$ and $dp_s/dw_s > 0$.

Cournot downstream competition – The first order condition with respect to either quantity for a retailer facing the constraint $q_s = q_{s'}$ is

$$(p_s - w_s) + (p_{s'} - w_{s'}) + (q_s + q_{s'})(\partial_1 P + \partial_2 P) = 0. \tag{A-16}$$

Totally differentiating (A-16) one obtains

$$\frac{dq_s}{dw_s} = \frac{dq_{s'}}{dw_s} = \frac{1}{2(X + Y)} < 0 \tag{A-17}$$

where X and Y are defined in (B-15) and (B-16) in online Appendix B.2 and the sign follows from the conditions in Assumption 2 (see also (B-14) in online Appendix B.2).■

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APPENDIX B

This appendix provides a detailed discussion of the main assumptions of the model (Section B.1), derives in detail the regularity conditions on demand introduced in Assumption 2 (Section B.2), provides the proofs of Propositions 2, 3, 4, 5 and of Lemma 3 (Section B.3), and presents the solution of the linear demand example introduced in Section 3.5 for the case of Cournot downstream competition (Section B.4).

B.1   Discussion of assumptions

Bargaining and the set of admissible contracts – As discussed in the introduction, for this model to have delegated common agency equilibria retailers must retain a sufficiently large portion of the surplus generated by each supplier. I allow for this possibility by assuming that the surplus generated by the single contract offered by the supplier is split by the supplier and the retailer through Nash bargaining, with a share $(1 - \beta)$ going to the retailer. Another possible approach would be to assume that suppliers make take-it-or-leave-it offers, but offer menus of contracts instead of a single contract. In that approach each supplier would offer each retailer both a contract that is designed to be selected in a common agency equilibrium and a contract that is not designed to be selected in that equilibrium, but to be instead selected in the off-equilibrium eventuality that the retailer decided to represent that supplier exclusively. When the off-equilibrium contracts offered by the two suppliers specify sufficiently favorable prices, they may boost the retailer's outside options, and thus its equilibrium profits, sufficiently to ensure the existence of a common agency equilibrium.[42] As discussed by Klemperer and Meyer (1989), this approach is, however, not robust to the introduction of uncertainty, since with uncertainty suppliers may not find it profitable to offer excessively low prices in contracts that can be selected with some probability.

Binding and publicly observable contract offers – The purpose of this assumption is to rule out opportunism in contract negotiations. As discussed by O'Brien and Shaffer (1992) and McAfee

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[42]This approach is adopted by Miklós-Thal, Rey and Vergé (2011) and Rey and Whinston (2013) in models with one supplier and two retailers and by Calzolari and Denicolò (2013) in a model with two suppliers, one retailer and asymmetric information. Obviously, a combination of this approach and the one I adopt in this paper would *a fortiori* ensure that the retailer obtains a sufficiently high surplus from each product. Note that most of the conclusions of my paper, and in particular its predictions regarding the implications of different types of vertical contracts for social and consumer welfare in common agency equilibria, are unaffected by the specific approach adopted to ensure the existence of such equilibria.

and Schwartz (1994) for the case of a monopolistic supplier and many retailers, if retailers were not able to observe the contract offers received by their competitors or if those offers were not binding, the supplier would have an incentive to lower the wholesale price offered to one of the retailers after all other retailers have accepted their contracts (and paid the fixed fees associated with those contracts). This type of opportunism would be present also in a multi-supplier setting like the one studied in this paper, see e.g. Nocke and Rey (2012), and would undermine a supplier's ability to use vertical contracts to soften downstream competition, since retailers would be unwilling to commit to contracts with relatively high wholesale prices. In order to derive a number of new results on upstream competition with vertical contracts, I rule out this possibility by assuming that each retailer observes the contract offers received by its rivals and that those offers are binding. Note that, although perfect observability of other contracts can be a strong assumption in many settings, assuming that retailers do not have, or cannot infer, any information at all on the contracts offered by their rivals is not very realistic either. For example, in industries in which the same small number of suppliers and retailers interact repeatedly over time by signing contracts that are often staggered, a retailer can infer the wholesale price in its rivals' supply contracts by observing the retail prices charged by those rivals.

Suppliers need to sell through both retailers to be active – Assumption 1 simplifies the analysis considerably in two respects, without significantly affecting the main qualitative results of the paper (except for its implications for the range of the bargaining power parameter β over which common agency equilibria exist, discussed further below).[43] First, it ensures that, in any negotiation with retailers over fixed fees, each supplier's outside option is zero. This greatly simplifies the solution of the bilateral bargaining model.[44] Second, it ensures that the wholesale price w_{sr} offered by each supplier s to each retailer r does not affect the outside option of the other retailer, r', in its negotiation with supplier s. This implies that supplier s has no rent-shifting motives when choosing wholesale prices and always offers the w_{sr} and $w_{sr'}$ that maximize the joint surplus from

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[43]Note that, notwithstanding Assumption 1, the model remains fundamentally one of *delegated* common agency, since each retailer can choose whether to carry both products or only one of them when the other retailer carries both products. It is, however, a particular type of delegated common agency, since a retailer's ability to carry both products depends on the actions of the other retailer. In this sense, Assumption 1 causes my model to have some elements of models of naked exclusion that rely on externalities between buyers (see Rasmusen, Ramseyer and Wiley (1991), Segal and Whinston (2000), and subsequent contributions). The focus of my paper is, however, quite different from that of those models, since I mostly study common agency equilibria and, even when I analyze equilibria with exclusive contracts in Section 6, I do so in a context of competition for exclusives between two equally situated suppliers.

[44]The predictions of the bargaining model are, however, still sufficiently rich, as the outside option of each retailer still depends on the terms negotiated in the contract between that retailer and the other supplier.

trading with the retailers. To see why the choice of wholesale prices by supplier s may be affected by rent-shifting motives in the absence of Assumption 1, note that if retailer r' were to disagree with supplier s its outside option would be equal to the profits that it could earn by selling only good s' in competition with retailer r, and those profits would be lower the lower is w_{sr} (since a lower w_{sr} would make retailer r a more aggressive competitor). In light of this, supplier s would have an incentive to lower w_{sr} below the level that would be jointly optimal for s and r, in order to boost its bargaining position vis-à-vis retailer r' (an analogous reasoning would apply to $w_{sr'}$). When Assumption 1 instead holds, supplier s would have to exit the market in case of disagreement with either retailer and the wholesale prices it offers are therefore irrelevant for the retailers' outside options. This rules out any rent-shifting motives to lower wholesale prices below the level that maximizes joint surplus. Although those motives may be of independent interest in other contexts, they are not closely related to the main effects that this paper sets out to study and would significantly complicate the analysis.[45]

Finally, note that, in the absence of this assumption, if retailers had all the bargaining power they would always find it profitable to induce suppliers to exclude the other retailer, for the same reasons that suppliers find it profitable to exclude each other when they have all the bargaining power. In that case, equilibria in which both retailers are active, and in which wholesale prices are therefore above marginal cost, would exist only for intermediate ranges of β, with the width of the range depending on the degree of product and retailer differentiation. When Assumption 1 holds, instead, a retailer cannot induce a supplier to exclude the other retailer (unless it can pay that supplier to exit the market, which I rule out by assumption), since this would entail that the supplier itself would have to exit the market.

No uncertainty – In the absence of uncertainty, the solution concept adopted in the present paper (subgame perfection) does not impose any restriction on the off-the-equilibrium shape of the pricing schedules, even though, as discussed in Sections 4 and 5.2, that shape may be crucial for determining the equilibrium outcomes of the game and lead to the existence of a very large number of equilibria. However, as discussed in footnote 29 and shown by Klemperer and Meyer (1989), this result is not robust to the introduction of uncertainty. The fact that, in the presence of uncertainty, the off-equilibrium portions of pricing schedules may be reached with some probability may greatly

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[45]This issue arises also in Inderst and Shaffer (2010), who also rule out rent-shifting motives by assumption. In particular, they assume that the contract between any supplier s and retailer r is renegotiated whenever retailer r' rejects the contract offered by supplier s.

reduce the suppliers' freedom in specifying those portions and may significantly shrink the set of equilibria. For example, in the specific case of the quantity-forcing contracts studied in this section, one could argue that, if there were a non-negligible probability that one or more retailers experienced a negative demand shock, the suppliers may not find it optimal to refuse to sell any quantity below the threshold $\underline{q}$. Note that this potential limitation is not specific to my analysis, but is shared by other contributions to the literature on the topic, such as Inderst and Shaffer (2010), and by virtually every applied antitrust analysis of all-units discounts. Notwithstanding this, quantity-forcing contracts (or share-forcing contracts, as those studied in the next section) are increasingly common in reality. This may be so for a number of reasons: perhaps these contracts are adopted mostly in sectors or situations in which suppliers are not excessively concerned about uncertainty, or perhaps they have benefits (not modeled here) that outweigh their potential costs in the face of uncertainty.[46] Regardless of the specific reasons for their adoption, these contracts may have significant implications for pricing incentives and equilibrium outcomes when they are adopted; and the analysis in this section sheds some light on those implications.

B.2   Restrictions on demand (Assumption 2)

In this section I derive the restrictions on the primitives of the demand system that, in the absence of vertical restraints, ensure that the equilibrium of the downstream multiproduct duopoly has the comparative static properties introduced in Assumption 2. Note that, although those comparative static properties are the same as those assumed by Rey and Vergé (2010) for the case of Bertrand downstream competition (Rey and Vergé do not analyze the case of Cournot downstream competition), in this paper I need to characterize explicitly the restrictions on the primitives of the demand system that give rise to those comparative static properties. This is made necessary by the fact that in Section 5 I characterize the implications of restraints that reference rivals for the comparative static properties of the downstream equilibrium *under the same restrictions on the primitives of the demand system*. As shown in that section, equilibrium quantities respond in very different ways to changes in wholesale prices in the absence and in the presence of restraints that reference rivals, with important implications for the overall equilibrium of the model.

Note that, as in Rey and Vergé (2010), symmetry of the demand system implies that, for any $w_{s'r} = w_{s'r'} = w_{s'}$, the profit function of supplier s, as given by Π_s in (8), is symmetric in w_{sr} and

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[46]See, for example, Kolay, Shaffer and Ordover (2004).

$w_{sr'}$. This implies that, for any $w_{s'r} = w_{s'r'} = w_{s'}$, maximization of Π_s requires $w_{sr} = w_{sr'} = w_s$ and that the optimal w_s must therefore satisfy $\partial\Pi_s\left(w_s, w_s, w_{s'}, w_{s'}\right)/\partial w_s = 0$. Given this and the fact that throughout the paper I consider only symmetric equilibria, I can limit myself to characterizing the response of downstream equilibrium prices $p_{sr} = p_{sr'} = p_s$ and $p_{s'r} = p_{s'r'} = p_{s'}$ and quantities $q_{sr} = q_{sr'} = q_s$ and $q_{s'r} = q_{s'r'} = q_{s'}$ to simultaneous changes in $w_{sr} = w_{sr'} = w_s$, for given $w_{s'r} = w_{s'r'} = w_{s'}$, around symmetric equilibria in which $w_s = w_{s'} = w$, and thus $p_s = p_{s'} = p$ and $q_s = q_{s'} = q$. I first analyze the case of Bertrand competition and then the case of Cournot competition.

Bertrand downstream competition

Given the symmetric demand system $q_{sr} = D(p_{sr}, p_{s'r}, p_{sr'}, p_{s'r'})$ and the notation for derivatives introduced in footnote 12, consider the first order conditions of either retailer with respect to p_s and $p_{s'}$

$$q_s + (p_s - w_s)\,\partial_1 D + (p_{s'} - w_{s'})\,\partial_2 D \;=\; 0 \tag{B-1}$$

$$q_{s'} + (p_s - w_s)\,\partial_2 D + (p_{s'} - w_{s'})\,\partial_1 D \;=\; 0 \tag{B-2}$$

Totally differentiating (B-1) and (B-2) with respect to all four retail prices around a symmetric equilibrium with $w_s = w_{s'} = w$ (and keeping in mind that $dp_{sr} = dp_{sr'} = dp_s$ and $dp_{s'r} = dp_{s'r'} = dp_{s'}$) one obtains the following two equations characterizing the response of p_s to changes in $p_{s'}$, and vice versa, around a symmetric equilibrium.

$$A dp_s + B dp_{s'} \;=\; 0 \tag{B-3}$$

$$B dp_s + A dp_{s'} \;=\; 0 \tag{B-4}$$

where

$$A \;\equiv\; 2\partial_1 D + \partial_3 D - \frac{\partial_{11}^2 D + \partial_{13}^2 D + \partial_{22}^2 D + \partial_{24}^2 D}{\partial_1 D + \partial_2 D} q \tag{B-5}$$

$$B \;\equiv\; 2\partial_2 D + \partial_4 D - \frac{\partial_{12}^2 D + \partial_{14}^2 D + \partial_{21}^2 D + \partial_{23}^2 D}{\partial_1 D + \partial_2 D} q \tag{B-6}$$

Note that (B-3) and (B-4) are similar to, but not the same as, typical reaction functions in single product duopolies, as they encompass both elements of inter-retailer reactions (e.g. the optimal choice of p_{sr} given $p_{sr'}$) and elements of intra-retailer choices (e.g. the optimal choice of p_{sr} given $p_{s'r}$, and vice versa). From (B-3) and (B-4) it is straightforward to see that stability of the Bertrand equilibrium requires the following restrictions on demand

$$A < 0 \text{ and } |A| > |B| \tag{B-7}$$

The stability conditions in (B-7) do not necessarily imply that p_s and $p_{s'}$ are strategic comple-ments, since the latter would be the case only if the the most stringent condition $|A| > B > 0$ were also satisfied. Given that strategic complementarity is not required for the results in the paper (in fact, the results hold also for Cournot downstream competition under the fairly general conditions derived further below), I do not impose the restriction that $B > 0$. By totally differentiating (B-1) and (B-2) with respect to w_s, p_s and $p_{s'}$ around a symmetric equilibrium one obtains

$$\frac{dp_s}{dw_s} = \frac{A\partial_1 D - B\partial_2 D}{A^2 - B^2} \tag{B-8}$$

$$\frac{dp_{s'}}{dw_s} = \frac{A\partial_2 D - B\partial_1 D}{A^2 - B^2} \tag{B-9}$$

The stability conditions in (B-7) imply that

$$\frac{dp_s}{dw_s} > \frac{dp_{s'}}{dw_s} \text{ and } \frac{dp_s}{dw_s} + \frac{dp_{s'}}{dw_s} > 0 \tag{B-10}$$

Moreover, if

$$\frac{A\partial_1 D - B\partial_2 D}{A\partial_2 D - B\partial_1 D} > -\frac{\partial_1 D + \partial_3 D}{\partial_2 D + \partial_4 D} > 1, \tag{B-11}$$

the derived demand faced by each of the two suppliers has positive cross-derivatives and the total quantity is decreasing in any wholesale price, i.e.

$$\frac{dq_s}{dw_s} > 0 > \frac{dq_{s'}}{dw_s} \text{ and } \frac{dq_s}{dw_s} + \frac{dq_{s'}}{dw_s} < 0 \tag{B-12}$$

As shown in the *Mathematica* code enclosed with this submission, the regularity conditions in (B-7) and (B-11) always hold for the linear demand system in (13). In fact, since $B = (2 + b)\, a > 0$, with linear demand p_s and $p_{s'}$ are strategic complements.

Cournot downstream competition

Given the symmetric inverse demand system $p_{sr} = P(q_{sr}, q_{s'r}, q_{sr'}, q_{s'r'})$ and the notation for derivatives introduced in footnote 12, consider the first order conditions of either retailer with respect to q_s and $q_{s'}$

$$(p_s - w_s) + \partial_1 P q_s + \partial_2 P q_{s'} = 0 \tag{B-13}$$

By a logic analogous to the one outlined above for the case of Bertrand competition, stability of the Cournot equilibrium requires

$$X, Y < 0 \text{ and } |X| > |Y| \tag{B-14}$$

where

$$X \equiv 2\partial_1 P + \partial_3 P - \left(\partial_{11}^2 P + \partial_{13}^2 P + \partial_{22}^2 P + \partial_{24}^2 P\right) q \tag{B-15}$$

$$Y \equiv 2\partial_2 P + \partial_4 P - \left(\partial_{12}^2 P + \partial_{14}^2 P + \partial_{21}^2 P + \partial_{23}^2 P\right) q \tag{B-16}$$

Moreover, total differentiation of (B-13) yields the following comparative statics

$$\frac{dq_s}{dw_s} = \frac{X}{X^2 - Y^2} \tag{B-17}$$

$$\frac{dq_{s'}}{dw_s} = -\frac{Y}{X^2 - Y^2} \tag{B-18}$$

The stability conditions in (B-14) imply that

$$\frac{dq_{s'}}{dw_s} > 0 > \frac{dq_s}{dw_s} \text{ and } \frac{dq_s}{dw_s} + \frac{dq_{s'}}{dw_s} < 0 \tag{B-19}$$

and it is straightforward to verify that this implies

$$\frac{dp_s}{dw_s} + \frac{dp_{s'}}{dw_s} > 0. \tag{B-20}$$

As shown in the *Mathematica* code enclosed with this submission, the conditions in (B-14) are always satisfied by the linear demand system in (13).

B.3 Proofs of Propositions 2, 3, 4, 5 and Lemma 3

Proof of Proposition 2:

I first prove that there exists no profitable deviation to alternative contracts that would also induce common agency and then I derive the conditions under which there exists no profitable deviation to exclusivity.

No profitable deviation to alternative common agency contracts – This part of the proof proceeds in two steps. I first establish that each supplier is indifferent between implementing a given profile of downstream quantities using a two-part tariff contract and using a quantity-forcing contract, so that a quantity-forcing contract is a (weak) best response. I then show that, starting from any candidate symmetric common agency equilibrium with quantity-forcing contracts and $w^v \in [w^t, w^m]$, there exists no profitable deviation to alternative contracts that induce common agency.

Given that any desired distribution of profits can be achieved through fixed fees, each supplier s is free to use w_s to ensure that, given any profile of contracts offered by supplier s', downstream competition yields any profile of quantities $\mathbf{q}$ necessary to maximize Π_s. In light of this, supplier s

cannot increase its profits by including minimum volume requirements in its contracts. Given an optimal choice of w_s, a contract with a minimum volume requirement that were *just* binding would, nevertheless, leave the supplier's profits unchanged and would thus be a (weak) best response. The next step is then to determine the wholesale prices that can be sustained as equilibria with such contracts. Consider a candidate symmetric common agency equilibrium with quantity-forcing contracts specifying $w_s = w^v$ for $q_s \geq \underline{q} = q^v$ (and a much higher w_s for the off-equilibrium case in which $q_s < \underline{q}$), with $w^v \in \left[w^t, w^m\right]$ and $\underline{q} = q^v \in \left[q^m, q^t\right]$. Starting from this candidate equilibrium, consider first a deviation to a contract specifying $w_s < w^v$ and $\underline{q}_s > q^v$. By Assumption 2, absent the minimum volume requirements $q_{s'} \geq \underline{q}$ imposed by supplier s', such a deviation would give retailers incentives to reduce $q_{s'}$. However, given $q_{s'} \geq \underline{q}$, such a deviation can only have one of two effects: either i) it preserves common agency and leaves $q_{s'}$ unaffected, or ii) it induces exclusivity by causing the retailers to set $q_{s'} = 0$. Case ii) is discussed in the second part of the proof. Case i), instead, implies that $d\Pi_{s'}/dw_s|_{w_s=w^{v-}} = 0$ and thus that $d\Pi_s/dw_s|_{w_s=w^{v-}} = dV/dw_s$ in (9). Since V is maximized at w^m and everywhere concave, $d\Pi_s/dw_s|_{w_s=w^{v-}} > 0$ at any $w_s < w^v \leq w^m$. This establishes that, starting from any $w^v \leq w^m$, lowering w_s below w^v is not a profitable deviation.

Consider next a deviation to a contract with $w_s > w^v$ and $\underline{q}_s < q^v$. By Assumption 2, this deviations gives retailers incentives to increase $q_{s'}$, and thus makes the minimum volume requirements imposed by supplier s' non-binding. This implies that $d\Pi_s(w^v)/dw_s$ to the right of w^v is the same as in (9). Given that Π_s is maximized at $w^t \leq w^v$ and concave, $d\Pi_s(w^v)/dw_s < 0$, which implies that raising w_s above any $w^v \geq w^t$ is not a profitable deviation. Taken together, these results imply that, with quantity-forcing contracts contingent only on own volume, any $w^v \in \left[w^t, w^m\right]$ can be sustained as a symmetric common agency equilibrium, unless a deviation to exclusivity is profitable (see the second part of the proof). Finally, I conclude this part of the proof by showing that neither $w^v < w^t$ nor $w^v > w^m$ can be symmetric common agency equilibria. When $w^v < w^t$, there always exists a profitable deviation to contracts with $w_s > w^v$ which would preserve common agency and increase Π_s (since Π_s is maximized at $w^t > w^v$). When instead $w^v > w^m$, there always exists a profitable deviation to a $w_s < w^v$, since such a deviation would not affect $q_{s'}$ whenever $q_{s'} > 0$ and would increase total industry profits, V, thus increasing Π_s.

No profitable deviation to exclusivity – The existence of common agency equilibria can be proven with a logic analogous to that in the proof of Proposition 1, with the only difference that the common agency equilibria in this proposition are more profitable, and thus more likely to exist, than those in Proposition 1. In particular, since with quantity-forcing contracts the outcome that

maximizes total industry profits, q^m, can always be sustained in a common agency configuration, and since $V^e < V^m$, there always exist at least one common agency configuration for which the necessary condition $V^e_{\backslash s'} - V^v < 0$ is satisfied. $\blacksquare$

Proof of Lemma 3:

Consider a contract $\widehat{C}_s$, offered by supplier s to both retailers, that does not include any binding restraints that reference rivals and specifies a wholesale price $\widehat{w}_s$ that maximizes Π_s, given the absence of any restraints that reference rivals in $\widehat{C}_s$ and given the contract $C_{s'}$ offered by supplier s' to both retailers, i.e. $\partial \Pi_s (\widehat{w}_s, w_{s'})/\partial w_s = 0$. Such a contract is always dominated by a contract that references rivals, $\widetilde{C}_s$, with restraints that are just binding (i.e. restraints that induce the same relative retail prices $\widehat{p}_{s'}/\widehat{p}_s$ and relative quantities $\widehat{q}_{s'}/\widehat{q}_s$ as those that prevail under the contract $\widehat{C}_s$) and a wholesale price $\widetilde{w}_s > \widehat{w}_s$. To see this note that a restraint that is just binding leaves the value of $\Pi_s (\widehat{w}_s, w_{s'})$ unchanged but implies $\partial \Pi_s (\widehat{w}_s, w_{s'})/\partial w_s|_{w_s = \widehat{w}_s^+} > 0$ for small increases in w_s above $\widehat{w}_s$, which in turn implies that there always exists a $\widetilde{w}_s > \widehat{w}_s$ such that $\Pi_s (\widetilde{w}_s, w_{s'}) > \Pi_s (\widehat{w}_s, w_{s'})$ and thus that the adoption of non-exclusive CRRs is a dominant strategy for both suppliers. The fact that $\partial \Pi_s (\widehat{w}_s, w_{s'})/\partial w_s|_{w_s = \widehat{w}_s^+} > 0$ with CRRs follows from the fact that, by Lemma 2, $dq_{s'}/dw_s < 0$ and thus $\partial \Pi_{s'}/\partial w_s < 0$. $\blacksquare$

Proof of Proposition 3: Lemmas 3 and 4 have already established that in any common agency equilibrium both suppliers adopt non-exclusive CRRs and that, when the equilibrium is symmetric, these contracts lead to $w^c > w^m$, $p^c > p^m$ and $q^c < q^m$. The fact that, when the necessary condition $V^e - V^c < 0$ holds, such a symmetric common agency equilibrium exists for sufficiently low values of β can be proven by a logic identical to that in Proposition 1, the details of which are omitted here. An important difference with respect to the results characterized in Proposition 1 for the case of two-part tariffs is, however, that with non-exclusive CRRs one cannot conclude unambiguously that the necessary condition $(V^e - V^c) < 0$ is always satisfied when the degree of product substitutability tends to zero. This is because with non-exclusive CRRs the retailers always act as if the products were perfect complements regardless of the actual degree of product substitutability, which implies that the resulting pricing inefficiencies persist even when the products are completely independent in demand. When this is the case, one can only conclude that $V^c < 2V^e$, which is not sufficient to sign the difference $(V^e - V^c)$ unambiguously. One should, however, note that when the products are highly differentiated the loss in variety from a deviation to exclusivity is significant, which tends to make V^e small relative to V^c and thus the necessary

condition more likely to hold. The linear demand example discussed at the end of this section confirms this intuition. ■

Proof of Proposition 4:

This proof, like the proof of Proposition 2 above, first shows that there exists no profitable deviation to alternative common agency contracts and then derives the conditions under which there exists no profitable deviation to exclusivity.

No profitable deviation to alternative common agency contracts – Starting from any candidate symmetric common agency equilibrium with $w^{cv} \in [w^m, w^c]$ and $\underline{q}^{cv} \in [q^c, q^m]$, consider first a deviation by supplier s to a contract with $w_s > w^{cv}$. Since $w^{cv} \leq w^c$ and w^c maximizes the supplier's profits with CRRs without minimum volume requirements, such a deviation would be profitable in the absence of minimum volume requirements (except, obviously, for $w^{cv} = w^c$). However, in the presences of the minimum volume requirement imposed by supplier s' such a deviation either (i) preserves common agency and is unprofitable, because it does not affect $\Pi_{s'}$ and it reduces total industry profits (since $w^{cv} > w^m$), or (ii) leads to exclusivity by inducing the retailers to drop product s' (see the second part of the proof for this case).

Consider next a deviation by supplier s to a contract with $w_s < w^{cv}$. In the presence of the restraints on *relative* prices or quantities imposed by supplier s', such a deviation would induce the retailer to increase sales of both products, rendering the (*absolute*) minimum volume requirement of supplier s' non-binding. This makes the problem equivalent to that without minimum volume requirements studied in Proposition 3: since Π_s is maximized at $w^c > w^{cv}$, lowering w_s below w^{cv} would reduce Π_s and thus be unprofitable. This establishes that any symmetric common agency equilibrium with $w^{cv} \in [w^m, w^c]$ is immune to deviations to other contracts that would still induce common agency. Finally, one needs to prove that neither $w^{cv} < w^m$ nor $w^{cv} > w^c$ can be symmetric common agency equilibria. If $w^{cv} < w^m$, there would always exist a profitable deviation to contracts with $w_s > w^{cv}$. Such a deviation would make the minimum volume requirement imposed by supplier s' non-binding and increase Π_s, since when the minimum volume requirement imposed by supplier s' is non-binding Π_s is maximized at $w^c > w^m > w^{cv}$. If instead $w^{cv} > w^c > w^m$, there would always exist a profitable deviation to a $w_s < w^{cv}$, since such a deviation would not affect $q_{s'}$ whenever $q_{s'} > 0$ and would increase total industry profits, V, thus increasing Π_s.

No profitable deviation to exclusivity – Deviations to exclusivity can be studied using the same logic outlined in the proofs of Propositions 1, 2 and 3, the details of which are omitted here. Note that, for the candidate equilibrium that implements the monopoly outcome, q^m, the necessary

condition $V^e - V^{cv} < 0$ is always satisfied when the products are imperfect substitutes. This is, however, not necessarily the case for more inefficient candidate equilibria with significantly lower quantities, even when the products are poor substitutes (see the discussion in the proof of Proposition 3). ∎

Proof of Proposition 5:

The existence of an exclusive equilibrium is straightforward: if supplier s' offers only an exclusive contract, it is always a (weak) best response for supplier s to offer also an exclusive contract, since either $q_{sr} = 0$ when $q_{s'r} > 0$ (and thus the structure of the contract offered by s is irrelevant) or $q_{s'r} = 0$ when $q_{sr} > 0$ (and thus supplier s can do as well with an explicit exclusive contract as with any other contract). As for the properties of such an equilibrium:

Part 1: Note that, when both suppliers offer exclusive contracts, each retailer must choose only one supplier. To account for this, I assume that after the negotiation of fixed fees in stage 1.(b) the retailer chooses the supplier that allows it to obtain the highest profit and, in case of a tie, chooses either supplier with some positive probability (the exact tie-breaking rule does not affect the result). Consider exclusive contracts in which each supplier offers the same wholesale price to both retailers in stage 1.(a), so that $\Pi_{r\backslash i} = \Pi_{r'\backslash i} = \Pi_{\backslash i}$ for $i = s, s'$ (it is straightforward to show that, because retailers enter demand symmetrically, asymmetric offers to retailers would be dominated). When both suppliers offer exclusive contracts, the bargaining problem in stage 1.(b) is the same as in (A-7). In particular, given wholesale prices $w_{s\backslash s'}$ and $w_{s'\backslash s}$, the incremental profits earned by either retailer r if it accepts the exclusive contract offered by supplier s instead of that offered by supplier s' is

$$\Pi_{r\backslash s'}\left(w_{s\backslash s'}\right) - \Pi_{r\backslash s}\left(w_{s'\backslash s}\right) = \frac{(1-\beta)}{2}\left[V_{\backslash s'}\left(w_{s\backslash s'}\right) - V_{\backslash s}\left(w_{s'\backslash s}\right)\right] \tag{B-21}$$

This shows that the retailer chooses the contract that maximizes total industry profits (conditional on exclusivity). The total profits earned by supplier s through both retailers when it offers $w_{s\backslash s'}$ are

$$\Pi_{s\backslash s'}\left(w_{s\backslash s'}\right) = \begin{cases} \beta\left[V_{\backslash s'}\left(w_{s\backslash s'}\right) - V_{\backslash s}\left(w_{s'\backslash s}\right)\right] & \text{if } V_{\backslash s'}\left(w_{s\backslash s'}\right) \geq V_{\backslash s}\left(w_{s'\backslash s}\right) \\ \\ 0 & \text{otherwise} \end{cases} \tag{B-22}$$

Denote by w^e the wholesale price that maximizes $V_{\backslash s'}\left(w_{s\backslash s'}\right)$ and $V_{\backslash s}\left(w_{s'\backslash s}\right)$. One can use (B-21) and (B-22) to show that $w_{s\backslash s'} \neq w^e$ and $w_{s'\backslash s} \neq w^e$ cannot be an equilibrium. If $w_{s\backslash s'} \neq w^e$ and $w_{s'\backslash s} \neq w^e$, at least one of the two suppliers (say s) would profit by deviating to $w_{s\backslash s'} = w^e$,

since by doing so it would win exclusivity and strictly increase its profits (to see this note that $w_{s'\backslash s} \neq w^e$ and, by the definition of w^e, one has $V_{\backslash s'}(w^e) > V_{\backslash s}(w_{s'\backslash s})$ in (B-21) and (B-22) above). This establishes that at least one of the two (and possibly both) wholesale prices must be equal to w^e and that w^e is always the wholesale price in the contracts that are selected in equilibrium (and thus that retail prices are p^e in any exclusive equilibrium). Note, however, that the equilibrium does not necessarily require both wholesale prices to be equal to w^e. If $w_{s\backslash s'} = w^e$, supplier s' obtains zero profit no matter what wholesale price $w_{s'\backslash s}$ it offers in stage 1.(a) and thus any $w_{s'\backslash s}$ is a best response. This also implies that in an equilibrium with $w_{s\backslash s'} = w^e$ and any $w_{s'\backslash s}$ the profits earned by supplier s in (B-22) can take any value. However, if one imposes a strict symmetry criterion and requires all contracts to be identical, the only equilibrium has both wholesale prices equal to w^e and both suppliers earning zero profits and charging fixed fees $F^e = -(w^e - c) q^e < 0$.

Part 2: In a symmetric equilibrium with exclusive contracts suppliers obtain zero profits, and thus $\Pi_r = V_r$ (i.e. retailers appropriate all industry profits). In an asymmetric equilibrium in which one supplier offers $w_{s\backslash s'} = w^e$ and the other $w_{s'\backslash s} \neq w^e$, supplier s earns positive profits and thus $\Pi_r \leq V_r$. Compare these outcomes to common agency equilibria with non-exclusive contracts when $\beta = 0$ (i.e. when the retailers have all the bargaining power). In such common equilibria the retailer would also appropriate all industry profits. Since for a common agency equilibrium with two-part tariffs to exist it must be $V^e < V^t$, when $\beta = 0$ retailers are always worse off in an exclusive equilibrium than in an equilibrium with two part tariffs (an analogous conclusion applies to a common agency equilibrium with non-exclusive CRRs, for which it must be $V^e < V^c$). By continuity, there exist values of β sufficiently close to zero for which the retailer is worse off with competition for exclusives.

Part 3: As established in part 1, in any exclusive equilibrium retail prices are p^e. These prices can be higher or lower than the prices in a common agency equilibrium with two-part tariffs, p^t, or with non-exclusive CRRs, p^c, and with general demand functions one cannot establish any general result regarding consumer welfare (see discussion in the text, in particular footnote 38) However, with linear demand, consumer welfare is lower in an exclusive equilibrium than in a common agency equilibrium with two-part tariffs under any configuration of parameters and than in a common agency equilibrium with non-exclusive CRRs for the configurations of parameters shown in Figure 6. ∎

B.4 Linear demand example with Cournot downstream competition

The results for the linear demand example presented in the body of the paper have been derived under the assumption of Bertrand downstream competition. Since the demand system introduced in (13) can be inverted to yield a well-defined inverse demand system in which each price is decreasing in the quantity of every product, an analogous set of results can be derived under the assumption of Cournot downstream competition. In this section I present and briefly discuss these results and compare them to the results presented in the main body of the paper for the case of Bertrand downstream competition.[47] As explained in Section 2.2, the qualitative conclusions of the paper do not differ when one assumes Cournot instead of Bertrand downstream competition.

Two-part tariffs – Figure 7 below shows the wholesale price (left panel) and equilibrium industry profits (right panel) in a symmetric common agency equilibrium with two-part tariffs and Cournot downstream competition.
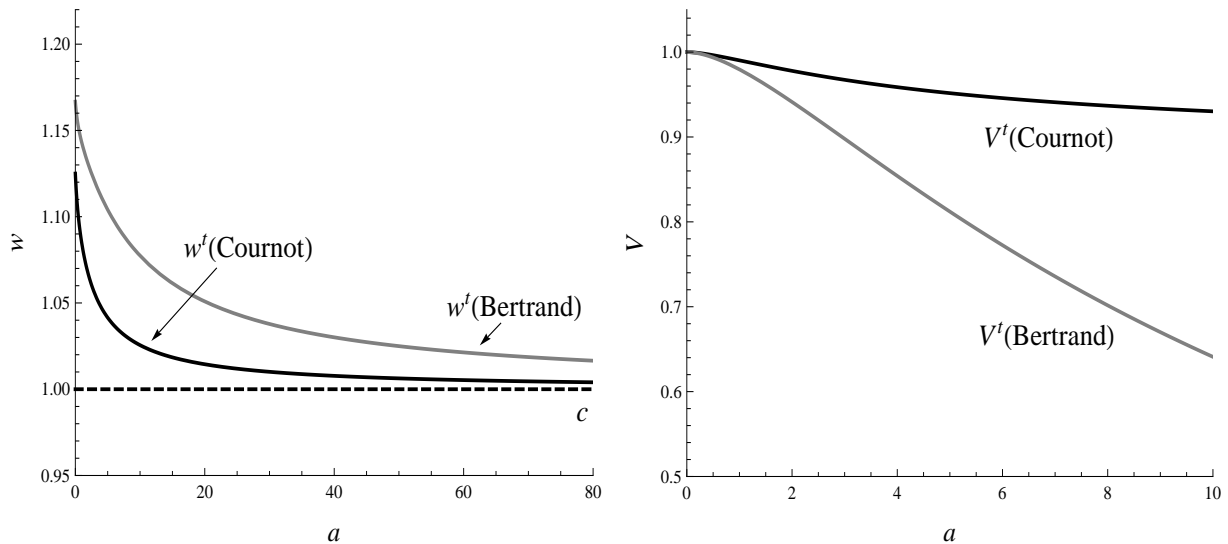

Figure 7: Two-part tariff equilibrium with Cournot downstream competition.

Note that the equilibrium wholesale price is lower with Cournot than with Bertrand downstream competition. This is due to the fact that, all else equal, an increase in the wholesale price offered to any retailer r is more effective in raising overall industry profits with Bertrand than with Cournot downstream competition. With Bertrand downstream competition the resulting increase in p_r is

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[47]The details of the derivation of the results can be found in the Mathematica code enclosed with this submission.

accompanied by an increase in $p_{r'}$ (because of strategic complementarity) and thus causes a larger increase in equilibrium prices and reduction in equilibrium output than with Cournot downstream competition, where the resulting reduction in q_r is instead accompanied by an increase in $q_{r'}$ (because of strategic substitutability). This notwithstanding, as shown in the right panel of Figure 7, equilibrium industry profits are higher with Cournot than with Bertrand downstream competition, since Cournot is generally less competitive than Bertrand. This contributes to explaining why a common agency equilibrium exists for a broader range of parameters with Cournot than with Bertrand downstream competition, as shown in Figure 8.
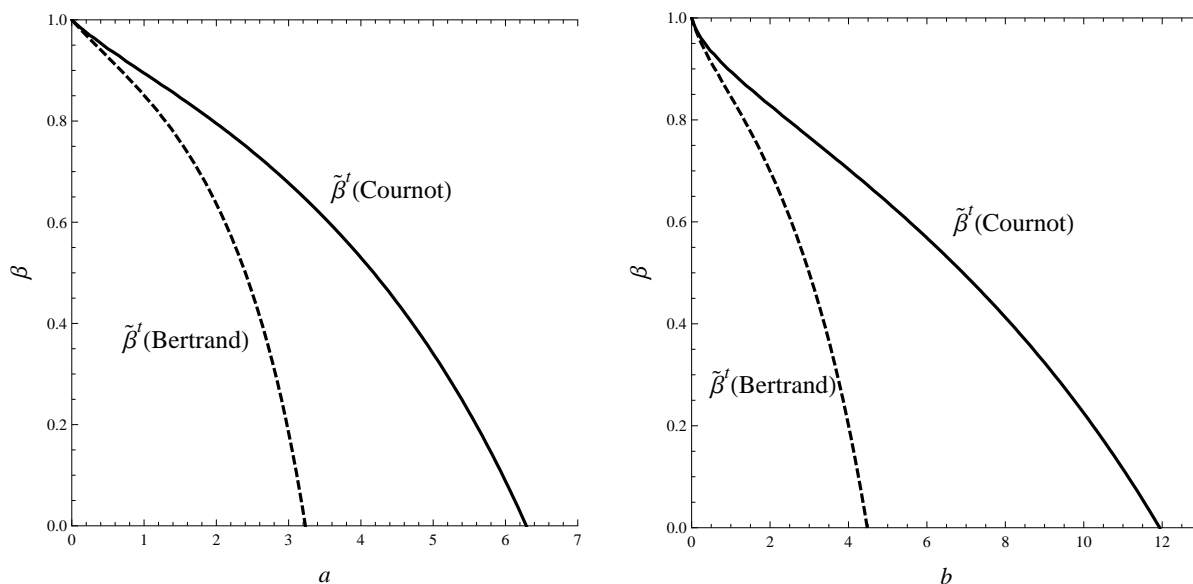

Figure 8: Existence of common agency equilibrium with two-part tariffs and Cournot competition.

CRRs without minimum volume requirements – Figure 9 below shows the equilibrium wholesale price (left panel) and equilibrium industry profits (right panel) in a symmetric common agency equilibrium with CRRs and Cournot downstream competition. Just as in the case of two-part tariffs, illustrated in Figure 7 above, also in the case of CRRs the fact that the actions of retailers are strategic substitutes with Cournot and strategic complements with Bertrand leads to lower equilibrium wholesale prices with Cournot than with Bertrand downstream competition, while the fact that Cournot is less competitive than Bertrand explains the fact that industry profits are higher with Cournot than with Bertrand downstream competition. As shown in Figure 10, and just as in the case of two-part tariffs, this helps explain why a common agency equilibrium with CRRs exists under a broader range of parameters with Cournot than with Bertrand downstream competition.
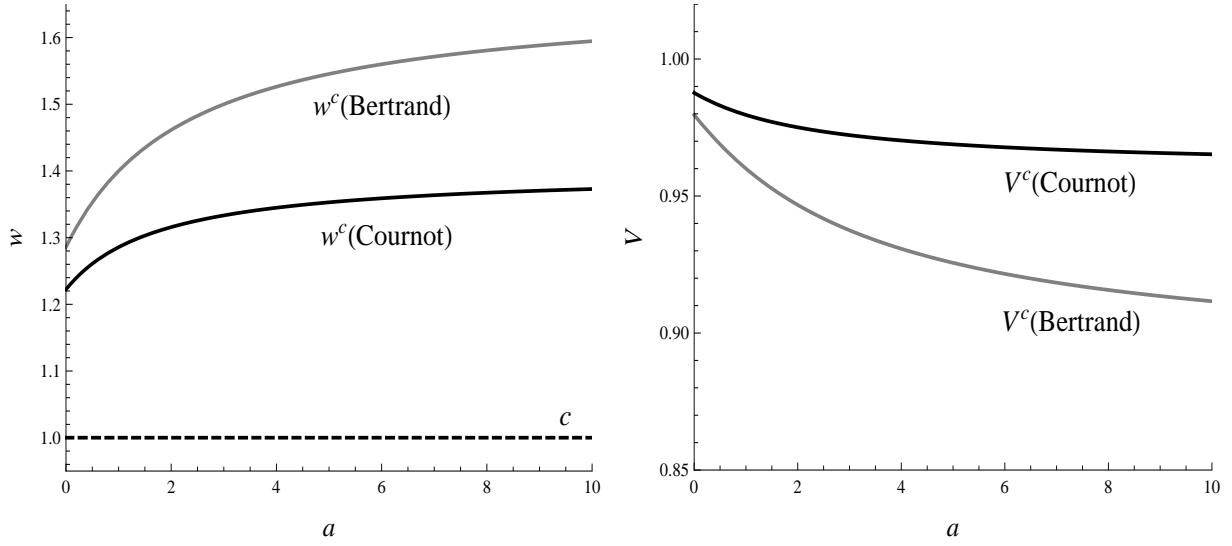
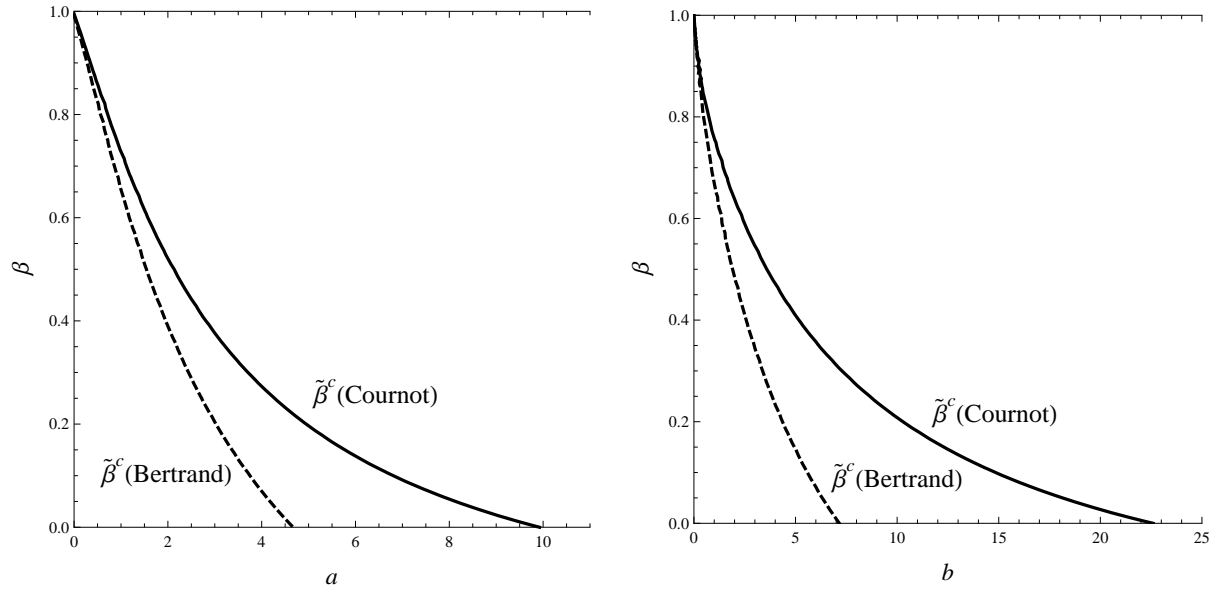Figure 9: Equilibrium with CRRs and Cournot downstream competition.

Figure 10: Existence of common agency equilibrium with CRRs and Cournot competition.