Disclosure Regime and Bargaining in Vertical Markets

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March 15, 2018

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Abstract

We study the strategic implications of the disclosure regime of vertical contracts. We show that the downstream competition mode and fierce (as proxied by product's differentiation) as well as the upstream market structure play a significant role in the observability (or not) of the vertical contract's terms. When a common supplier bargains with each retailer over a two-part tariff contract, interim observability offers a useful tool to ease the commitment problem, by offering wholesale price below marginal cost. That is also the case under linear wholesale contracts or even Bertrand competition in the product market. On the other hand, under dedicated exclusive suppliers, it is more profitable to bargain over interim unobservable contracts. Policymakers could increase social welfare by encouraging interim observability (unobservability) when firms compete in quantities (prices). Monopolized upstream markets are more prone to have aligned incentives with the policy makers, especially if the downstream retailers compete over quantities.

JEL Classification: D43; L13; L14

Keywords: bilateral contracting; vertical relations; two–part tariffs; bargaining; contract's disclosure;

*petrakis@uoc.gr. We would like to thanks the participants of the CRETE 2016, 2017 conferences for their comments, and and Garella P., Serfes K. and Rey P. for their insights. The usual disclaimer applies.

1 Introduction

Vertical contracts in which one or more of the parties to the agreement possesses market power on the relevant market, give rise to competition concerns (Office of Fair Trading, 2004). Additionally, the various contractual provisions (broadly characterized as *vertical restrains*) could produce pro- and anti- competitive effects (Rey, 2012). Two negative effects are the softening of the competition between some parties of the agreement and/or the facilitation of downstream collusion through the manipulation of prices. The latter, in turn, could cause negative effects in the competition and can harm consumers (European Commission, 2010). The contract terms of the vertical agreements are of paramount importance, but nevertheless, the disclosure regime of these terms could, also, play a vital role in the competition process (Arya and Mittendorf, 2011).

In the past few decades, regulators all over the world demand for extra disclosure in the contract terms, but its efficacy is unclear (Marotta-Wugler, 2012). A question spontaneously arises: is the demand for more disclosure in the right direction? In this paper we show that the disclosure regime of the vertical contracts can be a game–changer; it can be used by market participants to soften product market competition and has significant effects on the social welfare. Furthermore, we prove that when firms compete in quantities (prices) a policymaker should increase social welfare by encouraging (discouraging) the disclosure of the vertical contract's terms, no matter the type of the contract (linear or two–part tariffs), and the structure of the upstream market. In particular, this paper addresses the following research questions.

First, can the bargaining process and the competition fierce (as described by the product's horizontal differentiation) soften the anti-competitive effects of the vertical restraints? Marx and Shaffer (2007) show that when the suppliers have high bargain power, they tend to exclude the weaker retailers, and thus effectively softening downstream competition. In a different setup, Shaffer (2005) shows that competitive suppliers could offer wholesale prices above the marginal cost in order to soften downstream competition and maintain high prices on the retail market. Arya and Mittendorf (2011) show that when suppliers maximize the vertical chain's profits, wholesale price under observable contracts is above marginal cost. We argue that when suppliers bargain with retailers, wholesale price is below marginal cost. Furthermore, the product's substitutability acts as a bargain power's substitute: as products become more homogeneous, the supplier could use the fixed fee to extract more downstream profits without changing his bargain power.

Second, which are the different anti-competitive effects between the linear and the non-linear contracts (in particular: two-part tariffs) in the same setup? The related literature offers papers with either non-linear contracts (Arya and Mittendorf, 2011) or papers with linear tariffs (Liu and Wang, 2014), but there is no single paper to address both under the same assumptions and timing. Literature has shown that non-linear contracts such as the two-part tariffs could enhance coordination and lead to joint-profit maximization, while linear contracts could create negative vertical externalities (Rey, 2012), but in this paper, we are interested in showing how the contract type could affect the disclosure regime decision and change the possible disclosure equilibria. We show that in contrast to two-part tariffs in which we encounter multiple disclosure equilibria, under linear contracts we encounter a single disclosure equilibrium.

To address our research questions, we consider a two-tier vertical market, consisting of a single common upstream supplier of a differentiated good, and a downstream Cournot duopoly, forming a bottleneck with two vertical chains. In a pre-stage, upstream and downstream firms decide simultaneously whether to publicly announce or kept secret the vertical contract terms. For a contract to remain secret, both parties of the vertical chain must keep the contract terms secret. For a contract to become observable, at least one party of the vertical chain must publicly announce the contract terms. In the first stage, the members of the vertical chain bargain over the contract terms, while in the second stage the downstream retailers compete a la Cournot in the differentiated product market.

This paper fits on the broader literature over information sharing in vertical structures. Two papers that are closely related to ours are Arya and Mittendorf (2011) and Liu and Wang (2014). Arya and Mittendorf (2011) use a two-tier vertical set-up, with Cournot competition downstream over a homogeneous product, while the upstream firm unilaterally decides the wholesale price. The disclosure regime is set exogenously. We depart from Arya and Mittendorf (2011) in three important points: (a)we endogenize the disclosure regime decision, by adding a pre-stage in the game, in which all the parties of the agreement decide simultaneously over the disclosure regime that maximizes their profits, (b)we let the parties to the agreement to bargain over the contract terms, (c)we extend the analysis by allowing for (horizontal) product differentiation and by characterizing the equilibrium when firms use linear contracts.

Our paper is also closely related to Liu and Wang (2014). They use a two-tier vertical model with differentiated Cournot competition downstream and linear contracts. The differences with our model are the following: (i)they allow for linear contracts only, (ii)they set the supplier(s) to decide over the disclosure regime, and (iii)there is no bargain. None of these papers explores the role of the retailers' bargain power because both set the supplier(s) to unilaterally set wholesale prices. Both papers account for a single common and for two dedicated upstream suppliers, while Arya and Mittendorf (2011) accounts also for price competition in the product market.

The rest of the paper is structured as follows. In Section 2 we describe the model structure, the sequence of the events and the bargaining framework. In Section 3 we characterize the equilibrium outcomes under different disclosure regimes and determine the equilibrium regime. In Section 4 we conduct welfare analysis and some comparative statics. In Section 5 we extend our analysis by assuming Bertrand competition in the product market, or bargain over linear wholesale contracts, or dedicated exclusive suppliers. Finally, Section 6 offers the concluding remarks. The paper ends with the References, and the Appendix, in which all proofs are relegated.

2 The Model

2.1 Market structure and disclosure regimes

Consider a two-tier vertical industry, consisting of a single common upstream manufacturer $\mathcal{M}$, and two rival downstream retailers, namely $\mathcal{R}_i$ and $\mathcal{R}_j$. $\mathcal{M}$ produces a differentiated good, at a constant unit cost $c > 0$. This good is sold to the retailers through non-linear two-part tariffs vertical contracts, consisting of a (consumption independent) fixed fee F_i and a (per unit) wholesale price w_i. Contract terms are bargained separately and simultaneously between $\mathcal{M}$, and each $\mathcal{R}_i$. The latter sells quantity q_i at a retail price p_i. $\mathcal{R}_i$ faces a constant unit cost k_i, which for simplicity is set equal to zero. $\mathcal{R}_i$'s only cost is the cost induced by the two-part tariff vertical contract. Both retailers face a linear inverse demand function $p_i(q_i, q_j) = \alpha - q_i - \gamma q_j$, where $c < \alpha$ and $0 < \gamma < 1$ (products are imperfect substitutes).[1]

In the pre-stage, firms decide their disclosure regime. Following the literature (Arya and Mittendorf, 2011; Liu and Wang, 2014), we consider two possible disclosure regimes:

(a)*Interim observability:* the contract terms agreed by the bargain pair $(\mathcal{R}_i, \mathcal{M})$ can be observed by the rival $\mathcal{R}_j$ just after the successful end of the bargains. For a contract to become interim observable, at least one member of the bargain pair should announce them.[2]

(b)*Interim unobservability:* the contract terms agreed by the bargain pair $(\mathcal{R}_i, \mathcal{M})$ cannot be observed by the rival $\mathcal{R}_j$ in the time interval between the successful end of the bargains and the completion of the product market competition. For a contract to remain interim unobservable, both members of the bargain pair should keep the contract terms secret.

Each retailer is aware of its own contract terms, but whether or not he is aware of its rival's contract terms depends on the disclosure regime in place. Notice that in the interim unobservability regime, each retailer does not observe either the out-of-equilibrium

[1]Following Singh and Vives (1984), we consider a unit mass of identical consumers, each having the same quadratic utility function $u(q_i, q_j) = \alpha(q_i + q_j) - \frac{1}{2}(q_i^2 + q_j^2 + 2\gamma q_i q_j)$. Higher $\gamma \in (0, 1)$ indicates more homogeneous products.

[2]As stated in Rey and Verge (2004), in interim observability, contract terms remain secret up until the moment the final contract is signed. Therefore, acceptance decisions are based on beliefs. In what follows, we assume passive beliefs: retailers' do not revise their beliefs about the offers made to rivals when receiving an out-of-equilibrium offer.

contract offers during the bargaining process nor the ultimate equilibrium bargaining outcome (Arya and Mittendorf, 2011).[3]

2.2 Sequence of events and bargaining framework

The sequence of events is summarized in Figure 1. Firms play a 2-stage game, with a pre-stage attached. Game timing reflects the idea that the long-run decisions, such as the disclosure regime decision, may have considerable effects on the short-run decisions, such as the output decision.

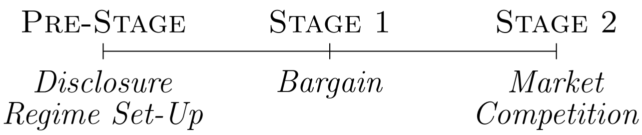

Figure 1: *Pre-Stage: firms decide their disclosure regime; Stage 1: the common manufacturer bargains simultaneously and separately with each retailer; Stage 2: rival retailers compete in the product market.*

Pre-stage: Disclosure regime set-up stage. Each firm decides simultaneously and separately over the preferred disclosure regime, having to choose between interim observability and interim unobservability.

Stage 1: Bargaining stage. $\mathcal{M}$ bargains simultaneously and separately with either $\mathcal{R}_i$ or $\mathcal{R}_j$, over a two-part tariff contract (w_i, F_i) or (w_j, F_j).[4] To model the bargaining stage, we use the generalized asymmetric Nash bargaining product (Milliou and Petrakis, 2007). $\mathcal{M}$ has bargain power $0 < \beta < 1$ while each $\mathcal{R}_i, \mathcal{R}_j$ have bargain power $1 - \beta$. Due to the multiplicity of beliefs retailers form when they receive an out-of-equilibrium offer, multiple equilibria could arise. To remedy this situation, we obtain a unique equilibrium by imposing *pairwise proofness* on the equilibrium contracts. Pairwise proofness is closely related to *passive beliefs*.[5] An additional assumption, common in the aforementioned

[3] An alternative timing of the game, which can favor deviation, is mentioned in McAfee and Schwartz (1994): downstream firm first pays the fixed fee F_i under secret contract and before the determination of the wholesale price w_i, rival's contract could become observable (ex–post observability). Under this game framework, timing favors deviation because it can affect upstream firm's profitability and downstream firm's total cost.

[4] The simultaneous and separate bargains is standard in situations with multilateral contracting e.g. Horn and Wolinsky (1988); Milliou and Petrakis (2007); Rey and Verge (2004). It captures the fact that each bargaining pair has incentives to behave opportunistically. The rationale behind this assumption could be that the manufacturer has two representatives, each negotiating at the same time with a different retailer.

[5] Passive beliefs and pairwise proofness go hand in hand and are appropriate when we perceive the generalized asymmetric Nash bargaining solution as the limit equilibrium of an alternating offers-counter-offers non-cooperative bargaining game (Binmore et al., 1986). In that case, passive beliefs state that $\mathcal{R}_i$ will handle any out-of-equilibrium offer from $\mathcal{M}$ as a "tremble", uncorrelated with any offer from $\mathcal{M}$ to $\mathcal{R}_j$. $\mathcal{R}_i$ believes that under any offer received from $\mathcal{M}$, the pair $(\mathcal{M}, \mathcal{R}_j)$ has reached an equilibrium outcome. Note that different beliefs lead to other equilibrium outcomes (Hart and Tirole, 1990; McAfee and Schwartz, 1994).

literature, is that the contract terms of one pair are *non-contingent* of any disagreements of the rival pair. This assumption captures nicely the idea that bargaining parties cannot commit to a permanent and irrevocable breakdown in their negotiations.[6]

Stage 2: Market competition stage. The two rival downstream retailers compete a la Cournot in the product market. To solve this dynamic multi-stage game we evoke the *Nash-in-Nash* solution concept: the Cournot-Nash equilibrium (the non-cooperative solution of stage 2) of the asymmetric generalized Nash bargaining solution (the cooperative solution of stage 1). We also assume that the negotiated outcome of a bargaining pair is non-contingent on whether the rival pair has reached or not an agreement. In other words, we impose the negotiated agreement between $(\mathcal{R}_i, \mathcal{M})$ to be immune to a bilateral deviation of the rival's agreement.

3 Equilibrium results

In order to set the pre-stage, in which the disclosure regime is decided, we have to characterize the equilibrium outcomes under all possible disclosure regimes. We consider the following three: (a)the *universal interim observability* regime, (b)the *interim unobservability* regime, as well as (c)the *mixed regime* in which one firm is under interim observability while the other firm is under interim unobservability.

3.1 Universal Interim Observability Regime

Under interim observability, both firms observe rival contract terms just after the successful ending of the stage 2 bargains. $\mathcal{R}_i$ chooses q_i in order to maximize its net profits: $\pi_i(q_i, q_j) = (\alpha - q_i - \gamma q_j - w_i)q_i - F_i$. The first order condition (foc) gives rise to the following reaction function:

$$q_i(w_i, q_j) = \frac{1}{2}(\alpha - w_i - \gamma q_j)$$

A decrease in w_i moves q_i upwards, making $\mathcal{R}_i$ a more aggressive competitor in the product market. Solving the system of reaction functions we get:

$$q_i^{\mathcal{O}}(w_i, w_j) = \frac{\alpha(2-\gamma) - 2w_i + \gamma w_j}{4-\gamma^2}$$
$$\pi_i^{\mathcal{O}}(w_i, w_j, F_i) = [q_i^{\mathcal{O}}(w_i, w_j)]^2 - F_i^{\mathcal{O}}$$

where the superscript $\mathcal{O}$ denotes the universal interim observability regime. In stage 1,

[6]Non-contingency states that it is common knowledge that any breakdown in the negotiations between $(\mathcal{R}_i, \mathcal{M})$ is non-permanent and non-irrevocable (Horn and Wolinsky, 1988). In other words, in case of a breakdown in the bargain of $(\mathcal{R}_i, \mathcal{M})$, then $(\mathcal{R}_j, \mathcal{M})$ will not renegotiate their contract terms (Milliou and Petrakis, 2007).

the retailers-manufacturer vertical chains bargain simultaneously and separately over its specific two-part tariff contract. If $\mathcal{R}_i$ fails to reach an agreement with $\mathcal{F}_i$, then it can still extract some economic rents from selling products to the rival retailer $\mathcal{F}_j$. By doing so, $\mathcal{F}_j$ becomes a monopolist in the product market, thus its output equals $q_j^m(w_j) = \frac{1}{2}(a - w_j)$. Hence, $\mathcal{R}_i$'s disagreement payoff is $(w_j - c)q_j^m(w_j) + F_j$. Having that in mind, the vertical chain $(\mathcal{M}, \mathcal{R}_i)$ chooses (w_i, F_i) to maximize the following generalized asymmetric Nash bargain product:

$$\mathcal{N}_i^{\mathcal{O}}(w_i, w_j, F_i) = [\pi_i^{\mathcal{O}}(w_i, w_j, F_i)]^{1-\beta}[\Pi^{\mathcal{O}}(w_i, w_j, F_i, F_j) - (w_j - c)q_j^m(w_j) - F_j]^{\beta}$$

where

$$\Pi^{\mathcal{O}}(w_i, w_j, F_i, F_j) = \sum_{i=1}^{2}[(w_i - c)q_i^{\mathcal{O}}(w_i, w_j) + F_i]$$

are $\mathcal{M}$'s aggregate net profits. Following O'Brien and Shaffer (1992), we maximize Nash product into two steps: (a)we use w_i to maximize joint surplus, and (b)we use F_i to distribute the joint surplus between the bargaining parties, according to their bargain power. By invoking the equilibrium symmetry, we get:

$$w^{\mathcal{O}} = c - \frac{\gamma^2\tilde{\alpha}}{2(2+\gamma^2)}, \quad q^{\mathcal{O}} = \frac{(2-\gamma)\tilde{\alpha}}{2(2-\gamma^2)}, \quad p^{\mathcal{O}} = \alpha - \frac{(1+\gamma)(2-\gamma)\tilde{\alpha}}{2(2-\gamma^2)}$$

where: $\tilde{\alpha} = \alpha - c > 0$. The following Lemma summarizes.

Lemma 1. *Under Cournot competition downstream, interim observable contracts, two-part tariffs and linear demand:*

1. *Wholesale price is below marginal cost, is bargain power independent, and it decreases as products become more homogeneous* $\frac{\partial w^{\mathcal{O}}}{\partial \gamma} < 0$.
2. *Quantity and retail price are bargain power independent, and they both decrease as products become more homogeneous* $\frac{\partial q^{\mathcal{O}}}{\partial \gamma} < 0 \Leftrightarrow \gamma < 0.58$, *while* $\frac{\partial p^{\mathcal{O}}}{\partial \gamma} < 0$.
3. *Fixed fee increases as the manufacturer's bargain power increases* $\frac{\partial F^{\mathcal{O}}}{\partial \beta} > 0$, *while* $\frac{\partial F^{\mathcal{O}}}{\partial \gamma} > 0 \Leftrightarrow \beta > \beta_{crit}^{\mathcal{O}}(\gamma) = \frac{\gamma(2+\gamma^2-2\gamma)}{(1-\gamma)(2-\gamma^2)}$.

The intuition behind this Lemma is straightforward: a stronger manufacturer ($\beta \uparrow$) will negotiate for more fixed fee, but it will not increase wholesale price, knowing that this will create less profits for the retailers, and thus less fixed fee for him ($\mathcal{M}$ is treating downstream competition as inter-brand). On the other hand, a lower product differentiation ($\gamma \uparrow$) has mixed effects on both the quantity and the fixed fee.

3.2 Universal Interim Unobservability Regime

Under interim unobservability, $\mathcal{R}_i$ is unable to observe the contract terms $(\tilde{w}_j, \tilde{F}_j)$ agreed by the vertical chain $(\mathcal{R}_j, \mathcal{M})$ before he makes his output choice, thus he is unable to calculate $\tilde{q}_j = \frac{1}{2}(\alpha - \tilde{w}_j - \gamma\tilde{q}_i)$, which is treated as a constant parameter (Arya and Mittendorf, 2011; Liu and Wang, 2014).[7] The first order condition produce the following equilibrium:

$$q_i^{\mathcal{S}}(w_i; \tilde{q}_j) = \frac{1}{2}(\alpha - w_i - \gamma\tilde{q}_j)$$
$$\pi_i^{\mathcal{S}}(w_i, F_i; \tilde{q}_j) = [q_i^{\mathcal{S}}(w_i; \tilde{q}_j)]^2 - F_i^{\mathcal{S}}$$

Intuitively, $\mathcal{R}_i$ knows that his rival plays a Cournot game, thus he is able to formulate his equilibrium output, but he is unable to replace $\tilde{w}_j$ with a credible equilibrium value. Furthermore, $\mathcal{R}_i$ knows that $\mathcal{R}_j$ faces the same unobservability problem, and thus $\mathcal{R}_j$ has to form a belief about $\tilde{q}_i$. Consequently, $\mathcal{R}_i$ acts as a monopolist over the residual demand: $q_i^{\mathcal{S}}(w_i) = \frac{1}{2}(A - w_i)$ where $A = \alpha - \gamma\tilde{q}_j$.

Moving to Stage 1, we choose (w_i, F_i) to maximize the following generalized asymmetric Nash bargain product:

$$\mathcal{N}_i^{\mathcal{S}}(w_i, w_j, F_i; \tilde{q}_j) = [\pi_i^{\mathcal{S}}(w_i, F_i; \tilde{q}_j)]^{1-\beta}[\Pi^{\mathcal{S}}(w_i, w_j, F_i, F_j; \tilde{q}_j) - (w_j - c)q_j^m(w_j) - F_j]^{\beta}$$

where:

$$\Pi^{\mathcal{S}}(w_i, w_j, F_i, F_j; \tilde{q}_j) = (w_i - c)q_i^{\mathcal{S}}(w_i; \tilde{q}_j) + (w_j - c)\tilde{q}_j + F_i + F_j$$

are $\mathcal{M}$'s aggregate net profits. By obtaining the foc's of the rival vertical chain $(\mathcal{R}_j, \mathcal{M})$, and knowing that, in equilibrium, beliefs are correct (Liu and Wang, 2014), we get:

$$w^{\mathcal{S}} = c, \quad q^{\mathcal{S}} = \frac{\tilde{\alpha}}{2+\gamma}, \quad p^{\mathcal{S}} = \alpha - \frac{(1+\gamma)\tilde{\alpha}}{2+\gamma}$$

The following Lemma summarizes.

Lemma 2. *Under Cournot competition downstream, interim unobservable contracts, two-part tariffs and linear demand:*

1. *Wholesale price is equal to marginal cost, and thus it is independent of the manufacturer's brgain power and the market features (such as product differentiation).*

[7] Based on Brandenburger and Dekel (1993), $\tilde{w}_j$ is the level 1 belief $\mathcal{R}_i$ has to form for $\mathcal{R}_j$'s wholesale price, while $\tilde{q}_i$ is the level 2 belief $\mathcal{R}_i$ has to form for $\mathcal{R}_j$'s belief over $\mathcal{R}_i$'s equilibrium output. Level 0 beliefs (common knowledge to both retailers) are: (1)the existence of a single common upstream supplier, (2)the Cournot duopoly in the product market, (3)the mutual unobservability, and (4)the use of two-part tariff contracts. Thus, as stated in Rey and Verge (2004), q_i depends on $\mathcal{R}_i$'s belief about $\tilde{q}_j$, and not the actual q_j.

2. *Quantity and retail price are bargain power independent, and they both decrease as products become more homogeneous* $\frac{\partial q^{\mathcal{S}}}{\partial \gamma} < 0$ *and* $\frac{\partial p^{\mathcal{S}}}{\partial \gamma} < 0$.

3. *Fixed fee increases with bargain power* $\frac{\partial F^{\mathcal{S}}}{\partial \beta} > 0$, *and decreases as products become more homogeneous* $\frac{\partial F^{\mathcal{S}}}{\partial \gamma} < 0$.

Wholesale price is free of any beliefs or market features, and thus is a dominant strategy for the manufacturer. The fact that each retailer cannot observe rival's contract terms, pushes wholesale price in higher levels. Thus, information structure plays a crucial role in vertical contracts. The common upstream manufacturer has maximum profits when product's substitutability is zero. The same holds true for the retailers' profits.

3.3 Mixed Regime

Under the mixed regime, and without any loss of generality let assume that $\mathcal{M}$ bargains with $\mathcal{R}_j$ under interim unobservability, while $\mathcal{M}$ bargains with $\mathcal{R}_i$ under interim observability.

In Stage 2, the two different foc's give rise to the following functions:

$$\begin{aligned} q_i^{\mathcal{M}}(q_j) &= \frac{1}{2}(\alpha - w_i - \gamma q_j) \\ q_j^{\mathcal{M}}(w_j; \tilde{q}_i) &= \frac{1}{2}(\alpha - w_j - \gamma \tilde{q}_i) \end{aligned}$$

$\mathcal{R}_i$ observes $\mathcal{R}_j$'s contract terms and thus he can react optimally ($q_i^{\mathcal{M}}$ is a function of both (w_i, w_j)). On the other hand, $\mathcal{R}_j$ cannot observe $\mathcal{R}_i$'s contract terms, and has to form beliefs in the form of $\tilde{q}_i$.

In Stage 1, the two different generalized asymmetric Nash bargain products are:

$$\begin{aligned} \mathcal{N}_i^{\mathcal{M}}(w_i, w_j, F_i) = {} & [(q_i^{\mathcal{M}}(w_i, w_j))^2 - F_i]^{1-\beta}[(w_i - c)q_i^{\mathcal{M}}(w_i, w_j) + \\ & + (w_j - c)q_j^{\mathcal{M}}(w_i, w_j) + F_i - (w_j - c)q_j^m(w_j)]^{\beta} \\ \mathcal{N}_j^{\mathcal{M}}(w_i, w_j, F_j; \tilde{q}_i) = {} & [(q_j^{\mathcal{M}}(w_j; \tilde{q}_i))^2 - F_j]^{1-\beta}[(w_i - c)\tilde{q}_i + \\ & + (w_j - c)q_j^{\mathcal{M}}(w_j; \tilde{q}_i) + F_j - (w_i - c)q_i^m(w_i)]^{\beta} \end{aligned}$$

Maximizing each Nash bargain product over its respective wholesale price and fixed fee, and following the standard procedure, we get the equilibrium values stated below:

$$\begin{aligned} & w_i^{\mathcal{M}} = c - \frac{(2-\gamma)\gamma^2\tilde{\alpha}}{4(2-\gamma^2)}, \quad q_i^{\mathcal{M}} = \frac{(2-\gamma)\tilde{\alpha}}{2(2-\gamma^2)}, \quad p_i^{\mathcal{M}} = \alpha - \frac{1}{4}(2+\gamma)\tilde{\alpha} \\ & w_j^{\mathcal{M}} = c, \quad q_j^{\mathcal{M}} = \frac{(4-\gamma(\gamma+2))\tilde{\alpha}}{4(2-\gamma^2)}, \quad p_j^{\mathcal{M}} = \alpha - \frac{(4+\gamma(2-3\gamma))\tilde{\alpha}}{4(2-\gamma^2)} \end{aligned}$$

The following Lemma summarizes.

Lemma 3. *Under Cournot competition downstream, mixed regime, two-part tariffs and linear demand:*

1. *Both wholesale prices are bargain power independent, while the firm who observes the rival has wholesale price below marginal cost:* $w_i^{\mathcal{M}} < w_j^{\mathcal{M}} = c$.

2. *Both quantities are bargain power independent, while the firm who observes the rival has higher output:* $q_i^{\mathcal{M}} > q_j^{\mathcal{M}}$. *As for product differentiation, the following holds:* $\frac{\partial q_i^{\mathcal{M}}}{\partial \gamma} < 0 \Leftrightarrow \gamma < 0.58$*, while* $\frac{\partial q_j^{\mathcal{M}}}{\partial \gamma} < 0$.

3. *Both retail prices are bargain power independent, and both decrease as product's become more homogeneous:* $\frac{\partial p_i^{\mathcal{M}}}{\partial \gamma} < 0$ *and* $\frac{\partial p_j^{\mathcal{M}}}{\partial \gamma} < 0$. *The firm who does not observe the rival sets higher retail price:* $p_j^{\mathcal{M}} > p_i^{\mathcal{M}}$.

4. *Fixed fees rise with bargain power, while the firm who observes the rival pays higher fixed fee:* $F_i^{\mathcal{M}} > F_j^{\mathcal{M}}$.

The intuition for this Lemma is along the lines of the two previous Lemmata. Higher bargain power will not change equilibrium quantities (and thus equilibrium retail prices) or equilibrium wholesale prices. But, it will affect downstream firms' profits, because a stronger upstream manufacturer will exploit the downstream firms through the use of the fixed fee. The common upstream manufacturer has maximum profits when products are independent (for $\gamma \to 0$), because $\frac{\partial \Pi^{\mathcal{M}}}{\partial \gamma} < 0$.

3.4 Disclosure regime set-up

In the pre-stage, each of the three firms of the game (the common upstream manufacturer, and the two rival downstream retailers) decide simultaneously and separately over the desired disclosure regime. For a contract to be interim unobservable, both bargain parties (both the manufacturer and the respective retailer) must decide to keep it secret. For a contract to be interim observable, at least one of the bargain parties (either the manufacturer or the respective retailer) must publicly announce the contract terms.

When the contract is signed, there is no reason to change the disclosure regime, because this will not change the contract terms. To illustrate this proposition, assume that the manufacturer bargains with both retailers under the interim unobservable regime. This will lead to the known result: $w_i = w_j = c$. Now, let assume that after both contracts are signed, the common manufacturer publicly announces the contract terms of both contracts. Thus, retailers will compete in the product market under interim observability. The equilibrium output for interim observability is: $q_i^{\mathcal{O}}(w_i, w_j) = \frac{\alpha(2-\gamma)-2w_i+\gamma w_j}{4-\gamma^2}$. Substituting the wholesale price, we get: $q_i^{\mathcal{O}}(c, c) = \frac{\alpha-c}{2+\gamma} = q_i^{\mathcal{S}}$. Similar reasoning holds for the deviation from interim observable into interim unobservable contracts (even though this deviation is not realistic). The following Lemma summarizes.

Lemma 4. *Any deviation in the disclosure regime after the sign of the contracts, cannot change the equilibrium results of the product market competition.*

Having that in mind, we state the following Proposition. The proof of this proposition can be found in the Appendix.

Proposition 3.1. *Under Cournot competition, a common supplier, and bargain over two-part tariffs, both universal interim observability, and universal interim unobservability can arise as equilibria, with the former equilibrium Pareto dominating the latter.*

Proposition 3.1 suggests that independent of the supplier's bargain power or the degree of product substitutability (i.e. the competitive pressure) in the product market, both disclosure regimes could arise endogenously as equilibria. This is not something far from practical observations of the real business world; from economic sector to another, or even within the same, disclosure regimes vary. Note that asymmetric equilibria never arise, while the universal interim observability equilibrium Pareto dominates the universal interim unobservability equilibrium.

4 Welfare Analysis

In this section, we will perform a welfare analysis and discuss briefly the regulator's incentives to encourage (or not) a certain disclosure regime over the other. Social welfare is defined as the sum of consumer surplus, retailers' profits, and manufacturer's profits:

$$SW = CS + (\pi_i + \pi_j) + \Pi$$

where $CS = \frac{1}{2}(q_i^2 + q_j^2 + 2\gamma q_i q_j)$.[8] Substituting the relevant expressions, and after having some simple algebraic manipulations, we obtain the relevant SW expressions under the three different disclosure regimes. The following Proposition summarizes.

Proposition 4.1. *Social Welfare is higher under universal interim observability, and lower under universal interim unobservability:* $SW^{\mathcal{O}} > SW^{\mathcal{M}} > SW^{\mathcal{S}}$.

The proof of the Proposition can be found in the Appendix. Proposition 4.1 shows that the highest social welfare can be obtained only under universal interim observability of vertical contract terms. The results are driven by the output, which is higher (lower) under interim observability (unobservability) regime. The mixed regime creates a mixed situation, which stands between the two interim regimes. As a consequence, the interim observability is always preferable from the policy maker's point of view. This suggests that the policy makers should encourage interim observability in the vertical contracts.

[8] Following Singh and Vives (1984), we substitute $p_i = \alpha - q_i - \gamma q_j$ into $u(q_i, q_j) - p_i q_i - p_j q_j$ and thus obtain the CS.

4.1 Comparative Statics

The following Lemma highlights the comparative statics between the disclosure regimes. Comparing equilibrium values is quite straightforward, based on the relevant expressions stated above.

Lemma 5. *Under Cournot competition downstream, two-part tariffs and linear demand:*

1. *Output is higher in interim observability:* $q^{\mathcal{O}} = q_i^{\mathcal{M}} > q^{\mathcal{S}} > q_j^{\mathcal{M}}$.
2. *Wholesale price is lower in interim observability:* $w^{\mathcal{S}} = w_j^{\mathcal{M}} > w_i^{\mathcal{M}} > w^{\mathcal{O}}$.
3. *Retail price is higher in interim unobservability:* $p^{\mathcal{S}} > p_j^{\mathcal{M}} > p_i^{\mathcal{M}} > p^{\mathcal{O}}$.
4. *Fixed fee is higher in observability:* $F^{\mathcal{O}} = F_i^{\mathcal{M}} > F^{\mathcal{S}} > F_j^{\mathcal{M}}$.
5. *Retailers' profits are higher in interim observability:* $\pi^{\mathcal{O}} = \pi_i^{\mathcal{M}} > \pi^{\mathcal{S}} > \pi_j^{\mathcal{M}}$.
6. *Manufacturer's profits are higher in interim unobservability:* $\Pi^{\mathcal{S}} > \Pi^{\mathcal{M}} > \Pi^{\mathcal{O}}$.

A common upstream has incentives (higher profits) to bargain with both downstream retailers under interim unobservability, getting a higher (consumption dependent) wholesale price, and a lower (consumption independent) fixed fee. On the other hand, downstream retailers have incentives (higher profits) to bargain with the common manufacturer under interim observable contracts, paying a lower (consumption dependent) wholesale price, and a higher (consumption independent) fixed fee. Under the mix regime, the upstream manufacturer collaborates with $\mathcal{R}_i$ to exploit $\mathcal{R}_{\mathbf{j}}$'s profits.

5 Extensions

In this section, we will discuss some possible extensions of the basic model. The reasoning of these extensions is to show which forces at work will change if we move to: (a)Bertrand competition in the product market, or (b)bargain over wholesale linear contracts, or (c)two separate dedicated exclusive upstream suppliers. All the relevant conditions can be found in the Appendix.

5.1 Bertrand competition in the product market

In the aforementioned basic model, the firms produce a differentiated product and compete in quantities. This is because the wholesale market is better approximated by the quantity competition (Arya and Mittendorf, 2011). However, in this extension, we will consider how a shift to price competition could change the dynamics of the game. The following Lemma summarizes the equilibrium values in each regime.

Lemma 6. *Under Bertrand competition, a common supplier and bargain over two-part tariff contracts, the following equilibrium values hold per disclosure regime:*

(i) Under the universal interim observability regime,

$$w^{\mathcal{BO}} = c + \frac{1}{4}\gamma^2\tilde{\alpha}, \quad p^{\mathcal{BO}} = \alpha - \frac{1}{4}(2+\gamma)\tilde{\alpha}, \quad q^{\mathcal{BO}} = \frac{(2+\gamma)\tilde{\alpha}}{4(1+\gamma)}$$

(ii) Under the universal interim unobservability regime,

$$w^{\mathcal{BS}} = c, \quad q^{\mathcal{BS}} = \frac{\tilde{\alpha}}{(2-\gamma)(1+\gamma)}, \quad p^{\mathcal{BS}} = \alpha - \frac{\tilde{\alpha}}{2-\gamma}$$

(iii) Under the mixed regime,

$$w_i^{\mathcal{BM}} = c + \frac{\gamma^2(2+\gamma)\tilde{\alpha}}{8(1+\gamma)}, \quad q_i^{\mathcal{BM}} = \frac{(2+\gamma)\tilde{\alpha}}{4(1+\gamma)}, \quad p_i^{\mathcal{BM}} = \alpha - \frac{(4+\gamma(6+\gamma(2+\gamma)))\tilde{\alpha}}{8(1+\gamma)}$$
$$w_j^{\mathcal{BM}} = c + \frac{\gamma^3(2+\gamma)\tilde{\alpha}}{8(1+\gamma)}, \quad q_j^{\mathcal{BM}} = \frac{(4+\gamma(2+\gamma))\tilde{\alpha}}{8(1+\gamma)}, \quad p_j^{\mathcal{BM}} = \alpha - \frac{(4+3\gamma(2+\gamma))\tilde{\alpha}}{8(1+\gamma)}$$

Notice that wholesale price is above marginal cost. This is due to the upward slopping reaction functions in Bertrand: when one retailer reduces his retail price, it is for the best interest of the rival retailer to reduce it as well. Given the fact that wholesale and retail prices are positive correlated $\frac{\partial p}{\partial w} > 0$, this could extinguish the manufacturer's profits, and thus the manufacturer has to restrict downstream competition by agreeing on a wholesale price above the marginal cost. This has an impact on both the quantities sold and the fixed fee extracted by the manufacturer.

Proposition 5.1. *Under Bertrand competition, a common supplier, and bargain over two-part tariffs, the unique equilibrium is the universal interim observability.*

Price competition can alter firm's strategic incentives and the forces at work, and bring out the universal interim observability as the sole equilibrium disclosure regime. A common supplier wishes to soften downstream competition, and with prices being a strategic complements, can only do so by choosing to reveal vertical contract's terms. The main driver of the result of Proposition 5.1 is that price competition differs from quantity competition because contracts are more inherently independent (Arya and Mittendorf, 2011).

Using the social welfare formula stated in section 4, and after some simple algebraic manipulations, it is easy to show that: $\forall \beta, \gamma \in (0,1) : SW^{\mathcal{BS}} > SW^{\mathcal{BO}}$. Surprisingly, a policymaker who cares for the maximum social welfare, and when retailers compete over prices in the product market, should encourage for less disclosure, leading to interim unobservability of vertical contract terms.

Furthermore, notice that: $\forall \beta, \gamma \in (0,1) : w^{\mathcal{BS}} < w^{\mathcal{BO}}, \quad p^{\mathcal{BS}} < p^{\mathcal{BO}}$, while $q^{\mathcal{BS}} > q^{\mathcal{BO}}$, and $F^{\mathcal{BS}} > F^{\mathcal{BO}}$. In contrast to the Cournot case, when firms compete over prices, wholesale and retail price are lower under interim unobservability, while output and fixed fee are lower under interim observability. This comes to defense the previous paragraph mentioning the social welfare: when firms bargain over secrecy, they manage to keep retail price low and they give higher fixed fee to their supplier, leading to lower net profits for them.

5.2 Bargaining over wholesale linear contracts

The use of two–part tariff contracts: (i)eliminates double marginalization problem, (ii)maximizes joint profits, and (iii)distributes the maximized "pie"according to each member's bargain power. All these three characteristics are absent in wholesale contracts (Milliou and Petrakis, 2007). Nevertheless, common knowledge dictates that wholesale contracts are in wide use all over the business world. On these grounds, therefore it is quite useful and interesting to characterize the disclosure regime equilibrium when bargain pairs use wholesale contracts. The following Lemma summarizes.

Lemma 7. *Under Cournot competition, a common supplier and bargain over linear contracts, the following equilibrium values hold per disclosure regime:*

(i) Under the universal interim observability regime:

$$w^{\lambda\mathcal{O}} = c + \frac{1}{2}\beta\tilde{\alpha}, \quad q^{\lambda\mathcal{O}} = \frac{(2-\beta)\tilde{\alpha}}{2(2+\gamma)}, \quad p^{\lambda\mathcal{O}} = \alpha - \frac{(2-\beta)(1+\gamma)\tilde{\alpha}}{2(2+\gamma)}$$

(ii) Under the universal interim unobservability regime,

$$w^{\lambda\mathcal{S}} = c + \frac{2\beta\tilde{\alpha}}{4+\gamma(\beta-(1-\beta)\gamma)}, \quad q^{\lambda\mathcal{S}} = \frac{(2-(1-\beta)\gamma-\beta)\tilde{\alpha}}{4+\gamma(\beta-(1-\beta)\gamma)}$$
$$p^{\lambda\mathcal{S}} = \alpha - \frac{(1+\gamma)(2-\beta(1-\gamma)-\gamma)\tilde{\alpha}}{4+\gamma(\beta-(1-\beta)\gamma)}$$

(iii) Under the mixed regime,

$$w_i^{\lambda\mathcal{M}} = c + \frac{(\beta+\gamma)\tilde{\alpha}}{2+\gamma}, \quad q_i^{\lambda\mathcal{M}} = \frac{(2-\beta)\tilde{\alpha}}{2(2+\gamma)}, \quad p_i^{\lambda\mathcal{M}} = \frac{(2-\beta)^2(\gamma((2+\beta)\gamma+4)-8)^2\tilde{\alpha}^2}{16(2-\gamma)^2(2+\gamma)^4}$$
$$w_j^{\lambda\mathcal{M}} = c + \frac{\beta(4+\beta\gamma)\tilde{\alpha}}{4(2+\gamma)}, \quad q_j^{\lambda\mathcal{M}} = \frac{(2-\beta)(4+\beta\gamma)\tilde{\alpha}}{8(2+\gamma)}, \quad p_j^{\lambda\mathcal{M}} = \alpha - \frac{(2-\beta)(4+(4+\beta)\gamma)\tilde{\alpha}}{8(2+\gamma)}$$

Proposition 5.2. *Under Cournot competition, a common supplier, and bargain over linear contracts, the unique equilibrium is the universal interim observability.*

Linear contracts lack some important features of the two–part tariff contracts, but nevertheless are in wide use all over the world. The lack of proper distribution of vertical chain's profits, based on each participant's bargain power, push both members of the bargain pair to seek universal interim observability. Notice that: $k^{\lambda\mathcal{S}} > k^{\lambda\mathcal{O}} \Leftrightarrow \beta > \frac{\gamma}{1+\gamma}$, where: $k \in \{\pi, w, p\}$, while $m^{\lambda\mathcal{S}} > m^{\lambda\mathcal{O}} \Leftrightarrow \beta < \frac{\gamma}{1+\gamma}$, where: $m \in \{\Pi, q\}$. The intuition behind this is straightforward: for an area of low (high) bargain power, firms wish to bargain under secrecy (observability), but it is in the best interest of the supplier to make the contract terms observable (secret).

Using the social welfare formula stated in section 4, and after some simple algebraic manipulations, it is easy to show that: $\forall \beta, \gamma \in (0,1) : SW^{\lambda\mathcal{S}} < SW^{\lambda\mathcal{O}}$. Obviously, a policymaker who cares for the maximum social welfare, and when wholesale contracts prevail, should encourage for more disclosure, leading to interim observability of vertical contract terms.

5.3 Dedicated upstream suppliers

The upstream market structure plays an important role for the contract type selection (Milliou and Petrakis, 2007). Consequently, it should play a role in the disclosure regime selection. In this extension, we will change the vertical chain by assigning an exclusive dedicated upstream supplier to each downstream retailer. As Arya and Mittendorf (2011) notice, a common upstream supplier has incentives to treat downstream competition as intra–brand, and thus seeks to soften it by inflating retail prices. In contrast, a dedicated upstream supplier treats downstream competition as inter–brand, and thus has to gain from fierce price cuts. The following Lemma summarizes.

Lemma 8. *Under Cournot competition, dedicated suppliers and bargain over two-part tariff contracts, the following equilibrium values hold per disclosure regime: (i) Under the universal interim observability regime,*

$$w^{\delta\mathcal{O}} = c - \frac{\gamma^2\tilde{\alpha}}{4+(2-\gamma)\gamma}, \quad q^{\delta\mathcal{O}} = \frac{2\tilde{\alpha}}{4+(2-\gamma)\gamma}, \quad p^{\delta\mathcal{O}} = \alpha - \frac{2(1+\gamma)\tilde{\alpha}}{4+(2-\gamma)\gamma}$$

(ii) Under the universal interim unobservability regime,

$$w^{\delta\mathcal{S}} = c, \quad q^{\delta\mathcal{S}} = \frac{\tilde{\alpha}}{\gamma+2}, \quad p^{\delta\mathcal{S}} = \alpha - \frac{(1+\gamma)\tilde{\alpha}}{2+\gamma}$$

(iii) Under the mixed regime,

$$w_i^{\delta\mathcal{M}} = c - \frac{(2-\gamma)\gamma^2\tilde{\alpha}}{4(2-\gamma^2)}, \quad q_i^{\delta\mathcal{M}} = \frac{(2-\gamma)\tilde{\alpha}}{2(2-\gamma^2)}, \quad p_i^{\delta\mathcal{M}} = \alpha - \frac{1}{4}(2+\gamma)\tilde{\alpha}$$
$$w_j^{\delta\mathcal{M}} = c, \quad q_j^{\delta\mathcal{M}} = \frac{(4-\gamma(2+\gamma))\tilde{\alpha}}{4(2-\gamma^2)}, \quad p_j^{\delta\mathcal{M}} = \alpha - \frac{(4-\gamma(3\gamma-2))\tilde{\alpha}}{4(2-\gamma^2)}$$

Proposition 5.3. *Under Cournot competition, dedicated suppliers, and bargain over two-part tariffs, the unique equilibrium is the universal interim unobservability.*

Proposition 5.3 offers an interesting insight in the difference between a common or dedicated suppliers. Notice that $\forall \beta, \gamma \in (0,1) : w^{\delta\mathcal{O}} < w^{\delta\mathcal{S}} = c$, but $F^{\delta\mathcal{O}} > F^{\delta\mathcal{S}}$, and $\Pi^{\delta\mathcal{O}} < \Pi^{\delta\mathcal{S}}$. That is, a dedicated supplier has higher profits under interim unobservability, even though the higher wholesale price could lead to lower output and higher retail prices.

Using the social welfare formula stated in section 4, and after some simple algebraic manipulations, it is easy to show that: $\forall \beta, \gamma \in (0,1) : SW^{\delta\mathcal{S}} < SW^{\delta\mathcal{O}}$. Obviously, a policymaker who cares for the maximum social welfare, and when exclusivity in the supply chain prevails, should encourage for more disclosure, leading to interim observability of vertical contract terms.

6 Conclusions

Vertical contracts, and the various contractual provisions give rise to serious competition concerns. Among the latter is the disclosure regime of the contract's terms. For the last decades, policymakers around the world have opted for more disclosure, but is this decision on the right direction?

To answer this question we have setup a differentiated two-tier market duopoly model, in which firms, both upstream and downstream, decide over the desired disclosure regime. For a contract to have interim observable terms, at least one bargain member should announce them; for a contract to have interim unobservable terms, both bargain members should keep them secret. We have shown that once the bargaining stage is over, there is no reason for any firm to deviate from its disclosure regime, because this will not change the contract terms.

A Cournot duopolist facing a single supplier and bargaining over a two-part tariff contract has incentives to reveal the contract terms. The same holds for the supplier himself. Even if the retailers compete in quantities, or the vertical chain bargain over linear wholesale contracts, the forces at work won't change, leaving the disclosure regime equilibrium exactly the same. On the other hand, a dedicated supplier has incentives to bargain with his respective retailer over interim unobservable contracts. Even if this lowers the output and makes the product more expensive, it is a disclosure regime that maximizes the profits of both members of the vertical chain.

The following two tables summarize the findings of the paper.

	Cournot Common U 2PT	Bertrand Common U 2PT	Cournot Dedicated U_i 2PT	Cournot Common U Linear
Observable	X	X		X
Unobservable	X		X	

Table 1: Optimal disclosure regime; firms' point of view.

Table 1 summarizes the disclosure regime equilibria stated in this paper. When firms compete over quantities, the upstream market structure as well as the type of the contract play a significant role in the disclosure regime setup. A common upstream who bargains over a two–part tariff contract, treats downstream competition as intra-brand competition and he is willing to accept both interim observability and unobservability, even though the former Pareto dominates the latter. Under contrary, when the same common supplier bargains over linear contract, due to double marginalization and the lack of joint profit maximization, he is not willing to bargain under interim unobservability. At the same time, the existence of two separate dedicated exclusive upstream suppliers could change, once again, the disclosure regime equilibrium. The latter, understanding the downstream competition as inter-brand competition, are willing to bargain under interim unobservability to give their respective retailers a competitive advantage over the rival firm. On the other hand, when firms compete over prices, the strategic complementarity of the differentiated products pushes the common upstream to bargain under interim observability only. This decision softens downstream competition by charging higher wholesale prices, and thus avoiding any unnecessary (for them) fierce competition.

	Cournot Common U 2PT	Bertrand Common U 2PT	Cournot Dedicated U_i 2PT	Cournot Common U Linear
Observable	X		X	X
Unobservable		X		

Table 2: Optimal disclosure regime; policymaker's point of view.

The picture seems to change when it comes for a policymaker to choose the disclosure regime that maximizes social welfare (Table 2). It seems that the existence of a common upstream supplier and downstream competition over quantity guarantees the alignment of interests between the firms and the policymaker. On the opposite side, when firms compete over prices, or the upstream market is not monopolized, the interests of the firms are the opposite of the policymaker.

This paper focused on a theoretical approach to the disclosure regime of vertical contracts. We have shown that the downstream competition mode and fierce, as well as the upstream market structure play a significant role in the observability or not of the vertical contracts. Any future work should be focused on the empirical side of this problem. There is a testable implication that emerges from thee findings. The theoretical model implies that exclusivity leads to poor disclosure. It might be quite interesting to check if data from the real world show a correlation between upstream market competition and disclosure regime of the vertical contracts.

7 Appendix

7.1 Proofs

Proof. Proposition 3.1. The equilibrium profits of the firms π_i and the common supplier Π, under different disclosure regimes are:

$$\pi^{\mathcal{O}} = \frac{(1-\beta)(2-\gamma)^2\tilde{\alpha}^2}{8(2-\gamma^2)}, \quad \pi^{\mathcal{S}} = \frac{(1-\beta-1)\tilde{\alpha}^2}{(2+\gamma)^2}, \quad \Pi^{\mathcal{O}} = \frac{(2-\gamma)(\beta(2-\gamma)(2-\gamma^2)-\gamma^3)\tilde{\alpha}^2}{4(2-\gamma^2)^2}$$
$$\pi_i^{\mathcal{M}} = \frac{(1-\beta)(2-\gamma)^2\tilde{\alpha}^2}{8(2-\gamma^2)}, \quad \pi_j^{\mathcal{M}} = \frac{(1-\beta)(16-\gamma(16+\gamma^3-4\gamma))\tilde{\alpha}^2}{32(2-\gamma^2)}$$
$$\Pi^{\mathcal{S}} = \frac{2\beta\tilde{\alpha}^2}{(2+\gamma)^2}, \quad \Pi^{\mathcal{M}} = \frac{(\beta(2-\gamma^2)(32-\gamma(32+\gamma^3-8\gamma))-\gamma^3(8+\gamma^3-8\gamma))\tilde{\alpha}^2}{32(2-\gamma^2)^2}$$

For a contract to have interim observable terms, at least one member of the bargain must have incentives to publicly reveal these terms, after the end of the bargains but before the output decision. For a contract to have interim unobservable terms, all members of the bargain must keep the contract terms secret until the end of the output decision.

(i) After some simple algebraic manipulations, it is easy to show that: $\forall \beta, \gamma \in (0,1)$: $\pi^{\mathcal{S}} > \pi_j^{\mathcal{M}}$ and $\Pi^{\mathcal{S}} > \Pi^{\mathcal{M}}$, thus universal interim unobservability is an equilibrium.

(ii) It can be readily verified that for all β, γ in $(0,1)$ the following hold: $\pi^{\mathcal{O}} = \pi_i^{\mathcal{M}}$ while $\Pi^{\mathcal{O}} < \Pi^{\mathcal{M}}$, so universal interim observability is an equilibrium.

(iii) If we Pareto rank them, universal interim observability dominates universal interim unobservability: $\forall \beta, \gamma \in (0,1)$: $\quad \pi^{\mathcal{O}} > \pi^{\mathcal{S}}$. □

Proof. Proposition 4.1. The Social Welfare expressions under different disclosure regimes are:

$$SW^{\mathcal{O}} = \frac{(8(1-\gamma)+\gamma^3)\tilde{\alpha}^2}{2(2-\gamma^2)^2}, \quad SW^{\mathcal{S}} = \frac{4\tilde{\alpha}^2}{(\gamma+2)^2}$$
$$SW^{\mathcal{M}} = \frac{(128-\gamma(128+\gamma(16-(32-\gamma)\gamma)))\tilde{\alpha}^2}{32(2-\gamma^2)^2}$$

It can be readily verified that $\forall \beta, \gamma \in (0,1)$ the following inequalities hold: $SW^{\mathcal{O}} > SW^{\mathcal{M}}$ and $SW^{\mathcal{M}} > SW^{\mathcal{S}}$. □

Proof. Lemma 6. Assume the linear demand function: $q_i(p_i,p_j) = \frac{\alpha}{1+\gamma} - \frac{1}{1-\gamma^2}p_i + \frac{\gamma}{1-\gamma^2}p_j$, and price competition in the product market.

Universal Interim Observability regime: Under interim observability, the product market competition is characterized by the following equations: $\max_{p_i}[\pi_i(p_i,p_j)] \Rightarrow p_i^*(p_j) = \frac{1}{2}(\alpha(1-\gamma)+w_i+\gamma p_j)$. Following the standard procedure, we get: $p_i^{\mathcal{BO}}(w_i,w_j) = \frac{\alpha(2-\gamma^2-\gamma)+2w_i+\gamma w_j}{4-\gamma^2}$. Moving to Stage 1, we model the generalized asymmetric Nash bargain product as follows:

$$\mathcal{N}_i^{\mathcal{BO}}(w_i, w_j, F_i) = [\pi_i^{\mathcal{BO}}(w_i, w_j, F_i)]^{1-\beta}[\Pi^{\mathcal{BO}}(w_i, w_j, F_i, F_j) - (w_j - c)q_j^{Mon}(w_j) - F_j]^{\beta}$$

where: $\Pi^{\mathcal{BO}}(w_i, w_j, F_i, F_j) = (w_i - c)q_i^{\mathcal{BO}}(w_i, w_j) + (w_j - c)q_j^{\mathcal{BO}}(w_i, w_j) + F_i + F_j$ are $\mathcal{M}$'s profits. Following the standard procedure, we get:

$$w^{\mathcal{BO}} = c + \frac{1}{4}\gamma^2\tilde{\alpha}, \quad q^{\mathcal{BO}} = \frac{(\gamma+2)\tilde{\alpha}}{4(\gamma+1)}, \quad p^{\mathcal{BO}} = \alpha - \frac{1}{4}(2+\gamma)\tilde{\alpha}$$

In contrast to the interim observability regime under Cournot competition, wholesale price is above marginal cost, and it increases as products become more homogeneous $\frac{\partial w^{\mathcal{BO}}}{\partial \gamma} > 0$. Quantity and retail price are bargain power independent, while the fixed fee increases with bargain power $\frac{\partial F^{\mathcal{BO}}}{\partial \beta} > 0$. Quantity, retail price and fixed fee are always decreasing when products become more homogeneous $\frac{\partial p^{\mathcal{BO}}}{\partial \gamma} < 0$ and $\frac{\partial q^{\mathcal{BO}}}{\partial \gamma} < 0$ and $\frac{\partial F^{\mathcal{BO}}}{\partial \gamma} < 0$.

Universal Interim Unobservability regime: Having the same considerations as in Cournot case, and following the standard procedure, we get: $\max_{p_i}[\pi_i(p_i; \tilde{p}_j)] \Rightarrow p_i^{\mathcal{BS}}(w_i; \tilde{p}_j) = \frac{1}{2}(\alpha(1-\gamma) + \gamma\tilde{p}_j + w_i)$. We model the 1st Stage as follows:

$$\mathcal{N}_i^{\mathcal{BS}}(w_i, w_j, F_i; \tilde{p}_j) = [\pi_i^{\mathcal{BS}}(w_i, F_i; \tilde{p}_j)]^{1-\beta}[\Pi^{\mathcal{BS}}(w_i, w_j, F_i, F_j; \tilde{p}_j) - (w_j - c)q_j^{Mon}(w_j) - F_j]^{\beta}$$

where: $\Pi^{\mathcal{BS}}(w_i, w_j, F_i, F_j; \tilde{p}_j) = (w_i - c)q_i^{\mathcal{BS}}(w_i; \tilde{p}_j) + (w_j - c)q_j^{\mathcal{BS}}(w_i; \tilde{p}_j) + F_i + F_j$ are $\mathcal{M}$'s profits. Maximizing Nash product and following the standard procedure, we get:

$$w^{\mathcal{BS}} = c, \quad q^{\mathcal{BS}} = \frac{\tilde{\alpha}}{(2-\gamma)(\gamma+1)}, \quad p^{\mathcal{BS}} = \alpha - \frac{\tilde{\alpha}}{2-\gamma}$$

Wholesale price equals marginal cost, and thus is independent of the manufacturer's bargain power and the market features (such as product's differentiation). Quantity and retail price are bargain power independent, and they both decrease as products become more homogeneous: $\frac{\partial q^{\mathcal{BS}}}{\partial \gamma} < 0 \Leftrightarrow \gamma < 0.5$ and $\frac{\partial p^{\mathcal{BS}}}{\partial \gamma} < 0$. Fixed fee increases with bargain power $\frac{\partial F^{\mathcal{BS}}}{\partial \beta} > 0$, and decreases as products become more homogeneous $\frac{\partial F^{\mathcal{BS}}}{\partial \gamma} < 0$.

Mixed regime: Following the standard procedure we assume that bargain pair $(\mathcal{M}, \mathcal{R}_i)$ is under interim unobservability, while bargain pair $(\mathcal{M}, \mathcal{R}_j)$ is under interim observability. This gives rise to the following first order conditions: $\max_{p_i}[\pi_i(p_i; \tilde{p}_j)] \& \max_{p_j}[\pi_j(p_i, p_j)] \Rightarrow p_i^{\mathcal{BM}}(w_i, w_j) \& p_j^{\mathcal{BM}}(w_j; \tilde{p}_i)$. Moving to the 1st stage, the two different asymmetric generalized Nash bargain products are:

$$\mathcal{N}_i^{\mathcal{BM}}(w_i, w_j, F_i) = [\pi_i^{\mathcal{BM}}(w_i, w_j, F_i)]^{1-\beta}[\Pi^{\mathcal{BM}}(w_i, w_j, F_i, F_j) - (w_j - c)q_j^{Mon}(w_j) - F_j]^{\beta}$$
$$\mathcal{N}_j^{\mathcal{BM}}(w_i, w_j, F_j; \tilde{p}_i) = [\pi_j^{\mathcal{BM}}(w_j, F_j; \tilde{p}_i)]^{1-\beta}[\Pi^{\mathcal{BM}}(w_i, w_j, F_i, F_j; \tilde{p}_i) - (w_i - c)q_i^{Mon}(w_i) - F_i]^{\beta}$$

Maximizing these two Nash products with respect to wholesale price and fixed fee, and having in mind that beliefs are true in equilibrium, we get:

$$w_i^{\mathcal{BM}} = c + \frac{\gamma^2(2+\gamma)\tilde{\alpha}}{8(1+\gamma)}, \quad q_i^{\mathcal{BM}} = \frac{(2+\gamma)\tilde{\alpha}}{4(1+\gamma)}, \quad p_i^{\mathcal{BM}} = \alpha - \frac{(4+\gamma(6+\gamma(2+\gamma)))\tilde{\alpha}}{8(1+\gamma)}$$
$$w_j^{\mathcal{BM}} = c + \frac{\gamma^3(2+\gamma)\tilde{\alpha}}{8(1+\gamma)}, \quad q_j^{\mathcal{BM}} = \frac{(4+\gamma(2+\gamma))\tilde{\alpha}}{8(1+\gamma)}, \quad p_j^{\mathcal{BM}} = \alpha - \frac{(4+3\gamma(2+\gamma))\tilde{\alpha}}{8(1+\gamma)}$$

Wholesale prices, quantities and retail prices are bargain power independent, while $w_i^{\mathcal{BM}}$ (respectively, $q_i^{\mathcal{BM}}$, $w_j^{\mathcal{BM}}$ and both retail prices) decrease (respectively, increase) as products become more homogeneous. □

Proof. Proposition 5.1. Based on the analysis and reasoning of the proof of the Lemma 6, the equilibrium values of profits, for both the supplier and the retailers, under all disclosure regimes, are stated below:

$$\pi^{\mathcal{BO}} = \frac{(1-\beta)(\gamma+2)(4+\gamma^4-\gamma^3-2\gamma)\tilde{\alpha}^2}{32(1+\gamma)}, \quad \pi^{\mathcal{BS}} = \frac{(1-\beta)(1-\gamma)\tilde{\alpha}^2}{(2-\gamma)^2(\gamma+1)}$$
$$\Pi^{\mathcal{BO}} = \frac{(2+\gamma)(4\beta-(1-\beta)\gamma^4+(1-\beta)\gamma^3-2\beta\gamma)\tilde{\alpha}^2}{16(1+\gamma)}, \quad \Pi^{\mathcal{BS}} = \frac{2\beta(1-\gamma)\tilde{\alpha}^2}{(2-\gamma)^2(\gamma+1)}$$
$$\pi_i^{\mathcal{BM}} = \frac{(1-\beta)(2+\gamma)(16+\gamma(8-\gamma(8-\gamma(4-\gamma(4-\gamma(2+\gamma(2+\gamma)))))))\tilde{\alpha}^2}{128(1+\gamma)^2}$$
$$\pi_j^{\mathcal{BM}} = \frac{(1-\beta)(32+(2-\gamma)\gamma(16+\gamma(2+\gamma)(2-\gamma(4+\gamma))))\tilde{\alpha}^2}{128(1+\gamma)^2}$$
$$\Pi^{\mathcal{BM}} = \frac{\beta\tilde{\alpha}^2}{128(1+\gamma)^2}[(64+\gamma(64-\gamma(16-\gamma(32-\gamma(18-\gamma(1+\gamma)(4+\gamma(3+\gamma)))))))+$$
$$+(1-\gamma)\gamma^3(1+\gamma)(2+\gamma)(4+\gamma(2+\gamma))]$$

For a contract to have interim observable terms, at least one member of the bargain must have incentives to publicly reveal these terms, after the end of the bargains but before the output decision. For a contract to have interim unobservable terms, all members of the bargain must keep the contract terms secret until the end of the output decision. It can be readily verified that $\forall\beta,\gamma \in (0,1)$ the following inequalities hold:

(i) $\pi^{\mathcal{BS}} < \pi_j^{\mathcal{BM}}$ and $\Pi^{\mathcal{BS}} < \Pi^{\mathcal{BM}}$ thus universal interim unobservability can never be an equilibrium because both bargain parties have incentives to reveal the contract terms.

(ii) $\pi^{\mathcal{BO}} > \pi_i^{\mathcal{BM}}$ and $\Pi^{\mathcal{BO}} > \Pi^{\mathcal{BM}}$, so universal interim observability is an equilibrium because at least one of the bargain parties (in this case, both) has incentives to reveal the contract terms.

□

Proof. Lemma 7. We assume the same model and market structure, and the same disclosure regimes as in section 3, with the sole exemption of the usage of linear vertical contracts.

Universal Interim Observability Regime: The product market competition between the two retailers (Stage 2 of the game) is characterized by the following equations: $\max_{q_i}[\pi_i(q_i, q_j)] = \max_{q_i}[(\alpha - q_i - \gamma q_j - w_i)q_i] \Rightarrow q_i^*(q_j) = \frac{1}{2}(\alpha - w_i - \gamma q_j)$. Following a similar reasoning for $\mathcal{R}_j$ and solving the system of the two reaction functions we get: $q_i^{\lambda\mathcal{O}}(w_i, w_j) = \frac{\alpha(2-\gamma)-2w_i+\gamma w_j}{4-\gamma^2}$, $\pi_i^{\lambda\mathcal{O}}(w_i, w_j) = [q_i^*(w_i, w_j)]^2$. Moving to Stage 1, we model the generalized asymmetric Nash bargain product as follows:

$$\mathcal{N}_i^{\lambda\mathcal{O}}(w_i, w_j) = [\pi_i^{\lambda\mathcal{O}}(w_i, w_j)]^{1-\beta}[\Pi^{\lambda\mathcal{O}}(w_i, w_j) - \frac{1}{2}(w_j - c)(\alpha - w_j)]^\beta$$

where: $\Pi^{\lambda\mathcal{O}}(w_i, w_j) = (w_i - c)q_i^{\lambda\mathcal{O}}(w_i, w_j) + (w_j - c)q_j^{\lambda\mathcal{O}}(w_i, w_j)$ are the profits of the manufacturer $\mathcal{M}$ from selling through linear contracts to both retailers. Maximizing Nash product over the wholesale price we get: $\max_{w_i} \mathcal{N}_i^{\lambda\mathcal{O}}(w_i, w_j) \Rightarrow w_i^{\lambda\mathcal{O}}(w_j) = \frac{1}{2}\gamma w_j + \frac{2-\gamma}{4}(2 + \tilde{\alpha}\beta)$. Following a similar reasoning for $\mathcal{R}_j$, solving the system of the foc's, and imposing symmetry in equilibrium, we get:

$$w^{\lambda\mathcal{O}} = c + \frac{1}{2}\beta\tilde{\alpha}, \quad q^{\lambda\mathcal{O}} = \frac{(2-\beta)\tilde{\alpha}}{2(\gamma + 2)}$$

Wholesale price is above marginal cost $w^{\lambda\mathcal{O}} > c$, is independent of product's substitutability, and increases with bargain power: $\frac{\partial w^{\lambda\mathcal{O}}}{\partial\beta} > 0$. Quantity decreases as bargain power increases $\frac{\partial q^{\lambda\mathcal{O}}}{\partial\beta} < 0$. As products become more homogeneous ($\gamma \to 1$), quantity decreases $\frac{\partial q^{\lambda\mathcal{O}}}{\partial\gamma} < 0$.

Universal Interim Unobservability Regime: Maximizing profits over quantity we get: $\max_{q_i}[\pi_i(q_i; \tilde{q}_j)] \Rightarrow q_i^{\lambda\mathcal{S}}(w_i; \tilde{q}_j) = \frac{1}{2}(\alpha - w_i - \gamma\tilde{q}_j)$, $\pi_i^{\lambda\mathcal{S}}(w_i; \tilde{q}_j) = (q_i^{\lambda\mathcal{S}}(w_i; \tilde{q}_j))^2$. In Stage 1, we model the generalized asymmetric Nash bargain product as follows:

$$\mathcal{N}_i^{\lambda\mathcal{S}}(w_i, w_j; \tilde{q}_j) = [\pi_i^{\lambda\mathcal{S}}(w_i; \tilde{q}_j)]^{1-\beta}[\Pi^{\lambda\mathcal{S}}(w_i, w_j; \tilde{q}_j) - \frac{1}{2}(w_j - c)(\alpha - w_j)]^\beta$$

where: $\Pi^{\lambda\mathcal{S}}(w_i, w_j; \tilde{q}_j) = (w_i - c)q_i^{\lambda\mathcal{S}}(w_i; \tilde{q}_j) + (w_j - c)\tilde{q}_j$ are the profits of $\mathcal{M}$. Maximizing Nash product over the wholesale price, and following the standard procedure, we get:

$$w^{\lambda\mathcal{S}} = c + \frac{2\beta\tilde{\alpha}}{4 + \gamma(\beta - (1-\beta)\gamma)}, \quad q^{\lambda\mathcal{S}} = \frac{(\beta(\gamma - 1) - \gamma + 2)\tilde{\alpha}}{4 + \gamma(\beta - (1-\beta)\gamma)}$$

Wholesale price is above marginal cost $w^{\lambda\mathcal{S}} > c$, it increases when $\mathcal{M}$'s bargain power increases $\frac{\partial w^{\lambda\mathcal{S}}}{\partial\beta} > 0$, and $\frac{\partial w^{\lambda\mathcal{S}}}{\partial\gamma} \gtrless 0 \Leftrightarrow \beta \lesseqgtr \beta_{crit} = \frac{2\gamma}{1+2\gamma}$. Quantity decreases when bargain power increases $\frac{\partial q^{\lambda\mathcal{S}}}{\partial\beta} < 0$, and it decreases as products become more homogeneous $\frac{\partial q^{\lambda\mathcal{S}}}{\partial\gamma} < 0$.

Mixed Regime: In the mix regime, we assume that $\mathcal{M}$ bargains with $\mathcal{R}_i$ under interim unobservability, and with $\mathcal{R}_j$ under interim observability. Consequently, in stage 2, the two retailers maximize different profit functions: $\max_{q_i}[\pi_i(q_i, q_j)] \Rightarrow q_i^{\lambda\mathcal{M}}(w_i, w_j) =$

$\frac{\alpha(2-\gamma)-2w_i+\gamma w_j}{4-\gamma^2}$, while: $\max_{q_j}[\pi_j(q_j;\tilde{q}_i)] \Rightarrow q_j^{\lambda\mathcal{M}}(w_j;\tilde{q}_i) = \frac{1}{2}(\alpha - w_j - \gamma\tilde{q}_i)$. We model the bargains in Stage 1 using the generalized asymmetric Nash bargain product:

$$\mathcal{N}_i^{\lambda\mathcal{M}}(w_i,w_j) = [(q_i^{\lambda\mathcal{M}}(w_i,w_j))^2]^{1-\beta}[(w_i-c)q_i^{\lambda\mathcal{M}}(w_i,w_j)+(w_j-c)q_j^{\lambda\mathcal{M}}(w_i,w_j)-\frac{1}{2}(w_j-c)(\alpha-w_j)]$$

$$\mathcal{N}_j^{\lambda\mathcal{M}}(w_i,w_j;\tilde{q}_i) = [(q_j^{\lambda\mathcal{M}}(w_j;\tilde{q}_i))^2]^{1-\beta}[(w_i-c)\tilde{q}_i+(w_j-c)q_j^{\lambda\mathcal{M}}(w_j;\tilde{q}_i)-\frac{1}{2}(w_i-c)(\alpha-w_i)]^\beta$$

Maximizing each Nash bargain product over its respective wholesale price, and following the standard procedure, we get:

$$w_i^{\lambda\mathcal{M}} = c+\frac{(\beta+\gamma)\tilde{\alpha}}{2+\gamma}, \quad q_i^{\lambda\mathcal{M}} = \frac{(2-\beta)(\alpha-c)}{2(2+\gamma)}$$
$$w_j^{\lambda\mathcal{M}} = c+\frac{\beta(4+\beta\gamma)\tilde{\alpha}}{4(2+\gamma)}, \quad q_j^{\lambda\mathcal{M}} = \frac{(2-\beta)(4+\beta\gamma)\tilde{\alpha}}{8(2+\gamma)}$$

Both wholesale prices are above marginal cost $w_{i,j}^{\lambda\mathcal{M}} > c$, they both increase with bargain power $\frac{\partial w_{i,j}^{\lambda\mathcal{M}}}{\partial\beta} > 0$, while the unobserved wholesale price increases as products become more homogeneous $\frac{\partial w_i^{\lambda\mathcal{M}}}{\partial\gamma} > 0$, while the observable wholesale price decreases $\frac{\partial w_j^{\lambda\mathcal{M}}}{\partial\gamma} < 0$. Both quantities decrease as bargain power increases $\frac{\partial q_{i,j}^{\lambda\mathcal{M}}}{\partial\beta} < 0$. □

Proof. Proposition 5.2. Based on the analysis and reasoning of the Lemma 7, the equilibrium values for the supplier's and the retailers' profits are:

$$\pi^{\lambda\mathcal{O}} = \frac{(2-\beta)^2\tilde{\alpha}^2}{4(\gamma+2)^2}, \quad \Pi^{\lambda\mathcal{O}} = \frac{(2-\beta)\beta\tilde{\alpha}^2}{2(2+\gamma)}$$
$$\pi^{\lambda\mathcal{S}} = \frac{(2-\beta(1-\gamma)-\gamma)^2\tilde{\alpha}^2}{(4+\gamma(\beta-(1-\beta)\gamma))^2}, \quad \Pi^{\lambda\mathcal{S}} = \frac{4\beta(2-\beta(1-\gamma)-\gamma)\tilde{\alpha}^2}{(4+\gamma(\beta-(1-\beta)\gamma))^2}$$
$$\pi_i^{\lambda\mathcal{M}} = \frac{(2-\beta)^2\tilde{\alpha}^2}{4(2+\gamma)^2}, \quad \pi_j^{\lambda\mathcal{M}} = \frac{(2-\beta)^2(4+\beta\gamma)^2\tilde{\alpha}^2}{64(2+\gamma)^2}$$
$$\Pi^{\lambda\mathcal{M}} = \frac{(2-\beta)(\beta+16\gamma(32+\beta\gamma(8+\beta\gamma)))\tilde{\alpha}^2}{32(2+\gamma)^2}$$

For a contract to have interim observable terms, at least one member of the bargain must have incentives to publicly reveal these terms, after the end of the bargains but before the output decision. For a contract to have interim unobservable terms, all members of the bargain must keep the contract terms secret until the end of the output decision. It can be readily verified that $\forall\beta,\gamma\in(0,1)$ the following inequalities hold:

(i) $\pi^{\lambda\mathcal{S}} < \pi_j^{\lambda\mathcal{M}}$ and $\Pi^{\lambda\mathcal{S}} < \Pi^{\lambda\mathcal{M}}$ thus universal interim unobservability can never be an equilibrium because both bargain parties have incentives to reveal the contract terms.

(ii) $\pi^{\lambda\mathcal{O}} > \pi_i^{\lambda\mathcal{M}}$ and $\Pi^{\lambda\mathcal{O}} > \Pi^{\lambda\mathcal{M}}$, so universal interim observability is an equilibrium because at least one of the bargain parties (in this case, both) has incentives to reveal the contract terms. □

Proof. Lemma 8. We assume the same model and market structure, and the same disclosure regimes as in section 3, with the sole exemption of the existence of two dedicated separate exclusive upstream suppliers.

Universal Interim Observability Regime: The product market competition between the two retailers (Stage 2 of the game) is characterized by the following equations: $\max_{q_i}[\pi_i(q_i, q_j, F_i)] = \max_{q_i}[(\alpha - q_i - \gamma q_j - w_i)q_i - F_i] \Rightarrow q_i^*(q_j) = \frac{1}{2}(\alpha - w_i - \gamma q_j)$. Following a similar reasoning for $\mathcal{R}_j$ and solving the system of the two reaction functions we get: $q_i^{\delta\mathcal{O}}(w_i, w_j) = \frac{\alpha(2-\gamma)-2w_i+\gamma w_j}{4-\gamma^2}$, $\pi_i^{\delta\mathcal{O}}(w_i, w_j, F_i) = [q_i^*(w_i, w_j)]^2 - F_i$. Moving to Stage 1, we model the generalized asymmetric Nash bargain product as follows:

$$\mathcal{N}_i^{\delta\mathcal{O}}(w_i, w_j, F_i) = [\pi_i^{\delta\mathcal{O}}(w_i, w_j, F_i)]^{1-\beta}[(w_i - c)q_i^{\delta\mathcal{O}}(w_i, w_j) + F_i]^\beta$$

Following the standard procedure, we get:

$$w^{\delta\mathcal{O}} = c - \frac{\gamma^2\tilde{\alpha}}{4 + (2-\gamma)\gamma}, \quad q^{\delta\mathcal{O}} = \frac{2\tilde{\alpha}}{4 + (2-\gamma)\gamma}$$

Wholesale price is below marginal cost $w^{\delta\mathcal{O}} < c$, is independent of bargain power, and decreases as products become more homogeneous: $\frac{\partial w^{\delta\mathcal{O}}}{\partial\gamma} < 0$. Quantity is bargain power independent, and decreases as products become more homogeneous: $\frac{\partial q^{\delta\mathcal{O}}}{\partial\gamma} < 0$.

Universal Interim Unobservability Regime: Maximizing profits over quantity we get: $\max_{q_i}[\pi_i(q_i; \tilde{q}_j)] \Rightarrow q_i^{\delta\mathcal{S}}(w_i; \tilde{q}_j) = \frac{1}{2}(\alpha - w_i - \gamma\tilde{q}_j)$, $\pi_i^{\delta\mathcal{S}}(w_i, F_i; \tilde{q}_j) = (q_i^{\delta\mathcal{S}}(w_i; \tilde{q}_j))^2 - F_i$. In Stage 1, we model the generalized asymmetric Nash bargain product as follows:

$$\mathcal{N}_i^{\delta\mathcal{S}}(w_i, w_j, F_i; \tilde{q}_j) = [\pi_i^{\delta\mathcal{S}}(w_i, F_i; \tilde{q}_j)]^{1-\beta}[(w_i - c)q_i^{\lambda\mathcal{S}}(w_i; \tilde{q}_j) + F_i]^\beta$$

Maximizing Nash product over the wholesale price, and following the standard procedure, we get:

$$w^{\delta\mathcal{S}} = c, \quad q^{\delta\mathcal{S}} = \frac{\tilde{\alpha}}{2+\gamma}$$

Wholesale price equals marginal cost, and is independent of the product's differentiation factor and the bargain power. Quantity is bargain power independent, and it decreases as products become more homogeneous $\frac{\partial q^{\delta\mathcal{S}}}{\partial\gamma} < 0$.

Mixed Regime: In the mix regime, we assume that $\mathcal{M}$ bargains with $\mathcal{R}_i$ under interim unobservability, and with $\mathcal{R}_j$ under interim observability. Consequently, in stage 2, the two retailers maximize different profit functions: $\max_{q_i}[\pi_i(q_i, q_j, F_i)] \Rightarrow q_i^{\delta\mathcal{M}}(w_i, w_j) = \frac{\alpha(2-\gamma)-2w_i+\gamma w_j}{4-\gamma^2}$, while: $\max_{q_j}[\pi_j(q_j, F_j; \tilde{q}_i)] \Rightarrow q_j^{\delta\mathcal{M}}(w_j; \tilde{q}_i) = \frac{1}{2}(\alpha - w_j - \gamma\tilde{q}_i)$. We model the bargains in Stage 1 using the generalized asymmetric Nash bargain product:

$$\mathcal{N}_i^{\delta\mathcal{M}}(w_i, w_j, F_i) = [(q_i^{\delta\mathcal{M}}(w_i, w_j))^2 - F_i]^{1-\beta}[(w_i - c)q_i^{\delta\mathcal{M}}(w_i, w_j) + F_i]^{\beta}$$
$$\mathcal{N}_j^{\delta\mathcal{M}}(w_i, w_j, F_i; \tilde{q}_i) = [(q_j^{\delta\mathcal{M}}(w_j; \tilde{q}_i))^2 - F_j]^{1-\beta}[(w_j - c)q_j^{\delta\mathcal{M}}(w_j; \tilde{q}_i) + F_j]^{\beta}$$

Maximizing each Nash bargain product over its respective wholesale price, and following the standard procedure, we get:

$$w_i^{\delta\mathcal{M}} = c - \frac{(2-\gamma)\gamma^2\tilde{\alpha}}{4(2-\gamma^2)}, \quad q_i^{\delta\mathcal{M}} = \frac{(2-\gamma)\tilde{\alpha}}{2(2-\gamma^2)}$$
$$w_j^{\delta\mathcal{M}} = c, \quad q_j^{\delta\mathcal{M}} = \frac{(4-\gamma(2+\gamma))\tilde{\alpha}}{4(2-\gamma^2)}$$

Notice that $w_i^{\delta\mathcal{M}} < c$ while $w_j^{\delta\mathcal{M}} = c$, and they both are bargain power independent, while the unobserved wholesale price decreases as products become more homogeneous $\frac{\partial w_i^{\delta\mathcal{M}}}{\partial\gamma} < 0$. Both quantities are bargain power independent, and the observed quantity decreases as products become more homogeneous $\frac{\partial q_i^{\delta\mathcal{M}}}{\partial\gamma} < 0$. □

Proof. Proposition 5.3. Based on the analysis and reasoning of the Lemma 8, the equilibrium values for the supplier's and the retailers' profits are:

$$\pi^{\delta\mathcal{O}} = \frac{2(1-\beta)(2-\gamma^2)\tilde{\alpha}^2}{(4+(2-\gamma)\gamma)^2}, \quad \Pi^{\delta\mathcal{O}} = \frac{2\beta(2-\gamma^2)\tilde{\alpha}^2}{(4+(2-\gamma)\gamma)^2}$$
$$\pi^{\delta\mathcal{S}} = \frac{(1-\beta)\tilde{\alpha}^2}{(2+\gamma)^2}, \quad \Pi^{\delta\mathcal{S}} = \frac{\beta\tilde{\alpha}^2}{(2+\gamma)^2}$$
$$\pi_i^{\delta\mathcal{M}} = \frac{(1-\beta)(2-\gamma)^2\tilde{\alpha}^2}{8(2-\gamma^2)}, \quad \pi_j^{\delta\mathcal{M}} = \frac{(1-\beta)(4-\gamma(2+\gamma))^2\tilde{\alpha}^2}{16(2-\gamma^2)^2}$$
$$\Pi_i^{\delta\mathcal{M}} = \frac{\beta(2-\gamma)^2\tilde{\alpha}^2}{8(2-\gamma^2)}, \quad \Pi_j^{\delta\mathcal{M}} = \frac{\beta(4-\gamma(2+\gamma))^2\tilde{\alpha}^2}{16(2-\gamma^2)^2}$$

For a contract to have interim observable terms, at least one member of the bargain must have incentives to publicly reveal these terms, after the end of the bargains but before the output decision. For a contract to have interim unobservable terms, all members of the bargain must keep the contract terms secret until the end of the output decision. It can be readily verified that $\forall\beta, \gamma \in (0, 1)$ the following inequalities hold:

(i) $\pi^{\delta\mathcal{S}} > \pi_j^{\delta\mathcal{M}}$ and $\Pi^{\delta\mathcal{S}} > \Pi_j^{\delta\mathcal{M}}$ thus universal interim unobservability is an equilibrium because both bargain parties have incentives not to reveal the contract terms.

(ii) $\pi^{\delta\mathcal{O}} < \pi_i^{\delta\mathcal{M}}$ and $\Pi^{\delta\mathcal{O}} < \Pi_i^{\delta\mathcal{M}}$, so universal interim observability can't be an equilibrium because both bargain parties have incentives to move to the mix regime. □

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