Vertical Integration and Bargaining: Linear vs Two-part tariffs

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Outline

- Introduction
- Literature review
- The model
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Introduction

- Vertical contracts range from simple linear to more complex non-linear tariffs.

- Contractual form is a crucial determinant of both market outcomes and market efficiency.

- The existing literature on vertical contracting has investigated the desirability of different contractual forms from the viewpoint of consumers and society, as well as from the viewpoint of involved firms, focusing on *vertically separated markets*,

  i.e., markets where upstream firms reach final consumers only through independent downstream firms

Introduction

- Dual-distribution channels are widespread: manufacturers sell their products directly to final consumers through their websites (the “internet” channel) and indirectly through independent retail stores (the “traditional” channel).

- Other examples: petroleum industry, regulated industries (energy, telecommunications and transportations)

- Main goal of the paper: examine the implications of the contractual form for *welfare* as well as for *firms’ profits* when there is vertical integration in the vertical chain.
- What is the role of
  - bargaining on contract terms
  - mode of competition

Main results

- The standard result of the desirability of the two-part tariffs over the linear contracts in terms of welfare may be reversed under Bertrand competition.
- When the independent downstream firm is powerful in negotiating the contract terms, the linear contract leads to a lower per-unit input price and generates higher CS and W than the two-part tariff.
- Under a two-part tariff, the optimal fixed fee is negative when the downstream rival is rather powerful in negotiating contract terms.
- The integrated firm prefers the linear contract (resp., two-part tariff) when its downstream rival is rather powerful (resp., weak) in negotiating contract terms. The opposite holds true for the downstream rival. The two firms' preferences over the contract type *always* collide.

Main results

- Our results crucially depend on the mode of downstream competition
- Irrespective of the mode of downstream competition, the preferred contract type of the integrated firm is always welfare superior.
- Even though we do not formally endogenize the contract-type decision, our analysis suggests that, irrespective of the mode of downstream competition, as well as irrespective of the distribution of bargaining power, *the society is always better off when the integrated firm gets to decide the contract type.*

Literature

- VI: Chen, 2001; Chemla (2003), Ordover and Shaffer (2007), Arya et al. (2008), Höffler and Schmidt (2008), Bourreau et al. (2011), Reisinger and Tarantino (2015), Moresi and Schwartz (2017), Milliou and Petrakis (2019), Fanti and Scrimitore (2019)

- The desirability of different contractual forms: Gal-Or (1991), Rey and Stiglitz (1995), Milliou and Petrakis (2007) Milliou et al. (2012), Reisinger and Schnitzer (2012), Milliou and Pavlou (2013), Milliou and Petrakis (2020), Constantatos and Pinopoulos (2021), Foros, Kind and Schaffer (WP 2021)

Literature

- Under an exogenous market structure, the literature demonstrates that two-part tariffs are more efficient than linear tariffs.
- Reisinger and Schnitzer (2012) and Milliou and Petrakis (2020) explore the implications of linear and two-part tariff contracts under free entry: linear contracts can generate higher CS and W due to higher market entry.
- Regarding profitability, Milliou and Petrakis (2007) has shown that an upstream supplier may prefer to deal with downstream firms through a linear rather than a two-part tariff contract. They consider interim observable contracts with no free entry.

The model

- An integrated firm, I, and an independent downstream firm, D.
- The downstream division of the integrated firm obtains the input internally from its upstream partner at marginal cost (normalized to zero), while D procures the input from I.
- Two contract types: a *linear contract* (L) that specifies a per-unit input price w, and a *two-part tariff contract* (T), consisting of (w, F) where F is a fixed fee. We study each case separately.
- The demand function, $q_i(p_i, p_j)$, $i = I, D$, $i \neq j$, is twice differentiable with $\partial q_i / \partial p_i < 0$ and $\partial q_i / \partial p_j > 0$. Final-goods are imperfect substitutes.

The game

1. In the *first* stage, I and D engage in Nash bargaining over contract terms. The bargaining weights (i.e., exogenous Nash parameters) of I and D are β and $1-\beta$ respectively, with $\beta \in (0,1)$.

2. In the *second* stage, firms I and D choose, simultaneously and separately, their final-good prices.

Equilibrium analysis

The equilibrium analysis in the last stage, the downstream market competition stage, is the same under both contract types. Firm I's and firm D's (gross) profits are:

$$\pi_I = p_I q_I(p_I, p_D) + w q_D(p_I, p_D), \qquad \pi_D = (p_D - w) q_D(p_I, p_D).$$

Industry profits are:

$$\pi_{ind} = p_I q_I(p_I, p_D) + p_D q_D(p_I, p_D).$$

We can then rewrite each firm's (gross) profits as function of industry profits:

$$\pi_I = \pi_{ind} + w q_D(p_I, p_D) - p_D q_D(p_I, p_D), \quad \pi_D = \pi_{ind} - w q_D(p_I, p_D) - p_I q_I(p_I, p_D).$$

Externalities

Firm I chooses its price p_I, taking p_D as given, to maximize its profit π_I. The F.O.C. is:

$$\frac{\partial \pi_{ind}}{\partial p_I} + \underbrace{w\frac{\partial q_D(p_I, p_D)}{\partial p_I}}_{\substack{accommodation \\ effect}} - \underbrace{p_D\frac{\partial q_D(p_I, p_D)}{\partial p_I}}_{\substack{horizontal \\ externality}} = 0$$

or

$$\frac{\partial \pi_{ind}}{\partial p_I} - \underbrace{(p_D - w)\frac{\partial q_D(p_I, p_D)}{\partial p_I}}_{\substack{net\ horizontal \\ externality}} = 0$$

The accommodation effect serves as to mitigate the horizontal externality.

Externalities

Firm D chooses its price p_D, taking p_I as given, to maximize its profit π_D. The F.O.C. is:

$$\frac{\partial \pi_{ind}}{\partial p_D} - \underbrace{w \frac{\partial q_D(p_I, p_D)}{\partial p_D}}_{\substack{vertical \\ externality}} - \underbrace{p_I \frac{\partial q_I(p_I, p_D)}{\partial p_D}}_{\substack{horizontal \\ externality}} = 0$$

Solving together the FOCs, we obtain the last-stage subgame equilibrium final-good prices as functions of the per-unit input price, $p_i(w), i = I, D$, with $\partial p_i / \partial w > 0$.

First stage: Two-part tariff

Firms I and D choose w and F to maximize the generalized Nash product:

$$[\pi_I(w) + F - d]^{\beta}[\pi_D(w) - F]^{1-\beta}$$

where I's disagreement payoff $d = \pi_I^{mon}$, i.e., the integrated monopoly profit.

First stage: Two-part tariff

Maximizing with respect to F we obtain:

$$F(w) = \beta\pi_D(w) - (1-\beta)[\pi_I(w) - \pi_I^{mon}]$$

and the generalized Nash product reduces to:

$$[\pi_D(w) + \pi_I(w) - \pi_I^{mon}] = \pi_{ind}(w) - \pi_I^{mon}$$

The two firms essentially choose w to maximize the industry profit:

$$\frac{\partial \pi_{ind}(w)}{\partial w} = 0$$

First stage: Two-part tariff

- After some straightforward but tedious calculations, the FOC can be rewritten as:

$$\underbrace{\left[(p_D - w)\frac{\partial q_D(p_I, p_D)}{\partial p_I}\right]}_{A}\underbrace{\frac{\partial p_I}{\partial w}}_{+} + \underbrace{\left[p_I \frac{\partial q_I(p_I, p_D)}{\partial p_D} + w\frac{\partial q_D(p_I, p_D)}{\partial p_D}\right]}_{B}\underbrace{\frac{\partial p_D}{\partial w}}_{+} = 0$$

gives the equilibrium per-unit input price w^T, independent of β

- A: externalities by I
- B: externalities by D

First stage: Two-part tariff

When final-goods are imperfect substitutes ($\partial q_i / \partial p_j > 0$), a two-part tariff contract *cannot* achieve the maximum industry profit, as pointed out by Moresi and Schwartz (2017) since the two externalities do not vanish: $A > 0$ and $B < 0$. The latter implies:

$$w^T > -p_I^T \frac{\partial q_I(p_I, p_D)/\partial p_D}{\partial q_D(p_I, p_D)/\partial p_D} > 0,$$

where $p_I^T = p_I(w^T)$. Even though firms cannot achieve the maximum industry profit, they still try to mitigate the horizontal externality and thus they set the per-unit input price above marginal cost.

First stage: Linear contract

Firms I and D choose w to maximize the generalized Nash product:

$$[\pi_I(w) - d]^{\beta}[\pi_D(w)]^{1-\beta}$$

The FOC after using the expression $\pi_I(w) = \pi_{ind}(w) - \pi_D(w)$ becomes:

$$\frac{\partial \pi_{ind}(w)}{\partial w} = \frac{\partial \pi_D(w)}{\partial w} \frac{[\beta \pi_D(w) - (1-\beta)[\pi_I(w) - \pi_I^{mon}]]}{\beta \pi_D(w)}$$

gives the equilibrium input price $w^L(\beta)$ which depends on β.

Comparison of per-unit input prices

- Under T: $\frac{\partial \pi_{ind}(w)}{\partial w} = 0$ (1)
- Under L: $\frac{\partial \pi_{ind}(w)}{\partial w} = \frac{\partial \pi_D(w)}{\partial w} \frac{\left[\beta \pi_D(w) - (1-\beta)\left[\pi_I(w) - \pi_I^{mon}\right]\right]}{\beta \pi_D(w)}$ (2)

- If we insert w^T into (2) and obtain that the RHS of (2) is positive (negative), we conclude that $w^L < (>) w^T$.
- Since $\partial \pi_D(w)/\partial w < 0$, the sign of the RHS of (2) depends on the sign of $\beta \pi_D(w) - (1-\beta)[\pi_I(w) - \pi_I^{mon}]$. By evaluating the latter on w^T, the latter is equal to $F(w^T)$

Comparison of per-unit input prices

$$\text{Sign of } \beta\pi_D(w^T) - (1-\beta)[\pi_I(w^T) - \pi_I^{mon}] = F(w^T)$$

- For $\pi_I(w^T) < \pi_I^{mon}$, it is straightforward that the RHS of (2) is positive and that $w^L > w^T$. In that case, $F(w^T) > 0$: if the equilibrium gross profits of firm I are lower than its outside option, then it always receives a fixed payment from D.
- For $\pi_I(w^T) > \pi_I^{mon}$, the RHS of (2) can be negative. We prove that $\partial F(w^T)/\partial\beta > 0$ and $F(w^T)|_{\beta=0} < 0,\ F(w^T)|_{\beta=1} > 0$ which lead to the following Lemma:

Comparison of per-unit input prices

Lemma 1. *Suppose that* $\pi_I(w^T) > \pi_I^{mon}$ *holds. There exists a unique* $\hat{\beta} \in (0,1)$ *such that* $w^L < w^T$ *if and only if* $\beta < \hat{\beta}$*. In that case,* $F(w^T) < 0$*.*

When the integrated firm is rather powerful in negotiating contract terms, the optimal per-unit input price under a linear contract is higher than the optimal per-unit input price under a two-part tariff.

As the bargaining-power distribution changes in favor of the downstream rival, the per-unit input price under a linear contract decreases and the per-unit input price under a two-part tariff remains unchanged (and above the marginal cost).

When the independent downstream rival is rather powerful, the optimal per-unit input price ends up being lower with a linear contract than with a two-part tariff.

Linear demand

Consumers' direct demands for the final-goods are (Singh and Vives, 1984):

$$q_i(p_i, p_j) = \frac{a(1-\theta) - p_i + \theta p_j}{1-\theta^2}, \qquad i, j = I, D, i \neq j$$

where $\theta \in (0,1)$ reflects the degree of substitutability among firms' final-goods, with higher values of θ reflecting greater inter-brand substitution.

Linear demand: CS and W

Lemma 2. *Under linear demand, the integrated firm never forecloses its downstream rival under either contract type*.

Proposition 1. *Under linear demand and a two-part tariff, the equilibrium per-unit input price is positive, while the fixed fee is positive (negative) if and only if* $\beta > (<) \hat{\beta}(\theta)$*, with* $\hat{\beta}(\theta) \equiv \frac{\theta^2(5+4\theta^2)}{(4+5\theta^2)(1+\theta^2)}$*, and* $\partial\hat{\beta}/\partial\theta > 0$.

Proposition 2. *Under linear demand (i)* $w^T > w^L$, $p_i^T > p_i^L$, $q_i^T < q_i^L$, $i = I, D$*, and (ii)* $CS^T < CS^L$, $TW^T < TW^L$*, if and only if* $\beta < \hat{\beta}(\theta)$.

Linear demand: profits

Proposition 3. *Under linear demand:*

(i) for $\beta > \hat{\beta}(\theta)$ *we have* $\pi_I^T > \pi_I^L, \pi_D^T < \pi_D^L$ *and* $\pi_{ind}^T > \pi_{ind}^L$

(ii) for $\beta < \hat{\beta}(\theta)$ *we have* $\pi_I^T < \pi_I^L, \pi_D^T > \pi_D^L$ *and* $\pi_{ind}^T > \pi_{ind}^L$.

- Proposition 3 reveals that the two firms have divergent preferences regarding the contract types.
- Industry profit is maximized under T but not under L.
- Nevertheless, besides the *size* of the 'pie' what also matters is the *distribution* of the pie.

Linear demand: profits

- After evaluating each firm's share of the profits, we have that

$$\frac{\pi_I^L}{\pi_{ind}^L} > \frac{\pi_I^T}{\pi_{ind}^T} \text{ iff } \beta < \hat{\beta}(\theta).$$

- When β is relatively low and/or θ is relatively high ($\partial\hat{\beta}/\partial\theta > 0$), firm I prefers the linear contract: a switch from a two-part tariff to a linear contract increases the slice of the pie that goes to firm I and compensates for the reduction in the size of the pie. Clearly, firm D prefers the two-part tariff since it can capture a larger share of the larger pie.

Linear demand

From Propositions 2 and 3, we immediately obtain the following.

Corollary 1. *The preferred contract type for firm I is always welfare superior, whereas the preferred contract type for firm D is always welfare inferior.*

Hence, the incentives of firm I and the society on which contract type should be employed are aligned.

Cournot competition

- Each firm's (gross) profits as function of industry profits:

$$\tilde{\pi}_I = \tilde{\pi}_{ind} + wq_D - p_D(q_I, q_D)q_D, \qquad \tilde{\pi}_D = \tilde{\pi}_{ind} - wq_D - p_I(q_I, q_D)q_I.$$

- FOC wrt q_I:

$$\frac{\partial \tilde{\pi}_{ind}}{\partial q_I} - \underbrace{q_D \frac{\partial p_D(q_I, q_D)}{\partial q_I}}_{\substack{horizontal \\ externality}} = 0$$

Cournot competition

- As is well-known, the accommodation effect present under Bertrand competition, is *not* present under Cournot competition: when firms set quantities rather than prices, the integrated firm takes the rival's output and hence the demand for its input as given, and consequently it does not perceive that variations in its own output will affect its upstream profit (e.g., Chen, 2001; Arya et al., 2008; Church, 2008).

- FOC wrt q_D:

$$\frac{\partial \tilde{\pi}_{ind}}{\partial q_D} - \underbrace{w}_{\substack{vertical \\ externality}} - \underbrace{q_I \frac{\partial p_I(q_I, q_D)}{\partial q_D}}_{\substack{horizontal \\ externality}} = 0.$$

Cournot competition

Our main results crucially depend on the mode of downstream competition. Under downstream Cournot:

(i) the per-unit input price is always lower, and consumer surplus and overall welfare are always higher under a two-part tariff than under a linear contract,

(ii) with a two-part tariff, optimal gross (net of fixed fee) profits of the integrated firm are always lower than the integrated monopoly profit (its outside option) so that the optimal fixed fee is always positive,

(iii) the integrated firm always prefers the two-part tariff,

(iv) the independent downstream rival prefers the linear contract (two-part tariff) when it is rather weak (powerful) in negotiating contract terms, and hence the two firms' preferences over the contract type collide only when the downstream rival is rather weak in negotiating contract terms; when it is rather powerful, both firms are better off under the two-part tariff.

Cournot competition

- The fact that the accommodation effect is not present under downstream Cournot implies that the integrated firm does not perceive that variations in its own output will affect its upstream profit and, thus, a higher per-unit input price under two-part tariff cannot relax downstream competition too much (compared to Bertrand competition) so as to increase the profits of the integrated firm at that level that it can compensate D via a negative fixed fee.

Conclusion

- Considering a framework in which an integrated firm sells its input to a downstream rival, we have shown that the standard result of the desirability of two-part tariffs over linear contracts in terms of welfare may be reversed.

- Our paper contributes to the literature on vertical contracting by considering the desirability in terms of welfare and profits of the two standard contractual forms under vertical integration and bargaining.