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The Ambiguous Competitive Effects of Passive Partial Forward Integration

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Abstract

In a two-tier industry with an upstream monopolist supplier and downstream competition with differentiated goods, we show that passive partial forward integration (PPFI) has ambiguous effects on competition and welfare. When vertical trading is conducted via linear tariffs, PPFI is pro-competitive and welfare-increasing. While under two-part tariffs, it is anti-competitive and welfare-decreasing. These hold irrespectively of the degree of product differentiation, the observability or secrecy of contract terms, the mode of downstream competition, and the distribution of bargaining power between firms.

JEL Classification: D43, L13.

Keywords: partial passive forward integration; two-part tariffs; linear tariffs; competition; welfare.

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1 Introduction

In recent years, we have witnessed a plethora of non-controlling stock buyouts of suppliers in their product distributors or retailers. In 2020, Coca-Cola Europacific Partners bought a minority stake in multi-beverage dispenser company Lavit¹ and a 25% stake in Innovative Tap Solutions.² In 2019, the world’s second-largest liquefied natural gas company Total has bought 37% of the Indian conglomerate Adani Group’s gas distribution business.³ In the same year, in the engine oils industry, Fuchs has acquired 50% of the shares of three distributors based in Sub-Saharan Africa.⁴ In 2018, China’s second-biggest drugmaker Harbin Pharmaceutical has announced a deal to buy a 40% percent stake in U.S. vitamin retailer GNC.⁵ In the same year, in the music industry, the artist development company Believe Music bought 49% in Tôt ou tard, the second biggest independent record label in France.⁶

These cases, along with many others reported in the literature, suggest that the acquisition of a stake in a downstream customer with no control over its strategic decisions, which is called *passive partial forward integration* (hereafter *PPFI*), is not a new phenomenon.⁷ PPFI is a common practice for many decades, but the analysis of its competitive effects rests on a handful of papers: Flath (1989), Fiocco (2016), and Levy (2019). In contrast, the literature on passive partial backward integration (*PPBI*), where a downstream firm has stakes on its upstream supplier with no control over its decisions, is rather extensive.⁸

This discrepancy may be explained by the widespread view that PPFI is pro-competitive as it mitigates double marginalization (Spengler, 1950).⁹ Indeed, an upstream supplier

¹<https://www.beveragedaily.com/Article/2020/12/15/Coca-Cola-European-Partners-invests-in-countertop-company-Lavit>

²<https://www.foodbev.com/news/coca-cola-invests-in-self-pour-self-pay-drink-dispense-technology/>

³<https://www.ft.com/content/379b5dd6-ee65-11e9-ad1e-4367d8281195>

⁴<https://www.bloomberg.com/press-releases/2019-12-05/dgap-news-fuchs-strengthens-presence-in-sub-saharan-africa-through-joint-ventures>

⁵<https://www.reuters.com/article/us-gnc-harbin-pharma-investment/chinas-harbin-pharma-to-buy-stake-in-u-s-health-retailer-gnc-idUSKCN1FY0DL>

⁶<https://www.musicbusinessworldwide.com/believe-digital-acquires-one-of-europes-biggest-distributors-germanys-groove-attack>

⁷Gilson and Roe (1993) report that the major Japanese firms are usually owned by their suppliers besides banks and insurers. For example steel makers hold a large stake in automakers. In the 70’s and the 80’s PepsiCo and Coca-Cola Company owned shares in their bottling and distribution companies. Other examples of forward and backward partial vertical integration can be found in Gilo and Spiegel (2011), and Levy et al. (2018).

⁸PPBI is analyzed in Greenlee and Raskovich (2006), Höffler and Kranz (2011a), Höffler and Kranz (2011b), Hunold and Stahl (2016), Lestage (2021), while controlling partial backward integration in Baumol and Ordober (1994). Also, Brito et al. (2016), Levy et al. (2018) and Hunold and Schlütter (2019) examine both controlling partial backward and forward integration.

⁹For instance, Hunold and Stahl (2016) state: “*Similar to a vertical merger, both passive and controlling forward integration of an upstream supplier in its customers tends to induce vertical coordination, by reducing double marginalization and thus downstream prices. Obviously, this is consumer surplus increasing and procompetitive.*”

having a non-controlling stake in a downstream customer has an incentive to lower its input price since it enjoys a higher dividend profit from its customer. The downstream firms pass on this cost-saving to the retail price, increasing consumer surplus. This kind of vertical coordination was demonstrated by [Flath \(1989\)](#) in an industry with successive Cournot oligopolies when upstream suppliers hold exclusive shares in downstream firms and there is no price discrimination across firms.

Nevertheless, Flath’s pro-competitive result hinges upon the “arm’s length” price assumption, which as he acknowledges, applies in special cases and prohibits any partial foreclosure (or raising rival’s cost - *RRC*) effects to emerge. In general, an upstream supplier may have incentives to charge a higher input price to the downstream rival of its partially owned firm. The incentives to divert sales through discriminatory pricing is the main cause of concern in antitrust policy and has been recently emphasized in the [DoJ and FTC \(2020\)](#) Vertical Merger Guidelines.

We consider a model with bottleneck upstream and downstream competition with differentiated products. The monopolist supplier may apply wholesale price discrimination between its partially integrated downstream firm and its independent downstream customer. We identify how PPFi affects the vertical transaction (the elimination of double marginalization effect - *EDM*) and downstream competition (the *RRC* effect). Therefore, we can determine their joint net effect on competition and welfare under various market characteristics.

Our main finding suggests that PPFi may have either a positive or a negative effect on competition and welfare, depending exclusively on the type of contract used in vertical trading. In particular, PPFi is pro-competitive and welfare-increasing when vertical trading is via linear tariffs.¹⁰ But, PPFi is anti-competitive and welfare-decreasing under trading via two-part tariffs.¹¹ This finding is independent of the degree of product differentiation, the mode of downstream competition (Cournot or Bertrand), the disclosure regime of contract terms (secret or interim observable), and the distribution of bargaining power between the upstream monopolist and downstream firms. We also find that the higher is the stake of the upstream monopolist on its downstream customer, the more pronounced are the pro- or anti-competitive effects of PPFi.

Under linear tariffs, the higher the level of PPFi, the stronger is the incentive of the upstream supplier to favor the downstream firm that it owns partially, by offering to it a lower wholesale price and thus reinforcing the *EDM* effect. The *RRC* effect is not sufficiently large to offset vertical coordination because the upstream supplier faces an opportunity cost of diverting sales to its favored downstream customer. The opportunity

¹⁰Linear tariffs are considered common practice in certain industries. Examples include the media ([Crawford and Yurukoglu, 2012](#); [Crawford et al., 2018](#)), book publishing ([Gilbert, 2015](#)) and hospital suppliers ([Ho and Lee, 2017](#)) and ([Grennan, 2013, 2014](#))

¹¹Empirical evidence on the use of two part tariffs is provided e.g. in [Sudhir \(2001\)](#); [Villas-Boas \(2007\)](#); [Bonnet and Dubois \(2010\)](#); [Cohen \(2013\)](#) for the supermarket industry and diary products.

cost is the foregone input sales to the downstream rival. As a result, industry output increases, leading to higher consumers surplus and social welfare.

In contrast, under secret two-part tariff contracts and Cournot competition, the double marginalization problem is absent, independently of the degree of vertical integration and the bargaining power distribution. In this case, PPFi leads to price discrimination against the downstream rival. Therefore, the RRC effect leads to lower industry output, consumers surplus, and social welfare. Finally, under observable two-part tariff contracts and Cournot competition, as well as under secret two-part tariff contracts and Bertrand competition, both wholesale prices increase with the degree of PPFi, leading again to lower industry output, consumers surplus, and social welfare.

We also identify PPFi as another source of the *waterbed effect* (Inderst and Valletti, 2011). The latter is due to the coexistence of the EDM and RRC effects. In particular, under secret linear tariffs and Cournot competition, the higher the degree of PPFi, the higher the wholesale price discount the partially integrated downstream firm enjoys as compared with its rival. And the latter is independent of the distribution of bargaining power between the upstream supplier and the downstream firms.

The remainder of the paper is organized as follows. Related literature is presented and discussed in Section 2. Section 3 describes the main model. Section 4 characterizes its equilibrium outcome under linear and two-part tariff contracts. To check the robustness of our main findings Section 5 extends the main model in prominent directions. Section 6 concludes. All proofs are relegated in the Appendix.

2 Related Literature

Our research is related to the literature on vertical mergers.¹² The competitive effects of (full) vertical integration are summarized in the recent Vertical Merger Guidelines of the U.S. Department of Justice and the Federal Trade Commission (DoJ and FTC, 2020).

A large part of the theoretical and empirical literature on vertical integration assesses the net effect of a merger on welfare by quantifying and comparing mainly two effects: (i) the *raising rivals' cost* (RRC) effect, and (ii) the *elimination of double marginalization* (EDM) effect.¹³ The welfare implications of the EDM effect have recently been challenged (Salop, 2018; Kwoka and Slade, 2019), and analyzed in various contexts (Choné and Linnemer, 2021; Rogerson, 2020; Moresi and Schwartz, 2021).

This dichotomy is even more pronounced in the empirical literature. On the one hand, vertical integration was found pro-competitive in the cement industry (Hortaçsu

¹²See the surveys of Perry (1989), Chen (2001) and Riordan (2005) regarding the impact of vertical mergers on competition. See also Loertscher and Reisinger (2014); Reisinger and Tarantino (2015).

¹³Besides these effects, cognizable efficiencies like asset coordination in production, inventory management and distribution, removal of contractual frictions and R&D cooperation may also be important in judging a vertical integration's welfare effects.

and Syverson, 2007), and in the theater industry, (Gil, 2015). On the other hand, it was found anticompetitive in the US pay television industry (Waterman and Weiss, 1996; Chipty, 2001; Suzuki, 2009) and the wholesale gasoline industry (Hastings and Gilbert, 2005). There is also evidence of anticompetitive effects of vertical mergers of multi-product firms (Luco and Marshall, 2020).

According to Slade (2021), the EDM effect has been overstated, probably due to the inability to measure other effects. Nevertheless, there is a wider consensus that most, *but not all*, vertical mergers are pro-competitive. Indeed, Salop and Culley (2020) report that from 1994 to 2016, U.S. agencies have challenged only fifty-two mergers that involved vertical integration.

This positive view on the welfare effects of full vertical integration is not necessarily extended to passive partial vertical integration. For instance, passive partial backward integration (PPBI) may decrease the incentives of an upstream manager to reduce production costs (Riordan, 1991) and is considered anticompetitive¹⁴ by Hunold and Stahl (2016) or neutral in Greenlee and Raskovich (2006).

The substantial difference between the welfare effects of PPF and PPBI is aptly explained in Hunold and Stahl (2016). PPBI induces an effect on consumer prices similar to that of partial horizontal cross-holdings. When a downstream firm holds a stake in its upstream supplier, it is entitled to the profit of its rival downstream firm through the upstream supplier. This kind of profit interlink induces anticompetitive horizontal coordination as if the downstream firm that partially owns its upstream supplier was holding a direct share in the rival downstream firm. The latter cannot occur under PPF.¹⁵

There are only a few papers that analyze the competitive effects of PPF. Flath (1989) builds a general model of successive Cournot oligopolies and determines the equilibrium price-cost margin of a downstream firm, allowing though only for symmetric vertical cross-ownership. That is, all downstream firms own the same share in upstream firms and vice-versa. Moreover, Flath (1989) considers vertical transactions at *arms' length*, thus not allowing for multilateral contracting and price discrimination.

In contrast, we consider an asymmetric setup with an upstream monopolist supplier having a positive share on one downstream firm and no share on its rival firm. More importantly, we consider simultaneous bilateral contracting of the upstream supplier with the downstream firms and highlight the crucial role of the contract type used in vertical trading for the welfare effects of PPF. Applying wholesale price discrimination turns out

¹⁴According to Brito et al. (2016), a controlling partial backward integration (PBI) can be welfare-increasing, nonetheless this strategy may not be profitable for firms under upstream competition as Hunold and Stahl (2016) underline. The effects of controlling PBI can also be found in Baumol and Ordover (1994) and Spiegel (2013).

¹⁵This is easily demonstrated by comparing the first order conditions of the partially integrated downstream firm under PPBI and PPF. PPBI affects the first-order conditions, while PPF does not.

to be an equilibrium strategy for the upstream supplier in our setup, leading to ambiguous competitive and welfare effects of PPFi.

Fiocco (2016) considers a model with competing supply hierarchies in which downstream firms that have private information about their costs, set the prices of their differentiated goods. Asymmetric information induces a misalignment of the objectives of a manufacturer-retailer pair and a higher retail price, that is accommodated by the rival pair due to strategic complementarity. This particular type of double marginalization from asymmetric information can be offset by PPFi. It is shown that increasing the degree of PPFi is welfare-increasing. Levy (2019) compares investment incentives under partial backward and forward integration. He shows that passive acquisitions can promote relationship-specific investments and increase surplus.

Finally, Lestage (2021) considers a market where an upstream monopolist owns a non-controlling share in two downstream firms. He shows that under the Shubik-Levitan linear demands system and interim observable linear tariffs, PPFi may be pro-competitive and welfare-increasing under both price and quantity competition. The latter is in line with our findings for the case of Cournot competition and interim observable linear tariffs.

Yet, unlike Lestage (2021), we consider also non-linear tariffs and highlight the importance of the vertical trading contracts for the competitive and welfare effects of PPFi. Our findings suggest that other market characteristics, like product differentiation, mode of downstream competition, secrecy or observability of contract terms, and distribution of bargaining power between upstream and downstream firms, do not qualitatively alter our main insights.¹⁶

3 The Model

Consider a two-tier industry where an upstream monopolist, U , supplies an essential input to two downstream competitors, D_1 and D_2 , that produce differentiated final goods. Downstream firms use U 's input in an "1 to 1" proportion to produce their goods. Each D_i faces a linear inverse demand function $p_i(q_i, q_j) = a - q_i - \gamma q_j$, $i = 1, 2 \neq j$, with $a > 0$ measuring the market size, and $\gamma \in (0, 1]$ the degree of product substitutability. The higher γ , the better substitutes the goods are.¹⁷

¹⁶In a different vein, Levy et al. (2018) and Hunold and Schlütter (2019) deal with *controlling* partial forward and backward vertical integration. Levy et al. (2018) consider a model where two downstream firms buy inputs from several upstream suppliers. They examine firm's incentives to partially integrate forward or backward and apply foreclosure. They show that the initial ownership structure of the target firm determines whether foreclosure is profitable under controlling partial vertical integration, no matter its direction. But, backward integration may facilitate input foreclosure, while forward integration may promote customer foreclosure. Hunold and Schlütter (2019) show that controlling forward and backward partial vertical integration may have the same welfare-decreasing effects.

¹⁷Following Singh and Vives (1984), we assume a unit mass of identical consumers, each having a quadratic utility function $u(q_i, q_j) = a(q_i + q_j) - (q_i^2 + q_j^2 + 2\gamma q_i q_j)/2 + m$, with m denoting the quantity of the numeraire sector's composite good whose price is normalized to 1.

U has a constant marginal cost $c \in (0, a)$. Each D_i incurs no other costs besides those induced by the vertical contract signed with U . These contracts can take the form of either (i) a two-part tariff (denoted by the superscript \mathcal{T}) consisting of a per unit of input price w_i and a fixed fee F_i , or (ii) a linear tariff (denoted by the superscript \mathcal{L}) consisting solely of a per unit of input price w_i .

U possesses an *exogenous* minority share $0 < k \leq \frac{1}{2}$ of D_1 's profits and has no control over its strategic decisions, i.e., U has *silent financial interests* on D_1 .¹⁸ In other words, there is passive partial forward integration (PPFI) between U and D_1 . So, the gross (from fixed fees) profits of the downstream firms and the monopolist supplier are:

$$\begin{aligned}\pi_1(q_1, q_2, w_1) &= (1 - k)(p_1(q_1, q_2) - w_1)q_1 \\ \pi_2(q_1, q_2, w_2) &= (p_2(q_1, q_2) - w_2)q_2 \\ \pi_U(q_1, q_2, w_1, w_2) &= \sum_{i=1}^2 (w_i - c)q_i + k(p_1(q_1, q_2) - w_1)q_1\end{aligned}\quad (1)$$

Under linear tariffs, since $F_i \equiv 0$, the firms' net profits coincide with gross profits. But, under two-part tariffs, the firms' net profits are: $\Pi_1(q_1, q_2, w_1, F_1) = \pi_1(q_1, q_2, w_1) - (1 - k)F_1$, $\Pi_2(q_1, q_2, w_2, F_2) = \pi_2(q_1, q_2, w_2) - F_2$, and $\Pi_U(q_1, q_2, w_1, w_2, F_1, F_2) = \pi_U(q_1, q_2) + (1 - k)F_1 + F_2$.

We consider a two-stage game with *secret* actions. In *stage 1*, U makes, simultaneously and separately, a “take-it or leave-it” offer to each downstream firm over its vertical contract terms. That is, we consider that U has two representatives, each dealing with a different downstream firm.¹⁹ In *stage 2*, D_i s engage in Cournot competition.²⁰

Secrecy dictates each D_i is unaware of its rival's contract terms when it makes its output decision. This could be caused, e.g., by contracts often renegotiable. Due to secrecy, each D_i must form beliefs about the rival's contract terms. We assume that these beliefs are *passive* (Hart and Tirole, 1990), i.e., D_i does not revise its beliefs when it receives an out-of-equilibrium offer from U . It treats it as an uncorrelated tremble, believing that (U, D_j) has settled to equilibrium contract terms.²¹ To solve the game we

¹⁸Even though a $k > 1/2$ implies control of U over D_1 's strategic decisions, the opposite is not necessarily true. Competition authorities often inspect non-controlling minority shareholdings that are between 15% and 25% (Salop and O'Brien, 2000). Further, to abstract from free-rider problems among small shareholders á la Grossman and Hart (1980), we assume that each firm is owned by a single shareholder.

¹⁹This is a standard assumption in multilateral contracting (Crémer and Riordan, 1987; O'Brien and Shaffer, 1992; Milliou and Petrakis, 2007).

²⁰In Section 5 we extend our analysis to consider interim observable contracts, downstream price competition, bargaining between U and each D_i over their contract terms, as well as an asymmetric setup where U makes a two-part tariff offer to D_i and a linear tariff offer to D_j .

²¹As Rey and Vergé (2004) points out, under quantity competition and secrecy (as in our setup), passive beliefs are equivalent to wary beliefs. Under the latter, when D_i gets an out-of-equilibrium offer from U , it believes that D_j has already got an acceptable contract that is the best response of U to D_i 's offer. Besides that, McAfee and Schwartz (1994) also consider symmetric beliefs, where each firm believes that rival firms get the same deal as it receives.

employ perfect Bayesian Nash equilibrium and restrict attention to pure strategies.

4 Equilibrium analysis

4.1 Competition stage

As fixed fees are determined in a previous stage and k is exogenous, it is easy to see that the analysis of stage 2 is the same under both contract types. Each D_i chooses output q_i to maximize $(p_i(q_i, \tilde{q}_j) - w_i)q_i$, with \tilde{q}_j being D_i 's conjecture about the output produced by its rival D_j . Due to passive beliefs, these conjectures are independent of the contract terms agreed between D_i and U . These maximization problems lead to the reaction functions $R_i(w_i, \tilde{q}_j) = \frac{1}{2}(a - w_i - \gamma\tilde{q}_j)$, $i = 1, 2, i \neq j$, that satisfy the usual properties $\partial_1 R_i < 0$ and $\partial_2 R_i < 0$.²²

In stage 1, an agent representing U makes a “take-it-or-leave-it” offer to D_i , taking as given the offer made by the other agent of U to D_j . These offers could be either (w_i, F_i) in case of two-part tariffs, or simply w_i in case of linear tariffs. We consider each contract type in turn.

4.2 Linear tariffs

In this case, one agent of U makes a “take-it-or-leave-it” w_1 offer to D_1 to maximize $\pi_U(R_1(w_1, \tilde{q}_2), \tilde{q}_2, w_1, w_2)$, taking as given that D_2 has accepted its w_2 offer and produces the conjectured output \tilde{q}_2 . At the same time, the other agent of U makes a “take-it-or-leave-it” w_2 offer to D_2 to maximize $\pi_U(\tilde{q}_1, R_2(w_2, \tilde{q}_1), w_1, w_2)$, taking as given (w_1, \tilde{q}_1) . We set $R_i(\cdot) = R_i(w_i, \tilde{q}_j)$. The first order conditions (*focs* henceforth) are:

$$\begin{aligned} R_1(\cdot) + (w_1 - c)\partial_1 R_1(\cdot) + k [\partial_1 R_1(\cdot) (p_1(R_1(\cdot), \tilde{q}_2) - w_1) + \\ + R_1(\cdot) (\partial_1 p_1(R_1(\cdot), \tilde{q}_2) \partial_1 R_1(\cdot) - 1)] &= 0 \\ R_2(\cdot) + (w_2 - c)\partial_1 R_2(\cdot) + k [\tilde{q}_1 \partial_2 p_1(\tilde{q}_1, R_2(\cdot)) \partial_1 R_2(\cdot)] &= 0 \end{aligned} \quad (2)$$

Given our linear demands system, $\partial_1 R_1(\cdot) = \partial_1 R_2(\cdot) = -\frac{1}{2}$, $\partial_1 p_1(\cdot) = -1$ and $\partial_2 p_1(\cdot) = -\gamma$. These imply that the expression in square brackets that multiplies k is negative (positive) in the first (second) foc. As a consequence, the equilibrium wholesale price for $D_1(D_2)$ is lower (higher) than under full separation ($k = 0$).

Solving the system of (2) and assuming that conjectures are true in equilibrium, i.e., $\tilde{q}_i = q_i^{\mathcal{L}}$, we obtain the equilibrium wholesale prices and outputs:

$$w_1^{\mathcal{L}} = c + \frac{2(1-k)(4-\gamma)(a-c)}{8(2-k) - \gamma^2(1+k)}$$

²²To simplify notation we set e.g. $\partial_1 R(w_1, \tilde{q}_2) \equiv \frac{\partial R(w_1, \tilde{q}_2)}{\partial w_1}$.

$$\begin{aligned}
w_2^{\mathcal{L}} &= c + \frac{[2(4 - \gamma) - k(4 - \gamma(2 - \gamma))](a - c)}{8(2 - k) - \gamma^2(1 + k)} \\
q_1^{\mathcal{L}} &= \frac{(4 - \gamma)(a - c)}{8(2 - k) - \gamma^2(1 + k)} \\
q_2^{\mathcal{L}} &= \frac{(4 - \gamma - k(2 + \gamma))(a - c)}{8(2 - k) - \gamma^2(1 + k)}
\end{aligned} \tag{3}$$

As under full separation ($k = 0$), wholesale prices under PPFi ($k > 0$) are above upstream marginal cost, $w_i^{\mathcal{L}} > c$. This is due to the distortionary nature of linear tariffs that leads to double marginalization.²³ Clearly, for $k = 0$ equilibrium wholesale prices and quantities are equal, i.e., $w_1^{\mathcal{L}}|_{k=0} = w_2^{\mathcal{L}}|_{k=0} \equiv w_{k=0}^{\mathcal{L}}$ and $q_1^{\mathcal{L}}|_{k=0} = q_2^{\mathcal{L}}|_{k=0} \equiv q_{k=0}^{\mathcal{L}}$. Lemma 1 summarizes our findings. The proof of Lemma 1 derives readily from an inspection of equilibrium values in (3).

Lemma 1. (i) $w_1^{\mathcal{L}} < w_{k=0}^{\mathcal{L}} < w_2^{\mathcal{L}}$, $\frac{\partial w_1^{\mathcal{L}}}{\partial k} < 0$, and $\frac{\partial w_2^{\mathcal{L}}}{\partial k} > 0$
(ii) $q_1^{\mathcal{L}} > q_{k=0}^{\mathcal{L}} > q_2^{\mathcal{L}}$, $\frac{\partial q_1^{\mathcal{L}}}{\partial k} > 0$, and $\frac{\partial q_2^{\mathcal{L}}}{\partial k} < 0$
(iii) $Q^{\mathcal{L}} = q_1^{\mathcal{L}} + q_2^{\mathcal{L}} > Q_{k=0}^{\mathcal{L}}$, and $\frac{dQ^{\mathcal{L}}}{dk} > 0$

The intuition behind Lemma 1(i) is as follows. As expected, U treats favorably its partially owned downstream firm at the expense of its independent customer. As U has stakes on D_1 , it offers a lower wholesale price $w_1^{\mathcal{L}}$ to D_1 than to its independent downstream customer D_2 , to make D_1 more aggressive competitor in the final market and enjoy part of its higher profits.

Notably, as the degree of vertical integration k increases, the incentive of U to favor its partially owned downstream firm D_1 becomes stronger. So, wholesale prices move to opposite directions: $\partial w_1^{\mathcal{L}}/\partial k < 0$ and $\partial w_2^{\mathcal{L}}/\partial k > 0$. By lowering w_1 , U is (partially) eliminating double marginalization for D_1 (EDM effect), while by increasing w_2 , U is raising the rival's - independent customer's - marginal cost (RRC effect). Thus, PPFi induces a *waterbed effect* which becomes stronger the higher is k . An immediate consequence is that $q_1^{\mathcal{L}} > q_{k=0}^{\mathcal{L}} > q_2^{\mathcal{L}}$ for all k and $\partial q_1^{\mathcal{L}}/\partial k > 0$ and $\partial q_2^{\mathcal{L}}/\partial k < 0$ (Lemma 1(ii)).

Further, $|w_1^{\mathcal{L}} - w_{k=0}^{\mathcal{L}}| > w_{k=0}^{\mathcal{L}} - w_2^{\mathcal{L}}$. That is, U favors more its partially owned downstream firm than it hurts its independent customer D_2 . This happens because U wants to increase its dividend revenues from D_1 without losing much from input sales revenues from D_2 . This implies that industry output $Q^{\mathcal{L}}$ is higher than under full separation, suggesting that consumers surplus is also higher under PPFi. Finally, industry output is increasing in k (Lemma 1(iii)).

Although both the favorable treatment of D_1 and the unfavorable treatment of D_2 by U become stronger as PPFi increases, the intensity of the former is higher than that of the latter. The reasons are similar to those explained above. Therefore, under secret

²³See Gaudin (2019) and Pinopoulos (2019) for an analysis of the opportunism problem with secret linear tariffs.

linear tariffs, the reduction of wholesale prices on average and the increase of industry output characterize PPFi as *pro-competitive*.

In our setup, $CS = \frac{1}{2}(q_1^2 + q_2^2 + \gamma q_1 q_2)$.²⁴ Using (3), we verify that $\frac{\partial CS^{\mathcal{L}}}{\partial k} > 0$. Hence, consumers surplus is higher under PPFi than under full separation. Further, social welfare is defined as $SW = CS + \Pi_I$, where $\Pi_I = \pi_1 + \pi_2 + \pi_U$ are the industry profits. It turns out that industry profits increase with k too, and thus social welfare is higher under PPFi than under full separation. This increase in both welfare measures under linear tariffs characterizes PPFi as *welfare-increasing*.

Clearly, PPFi harms the independent downstream firm's profits. As we saw above, under PPFi, D_2 faces a higher wholesale price and produces lower output than under full separation. And these effects become more pronounced as k increases. PPFi, via the waterbed effect it induces, leads to profit shifting from D_2 to D_1 .

Yet, D_1 does not always benefit from PPFi, because part of its profits are now going to the upstream monopolist. In fact, $\pi_1^{\mathcal{L}} > \pi_{k=0}^{\mathcal{L}}$ if and only if $k < k_{cr}^{\mathcal{L}}(\gamma) = \min[\frac{1}{2}, \frac{3\gamma^2(16-\gamma^2)}{(8+\gamma^2)^2}]$, with $\frac{dk_{cr}^{\mathcal{L}}}{d\gamma} > 0$, $k_{cr}^{\mathcal{L}}(0) = 0$ and $k_{cr}^{\mathcal{L}}(0.930) = \frac{1}{2}$. Intuitively, whenever U has low stakes on D_1 , due to profit shifting, D_1 's profits are higher under PPFi than under full separation.

Finally, under PPFi the upstream monopolist profits are always higher than under full separation. U , not only enjoys part of the higher profits of D_1 , but it can also manipulate wholesale prices to its own benefit. The increase in U 's profits outweighs the decrease in D_2 's profits and the (potential) decrease in D_1 's profits, leading to higher industry profits under PPFi than under full separation. Moreover, the industry profits increase with the degree of vertical integration k . Proposition 1 summarizes. Its proof is in the Appendix.

Proposition 1. *When an upstream monopolist makes secret “take-it or leave-it” linear tariffs offers to Cournot downstream competitors:*

- (i) *Consumers surplus, industry profits, and social welfare are higher under PPFi than under full separation.*
- (ii) *PPFi is thus pro-competitive and welfare-increasing.*

4.3 Two-part tariffs

Under two-part tariffs, one agent of U makes a “take-it or leave-it” (w_1, F_1) offer to D_1 to maximize $\Pi_U(R_1(w_1, \tilde{q}_2), \tilde{q}_2, w_1, w_2, F_1, F_2)$ subject to D_1 's participation constraint $\Pi_1(R_1(w_1, \tilde{q}_2), \tilde{q}_2, w_1, F_1) \geq 0$, taking as given that D_2 has accepted its (w_2, F_2) offer and produces the conjectured output \tilde{q}_2 . At the same time, another agent of U makes a “take-it or leave-it” (w_2, F_2) offer to D_2 to maximize $\Pi_U(\tilde{q}_1, R_2(w_2, \tilde{q}_1), w_1, w_2, F_1, F_2)$ subject to D_2 's participation constraint $\Pi_2(\tilde{q}_1, R_2(w_2, \tilde{q}_1), w_2, F_2) \geq 0$, taking as given (w_1, F_1, \tilde{q}_1) .

²⁴Following Singh and Vives (1984), to obtain consumer surplus we substitute $p_i = \alpha - q_i - \gamma q_j$ into $u(q_1, q_2) - p_1 q_1 - p_2 q_2$.

As each agent of U possesses two instruments, it is well-known that it uses w_i to maximize the (U, D_i) pair's *joint profits* and F_i to transfer upstream all downstream profits (O'Brien and Shaffer, 1992). So, w_1 and w_2 are chosen to maximize, respectively:

$$\begin{aligned} & [p_1(R_1(\cdot), \tilde{q}_2) - c]R_1(\cdot) + (w_2 - c)\tilde{q}_2 + F_2 \\ & [p_2(\tilde{q}_1, R_2(\cdot)) - c]R_2(\cdot) + (w_1 - c)\tilde{q}_1 + k[p_1(\tilde{q}_1, R_2(\cdot)) - w_1]\tilde{q}_1 + (1 - k)F_1 \end{aligned} \quad (4)$$

Note that (U, D_1) pair's joint profits are independent of k . The focs of the maximization problems are:

$$\begin{aligned} & [p_1(R_1(\cdot), \tilde{q}_2) - c + R_1(\cdot) \partial_1 p_1(R_1(\cdot), \tilde{q}_2)] \partial_1 R_1(\cdot) = 0 \\ & [p_2(\tilde{q}_1, R_2(\cdot)) - c + R_2(\cdot) \partial_2 p_2(\tilde{q}_1, R_2(\cdot))] \partial_1 R_2(\cdot) + k [\tilde{q}_1 \partial_2 p_1(\tilde{q}_1, R_2(\cdot)) \partial_1 R_2(\cdot)] = 0 \end{aligned} \quad (5)$$

As above, $R_i(\cdot) = R_i(w_i, \tilde{q}_j)$, $\partial_1 R_1(\cdot) = \partial_1 R_2(\cdot) = -\frac{1}{2}$, $\partial_1 p_1(\cdot) = -1$ and $\partial_2 p_1(\cdot) = -\gamma$. As the first foc is independent of k , the equilibrium wholesale price for D_1 is the same as under full separation. In contrast, the term multiplying k in the second foc is positive and thus the equilibrium wholesale price for D_2 is higher than under full separation ($k = 0$).

Solving the system of focs (5) and assuming that in equilibrium conjectures are true, i.e., $\tilde{q}_i = q_i^T$, we get the equilibrium wholesale prices and outputs:

$$\begin{aligned} w_1^T &= c \\ w_2^T &= c + \frac{k\gamma(2 - \gamma)(a - c)}{4 - \gamma^2(1 + k)} \\ q_1^T &= \frac{(2 - \gamma)(a - c)}{4 - \gamma^2(1 + k)} \\ q_2^T &= \frac{(2 - \gamma(1 + k))(a - c)}{4 - \gamma^2(1 + k)} \end{aligned} \quad (6)$$

Moreover, equilibrium fixed fees are equal to gross downstream profits: $(1 - k)F_1^T = \pi_1(q_1^T, q_2^T, w_1^T)$, and $F_2^T = \pi_2(q_1^T, q_2^T, w_2^T)$, and are thus equal to:

$$\begin{aligned} F_1^T &= \frac{(2 - \gamma)^2(a - c)^2}{(4 - \gamma^2(1 + k))^2} \\ F_2^T &= \frac{(2 - \gamma - k\gamma)^2(a - c)^2}{(4 - \gamma^2(1 + k))^2} \end{aligned} \quad (7)$$

Again, under full separation equilibrium wholesale prices and quantities are equal, i.e., $w_1^T|_{k=0} = w_2^T|_{k=0} \equiv w_{k=0}^T = c$, and $q_1^T|_{k=0} = q_2^T|_{k=0} \equiv q_{k=0}^T$. This is the well-known marginal cost pricing result that highlights U 's commitment problem (Hart and Tirole, 1990; O'Brien and Shaffer, 1992; Rey and Tirole, 2007). Due to contracts' secrecy, D_i fears that U will act opportunistically offering D_j a lower wholesale price than its own.

U has the interest to do so, because by making D_j more aggressive in the final market, it can fully extract its higher gross profits via the fixed fee. Thus, D_i is willing to accept the contract *only* under marginal cost pricing. U 's inability to credibly commit to both downstream firms prevents it from achieving monopoly profits. Lemma 2 summarizes our findings. The proof of Lemma 2 comes from an inspection of equilibrium values in (6) and (7).

Lemma 2. (i) $w_1^T = w_{k=0}^T < w_2^T$, $\frac{\partial w_1^T}{\partial k} = 0$, and $\frac{\partial w_2^T}{\partial k} > 0$
(ii) $q_1^T > q_{k=0}^T > q_2^T$, $\frac{\partial q_1^T}{\partial k} > 0$, and $\frac{\partial q_2^T}{\partial k} < 0$
(iii) $Q^T = q_1^T + q_2^T < Q_{k=0}^T$, and $\frac{dQ^T}{dk} < 0$

The intuition behind Lemma 2 is as follows. Notably, under PPFi D_2 is offered a wholesale price higher than the upstream marginal cost. U has incentives to divert input sales from D_2 to D_1 because it can thus fully enjoy, via the fixed fee, the higher gross profits of its partially owned firm. This benefits U despite that its markup drops from positive ($w_2^T - c > 0$) to zero ($w_1^T - c = 0$). That is, PPFi induces the RRC effect. And this effect becomes stronger, the higher is k ($\frac{\partial w_2^T}{\partial k} > 0$).

In contrast to the case of the linear tariffs, here PPFi does not induce the EDM effect. The input is offered to D_1 at marginal cost for all k . An immediate consequence is that $q_1^T > q_{k=0}^T > q_2^T$ and moreover, $\frac{\partial q_1^T}{\partial k} > 0$ and $\frac{\partial q_2^T}{\partial k} < 0$.

Further, as $w_2^T - c > 0 = w_1^T - c$, and is increasing in k , the increase in q_1^T is smaller than the decrease in q_2^T , and as a result, industry output is lower than under full separation ($k = 0$) and is decreasing in k . So, under secret two-part tariff contracts, the increase in D_2 's wholesale price and the decrease in industry output may characterize PPFi as *anti-competitive*.

Due to the decrease in industry output, CS^T turns out to be lower than under full separation and also decreasing with k . Under two-part tariffs, downstream profits are zero and industry profits are equal to the upstream monopolist's profits. As the upstream monopolist benefits from its stakes on D_1 , industry profits are higher than under full separation. Yet, the increase in industry profits is outweighed by the decrease in consumers surplus; hence, social welfare is lower than under full separation and is also decreasing in k . Therefore, under secret two-part tariffs, we may characterize PPFi as *welfare-decreasing*. Proposition 2 summarizes. Its proof is in the Appendix.

Proposition 2. *When an upstream monopolist offers secret "take-it or leave-it" two-part tariffs to Cournot downstream competitors:*

(i) *Industry profits are higher, yet consumers surplus and social welfare are lower, under PPFi than under full separation.*

(ii) *PPFi is anti-competitive and welfare-decreasing.*

Summarizing the driving forces behind Propositions 1 and 2, we highlight that, irrespectively of the contract type, the raising rivals' cost (RRC) effect is always present,

since PPFi increases D_2 's wholesale price. Thus, the welfare properties of PPFi are driven by its effect on the wholesale price w_1 of the partially integrated downstream firm D_1 . Under two-part tariffs, U sells at marginal cost to D_1 rendering w_1 independent of k . Double marginalization is absent and so is the elimination of the double marginalization (EDM) effect. Therefore, the RRC effect leads to lower industry output, consumers surplus, and social welfare. Under linear tariffs, w_1 decreases with k . Therefore, PPFi leads to vertical coordination and induces a positive EDM effect that outweighs the RRC effect. So, under linear tariffs, PPFi leads to an increase in total output, industry profits, consumer surplus, and social welfare.

5 Extensions

To check the robustness of our findings, we consider the following extensions: (i) Bertrand competition in the downstream market, denoted by the superscript \mathcal{B} , (ii) Contracts are interim observable, i.e., each downstream firm can observe the rival's contract terms before making its output decision, denoted by the superscript \mathcal{O} , and (iii) bargaining between U and each D_i over contract terms, denoted by the superscript \mathcal{N} .²⁵

5.1 Bertrand competition

Downstream firms compete in prices, instead of quantities. All the other specifications are as in the main model. Inverting $p_i = a - q_i - \gamma q_j, i = 1, 2 \neq j$, we obtain the demand functions: $q_i(p_i, p_j) = \frac{a(1-\gamma)-p_i+\gamma p_j}{1-\gamma^2}$. Firms' gross profits now are: $\pi_1^{\mathcal{B}}(p_1, p_2, w_1) = (1-k)(p_1 - w_1)q_1(p_1, p_2)$, $\pi_2^{\mathcal{B}}(p_1, p_2, w_2) = (p_2 - w_2)q_2(p_1, p_2)$, and $\pi_U^{\mathcal{B}}(p_1, p_2, w_1, w_2) = \sum_{i=1}^2 (w_i - c)q_i(p_1, p_2) + k(p_1 - w_1)q_1(p_1, p_2)$. To determine the firms' net profits under two-part tariffs, we follow the same operation as in section 3.

In stage 2, each D_i chooses p_i to maximize its gross profits, leading to the reaction functions $R_i(w_i, \tilde{p}_j) = \frac{1}{2}(a(1-\gamma) + w_i + \gamma\tilde{p}_j)$, with \tilde{p}_j the conjecture that D_i forms for D_j 's price. Again, as fixed fees are determined in the previous stage, stage 2's outcome is independent of the type of the vertical contract.

Linear tariffs: Each agent i of U solves $\max_{w_i} \pi_U^{\mathcal{B}}(R_i(w_i, \tilde{p}_j), \tilde{p}_j, w_i, w_j)$, taking as given (w_j, \tilde{p}_j) . Solving the system of the focs of these maximization problems and assuming that in equilibrium conjectures are true, i.e., $\tilde{p}_i = p^{\mathcal{B}\mathcal{L}}$, we get the equilibrium wholesale prices and quantities, $(w_i^{\mathcal{B}\mathcal{L}}, q_i^{\mathcal{B}\mathcal{L}}), i = 1, 2$, which are reported in the Appendix.

Simple calculations reveal that $w_{k=0}^{\mathcal{B}\mathcal{L}} > w_2^{\mathcal{B}\mathcal{L}} > w_1^{\mathcal{B}\mathcal{L}} > c$ and $\frac{\partial w_i^{\mathcal{B}\mathcal{L}}}{\partial k} < 0, i = 1, 2$. In contrast to quantity competition, PPFi leads to a reduction of both wholesale prices, which is larger the higher is k . Therefore, there is no waterbed effect under price competition and thus the RRC effect is absent. In fact, an EDM effect is observed for both wholesale

²⁵A detailed analysis is available by the authors upon request.

prices and this effect becomes stronger as k increases. As $w_1^{\mathcal{B}\mathcal{L}} < w_2^{\mathcal{B}\mathcal{L}}$, U diverts input sales and output from D_2 to D_1 : $q_1^{\mathcal{B}\mathcal{L}} > q_{k=0}^{\mathcal{B}\mathcal{L}} > q_2^{\mathcal{B}\mathcal{L}}$. Moreover, it can be verified that $\frac{\partial(w_2^{\mathcal{B}\mathcal{L}} - w_1^{\mathcal{B}\mathcal{L}})}{\partial k} > 0$; thus, $q_1^{\mathcal{B}\mathcal{L}}$ increases by more than $q_2^{\mathcal{B}\mathcal{L}}$ decreases. As a result, industry output is higher than under full separation and increases with k .

An immediate consequence is that consumer surplus is higher than under full separation ($k = 0$). Moreover, although profits are lower for both downstream firms, the increase in equilibrium upstream profits overweighs the latter overall decrease, and industry profits are also higher than under full separation. It follows that social welfare is higher too. So, secret linear tariffs under Bertrand competition lead to the same competition and welfare effects as under Cournot competition.

Two-part tariffs: Each agent i of U chooses (w_i, F_i) to maximize U 's net profits $\Pi_U^{\mathcal{B}}(R_i(w_i, \tilde{p}_j), \tilde{p}_j, w_i, w_j, F_i, F_j)$ subject to D_i 's participation constraint $\Pi_i^{\mathcal{B}}(R_i(w_i, \tilde{p}_j), \tilde{p}_j, w_i, F_i) \geq 0$, given (w_j, F_j, \tilde{p}_j) . As above, this leads to the choice of w_i that maximizes (U, D_i) 's joint profits $\Pi_U^{\mathcal{B}}(R_i(w_i, \tilde{p}_j), \tilde{p}_j, w_i, w_j, F_i, F_j) + \Pi_i^{\mathcal{B}}(R_i(w_i, \tilde{p}_j), \tilde{p}_j, w_i, F_i)$. Then U sets F_i to extract all of D_i 's gross profits. From the foci of the maximization problems and assuming that conjectures are true in equilibrium ($\tilde{p}_i = p^{\mathcal{B}\mathcal{T}}$), we get the equilibrium outcome $(w_i^{\mathcal{B}\mathcal{T}}, F_i^{\mathcal{B}\mathcal{T}}, q_i^{\mathcal{B}\mathcal{T}})$, $i = 1, 2$, which is reported in the Appendix.

Simple calculations reveal that both wholesale prices are above upstream marginal cost $w_2^{\mathcal{B}\mathcal{T}} > w_1^{\mathcal{B}\mathcal{T}} > w_{k=0}^{\mathcal{B}\mathcal{T}} = c$. This is in contrast to the Cournot competition case in which only $w_2^{\mathcal{T}} > c$ and highlights that PPFi alleviates more U 's opportunism problem under Bertrand competition. The RRC effect is still present ($w_2^{\mathcal{B}\mathcal{T}} > c$), but due to strategic complementarity of price competition *both* wholesale prices are above upstream marginal cost and they also increase in k . An immediate consequence is that $q_2^{\mathcal{B}\mathcal{T}} < q_1^{\mathcal{B}\mathcal{T}} < q_{k=0}^{\mathcal{B}\mathcal{T}}$ and that $\frac{dq_i^{\mathcal{B}\mathcal{T}}}{dk} < 0$, $i = 1, 2$. Therefore, industry output is less than under full separation and is decreasing in k .

As downstream profits are nil, industry profits are equal to upstream profits. PPFi benefits U , but the increase in its profits is outweighed by the decrease in consumers surplus induced by the lower industry output. As a result, social welfare is lower than under full separation. So, secret two-part tariffs under Bertrand competition lead to the same competition and welfare effects as under Cournot competition.

The following Lemma summarizes our findings.

Lemma 3. *When an upstream monopolist makes “take-it-or-leave-it” secret linear tariffs (two-part tariffs) offers to downstream Bertrand competitors, PPFi is pro-competitive (anti-competitive) and welfare-increasing (welfare-decreasing).*

Lemma 3 suggests that the mode of downstream competition does not qualitatively alter the competitive and welfare effects of PPFi. The contract type is what matters.

5.2 Interim observable contracts

Let now contracts be interim observable: each D_i learns the contract terms of its rival before taking its output decision. All the other specifications are as in the main model. Under interim observability, the last stage equilibrium outputs in terms of (w_1, w_2) is the solution to the system of reaction functions $R_i(w_i, q_j) = \frac{1}{2}(a - w_i - \gamma q_j)$, $i, j = 1, 2, i \neq j$. In particular, $q_i(w_1, w_2) = \frac{a(2-\gamma)-2w_i+\gamma w_j}{4-\gamma^2}$; hence, $p_i(w_1, w_2) = p_i(q_1(w_1, w_2), q_2(w_1, w_2))$. Then firms' gross profits are: $\pi_1^O(w_1, w_2) = (1-k)(p_1(w_1, w_2) - w_1)q_1(w_1, w_2)$, $\pi_2^O(w_1, w_2) = (p_2(w_1, w_2) - w_2)q_2(w_1, w_2)$, and $\pi_U^O(w_1, w_2) = \sum_{i=1}^2 (w_i - c)q_i(w_1, w_2) + k(p_1(w_1, w_2) - w_1)q_1(w_1, w_2)$. To determine the firms' net profits under two-part tariffs, we follow the same operation as in section 3.

Linear tariffs: Each agent i of U solves $\max_{w_i} \pi_U^O(w_1, w_2)$. The system of foci of these maximization problems gives rise to the equilibrium outcome (w_i^{OL}, q_i^{OL}) , which is reported in the Appendix.

Simple calculus reveals that $c < w_1^{OL} < w_2^{OL} = w_{k=0}^{OL}$ and $\frac{\partial w_1^{OL}}{\partial k} < 0$. Notably, w_2^{OL} is independent of k and thus there is neither RRC effect nor a waterbed effect. Yet, the EDM effect is present and becomes stronger as k increases. An immediate consequence is that $q_2^{OL} < q_{k=0}^{OL} < q_1^{OL}$. By decreasing the wholesale price of its partially owned downstream firm, U diverts input sales and output from D_2 to D_1 . The higher is k , the larger is the diversion: $\frac{\partial q_1^{OL}}{\partial k} > 0$, $\frac{\partial q_2^{OL}}{\partial k} < 0$. However, the increase in q_1^{OL} is again larger than the decrease in q_2^{OL} and industry output is higher than under full separation and also increases in k .

The higher industry output leads to a higher consumers surplus than under full separation. Firms' profits behave similarly to the case of secret contracts: π_U^O (π_2^O) are higher (lower) than under full separation, while π_1^O are higher if and only if $k < \frac{\gamma^2}{4}(4 - \gamma^2)$. As under secret contracts, industry profits and social welfare are higher than under full separation. So, linear tariffs are pro-competitive and welfare-increasing under interim observable contracts.

Two-part tariffs: Each agent i of U chooses (w_i, F_i) to maximize upstream net profits, $\Pi_U^O(w_1, w_2, F_1, F_2)$, subject to D_i 's participation constraint $\Pi_i^O(w_1, w_2, F) \geq 0$. Again, this leads to the choice of w_i that maximizes (U, D_i) 's joint profits and a fixed fee F_i that transfers all gross downstream profits upstream. Solving the system of foci of the maximization problems, we obtain the equilibrium outcome $(w_i^{OT}, F_i^{OT}, q_i^{OT})$, which is reported in the Appendix.

Simple calculus reveals that $w_{k=0}^{OT} < w_1^{OT} < w_2^{OT}$, $w_1^{OT} < c$, and $w_2^{OT} < c$ if and only if $k < \frac{\gamma(2-\gamma^2)}{4-2\gamma}$. PPFi alleviates U 's opportunism problem and both wholesale prices are higher than under full separation. In fact, as U favors its partially owned downstream firm, D_2 's wholesale price is above upstream marginal cost as long as k is large. As a result, $q_2^{OT} < q_1^{OT} = q_{k=0}^{OT}$ and $\frac{\partial q_2^{OT}}{\partial k} < 0$, while q_1^{OT} is independent of k . An immedi-

ate consequence is that industry output is lower than under full separation and is also decreasing in k .

Due to this, consumer surplus is lower than under full separation. Since $\Pi_1^{\mathcal{O}} = \Pi_2^{\mathcal{O}} = 0$, industry profits are equal to $\Pi_U^{\mathcal{O}}$. The latter increases with k , because PPFi alleviates U 's opportunism problem. However, the increase in industry profits does not compensate for the decrease in CS , and thus social welfare is higher than under full separation. Once again, two-part tariffs are welfare-decreasing and anti-competitive.

The following Lemma summarizes our findings.

Lemma 4. *When an upstream monopolist makes “take-it or leave-it” interim observable linear tariffs (two-part tariffs) offers to Cournot competitors, PPFi is pro-competitive (anti-competitive) and welfare-increasing (welfare-decreasing).*

Lemma 4 suggests that the disclosure regime of contract terms (interim observable or secret) does not qualitatively alter the effects of PPFi on competition and welfare. Instead, it is the contract type that matters.

5.3 Bargaining

Finally, consider that agent i of U bargains with D_i and bargaining sessions take place simultaneously and separately (Smith and Thanassoulis, 2009). All the other specifications are just as in the main model. The bargaining powers of U and D_i are, respectively, $\beta \in (0, 1)$ and $1 - \beta$. As contracts are secret, it is natural to assume that a pair's negotiations breakdown is also non-observable by the rival pair. Hence, one pair's bargaining outcome is *non-contingent* on whether the rival pair has reached an agreement or not (Horn and Wolinsky, 1988; Rey and Vergé, 2004).²⁶

Each D_i 's disagreement payoff is nil, since a breakdown in its negotiations with U leads D_i out of the market. On the other hand, U 's disagreement payoff while bargaining with D_1 and D_2 are, respectively:

$$\begin{aligned} d_1(\tilde{q}_2, w_2, F_2) &= (w_2 - c)\tilde{q}_2 + F_2 \\ d_2(\tilde{q}_1, \tilde{q}_2, w_1, F_1) &= (w_1 - c)\tilde{q}_1 + k[(p(\tilde{q}_1, \tilde{q}_2) - w_1)\tilde{q}_1 + (1 - k)F_1], \end{aligned} \quad (8)$$

with $F_1 = F_2 = 0$ under linear tariffs. Note that in $d_2(\cdot)$, \tilde{q}_2 is the output of D_2 as conjectured by D_1 ; hence it cannot be manipulated by the output decision of D_2 . As in the main model, the last stage equilibrium outcome is characterized by the reaction functions $R_i(w_i, \tilde{q}_j) = \frac{1}{2}(a - w_i - \gamma\tilde{q}_j)$, $i = 1, 2, i \neq j$. Finally, to solve the bargaining stage, we evoke the *Nash-in-Nash* solution concept (Collard-Wexler et al., 2017; Rey and

²⁶Non-contingency states that any breakdown in the negotiations between U and D_i will be *non-permanent* and *non-irrevocable*, and this is common knowledge.

Verge, 2017).²⁷

Linear tariffs: In stage 1, bargaining pairs (U, D_1) and (U, D_2) maximize each its generalized Nash product:

$$\begin{aligned} & \max_{w_1} [\pi_1(R_1(w_1, \tilde{q}_2), \tilde{q}_2, w_1)]^{1-\beta} [\pi_U(R_1(w_1, \tilde{q}_2), \tilde{q}_2, w_1, w_2) - d_1(\tilde{q}_2, w_2, 0)]^\beta \\ & \max_{w_2} [\pi_2(\tilde{q}_1, R_2(w_2, \tilde{q}_1), w_2)]^{1-\beta} [\pi_U(\tilde{q}_1, R_2(w_2, \tilde{q}_1), w_1, w_2) - d_2(\tilde{q}_1, \tilde{q}_2, w_1, 0)]^\beta \end{aligned} \quad (9)$$

Solving the foci of the maximization problems and assuming that in equilibrium conjectures are true, i.e. $\tilde{q}_i = q_i^{N\mathcal{L}}$, we get the equilibrium outcome, $(w_i^{N\mathcal{L}}, q_i^{N\mathcal{L}})$, which is reported in the Appendix.

It can easily be checked that bargaining over linear tariffs does not qualitatively alter the results obtained in the main model and the intuition behind them. For any given β , equilibrium wholesale prices move to the opposite direction as k increases, creating a waterbed effect. As a result, there is a diversion of input sales and output, which is increasing in k . The increase in $q_1^{N\mathcal{L}}$ is larger than the decrease in $q_2^{N\mathcal{L}}$, and thus industry output is higher than under full separation (and is increasing in k). This leads to a higher consumers surplus than under no PPF. Finally, although industry profits may sometimes decrease with k , social welfare is always higher under PPF than under full separation.

Notably, $w_i^{N\mathcal{L}} < w_i^{\mathcal{L}}$ and $q_i^{N\mathcal{L}} > q_i^{\mathcal{L}}$, i.e., bargaining over linear tariffs induces a more pro-competitive and welfare-increasing equilibrium outcome than U 's "take-it-or-leave-it" offers do.

Two-part tariffs: In stage 1, the bargaining pairs (U, D_1) and (U, D_2) maximize each its generalized Nash product:

$$\begin{aligned} & \max_{(w_1, F_1)} [\Pi_1(R_1(w_1, \tilde{q}_2), \tilde{q}_2, w_1)]^{1-\beta} [\Pi_U(R_1(w_1, \tilde{q}_2), \tilde{q}_2, w_1, w_2) - d_1(\tilde{q}_2, w_2, F_2)]^\beta \\ & \max_{(w_2, F_2)} [\Pi_2(\tilde{q}_1, R_2(w_2, \tilde{q}_1), w_2)]^{1-\beta} [\Pi_U(\tilde{q}_1, R_2(w_2, \tilde{q}_1), w_1, w_2) - d_2(\tilde{q}_1, \tilde{q}_2, w_1, F_1)]^\beta \end{aligned} \quad (10)$$

As bargaining pairs dispose of two instruments, each chooses w_i to maximize its excess joint surplus (i.e., joint profits minus U 's disagreement payoff) and F_i to apportion the maximized excess joint surplus to the parties according to their respective bargaining powers O'Brien and Shaffer (1992). Note that for each pair (U, D_i) , U 's disagreement payoff is independent of w_i . Thus, the solution of the foci of the excess joint surplus maximization problems, along with the conjectures being true in equilibrium ($\tilde{q}_i = q_i^{N\mathcal{T}}$), lead to (basically) the same equilibrium outcome as in the main model. The only exception is the equilibrium fixed fees that adjust in such a way to reflect the parties' bargaining

²⁷Recently, the Nash-in-Nash has become a standard solution concept in the multilateral contracting literature. A known caveat of this concept is that it does not allow for multilateral deviations of U that may, under some specific circumstances, lead to the non-existence of equilibria (McAfee and Schwartz, 1995; Rey and Vergé, 2004).

powers (see the Appendix for the equilibrium results).

Since fixed fees are just inter-firm transfers, they have no bear on our main findings and the intuition behind them. As in the main model, PPFIs are anti-competitive and welfare-decreasing under two-part tariffs.

The following Lemma summarizes our findings.

Lemma 5. *When an upstream monopolist bargains, separately and simultaneously, with each Cournot competitor over secret linear tariffs (two-part tariffs), PPFIs are pro-competitive (anti-competitive) and welfare-increasing (welfare-decreasing).*

Lemma 5 suggests that bargaining over contract terms does not qualitatively alter the effects of PPFIs on competition and welfare. Once more, what matters is the contract type used in vertical trading.

6 Concluding remarks

In a stylized supply chain model with bottleneck upstream and downstream competition with differentiated goods, we show that partial passive forward vertical integration (PPFI) has ambiguous effects on competition and welfare. Our findings suggest that the type of contract used in vertical trading plays a crucial role in the competitive and welfare effects of PPFIs. Under linear tariffs, a non-controlling stake of the upstream supplier in one of the downstream firms leads to higher industry output and increases consumers surplus and social welfare. The opposite holds when vertical trading is conducted via two-part tariffs. Further, our analysis suggests that these results are independent of the degree of product differentiation, the secrecy or (interim) observability of contract terms, the mode of downstream competition, and the distribution of bargaining power between the upstream supplier and its downstream customers.

The driving force behind our findings is that PPFIs create an incentive for the upstream monopolist to price discriminate against the rival of its partially owned downstream firm. This raising rivals' cost (RRC) effect is always present and it can only be offset by the elimination of the double marginalization (EDM) effect which is present under linear tariffs. The coexistence of these two effects reveals that PPFIs are a novel source of the well-known waterbed effect.

To the best of our knowledge, there is no empirical evidence on the welfare effects of PPFIs. Some of our findings on the positive competitive effects of PPFIs are supported by plenty of announcements made by firms about sales expansion or capacity increase, following a realization of PPFIs. For instance, Fuchs lubricants announced a plan to increase capacity by 35% after the partial acquisition of its distributors in Africa. Total announced a plan to build 1500 new LNG service stations to reach six million homes after the partial acquisition of Adani Gas. Eni will increase its refining capacity by 35% after

acquiring 20% in energy and petrochemicals group Adnoc. Moreover, our result on the profitability of PPFi under linear tariffs is in line with [Allen and Phillips \(2000\)](#), who have shown empirically that block equity purchases by corporations in the same four-digit SIC code improve operating performance.

Partial passive vertical integration is not directly addressed in the [DoJ and FTC \(2020\)](#) Vertical Merger Guidelines, although it is acknowledged there that the acquisition of a partial ownership interest is relevant to the evaluation of the competitive effects of vertical mergers as well. From the antitrust policy point of view, our analysis indicates two issues. First, the existence of the EDM effect *per se* should not be overstated since it is not sufficient to render PPFi pro-competitive. And second, competition authorities should be more concerned about PPFi in industries where non-linear contracts prevail.

Our stylized model suggests a few testable empirical implications. Questions to be answered by the empirical studies are: Is the vertical contract type of such paramount importance to welfare? Are the disclosure regime of contract terms, the bargaining over those terms, and the mode of product market competition empirically relevant?

All in all, we are aware of the limitations of our study. For instance, the use of a linear demands system can only produce indicative results. But, using general demand functions turned out to be mathematically intractable. Considering other extensions of our base model may be worthwhile. Some preliminary analysis shows that the welfare implications of linear tariffs may be partially reversed and depend on the specific market characteristics.

Finally, it might be useful to expand the current research by considering other contract types, like resale price maintenance or profit-sharing schemes.

Appendix

A. Proofs of Propositions

A.1 Proof of Proposition 1

(i) Substituting $q_i^{\mathcal{L}}$ s back to the expressions of consumer surplus CS and producer surplus PS we get:

$$CS^{\mathcal{L}} = \frac{[(4 - \gamma)^2(1 + \gamma) - k(4 - \gamma)(1 + \gamma)(2 + \gamma) + \frac{k^2}{2}(2 + \gamma)^2](a - c)^2}{(\gamma^2(1 + k) - 8(2 - k))^2}$$

$$SW^{\mathcal{L}} = \frac{[(4 - \gamma)^2(7 + \gamma) - k(4 - \gamma)(22 + \gamma(3 + 2\gamma)) + \frac{k^2}{2}(2 + \gamma)(14 - \gamma(1 - 2\gamma))](a - c)^2}{(\gamma^2(1 + k) - 8(2 - k))^2}$$

Some basic calculus leads to $\frac{\partial CS^{\mathcal{L}}}{\partial k} > 0$ and $\frac{\partial PS^{\mathcal{L}}}{\partial k} > 0$ for all $\gamma \in (0, 1)$ and $k \in (0, 1/2)$. Social welfare is $SW^{\mathcal{L}} = CS^{\mathcal{L}} + PS^{\mathcal{L}}$. Therefore, it is easy to conclude that: $\frac{\partial SW^{\mathcal{L}}}{\partial k} > 0$.

(ii) From Lemma 1 we get that wholesale and retail prices increase, while quantities

decrease with respect to k . Therefore, since an increase in k positively distorts the market outcome, PPFi under linear tariffs is pro-competitive. Given the proof of (i) stated above, we get that PPFi is also welfare-increasing since an increase in k would lead to an increase in both the consumer surplus and social welfare.

A.2 Proof of Proposition 2

(i) Substituting q_i^T s back to the expressions of consumer surplus CS and producer surplus PS we get:

$$CS^T = \frac{(8 - \gamma(8 - \gamma(2 - k(2 - \gamma + (1 - \gamma)k))))(a - c)^2}{2(4 - \gamma^2(1 + k))^2}$$

$$PS^T = \frac{(24 - \gamma(4(4 + k) + \gamma(2 - 2\gamma(1 + k)^2 + k(6 + k))))(a - c)^2}{(4 - \gamma^2(1 + k))^2}$$

It is easy to show that $\frac{\partial CS^T}{\partial k} < 0$ and $\frac{\partial PS^T}{\partial k} < 0$ for all $\gamma \in (0, 1)$, and $k \in (0, 1/2)$. Since social welfare is $SW^T = CS^T + PS^T$ it is easy to conclude that: $\frac{\partial SW^T}{\partial k} < 0$. Therefore, CS , PS , and SW are higher for $k > 0$ than under $k = 0$.

(ii) From Lemma 2 we get that wholesale and retail prices decrease and quantities increase with respect to k . Therefore, since an increase in k negatively distorts the market outcome, PPFi is considered as anti-competitive. Given the proof of (i) stated above, we get that PPFi is also welfare-decreasing since an increase in k would lead to a decrease in both the consumer surplus and social welfare.

B. Equilibrium results of the extensions

B.1 Equilibrium results under downstream Bertrand competition

(i) Two-part tariffs

$$w_1^{\mathcal{BT}} = c + \frac{\gamma^2 k(2 + \gamma)(a - c)}{(1 + \gamma)(4 - \gamma^2(1 - k))}$$

$$w_2^{\mathcal{BT}} = c + \frac{\gamma k(2 + \gamma)(a - c)}{(1 + \gamma)(4 - \gamma^2(1 - k))}$$

$$q_1^{\mathcal{BT}} = \frac{(2 + \gamma)(a - c)}{(1 + \gamma)(4 - \gamma^2(1 - k))}$$

$$q_2^{\mathcal{BT}} = \frac{(2 + \gamma(1 - k))(a - c)}{(1 + \gamma)(4 - \gamma^2(1 - k))}$$

$$F_1^{\mathcal{BT}} = \frac{(1 - \gamma)(2 + \gamma)^2(a - c)^2}{(1 + \gamma)(4 - \gamma^2(1 - k))^2}$$

$$F_2^{\mathcal{BT}} = \frac{(1 - \gamma)(2 + \gamma(1 - k))^2(a - c)^2}{(1 + \gamma)(4 - \gamma^2(1 - k))^2}$$

(ii) Linear tariffs

$$\begin{aligned}w_1^{\mathcal{BL}} &= c + \frac{[8 + 2\gamma(5 + \gamma) - 8k - \gamma k(6 - \gamma(2 + \gamma))](a - c)}{(1 + \gamma)[8(2 - k) - \gamma^2(1 - k)]} \\w_2^{\mathcal{BL}} &= c + \frac{[2(1 + \gamma)(4 + \gamma) - k(4 + \gamma(6 + \gamma))](a - c)}{(1 + \gamma)[8(2 - k) - \gamma^2(1 - k)]} \\q_1^{\mathcal{BL}} &= \frac{(4 + \gamma)(a - c)}{(1 + \gamma)[8(2 - k) - \gamma^2(1 - k)]} \\q_2^{\mathcal{BL}} &= \frac{(4 + \gamma - (2 + \gamma)k)(a - c)}{(1 + \gamma)[8(2 - k) - \gamma^2(1 - k)]}\end{aligned}$$

B.2 Equilibrium results under interim observable contracts

(i) Two-part tariffs

$$\begin{aligned}w_1^{\mathcal{OT}} &= c - \frac{\gamma^2(2 - \gamma^2 - (2 - \gamma)k)(a - c)}{2(2 - \gamma^2)^2} \\w_2^{\mathcal{OT}} &= c + \frac{\gamma(\gamma^3 + 4k - 2\gamma(1 + k))(a - c)}{2(2 - \gamma^2)^2} \\q_1^{\mathcal{OT}} &= \frac{(2 - \gamma)(a - c)}{2(2 - \gamma^2)} \\q_2^{\mathcal{OT}} &= \frac{(2 - \gamma)(2 - \gamma(1 + k))(a - c)}{2(2 - \gamma^2)^2} \\F_1^{\mathcal{OT}} &= \frac{(2 - \gamma)^2(a - c)^2}{4(2 - \gamma^2)^2} \\F_2^{\mathcal{OT}} &= \frac{(2 - \gamma^2 - \gamma k)^2(2 - \gamma)^2(a - c)^2}{4(2 - \gamma^2)^4}\end{aligned}$$

(ii) Linear tariffs

$$\begin{aligned}w_1^{\mathcal{OL}} &= c + \frac{[4(1 - k) - \gamma(\gamma - k)](a - c)}{2(4 - \gamma^2 - 2k)} \\w_2^{\mathcal{OL}} &= c + \frac{a - c}{2} \\q_1^{\mathcal{OL}} &= \frac{(2 - \gamma)(a - c)}{2(4 - \gamma^2 - 2k)} \\q_2^{\mathcal{OL}} &= \frac{(2 - \gamma - k)(a - c)}{2(4 - \gamma^2 - 2k)}\end{aligned}$$

B.3 Equilibrium results under Bargaining

(i) Two-part tariffs

$$\begin{aligned}w_1^{\mathcal{NT}} &= w_2^{\mathcal{T}} = c \\w_2^{\mathcal{NT}} &= w_2^{\mathcal{T}} = c + \frac{k\gamma(2 + \gamma)(a - c)}{4 - \gamma^2(1 + k)}\end{aligned}$$

$$\begin{aligned}
q_1^{\mathcal{NT}} &= q_1^{\mathcal{T}} = \frac{(2-\gamma)(a-c)}{4-\gamma^2(1+k)} \\
q_2^{\mathcal{NT}} &= q_2^{\mathcal{T}} = \frac{(2-\gamma(1+k))(a-c)}{4-\gamma^2(1+k)} \\
F_1^{\mathcal{NT}} &= \frac{\beta-k}{1-k} F_1^{\mathcal{T}} = \frac{(\beta-k)(2-\gamma)^2(a-c)^2}{(1-k)(4-\gamma^2(1+k))^2} \\
F_2^{\mathcal{NT}} &= \frac{(2-\gamma(1+k))[\beta(2-\gamma) - \gamma k(2-\beta(1-\gamma) - \gamma)](a-c)^2}{(4-\gamma^2(1+k))^2}
\end{aligned}$$

(ii) Linear tariffs

$$\begin{aligned}
w_1^{\mathcal{NL}} &= c + \frac{2(\beta-k)(4-\gamma(2-\beta))(a-c)}{8(2-k) - \gamma^2(2-\beta)(2-\beta(1-k))} \\
w_2^{\mathcal{NL}} &= c + \frac{\beta[8-4k - \gamma(2-\beta)(2-k(2-\gamma))](a-c)}{8(2-k) - \gamma^2(2-\beta)(2-\beta(1-k))} \\
q_1^{\mathcal{NL}} &= \frac{(2-\beta)(4-\gamma(2-\beta))(a-c)}{8(2-k) - \gamma^2(2-\beta)(2-\beta(1-k))} \\
q_2^{\mathcal{NL}} &= \frac{(2-\beta)[2(2-k) - \gamma(2-\beta(1-k))](a-c)}{8(2-k) - \gamma^2(2-\beta)(2-\beta(1-k))}
\end{aligned}$$

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