Separation versus affiliation with partial vertical ownership in network industries

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Citation:

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Separation versus Affiliation with Partial Vertical Ownership in Network Industries

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Abstract

The separation of integrated monopolies and new market entrants have changed vertical interactions between suppliers and dealers. Firms have substituted full integration with vertical restraints leading to collusive behaviour harmful to competition. We examine how a partial vertical ownership (an affiliation) of one of the competing downstream retailers by the upstream monopoly could help internalise the production decision after a complete divestiture. Our results in a Cournot framework confirm the positive role of partial integration on firms' profits and consumer surplus in increasing social welfare. These results are consistent with empirical studies of economies after vertical separation in network industries.

Keywords

Partial Ownership; Vertical Integration; Affiliation; Networks

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I   Introduction

Partial ownership (PO) is the acquisition by a company of a fraction of the equity of a horizontal competitor or a supplier/manufacturer in a vertical relationship. The acquired participation is generally not a majority or controlling stake and, in this case, is a silent operation (Reitman, 1994; Bresnahan and Salop, 1986). There are regulatory ownership thresholds (typically at the 5%, 10%, 20% and 30% levels) and publicly traded companies are required to disclose when they cross these thresholds. For instance, the 2010 US horizontal merger guidelines introduce a section on partial acquisitions (Fiocco, 2016).

The study of partial ownership is crucial because its effects differ from those of majority shareholdings and mergers which, in most cases, are identical (Reitman, 1994). Greenlee and Raskovich (2006) present the analysis of Partial Vertical Ownership (PVO) in vertically related industries. In their article, the PVO is backward (i.e. upward) and makes no change to production in the case of symmetric costs. The choice of forward (i.e. downward) PVO in our article is crucial for studying the effects of vertical affiliation following vertical separation and a subsequent competition opening. In this case, we allow the supplier to acquire an equity interest in one of dealers, corresponding to an affiliation. Affiliates are partially owned by parent companies while subsidiaries are majority owned (Slovin and Sushka, 1998). With this set-up we study different effects from those of a complete reintegration (see e.g. Cyrenne, 1993; Hunold and Stahl, 2016).

Vertical integration analysis recognises the benefits of aligned interests (Williamson, 1971) for firms. Moreover, vertical integration does not serve to reduce competition and may instead intensify it (Spengler, 1950). Unlike the "outsider effect" of horizontal mergers (Salant et al, 1983), in vertically related industries the gains of concluding a vertical arrangement (partial or full) outweigh the benefits of staying outside. In this article, we verify the incentives of a monopoly to affiliate a downstream retailer via PVO and confirm the profitability of this vertical agreement.

However, the change in government economic policy towards greater market liberalisation has led to the privatisation and the vertical separation of historic public network companies (railways, telecommunications, energy, water, television channels). Regulatory milestones, including the 1974 DOJ decision against AT&T and the 1998 European Commission directive on public telecom networks, opened competition to new entrants and forced the reorganisation of former monopolies (Mayer-Schonberger and Strasser, 1998; Waldfogel and Wulf, 2006).

Because of the opening to competition, suppliers and dealers of integrated network had to separate their upstream and downstream activities on the network. In 16 European countries, the positive effects of vertical separation (combined with new entries) on efficiency and productivity have been empirically demonstrated in the rail industry (Cantos et al., 2010). However, anti-competitive behaviour persists with discriminatory incentives in the US telephone industry after separation (Weisman, 1995). Outside regulated industries, in retail gasoline markets, vertical separation itself has anti-competitive effects such as output reduction, increases profits and welfare losses (Slade, 1998).

2

In contrast to horizontal separation, vertical separation can harm competition because the induced double margin increases the final price for the consumer. Vertical integration is then replaced by vertical contract arrangements (franchise fees, two-part tariffs) between upstream suppliers and downstream dealers (see e.g. Bonanno and Vickers, 1998; Ziss, 1995) leading to increased collusion detrimental to economic welfare. This article investigates the effectiveness of affiliations in vertically separated network industries to encourage monopoly investment and to reduce Cournot's collusion at the downstream level.

The novelty of our article is the presentation in a model of a two-level network industry with an upstream monopoly and a downstream Cournot oligopoly where a vertical forward affiliation is preferred to a subsidiarisation or a full integration. Examples of natural upstream monopolies are common in network industries, they include electricity (Lim and Yurukoglu, 2018) and gas distribution, telecommunications, or rail network management companies. In the US telecommunications sector, the separation of the monopoly from downstream retailers and the link with affiliates is of regulatory importance to the Federal Trade Commission (Reiffen, 1998). In addition, electricity and gas transmission holding companies with power generation are regulated by the Federal Energy Regulatory Commission, so they follow a strict code of conduct. Therefore, this study provides regulators with new information on the impact of affiliation in vertically related network industries.

Our paper, using this vertically related model, contributes to this part of the literature mainly as regards as the following aspects:

- The incentives to affiliate via PVO. In line with the real-world complexity of minority shareholding, this work complements existing literature on vertical integration in the context of network industries.

- The supplier's decision to invest in the network with or without PVO. As a network supplier, the upstream monopoly makes the investment decision on the network, which has an impact on its maintenance cost. Traditional and empirical results on monopoly pricing establish a problem of underinvestment (Knight, 1930; Blum et al., 2007). Our general results (without the need of asymmetric costs) for linear demand and Cournot setting (relevant to network industries, see e.g. Eichengreen et al., 2016; Katz and Shapiro, 1985) demonstrate the incentive effect of PVO affiliation on monopoly's investment relative to a benchmark.

- The impact of affiliation on Cournot competition at the retailers' level. The supplier's internalisation of the affiliate profit leads to double margin reduction which in turn improves downstream Cournot competition and consumer surplus.

- The impact of affiliation on the double margin and deadweight loss of the monopoly which, combined with increased competition, improves the economic welfare.

The result and the structure of our model appear consistent with empirical findings of vertical economies generated by partially integrated holding companies in the U.S. electric power industry (Kwoka, 2002).

The rest of the article is organised as follows. Section II reviews the relevant literature on partial ownership. Section III outlines the model used applying weak restrictions on demand

3

and competition's conjectures. Section IV highlights the key analytical results obtained after the study of the effects of PVO affiliation versus separation using a comparative static analysis. Section V concludes and discusses the opportunities for further work.

II   Literature review

Large companies have complex group structure which can include a principal and intermediate holdings, affiliates, subsidiaries and associate companies. The link between the different entities constituting of the group is realised with full or partial equity ownership. This participation networks of companies have been much studied in the literature. Cases include horizontal and vertical PO in the Cable TV industry in the US (Besen et al., 1999) and "Keiretsu" in Japan (Brown and Fung, 2009). The Keiretsu in Japan have been widely discussed for the implications of their complex equity and debt ownerships (Berglof and Perotti, 1994; Flath, 1993) on cooperation and mutual monitoring of managers practices.

Furthermore, during the "golden shares" era in the 1980's, European governments implemented the use of cross horizontal participations to protect strategic companies[2] from foreign takeovers (Serbera and Fry, 2018). "Deutschland AG" in Germany (Lantenois, 20110 and "noyaux-durs" in France (Goldstein, 1996) complete their use in Europe outside of the United Kingdom (Yergin and Stanislaw, 1998). Due to their relative intricacy, modelling of these shareholding interlocks has been studied in mixed framework including both vertical and horizontal PO (e.g. Greenlee and Raskovich, 2000; Serbera, 2011).

Simpler ownership structures are more common, they include partial integration in a manufacturer-retailer vertical relation or at the horizontal level, both can be reciprocal or unilateral. The impact of these PO on competition and market structure is substantial (see Allen and Philipps, 2000; Reitman, 1994). Reynolds and Snapp (1986) show that PO reduces output and increases prices in a Cournot model with barriers to entry. Even when the amount of PO is small, this result has anticompetitive effects similar to those of mergers (O'Brien and Salop, 1999).

Gilo et al. (2006) consider the case of cross participations in a dynamic Bertrand model and conclude that tacit collusion can be sustained in the long run. Cross holdings also increase collusion by incentivising competing firms to reciprocally reveal their costs leading to relaxed competition (Liu et al., 2018). In addition, Li et al. (2015) study the entry deterrence effect of cross partial holdings for a monopoly incumbent, leading to a no entry in exchange for redistribution of the monopoly profit.

In the case of vertically-related industries, Fiocco (2016) studies partial vertical ownership in successive duopolies with secret retailer costs leading to price increase and competition relaxation. Wadeson (2017) considers the incentives for an upstream supplier to fully integrate one of its price-taker dealers, however partial integration is not allowed. Our article complements the existing literature by modelling a monopoly manufacturer supplying an access to network to downstream retailers competing *à la Cournot*. The monopoly affiliates

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[2] Private companies with significant public interests such as military, nuclear energy and financial companies.

one of the downstream retailers by acquiring equity shares allowing us to study the impact of forward partial integration on investment in the network, competition and deadweight loss of the monopoly. The current study presents positive incentives to partial integration with forward PO in complement to the results of Hunold and Stahl (2016) in the case of backward partial integration.

This issue of ownership structure change applies after the privatization of historically public network companies (railway, energy, telecoms) and the regulatory requirements to open the market to new competition (see e.g. Amundsen and Bergman, 2002; Lee and Hwang, 2003). Using the illustrative case of the US and Japanese automobile industries Alley (1997) derives empirical results confirming the collusive effects of PO. In contrast, Malueg (1992) finds that in a dynamic Cournot framework, repeated interactions between competitors lead to a more competitive equilibrium.

In the US telecom industry, Reiffen (1998) re-examines the results of Weisman (1995) on discriminatory incentives of the monopoly using price access in a similarly structured downstream duopoly. Results are that, contrary to Weisman (1995), vertical PO align both firms' interests and lead to a potentially anti-competitive foreclosure. Our article extends the study of the competitive role of PO in network industries by introducing vertical affiliation in a downstream oligopoly and leads to modified results on competition and investment incentives. These results appear in line with empirical findings of Kwoka (2002) studying network economies following the adoption of partial holding structure in the US electric sector.

Finally, our study contributes to the issue of cost reducing technologies in industries using distribution networks, such as ethylene and propylene or oil (see Van Triest and Vis, 2007). In exchange for investment, Bester and Petrakis (1993) studied the incentives for firms to adopt cost-reduction technology and discussed the possibility of reaching different equilibria (symmetric or asymmetric) in a Cournot duopoly; depending on the type of equilibrium consumer surplus can be enhanced. Subsequently, Barcena-Ruiz and Olaizola (2006) introduced to the previous model a strategic delegation from the owner to the manager in both a Bertrand and Cournot framework. Kesavayuth et al. (2018) examine the impact of full integration on investment. We build on these previous works by introducing inter-company affiliation to study the use of PVO as an incentive to invest in reducing cost in the network.

In the following section, we present the Cournot model for a vertically related industry used to determine how a vertical affiliation affects network investment incentives, competition and welfare impact of the monopoly.

III   The model: Affiliation in a supplier-dealers industry with Partial Vertical Ownership

Our analysis presents a supplier-dealers two-level industry with the network supplying firm in a situation of monopoly at the upstream level and the downstream dealers in Cournot competition. Table 1 presents detailed notations of the Cournot-Nash model.

5

The network supplier, noted U, sells the network's access to the downstream dealing firms in exchange for a fee r, the network's maintenance cost is noted c. We focus on cases in which $r > c$, as a two-part tariff ($r = c$) will offset the effects of the PVO on the double margin. The maintenance cost is assumed to take two possible values conditionals to the level of investment in the network, $c = \{\underline{c}, \bar{c}\}$ for low and high level of investment respectively. The cost of investment I is amortized by the upstream monopoly when the difference in profit following the cost-reduction is greater[3] than the investment. The investment as a fixed one-off cost does not impact maximization choices and thus can be normalized to 0 to simplify the notations without loss of generality.

At the downstream level, we use a traditional setting of Cournot oligopoly (in networks industry: telecom, railways, energy) with homogenous goods[4] that has $n \geq 2$ dealing firms $d_1, d_2, ..., d_n \in D, n \in \mathbb{N}$ (Tirole, 1988). Assuming a quadratic utility function of consuming q_i of firm i's product and paying the price p_i with the homogeneous substitutability parameter set equal to 1, we derive that the inverse demand function for an individual firm is $p_i = A - \sum_i q_i$ and we note $D(p) = \sum_k q_k = Q$. Whilst an obvious simplification, the homogeneous substitutability condition and linear demand seems to have empirical relevance to applications to the network industries (see e.g. Eichengreen et al., 2016; Katz and Shapiro, 1985). Set up in this way this model arises as an important special case of the classical model in Greenlee and Raskovich (2006).

Definition 1. An affiliation is a financial transaction in which one upstream supplier acquires an equity participation (a PVO) in the capital of one of its downstream dealers.

(i) Partial ownership are silent participations (Reitman, 1994; Flath, 1989), giving the acquirer no right in the other firm management decisions.

(ii) The cost of acquisition paid by the supplier U, a transfer price t_{Ui} with $i \in D$, is assumed to be a flat payment and normalized[5] to 0.

Let $\beta_i \in [0, 0.5)$ denote the capital of firm d_i held by the supplier U. The affiliation involves the acquisition of β_i by the upstream supplier. Figure 1 illustrates the organisation of our two-level industry with forward PVO.

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[3] In the model's notation: $\Pi_U(\underline{c}) - \Pi_U(\bar{c}) \geq I \geq 0.$

[4] The introduction of differentiation in the demand function has no impact on the results in the Cournot model and should be used to generalise the model to other forms of competition such as Bertrand.

[5] The transfer price is thus independent of produced quantities and offsets at the industry profits' level. We discuss in Section IV the cost of acquisition of capital. Small capital acquisitions such as the silent PVO do not include the transfer of control between major shareholders. However, in the case of majority ownership, a premium would have to be paid in addition to the share market price to obtain the transfer of control.

[Insert Figure 1 near here]

Two firms U and say d_1 are in partial vertical ownership agreement if $\beta_1 > 0$. We write $U, d_1 \in PVO$. The special case $\beta_1 = 0$ represents a benchmark case of vertical separation. The decision of an affiliation[6] allows the affiliate to keep control over its decision while rebating profits to the parent company.

Profit for the downstream affiliated dealer $d_1 \in PVO$ is given by $\Pi_1 = (1 - \beta_1)D_1(p)(p-r)$. Operating profit for the non-affiliated dealers and representative of most of the industry is denoted by $\Pi_j = D_j(p)(p-r)$. Supplier U's operating profit is generated from charging network's access to the downstream dealers, total profit including downward participation in d_1 notes: $\Pi_U = (r-c)D(r) + \beta_1 D_1(p)(p-r)$.

[Insert Table I near here]

The industry is comprised of two levels and profits are maximized at each level starting with the network's price setting by the monopoly. We solve backward in a two-stage resolution.

Downstream. The $n-1$ downstream dealers and the single affiliate choose to maximise their individual profits over q_j and q_1 respectively. It yields the following two first-order conditions:

$$2q_1(1-\beta_1) = (A - \sum_{k \neq 1} q_k - r)(1-\beta_1) \text{ and } 2q_j = (A - \sum_{k \notin \{1,j\}} q_k - r).$$

(1)

Simplifying for the symmetric equilibrium we obtain first-stage quantities noted with a $^+$:

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[6] After a vertical separation an affiliation with PVO could be granted whereas a subsidiarisation may be blocked by the regulator.

7

$$q_1^+ = q_j^+ = \frac{A-r}{n+1}.$$

(2)

Aggregating over the n downstream firms we obtain final demand noted $D(p^+)$ and can derive the final good's price p^+:

$$D(p^+) = \sum q_k^+ = \frac{n(A-r)}{n+1}$$

(3)

and

$$p^+ = A - D(p^+) = \frac{A+nr}{n+1}.$$

(4)

Upstream. The supplier in monopoly

Using a one-to-one technology each unit of the final good requires one unit of intermediate good, hence the upstream total quantity must equate the total quantity on the downstream market: $D(r) = D(p) = Q$.

Replacing expressions (1), (2) and (3) in the profit expression of the upstream supplier Π_U and maximising over input price r yields the equilibrium value:

$$r^* = \frac{(nc + n^2 c + nA + n^2 A - 2A\beta_1)}{2(n^2 + n - \beta_1)}.$$

(5)

At the final good level, the consumer surplus notes $S = \int_p^A (A - p) dp$.

IV   Analytic results

In this section we establish the results of vertical partial ownership on both industry's levels.

From expression (5) we derive equilibrium values of the model summarised in table 2.

[Insert Table II near here]

IV (i)   Incentives for the acquisition of PVO

Using Cournot and Bertrand oligopoly models, Inderst and Wey (2004) compute the expected gains of a merger to derive acquiring firms' incentives. In the context of our model of an asymmetric vertical industry with downstream Cournot competition, we start computing the monopoly's incentives to acquire PVO and solve for optimal quantities of PVO (β_1). In addition, we discuss the solution obtained in terms of acquisition cost. Then, we determine the incentives to invest in the network by computing the expected gains of the cost-reduction following this investment: $\overline{c} \rightarrow \underline{c}$.

The difference between the profit of the monopoly with PVO and the benchmark profit allow us to determine the incentives of the upstream monopoly to acquire PVO. We note V_β these incentives:

$$V_\beta = \Pi_U^* - \Pi_U^b = \frac{n(a - c)^2 \beta_1}{4(n^2 + n - \beta_1)(n + 1)} .$$

(6)

For $\beta_1 \in [0, 0.5)$ we observe that $V_\beta > 0$ hence the incentive for the monopoly to acquire PVO. We then calculate the optimal quantities of acquired PVO using the ratio of profits with PVO and in the benchmark:

$$\frac{\Pi_U^*}{\Pi_U^b} = \frac{n(n+1)}{n^2 + n - \beta_1}.$$

(7)

Equation (7) is greater than 1 for any value of $\beta_1 > 0$. This result confirms the positive incentives of the monopoly to invest in the downstream dealer leading to proposition 1:

Proposition 1. *In a two-level Cournot industry the incentives for an acquisition of a forward PVO between an upstream supplier and a downstream dealer (an affiliation) are positive for any positive value of β_1.*

This result is important because it justifies the acquisition of minority interest below the regulatory threshold of 5%, which leads to a higher investment by the supplier without the need for regulatory approval.

We assume here that the acquisition cost is normalised to 0. This assumption holds for a single period-model if the value of the acquired share is equal to (or lower than) the proportional claim on the profit's rebate. In this case, which is appropriate for our study of minority shareholdings and toeholds (see e.g. Bris, 2002; Reitman, 1994), there is no interior solution for optimal PVO amounts. In the case of a larger integration or a complete acquisition following a toehold, the endogenisation of PVO interior solutions could be achieved by introducing a non-linear acquisition cost adding a control premium to encourage shareholders to waive their claim on profit and decision-making power.

IV (ii) Incentives for monopoly investment in the network

It is expected that cost-reduction will subsequently increase[7] the PVO and benchmark equilibrium profits and surplus. To characterise the incentivising effects of PVO we compare -by subtracting- the expected gains of cost-reduction between the PVO equilibrium quantities and the benchmark equilibrium quantities.

We note V_U the upstream monopoly's incentives to investment in the network:

$$V_U = \Pi_U^*(\underline{c}) - \Pi_U^*(\overline{c}) - [\Pi_U^b(\underline{c}) - \Pi_U^b(\overline{c})] = \frac{n(\overline{c} - \underline{c})(2A - \underline{c} - \overline{c})\beta_1}{4(n^2 + n - \beta_1)(n+1)}.$$

(8)

For $\beta_1 \in [0,0.5)$ we observe that $V_U > 0$ as it is commonly assumed that the demand parameter exceeds the cost: $A > c$, hence $A > \overline{c} > \underline{c}$. This result confirms the positive incentives of PVO on the monopoly's investment decision.

Furthermore, to confirm the impact of PVO on incentives to invest in cost reduction for the monopoly, we study the influence of β_1 on expected gains of investment for the monopoly $\Pi_U^*(\underline{c}) - \Pi_U^*(\overline{c})$.

$$\frac{\partial(\Pi_U^*(\underline{c}) - (\Pi_U^*(\overline{c}))}{\partial\beta_1} = \frac{(\overline{c} - \underline{c})(2A - \underline{c} - \overline{c})n^2}{4(\beta_1 - n^2 - n)^2}.$$

(9)

Similarly, for $\beta_1 \in [0,0.5)$ we observe that (9) is positive i.e. that investment incentives increase with PVO. Intuitively, the result of equation (9) supports the evidence that the PVO has a positive role in the investment decisions of a monopoly supplier.

The impact of cost reduction on investment incentives is particularly important for the upstream monopoly that makes the investment decision. Equation (9) is therefore adequate[8] to characterise the investment incentives in the industry.

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[7] As we normalize investment cost to 0.
[8] We include the calculation of investment incentives for downstream participants in the appendix.

11

This study allows us to derive incentives to invest in the network from the upstream supplier. The economic interpretation of equations (6)-(9) is a comparison between the PVO arrangement and the benchmark; it allows us to model an affiliation versus a full separation. Specifically, equations (8) and (9) allow us to obtain Proposition 2. It shows that in a two-level industry with PVO the incentives for investment in the network are increased relative to a benchmark.

Proposition 2. *In a two-level Cournot industry with a forward PVO between an upstream supplier and a downstream dealer (an affiliation) the incentives for an investment in the network are greater than in a benchmark industry.*

Affiliation therefore appears more economically efficient to promote investment in a network managed by an upstream supplier because positive incentives to reduce the cost will subsequently increase profits and surplus compared to a high-cost setup.

IV (iii) Comparative static

After discussing the impact of cost reduction in the previous subsection, we consider any value of the cost parameter *c* to characterise the impact of PVO on the social welfare at the economy's level. We thus study the influence of β_1 on industry profits and consumer surplus.

We start by calculating the variation in the profit balance - following the exchange of the share β_1 between the downstream dealer 1 and the upstream supplier – in relation to the PVO.

$$\frac{\partial(\Pi_U^* - \Pi_1^*)}{\partial \beta_1} = \frac{(a-c)^2(n^2 + n - 1)n^2}{2(n^2 + n - \beta_1)^3}.$$

(10)

Equation (10) is positive for $\beta_1 \in [0,0.5)$ and $n \geq 2$, the PVO thus increases the sum of the profits of the two firms involved in the affiliation. This specifically demonstrates the positive role of PVO on profit for the two firms engaged in the affiliation.

The following is the calculation of the variation of profits of the other downstream firm and the consumer surplus:

$$\frac{\partial \Pi_j^*}{\partial \beta_1} = \frac{(a-c)^2 n^2}{2(n^2 + n - \beta_1)^3},$$

(11)

and

$$\frac{\partial S^*}{\partial \beta_1} = \frac{(a-c)^2 n^4}{4(n^2 + n - \beta_1)^3}.$$

(12)

Equation (11) and (12) are positive for $\beta_1 \in [0,0.5)$ and $n \geq 2$, therefore, the PVO increases downstream profits and consumer surplus, characterising the positive incentives of PVO.

The incentives calculated in equations (10)-(12) are positive at all the levels of the considered industry: profits and consumer surplus. Therefore, the sum of these incentives is positive as well, leading to an increased social welfare with PVO in comparison to a benchmark without PVO.

We summarise this result in the following proposition:

Proposition 3. *In a two-level Cournot industry the acquisition of a forward PVO between an upstream supplier and a downstream dealer (the affiliation) increases the social welfare.*

13

IV (iv) Affiliation to reduce the deadweight loss of the monopoly

Traditionally, an industry with a monopolistic structure (at one or more levels) is expected to find equilibrium in a sub-optimal Pareto situation because of the deadweight loss of monopoly that reduces social welfare (Harberger, 1954). In our industry, we have shown that PVO through affiliation increases the welfare. This is due to a reduction in the deadweight loss of the upstream monopoly. By internalising part of the profit of its downstream affiliate with PVO, the monopoly is incentivised to reduce its network's charge r^*. In turn the downstream dealers react by increasing the second margin $p^* - r^*$ along with the final output quantities Q^* to boost their profits. The increased profits are then recaptured by the monopoly, this strategic reduction of the double margin improves the economic efficiency of the industry. The following proposition summarises the effect of reducing double marginalisation on the deadweight loss of the monopoly:

Proposition 4. *In a two-level Cournot industry the acquisition of a forward PVO between an upstream supplier and a downstream dealer reduces the deadweight loss of the monopoly following an increase in output and a decrease in the final price due to a strategic reduction in double marginalisation.*

Proof.

The impact of the PVO on the increase in final output Q^* coupled to a reduction of the final price p^* is given by:

$$\frac{\partial(Q^*)}{\partial\beta_1} = -\frac{\partial(p^*)}{\partial\beta_1} = \frac{n(A-c)^2}{2(n^2+n-\beta_1)^2} \ .$$

(13)

14

Equation (13) is positive for $\beta_1 \in [0, 0.5)$ and $n \geq 2$.

∎

V   Conclusion

This article explores the theoretical study of the impact of forward PVO in the context of affiliation in a two-level industry. A mixture of theoretical work (see e.g. Flath, 1989; Greenlee and Raskovich, 2006) and applied work (see Cantos et al., 2010) examines vertical participations but does not explicitly link them to affiliations. Our contribution is also timely and relevant. In the case of vertically-related industries Jullien and Rey (2007) study the impact of the resale price maintenance contract on collusion. Vertical contract models are empirically tested by Bonnet and Dubois (2010). More specifically, numerous articles highlight the role and functioning of the different forms of vertical integration for backward PVO (Greenlee and Raskovich, 2006), and for full integration (Grossman and Hart, 1986). However, studies of the effects of partial or foreclosing integration do not allow for affiliation (Schrader and Martin, 1998; Serbera, 2011).

In this paper, we study the incentives for affiliation versus separation in a vertically related industry with an upstream network provider and a downstream Cournot oligopoly. The use of the PVO reduces the market power of the monopoly on pricing and investment decision by providing increased incentives to invest compared to a benchmark. Double marginalisation is reduced, leading to increased output quantities. This reduces the deadweight loss of the monopoly and improves the consumer and social welfare. The implications for competition policy are compelling.

This competitive aspect is highlighted by a comparison of investment incentives between an affiliated industry (PVO) and a fully separated industry (benchmark), our model confirming empirical results of Kwoka (2002). It would be imprudent to use the theoretical results of our model to amend existing anti-trust policies (see e.g. Sweeting, 2007). However, allowing minority shareholdings below the minimal threshold of 5% after separation could be socially beneficial without alarming regulators.

This article sheds new light on the analysis of privatisation of public network industries' policy. The choice by policy makers between full separation and partial affiliation has consequences for competition, market power and social welfare. Future work will examine the consequences of multiple PVO forward arrangements. A combination of PHO and PVO could provide interior solutions for optimal values of partial ownership. This could be decisive in analysing the influence of partial ownership on market concentration and economic welfare. Other types of demand functions with non-homogeneous goods could

15

extend the model to other settings e.g. Bertrand competition. Other studies of equity strategies, which allow for the control of decisions, may have important implications both for policy makers responsible for the current regulatory oversight process and for the continuation of applied research in this area.

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19

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Appendix

Section IV.

We note V_1 the firm 1's (the affiliate linked with PVO) incentives to investment:

$$V_1 = \Pi_1^*(\underline{c}) - \Pi_1^*(\bar{c}) - [\Pi_j^b(\underline{c}) - \Pi_j^b(\bar{c})] = \frac{(\bar{c} - \underline{c})(2A - \underline{c} - \bar{c})(n^4 + 2n^3 - n^2 - 2n + \beta_1)}{4(n^2 + n - \beta_1)^2(n+1)n^2}$$

For $\beta_1 \in [0, 0.5)$ and $n \geq 2$ we observe that $V_1 > 0$.

We note V_j the firm j's (non-affiliated dealers) incentives to investment

$$V_j = \Pi_j^*(\underline{c}) - \Pi_j^*(\bar{c}) - [\Pi_j^b(\underline{c}) - \Pi_j^b(\bar{c})] = \frac{(\bar{c} - \underline{c})(2A - \underline{c} - \bar{c})(n^4 + 2n^3 - n^2 - 2n + \beta_1)}{4(n^2 + n - \beta_1)^2(n+1)n^2}$$

Similarly, it is straightforward to obtain that $V_1 > 0$ for $\beta_1 \in [0, 0.5)$ and $n \geq 2$.

Finally, we note V_s the consumer's (surplus) incentives to investment.

$$V_S = S^*(\underline{c}) - S^*(\bar{c}) - [S^b(\underline{c}) - S^b(\bar{c})] = \frac{n^2(\bar{c} - \underline{c})(2A - \underline{c} - \bar{c})(2n^2 + 2n - \beta_1)\beta_1}{8(n^2 + n - \beta_1)^2(n+1)^2}$$

20

Again, we observe that $V_s > 0$ for $\beta_1 \in [0,0.5)$ and $n \geq 2$.