Joint ownership and interconnection pricing in network industries
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Abstract

This paper investigates a vertical market structure called joint ownership, where a monopolistic upstream firm is jointly owned and operated by competing downstream firms. As such, a common interconnection price to an upstream bottleneck is determined by bargaining among the downstream firms. We show that (1) joint ownership can be superior to the other ownership structures by overcoming vertical externality of double marginalization; (2) collusive outcomes, however, may arise surrounding the setting of common interconnection price; (3) an overall performance of joint ownership depends crucially upon how equity shares are initially distributed and which bargaining rules are employed; and finally (4) a policy measure to promote downstream competition may have ambiguous consequences under joint ownership. Some managerial and political implications in implementing joint ownership in practice are also provided. © 1999 Elsevier Science Inc. All rights reserved.

Keywords: Network industry; Joint ownership; Interconnection pricing

1. Introduction

With the introduction of privatization and deregulation in network industries worldwide since 1980s, various ownership structures have emerged as alternative policy options about vertical market structure.1 Typical alternatives include (i) integrated monopoly; (ii) structural separation; (iii) vertical integration; (iv) accounting separation; and (v) joint ownership (Armstrong & Doyle, 1995; Armstrong et al., 1995).2 In a sense, the problem of vertical market structure can be understood as that of who owns

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the upstream bottleneck (or essential facility) after competition has been introduced in downstream operation. Vertical integration and separation are the two extremes (in the former, one of the downstream firms; in the latter, an independent entity owns the bottleneck), whereas joint ownership (JO hereafter) is an intermediate case where competing downstream firms jointly own the upstream bottleneck. Thus far, there has been a considerable amount of research on alternative (i) mainly from regulatory perspective, and on (ii), (iii) and (iv) mostly in the context of telecommunications and electricity industry, but alternative (v) has been given relatively little attention as a possible vertical market structure.

In this paper, we attempt to explore the welfare consequences of JO. Specifically, we ask 1) what are the main merits and drawbacks of JO compared to other ownership structures in network industries, and 2) what can a policy maker do to maximize overall performance of JO? In answering these questions, the focus of analysis will be laid on the interconnection price (or access price) for an upstream input, since it critically affects the performance of any ownership structures.3 Comparing JO with other structures, in particular, with separate ownership (SO hereafter), special attention will be paid to the trade-offs when one moves from the latter to the former: On one hand, JO eliminates welfare losses of double marginalization which prevails under SO; On the other hand, interconnection pricing under JO can be used as an instrument of collusion among the competing downstream firms. Together, these two determine the net performance of JO.4 After all, JO can be thought of as a compromise between the needs to preserve vertical economies of scope, to eliminate double marginalization and to avoid access pricing problems.5

It is not hard to find some examples of JO in practice. For instance, the 1988 White Paper of the UK government suggests JO of a monopolistic electricity transmission company (NGC: National Grid Company) by twelve distribution companies (RECs: Regional Electricity Companies) after generation and transmission operations of the former CEGB (Central Electricity Generating Board) were vertically separated (Department of Energy, 1988). In many financial service networks in the US, ownership of the network switch is shared jointly by the members of the network (McAndrews & Rob, 1996).6 Also, JO has been traditionally observed in many oil pipeline industries of the US (Hillman, 1991). Most recently, on June 13, 1997, a second nation-wide local loop operator (HANARO Telecommunications Inc.) was allowed to enter the local telecommunications market of Korea and the organization of which is by means of a JO: two competing long-distance operators (DACOM and ONSE Telecommunications Inc.) and a mobile company (SK Telecom) owns considerable shares of the HANARO (HANARO, 1998).

To our knowledge, there have been few attempts specifically focused on the interconnection pricing under JO, and the closest ones are Armstrong and Doyle (1995) and McAndrews and Rob (1996). In a comprehensive review of the issues associated with access pricing problems, Armstrong and Doyle (1995) briefly mentions that “without regulation, the way access prices are set by the jointly owned firm depends on the arrangements governing the management of the firm [and] the way this would be done in most cases would be to set a high access charge” (p. 10). McAndrews and Rob (1996) deals with the problem of JO in the context of the US ATM networks and ana-
analyzes adoption decision (which network a bank chooses to join) and subsequent pricing of a switch and ATM services. They show that upstream industry is more concentrated under the JO switch and the resulting retail price becomes more monopolistic.

Although contributing greatly to the understanding of JO, these studies build on the assumption of symmetric equity shares and joint profit maximization. One of the characterizing features of JO is that the competing downstream firms with respective equity shares in the bottleneck influence the determination of common interconnection price and surrounding this arises conflict of interests. In the current research, we allow for the possibility of asymmetric equity shares, which may well make the firms' interests diverge to the benefit of a society.\(^7\) In addition, in order to represent an internal process of setting an interconnection price and conflicts of interests therein, we suppose that actual interconnection price is an outcome of an associated bargaining rather than of a joint profit maximization which hardly makes sense in the absence of any arrangements for side payments. We analyze the effects of some alternative bargaining scenarios on the interconnection price, firms' profits and social welfare. Finally, we capture the effect of downstream competition on the equilibrium outcomes using a conjectural variations model.

The organization of this paper is as follows. In Section 2, we setup the basic model and derive the equilibrium outcomes of JO. Section 3 compares JO with SO to show the relative merits and drawbacks of JO and the way to maximize the performance of it. Section 4 discusses possible extensions of the basic model and several managerial and political implications associated with implementing JO in practice. Finally, Section 5 concludes the paper with acknowledging limitations of the paper and identifying further research directions.

2. The model

Consider a situation where a monopolistic upstream firm provides two Cournot-competing downstream firms with a vital input at marginal cost \(c \geq 0\). For simplicity, we assume away any distribution or retailing cost in downstream operation. The upstream is assumed to be subject to severe natural monopoly cost conditions, whereas the downstream is not. We assume a fixed coefficient production technology, such that one unit of input is necessary to produce one unit of final product. The inverse demand function for a final product is given by \(p = a - b(q_1 + q_2)\) where \(q_i\) is the quantity produced by downstream firm \(i (i = 1, 2)\) and \(a > c, b > 0\).

We employ (symmetric) conjectural variations approach to represent downstream market competition. Then, \(\partial q_i / \partial q_i = \beta (i, j = 1, 2, j \neq i)\), where \(-1 \leq \beta \leq (q_i / q_j)\) represents the degree of competition. For instance, \(\beta = -1\) corresponds to Bertrand competition, \(\beta = 0\) to Cournot competition and \(\beta = (q_i / q_j)\) (in a symmetric equilibrium, \(\beta = 1\)) to the collusion in downstream market.\(^8\)

The problem of JO can be thought of as a two-stage game: At the beginning, JO is created possibly in an effort of the government to privatize or liberalize the market, and the equity shares of downstream firm \(i\) in the bottleneck, \(0 \leq s_i \leq 1 (i = 1, 2)\), is exogenously given, say, by the government. We confine our attention to the case of complete JO, under which \(s_1 + s_2 = 1\).\(^9\) In stage 1, two downstream firms with
respective equity shares, \( s_i \), decide their preferred interconnection price, \( w_i \) (\( i = 1,2 \)), independently and noncooperatively and the realized interconnection price, \( w \), is an outcome of a bargaining. In stage 2 two firms compete in quantities in final good market with a degree of competition \( \beta \), while taking \( w \) as given.

2.1. Separate ownership (SO): Benchmark case

Before deriving the equilibrium outcomes of JO, we briefly consider the case of SO under which an upstream firm has its own identity as well as the right to determine the interconnection price. There exist three firms and the profit functions of an upstream firm, \( \pi_u \), and two downstream firms, \( \pi_i \) (\( i = 1,2 \)), can be represented as follows:

\[
\pi_u(w) = (w - c)(q_1 + q_2), \quad (1)
\]

\[
\pi_i(q_i, q_j) = (p - w)q_i \quad \text{for } i, j = 1,2, j \neq i. \quad (2)
\]

Taking the derivative of Eq. (2) with respect to \( q_i \) and solving the first-order conditions simultaneously yield

\[
q_i(w) = \frac{a - w}{(3 + \beta)b} \quad \text{for } i = 1,2. \quad (3)
\]

Eq. (3) states that equilibrium quantity of each firm is inversely related to the interconnection price. This is essentially an instance of the basic vertical externality of double marginalization, which can be mitigated (and eventually eliminated) by enhancing downstream market competition.

Substituting Eq. (3) into Eq. (1) and differentiating this with respect to \( w \), equilibrium interconnection price is given by:

\[
w = \frac{a + c}{2}. \quad (4)
\]

In Eq. (4), note that upstream monopolist does not care about the degree of downstream competition and always charges the interconnection price of \((a + c)/2\). As we shall see below, this is the starting point from which JO can distinguish itself from SO.\(^{11}\)

We use an unweighted sum of consumers’ surplus and total industry profits as a measure of social welfare. More precisely, since we have assumed linear demand,

\[
SW = b(q_1 + q_2)^2/2 + \pi_u + \pi_1 + \pi_2
\]

\[
= (5 + 2\beta)(a - c)^2/2b(3 + \beta)^2.
\]

As already mentioned, it is obvious that \( \partial SW/\partial \beta < 0 \).

2.2. Joint ownership (JO)\(^{12}\)

At the end of stage 2, downstream firms’ profit functions can be represented as a sum of their respective upstream and downstream profits. That is,

\[
\pi_i(q_i, q_j, w) = s_i(w - c)(q_i + q_j) + (p - w)q_i \quad \text{for } i = 1,2. \quad (6)
\]

Differentiating Eq. (6) with respect to \( q_i \) and solving the first-order conditions simultaneously yield
To solve for the equilibrium at the first stage (bargaining stage), inserting Eq. (7) into Eq. (6) gives reduced-form profit functions $\pi_i(w)$ of stage 1. Then, firm $i$'s preferred interconnection price, $w_i$, is given by solving

$$w_i \in \text{argmax}_w \pi_i(w)$$

subject to $c \leq w_i \leq p(w_i)$, for $i = 1, 2$

and the first- and second-order conditions of optimization yield

$$w_i = \begin{cases} c, & \text{if } 0 \leq s_i \leq S(\beta) \\ (a + c)/2, & \text{if } S(\beta) < s_i \leq 1 \end{cases} \text{ for } i = 1, 2$$

where $S(\beta) \equiv 4(1 + \beta)/(3 + \beta)^2$. Note that $0 \leq S(\beta) \leq 1/2$ and $S'(\beta) \geq 0$ for $|\beta| \leq 1$.13,14

In general, high interconnection price implies high profit in upstream activity but low profit in downstream, and vice versa. Hence, in choosing an interconnection price, a firm should balance the profitability from upstream and downstream operations and its preferred target is effectively determined by how much equity shares it hold. To illustrate, in case that the firms compete a la Cournot ($\beta = 0$), the threshold value is $S(0) = 44.4\%$. That is, a firm which owns more than 44.4\% of total equity shares would prefer upstream to downstream business and wish to set the interconnection price accordingly highly, and vice versa.15

Once each firm's preferred interconnection price is determined as in Eq. (9), it seems reasonable to suppose that the realized interconnection price, $w$, is an outcome of a bargaining procedure. To keep the analysis as simple as possible, we assume that $w$ can be expressed as a weighted average of $w_i$'s. That is to say,

$$w = \alpha w_1 + (1 - \alpha)w_2$$

where $0 \leq \alpha \leq 1$ is a bargaining weight of firm 1. In the next section, we shall consider several alternative bargaining scenarios which unambiguously fix $\alpha$ in Eq. (10). These include symmetric bargaining power, linear bargaining power and extreme bargaining power scenarios.

3. Comparison of equilibrium outcomes

3.1. Symmetric bargaining power scenario

To begin with, we consider the case where equal weight is given to each firm's preference regardless of the equity share holdings [$\alpha = 1/2$ in Eq. (10)]. We call this symmetric bargaining power scenario and it is straightforward to obtain the realized interconnection price and associated social welfare, which are summarized in the second column of Table 1 below.

It is interesting to find that realized interconnection price is lower and hence social welfare is higher when there are large asymmetries in the two firms' equity shares.16
Table 1
Equilibrium outcomes of joint ownership under several bargaining scenarios

<table>
<thead>
<tr>
<th>Symmetric bargaining power</th>
<th>Linear bargaining power</th>
<th>Extreme bargaining power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equity share of firm 1</strong></td>
<td>(α = 1/2)</td>
<td>(α = s₁)</td>
</tr>
<tr>
<td><strong>Realized interconnection</strong></td>
<td>((a + 3c)/4)</td>
<td>([1 - s₁]a + (1 + s₁)c]/2)</td>
</tr>
<tr>
<td>price</td>
<td>((a + c)/2)</td>
<td>((a + c)/2)</td>
</tr>
<tr>
<td>for 0 ≤ s₁ ≤ S(β)</td>
<td>((a + 3c)/4)</td>
<td>([s₁a + (2 - s₁)c]/2)</td>
</tr>
<tr>
<td>for S(β) &lt; s₁ &lt; 1 - S(β)</td>
<td>((a + c)/2)</td>
<td>((a + c)/2)</td>
</tr>
<tr>
<td>for 1 - S(β) ≤ s₁ ≤ 1</td>
<td>((119 + 66β + 7β²)K/)</td>
<td>([3(3 + β)² - 2s₁(β² + 2β - 3) - s₁(1 - β)²])</td>
</tr>
<tr>
<td>Social welfare</td>
<td>([12(3 + β)²])</td>
<td>(K[3(3 + β)²])</td>
</tr>
<tr>
<td>for S(β) &lt; s₁ &lt; 1 - S(β)</td>
<td>((119 + 66β + 7β²)K/)</td>
<td>([16(2 + β) - 4s₁(1 - \beta') - s₁(1 - \beta')²]K/)</td>
</tr>
<tr>
<td>for 1 - S(β) ≤ s₁ ≤ 1</td>
<td>([12(3 + β)²])</td>
<td>([3(3 + β)²])</td>
</tr>
</tbody>
</table>

\(K = 3(a - c)^²/(8b)\).
This can be explained as follows: When the two firms’ equity shares are not different too much from each other ($s_1 \in (S(\beta), 1 - S(\beta))$), upstream market becomes more attractive to both of them than downstream. Accordingly, they might well prefer cozy pie-splitting in upstream to cumbersome competition in downstream through the setting of high interconnection price $[w_1 = w_2 = (a + c)/2$ in Eq. (9)], at the expense of consumers. In this case, the setting of interconnection price can be understood as an instrument of collusion in the absence of any outright coordination between the firms.

On the other hand, if the two firms’ equity shares are sufficiently different from each other, there arises a conflict between the firms’ interests. A firm with small share, say firm 1 ($s_1 \in [0, S(\beta)]$), would try to lower the interconnection price as much as possible $[w_1 = c$ in Eq. (9)], whereas firm 2 with high share ($s_2 \in [1 - S(\beta), 1]$) will try exactly the opposite $[w_2 = (a + c)/2$ in Eq. (9)]. As a consequence, realized interconnection price will be lower than that under collusion, which is certainly beneficial to society.

3.2. Linear bargaining power scenario

Alternatively, imagine a situation where each firm’s equity share exactly reflects its bargaining power. That is to say, a firm with more equity shares might possess higher voice at the bargaining table for the common interconnection price. We call this a linear bargaining power scenario, in which $\alpha = s_i$. The realized interconnection price and associated social welfare can be similarly calculated as under symmetric bargaining power case, which is presented in the third column of Table 1. The qualitative result that asymmetric equity shares are desirable is the same as before. However, in this scenario, a low share firm that prefers low interconnection price would always be given weaker power in affecting the realized interconnection price. Hence, realized interconnection price is decreasing (resp. increasing) and associated social welfare is increasing (resp. decreasing) for $s_1 \in [0, S(\beta)]$ (resp. for $s_1 \in [1 - S(\beta), 1]$).

3.3. Extreme bargaining power scenario: Majority rule

Finally, imagine an extreme situation to which majority rule applies. In this case, it is obvious that realized interconnection price will always remain at its highest level since the high share firm with exclusive control authority under majority rule always prefers high interconnection price. Thus, social welfare will always be at its lowest level as seen in the fourth column of Table 1.

Fig. 1 below depicts the social welfare under several bargaining scenarios of JO as well as under SO which is given by Eq. (5).

3.4. Welfare comparison

Now, summarizing the findings thus far allow us to have:

Proposition 1. The performance of JO depends crucially upon how equity shares are divided and which bargaining rules are employed.
Precisely, interconnection prices and social welfares corresponding to the several bargaining scenarios of JO satisfy the following relationships. Here, SO stands for Separate Ownership; SB for Symmetric Bargaining Power; LB for Linear Bargaining Power; and EB for Extreme Bargaining Power scenario:

$$w^{SB} \leq w^{LB} \leq w^{EB} = s^{SO} \quad \text{and} \quad SW^{SB} \geq SW^{LB} \geq SW^{EB} \geq SW^{SO}.$$  

Proposition 1 is the direct result of the following two observations. First, as one moves from symmetric, through linear, to extreme bargaining power scenario, more bargaining power would be given to the high share firm. Second, high share firm will always try to raise the interconnection price, which is detrimental to a society as a whole. Consequently, as far as welfare is concerned, it is recommendable to suppress (resp. enhance) high (resp. low) share firm’s bargaining power as much as possible, possibly by designing an appropriate bargaining scheme. For this, the government should assume an active role of arbitrator and listen carefully to the voice of the weaker (low share firm). For instance, it may be possible for the government to affect the rules and procedures governing the organization and operation of joint board of directors. Or in distributing initial equity shares, the composition of equity shares in terms of common and preferred stocks could be made different between low and high share firms. In fact, symmetric bargaining power scenario can be attainable by obliging the allocation of common stocks to be symmetric and instead the allocation of preferred stocks to be arbitrary.
Turning to the issue of equity share allocation, we have:

**Proposition 2.** In JO, the setting of interconnection price can be an instrument of collusion. Hence, it is crucial to induce downstream firms to have sufficiently (resp. appropriately) heterogeneous equity shares in symmetric (resp. linear) bargaining power scenario. In majority rule, respective equity shares are not relevant at all to social welfare.

Concerning Proposition 2, it remains to be answered whether it is possible for the government to manipulate the allocation of equity shares, thus, to induce the firms’ interests diverge. The answer can be positive as verified in the experience of electricity market privatization in the UK where the procedure for the allocation of equity shares in the NGC was mainly dominated by other than purely economic principles. Precisely, equity shares were allocated as a sort of gift from the Secretary of State for Energy to the RECs, which was broadly proportional to the CCA net assets of each REC as at March 31, 1989 and adjusted so that the minimum holding is 5.4%.18 To take another example, in licensing a second nation-wide local loop operator in the Korean telecommunications market in 1997, several consortiums competed for a license and one of the important criteria for a license was the status of equity share diffusion as well as the identity of member firms.19,20

Now, we investigate the effect of downstream competition on the firms’ incentives in setting the interconnection price. As competition intensifies \((\beta \rightarrow -1)\), there simultaneously emerge two welfare effects with opposite signs. In the first place, the loss from downstream market imperfection decreases, which is obviously beneficial to consumers (direct effect of competition). Referring to Fig. 1, this welfare-increasing effect can be represented by an upward shift of all the relevant lines and curves (including the dashed line which represents social welfare under SO), except the horizontal line which represents the welfare level under collusion.21 At the same time, however, increased competition enhances firms’ incentives to avoid competition and instead resort to pie-splitting, which clearly harms the consumers (indirect effect of competition). Referring to Fig. 1, this is represented by the expansion of the collusive region since \(S'(\beta) \geq 0\) for \(|\beta| \leq 1\). In the limit, perfect downstream competition implies perfect collusion and social welfares associated with all the bargaining scenarios of JO drop abruptly to the point which makes JO indistinguishable from SO. The net effect of competition is not clear ex-ante, rather, depends on how the equity shares are initially allocated and which bargaining rules are employed. To sum up, we have:

**Proposition 3.** In JO, the benefit of encouraging downstream competition may be crowded out by correspondingly enhanced incentive for upstream collusion, unless equity shares and bargaining rules are appropriately adjusted.

Proposition 3 is of great importance in reality because a policy measure aimed at promoting competition tends to be blindly welcomed. Rather, in JO, a competition policy should be well accompanied by more careful measures of avoiding collusion. Not only is the latter desirable in itself, but also it helps to fully realize the virtue of the former measure.
4. Discussion

Having explored the basic model of JO, we now consider several practical and political implications in implementing JO in practice. Since actual adoption of a certain market structure must be much more politically-sensitive and time-consuming than our simple economic analysis suggests, this Section would provide public policy makers with useful suggestions and recommendations.

4.1. Extensions of the basic model

To begin with, generalizing the analysis to the case of $n$ downstream firms is straightforward and the preferred interconnection price of firm $i$, $w_i$, is

$$w_i = \begin{cases} 
    c, & \text{if } 0 \leq s_i \leq S'(\beta) \\
    (a + c)/2, & \text{if } S'(\beta) < s_i \leq 1 
\end{cases} \quad \text{for } i = 1, \ldots, n$$

where $S'(\beta) = 4[1 + (n - 1)\beta]/[n + 1 + (n - 1)\beta^2]$ and $\Sigma_i s_i = 1$.

Next, we check the robustness of the results under alternative specifications of social welfare function. We here define a modified measure of social welfare as a weighted sum of consumers’ and producers’ surplus. That is,

$$SW = \lambda CS + (1 - \lambda) PS$$

where $0 \leq \lambda \leq 1$ is a weight on consumer surplus. Under this specification, the conditions by which major findings of the paper remain valid are

$$SW^{SB} \geq SW^{EB} \iff \lambda \geq \frac{2(1 - \beta)}{15 + \beta} \equiv A(\beta),$$

$$SW^{LB} \geq SW^{EB} \iff \lambda \geq \frac{4(1 - \beta^2)}{33 + 27\beta + 3\beta^2 + \beta^3} \equiv B(\beta),$$

$$SW^{SB} \geq SW^{LB} \iff \lambda \geq \frac{2(17 - 3\beta - 13\beta^2 - \beta^3)}{159 + 99\beta - 3\beta^2 + \beta^3} \equiv C(\beta),$$

$$SW^{EB} \geq SW^{SO} \iff \text{always true}.$$  

Note that $C(\beta) \geq A(\beta) \geq B(\beta)$ for $|\beta| \leq 1$ and $\max C(\beta) = C(-0.8) = 0.3$. Hence, the results of the paper remain valid if $\lambda$ is greater than 0.3, which is generally the case in practice.

Finally, it should be noted that in deriving the equilibrium outcomes of JO, two assumptions have played critical roles: (i) two downstream firms are mutual competitors in the final good market; and (ii) they incur the same marginal downstream cost (with no loss of generality, we further assumed it was zero). It is straightforward, though rather tedious, to relax these assumptions to the case of regional monopolists with respective captive markets and of asymmetric downstream competitors with respect to downstream retailing costs. The point is that in the extended models of JO, firms’ conflicts of interests will be determined not only by the division of equity shares but also by their relative position in downstream market. Hence, a firm which
is less efficient downstream (in terms of either captive market sizes or retailing costs) would resort to upstream business fast, that is, seek to charge high interconnection price quicker than more efficient one. Moreover, the greater the efficiency disparity is, the clearer becomes the firms’ conflict of interests. After all, from the perspective of policy maker, it would be better to provide a more efficient firm in downstream market with both more equity shares and more bargaining power.

4.2. Regulatory implications

In most network industries worldwide, interconnection price is usually under tight regulatory oversight, whether it is cost-based (such as rate-of-return regulation) or incentive-based (such as price cap regulation). It seems unlikely that interconnection price regulation can be safely abandoned under JO due to the danger of collusion. When there exists significant informational asymmetry between the regulator and the regulated firms with respect to the upstream marginal cost, it is inevitable to allow some informational rents to the firms, the size of which depends upon how accurate the regulator’s information is (Baron & Myerson, 1982). The point is that in JO, there exist multiple firms upstream who have an access to the true cost information, whereas only a single firm monopolizes this information in SO.

In an appropriate model where information updating process can be explicitly handled, it is highly expected that under JO, there’s more likelihood that the true cost information can be revealed through time and accordingly updated by the regulator. In addition, some kinds of incentive schemes similar to yardstick competition could be applied to elicit the information. If successful, these measures would diminish the informational rents and clearly benefit the consumers.

4.3. Participation conditions

In the basic model of JO, we supposed that the right to choose a certain ownership structure is a sort of policy variable. Even so, however, firms should be ready to involve voluntarily in moving from SO (or any other ownership structures) to JO. This requires us to consider \textit{individual rationality constraints} on the part of the firms participating in JO. Precisely, the equity share of a firm and the price of which should be such that

$$\pi_{i}^{JO}(s_i) - t \cdot s_i \geq \pi_{i}^{SO} \quad \text{for} \quad i = 1, 2,$$

where $t \cdot s_i$ is the total amount of capital needed for firm $i$ to buy as much equity share as $s_i$. It seems possible, albeit rather complicated, to calculate the set $\{t, s_i\}$ which satisfies the above constraint for all the bargaining scenarios considered, which is beyond the scope of the current paper.

4.4. Managerial and political implications

Finally, it seems noteworthy to briefly consider the managerial and political implications of JO, to which we have yet paid explicit attention by our simple analytic model. In particular, we would like to note that, under JO, a number of downstream firms
should agree with each other about the operation of upstream bottleneck. This might include a number of activities ranging from various short-term decisions such as daily operation of the bottleneck facility and the periodic setting of common interconnection price, to the long-term investment decisions for quality enhancement and capacity expansion.

In the basic model, we have considered only one of the short-term decision problems (interconnection pricing) and depicted the joint decision-making process by extremely simple bargaining scenarios. It is, of course, too insufficient a proxy to represent a variety of conflicts among the firms participating in the bargaining process. After all, it is highly conceivable that inefficiencies from managerial and institutional conflicts, such as diseconomies of congestion or diseconomies of communication, may overwhelm the economic benefits of JO. This kind of drawbacks of JO should be well remembered and controlled in implementing JO in practice.

On the contrary, JO might help to alleviate the problem of economic power concentration, which has been one of the most serious economic and political issues in many developing countries. In this vein, it is worth recalling that one of the principal aims of privatization in the UK was widening share ownership and, hence, gaining political advantage (Vickers & Yarrow, 1988).

5. Conclusion

In this article, we have examined the welfare consequences of JO and found that there exist its own merits (elimination of double marginalization) and drawbacks (danger of collusion). To enhance the performance of JO, it is shown that the government should assume an active role in allocating initial equity shares and designing appropriate bargaining rules. Also, we show that a policy measure to promote downstream competition should be accompanied by more careful measures of avoiding collusive outcomes.

As privatization and liberalization progress further, more complicated ownership structures are expected to emerge. We believe that the findings of this paper would help to fill the gap in a comprehensive study of vertical market structures. Also, we hope that this research would provide public policy makers who wish to restructure network industries in pursuit of both static and dynamic efficiencies, with useful guidelines and recommendations in selecting appropriate ownership structures. In the paper, we suggest JO as a promising alternative for vertical market structures, particularly, of the developing countries where the problem of economic power concentration is urgently waiting to be tackled.

We conclude by mentioning the limitations of this paper and further research directions. The analytic model employed in this article flows from a number of simplifying assumptions including linear demand function and very simplified representation of the bargaining processes. To generalize, these must be a promising future research direction. Also, we neglect the share-trading stage of the game and simply assume that the equity share division is exogeneously determined, possibly by the government. In reality, however, a variety of factors might affect respective firm’s acquisition of
equity shares: share price, fund availability of each firm, each firm’s political power, past market performances, and so forth. An elaborate examination on the process of equity share acquisition must be another challenging research issue. Finally, as Armstrong and Doyle (1995) point out, it seems plausible that another effect of JO is to discourage further entry into a competitive market. In particular, how to respond to a new entry into downstream market remains to be addressed. Possible answers include urging (or inducing) the incumbents to sell a portion of their equity shares to an entrant; allowing a new entrant to operate without any equity shares in upstream bottleneck; and so forth.

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Notes

1. By network industry we mean an industry which is highly capital-intensive in building and maintaining its vital network, hence, exhibits significant economies of scale in some or all of its operations. Traditionally, it includes telecommunications, electricity, gas, water/sewerage, post, railway industries, etc. Note, however, that joint ownership can still be observed in other than network industries by various reasons specific to an industry. For instance, competing firms may agree to hire a common marketing agency (Bernheim & Whinston, 1985).

2. Throughout the paper, we implicitly assume that the ownership of a network industry is already in private hands. In other words, ownership transfer from public to private hands, that is, privatization itself, is not our concern.

3. Accordingly, interconnection price has been one of the most important decision variables in practice to be determined in vertically related industries. For example, in telecommunications industries worldwide, there have been hot disputes concerning the level and structure of interconnection price for a local loop. Existing research which focuses on the interconnection price in analyzing vertical market structures include Economides and Salop (1992), Vickers (1995), McAndrews and Rob (1995), Armstrong and Doyle (1995), and so forth. In addition to the interconnection pricing problems, there may arise holdup problems associated with a relationship-specific investments in a bottleneck. However, as Armstrong et al. (1995: p. 139) indicates, the existence of downstream competition could greatly alleviate the holdup problems. Hence, we rule out this issue in the paper.

4. We assume away any role of regulation except a simple restriction on the cross-subsidization between vertically related activities. This allows us to focus on the firms’ anti-competitive or collusive incentives in the absence of regulation and thereby to identify new regulatory focus in JO.
5. The SO suffers from missing the gains of vertical economies of scope and the problem of double marginalization will persist unless downstream market is highly competitive. Also, it is well known that there is a serious drawback in vertical integration surrounding the setting of access terms and conditions, especially the level and structure of access price.

6. McAndrews and Rob (1996) reports that “of the ten largest regional ATM networks, which had an 80% share of ATM network transactions in 1993, three are not-for-profit, essentially cooperatives. Of the remaining seven for-profit networks, three have diffuse ownership shares” (p. 731). Also, the two largest securities depositories and settlement networks, Depository Trust Company and the Participants Trust Company, and the two largest credit card corporations, Visa and Mastercard, are reported to be owned by the members.

7. Indeed, as will be clearly seen later in the paper, collusive outcomes arise only when the firms’ equity shares are similar to each other.

8. The use of conjectural variations approach is mainly for analytical simplicity and most results of the paper do not critically depend on this approach. It should, however, be admitted that conjectural variation model is subject to one serious criticism: It lacks consistency since it relies on the expectation that your opponent would do something different from what they actually do at an equilibrium. Nevertheless, many writers in industrial organization and/or international trade theory use this approach when analyzing oligopolistic competition. In addition, Dockner (1992) interprets a conjectural variations equilibrium as an outcome of dynamic strategic interactions.

9. When downstream firms possess only partial equity interests in upstream entity \( (s_1 + s_2 < 1) \), interconnection price is more likely to be a decision variable of an independent upstream firm. In this case, downstream firms are able to enjoy only silent financial interests.

10. This corresponds to the case of the UK electricity (between generation and transmission) and railway industries and the US telecommunications industry after breaking-up AT&T and before passing the new Telecommunications Act 1996. Since the focus of analysis is JO, SO alone would be sufficient for the purpose of comparison. It is easy to show that vertical integration is inferior to SO due to the incentive of the bottleneck owner to foreclose its downstream rivals.

11. A referee suggests that two downstream firms could make a one-time lump-sum transfer to a bottleneck and agree to transfer the input at marginal cost of supply, thus avoiding double marginalization. In this paper, we rule out this possibility by assuming contract incompleteness. In addition, Yarrow (1991: p. 37) provides two other reasons why this nonlinear tariff structure cannot be sustained: arbitrage would undermine the tariff structure and demand uncertainty would place too much risk burden on the downstream firms.

12. Among the examples of JO in practice, this case is more concerned with the US ATM and Korean local loop markets where downstream firms are competing with one another. For the UK electricity market, the salient feature must be
the regional monopolies with respective captive markets though adjacent RECs could still find themselves competing to supply large users near their common borders. The case of regional monopolies will be briefly discussed later in section 3.1.

13. The imposition of cross-subsidization constraint appears reasonable in view of the regulatory practices in most network industries. Technically, this constraint is to prevent indeterminacy in the bargaining stage of the game.

14. At this point, it should be noted that joint-profit maximizing interconnection price is always determined to be \((a + c) / 2\) by the optimality condition of \(\max_w \pi_i(w) + \pi_j(w)\). However, no one can be quite sure that both firms with different equity shares would agree to this level of interconnection price in the absence of any arrangements for side payments. Instead, it appears only as a special case of Eq. (9).

15. The sudden switch in the preferred interconnection prices from low to high price once it attains a critical upstream share is because the threshold share of \(S(\beta)\) alters the curvature of profit functions from convex to concave. When it is convex, cross-subsidization constraint is binding, making the lowest interconnection price of \(c\) as an optimal strategy. When it is concave, the first stage game reduces in effect to a zero-sum game. An increase in \(s_i\) shifts firm \(i\)'s profit function vertically upward and the other's vertically downward by the same amount, making the preferred interconnection prices be constant at \((a + c) / 2\) as equity shares vary (Note, in Eq. (7), that \(q_1(w) + q_2(w)\) does not depend on \(s_i\)).

16. In the second column of Table 1, note that \((a + 3c) / 4 \leq (a + c) / 2\) and \((119 + 66\beta + 7\beta^2)K/[12(3 + \beta)^2] \geq K\) for \(|\beta| \leq 1\). In fact, when cross-subsidization is not permitted, social welfare is a decreasing function of the realized interconnection price and is maximized at \(w = c\).

17. In the third column of Table 1, note that \([(1 - s_1)a + (1 + s_1)c] / 2 \leq (a + c) / 2\) and \([s_1a + (2 - s_1)c] / 2 \leq (a + c) / 2\) and the equalities hold at \(s_1 = 0\) and 1 respectively.

18. Actual equity share holdings of the twelve RECs were as follows: Eastern Electricity (12.5%), East Midlands Electricity (8.4%), London Electricity (10.5%), MANWEB (5.5%), Midlands Electricity (9.2%), Northern Electric (6.5%), NORWEB (8.2%), SEEBOARD (7.3%), Southern Electric (11.0%), South Wales Electricity (5.4%), South Western Electricity (6.3%) and Yorkshire Electricity (9.2%) (Thomson, 1993).

19. Major equity share holders of the HANARO Telecommunications Inc. include DACOM (10% share), KEPCO, Thrunet (8% share respectively), and Samsung, Hyundai, Daewoo, SK telecom (6% share respectively) (HANARO, 1998).

20. For an alternative way to model the equity share acquisition stage, see Nakamura and Xie (1998) where each firm’s bargaining power determines respective equity shares (and eventually ownership structures) by the process of Nash Bargaining. To consider the equity share bargaining as well as an interconnection price bargaining must be very complicated and, for the sake of model tractability,
we assume that equity shares are exogeneously determined. Similar simplification can be found in Bresnahan and Salop (1986) where a number of alternative control arrangements arising from stock-holding are analyzed in the context of production joint ventures between competing firms.

21. This is so because, in the region of collusive outcomes, firms would completely give up downstream profits to split upstream pie. Hence, the degree of downstream competition does not matter any longer.

References


