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ABSTRACT

Raskovich (2000) suggests that becoming pivotal through merger worsens the merging buyers bargaining position. We show that these results hold in the case where buyer bargaining power is equal across buyers, but not in the case where bargaining power is asymmetric. We demonstrate it is possible when there are asymmetries in bargaining power that larger buyers, including pivotal buyers, can extract greater gains from trade than smaller buyers. We show that this result holds even if the supplier's value function is convex. These results imply that horizontal merger might be used as a strategy to enhance bargaining position.

Introduction

In this paper, we extend the work of Raskovich (2000) and explore the case of asymmetric bargaining power. Building on the work of Chipty and Snyder (1999), Raskovich demonstrated that, under the assumption of constant bargaining power across firm size, 'pivotal' (i.e., large) buyers would be systematically disadvantaged in negotiations with sellers.[1] We show that if bargaining power increases with the size of the buying firm, Raskovich's results do not necessarily hold. On the contrary, large firms may be systematically advantaged in negotiations with sellers.

Chipty and Snyder (1999) and Raskovich (2000) explore simultaneous bilateral bargaining models in which there is a single seller and more than

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[1]Chipty, Tasneem and Christopher Snyder, "The Role of Firm Size in Bilateral Bargaining: A Study of the Cable Television Industry," *The Review of Economics and Statistics*, May, 1999, 81(2), 326-340; Raskovich, Alexander, "Pivotal Buyers and Bargaining Position," Economic Analysis Group Discussion Paper 00-9, U.S. Department of Justice, Anti-Trust Division, October, 2001.

several buyers. Both assume that the gains from trade are divided equally (i.e., 50-50), irrespective of firm size. Chipty and Snyder suggest that the effect on bargaining position of a merger by two (or more) buyers can be determined by the curvature of the supplier's value function, and they demonstrate that if the supplier's value function is concave, the merger will enhance the buyer's bargaining position; if the value function is convex, the merger will worsen the the buyer's bargaining position. Raskovich generalizes Chipty and Snyder's model by introducing a pivotal buyer; that is, a buyer so large that only the buyer can completely cover the supplier's costs. Thus, the large firm is "on the hook" for the supplier's costs. The result is that merger worsens a buyer's bargaining position.

In what follows, we generalize the approach of Chipty and Snyder (1999) and Raskovich (2000) by relaxing the assumption of equal division of the gains from trade. We demonstrate that an equilibrium exists when the division of the surplus varies across firms, and we analyze the case where bargaining power is assumed to increase in firm size.

We offer several plausible reasons why bargaining power might be increasing in firm size. First, a merger may augment the set of useful information regarding prices and other contractual terms the previously non-merged firms' possessed. Second, if there are differences in bargaining skills between the merging firms, the merger may result in the retention of the more-skilled bargaining team. Third, the merged firm may have a lower risk aversion coefficient. Fourth, the merged firm may be more patient, i.e., it may not discount the future as much as the previously non-merged firms may have.[2] Regardless, our goal in this paper is simply to explore the outcome of the bilateral bargaining model as if bargaining power is asymmetric, an assumption we see as no more or less heroic than any other.

After extending the model of Raskovich (2000) to incorporate asymmetric bargaining power, we then show that: (1) the results of the bargaining solution employed by Chipty and Snyder and Raskovich are robust to any constant division of the trade surplus (e.g., 80-20, 60-40, etc.) and not simply 50-50; (2) the curvature of the value function may no longer be a reliable rule-of-thumb method for evaluating the change in bargaining position and hence the effect of mergers on sellers; (3) the post-merger bargaining position of the merged firm may improve even though the merged firm becomes pivotal; and (4) a merger may decrease the merged firms' transfer payments and decrease the seller's transfer revenues.

Perhaps the simplest way to demonstrate the potential effects of asymmetric bargaining power is by example. We preface the example by introducing a bargaining power parameter that can vary across firms, and denote the i^{th} buyer's bargaining power by $\alpha_i \in (0, 1)$, where a higher

[2]We thank Alex Raskovich for his discussion relating to these reasons.

value of α means greater bargaining power.[3]

Now, assume that we have three buyers, each with different valuations of the seller's product, and each with different levels of bargaining power. For example, assume that $v_A = 80$, $v_B = 56$, and $v_C = 40$, and that $\alpha_A = .8$, $\alpha_B = .4$, and $\alpha_C = .3$. T_i denotes the transfer price for the i^{th} buyer. The level of seller costs, F, is 50. It is easy to demonstrate that under these conditions, buyer B is pivotal, whereas buyers A (with the highest valuation of the seller's product) and C (with the lowest valuation of the seller's product) are not pivotal. Note that for Raskovich (2000), buyers A and B would be pivotal. We see that $T_A = (1 - \alpha_A) \cdot v_A = (0.2 \cdot 80) = 16$ and that $T_C = (1 - \alpha_C) \cdot v_C = (0.7 \cdot 40) = 28$. It is immediately clear that $T_A + T_C = 44 < 50 = F$. Further, we note that $T_B = (1 - \alpha_B) \cdot (v_B - F + T_A + T_C) + (F - T_A - T_C) = (0.6 \cdot 50 + 6) = 36$. Observing that $T_A + T_B = 16 + 36 = 52 > 50$ and $T_B + T_C = 64 > 50$, it is clear that buyer A and buyer C are not pivotal, and that buyer B is pivotal. In fact, as we see from the example, $T_B > T_C > T_A$, i.e., the buyer with the highest valuation pays the least. Thus, in a framework with asymmetric bargaining power, pivotal buyers can derive significant benefits.

The rest of the paper is organized as follows. First, we extend Raskovich's (2000) model and show that under more general assumptions an equilibrium still exists. Next, we show that the introduction of asymmetric bargaining power can improve the buying firm's bargaining position (even if the firm is pivotal). We also show that in the presence of asymmetric bargaining power the 'curvature test' of the value function can be a misleading indicator of the effects of merger on bargaining position, i.e., that the bargaining position of the merged firm can improve even if the the value function is convex. Finally, we make some concluding remarks.

Nash Equilibrium with Bargaining Power

In this section, we extend Raskovich's (2000) model to accommodate asymmetric bargaining power. We begin by constructing the transfer prices faced by pivotal and non-pivotal buyers and then show that an equilibrium exists under conditions more general than Raskovich's.

Following Raskovich (2000), we assume the i^{th} buyer's surplus is given by $v_i = (q_i, q_{-i})$, while the supplier's gross surplus equals $V(Q)$, where $Q = \sum_{i=1}^{n} q_i$. Specifically, $V(Q) = A(Q) - C(Q)$, where $A(Q) \equiv$ ancillary revenue, and $C(Q) \equiv$ total cost. The supplier will produce iff:

$$V(Q) + \sum_{i=1}^{n} T_i \geq 0 \tag{1}$$

[3]For Raskovich (2000), $\alpha_1 = \alpha_2 = \alpha_n = \frac{1}{2}$. In fact, Raskovich's pivotal result will hold for any constant value $\alpha = \alpha_1 = \alpha_2 = \ldots \alpha_n$ where $\alpha \in (0, 1)$. Note that α_i represents the share of surplus kept by buyer i.

We also note that:

$$q_i^* = \arg\max_x [v_i(x, q_{-i}) + V(Q_{-i} + x)] \tag{2}$$

where we assume there exists a q_t^* that maximizes joint surplus.[4] Buyer i is pivotal iff:

$$V(Q_{-i}) + \sum_{j \neq i} T_j < 0 \tag{3}$$

and

$$\max_x [v_i(x, q_{-i}) + V(Q_{-i} + x)] + \sum_{j \neq i} T_j \geq 0 \tag{4}$$

where $v_i(0, q_{-i}) = 0$.[5]

The transfer price (incorporating asymmetric bargaining power and using α notation) becomes, for a non-pivotal buyer, $T_i = (v_i + (V - V_{-i}))(1 - \alpha_i) - (V - V_{-i})$ which can be written as:

$$T_i = v_i(1 - \alpha_i) - \alpha_i(V - V_{-i}) \tag{5}$$

Next, noting that $\sum_{j \neq i} T_j + V_{-i} < 0$, we see that the transfer price for a pivotal buyer can be written as $T_i = [v_i + (\sum_{j \neq i} T_j + V)](1 - \alpha_i) - V - \sum_{j \neq i} T_j$, or as:

$$T_i = v_i(1 - \alpha_i) - \alpha_i(\sum_{j \neq i} T_j + V) \tag{6}$$

Definition 1: A Nash Equilibrium in purchased quantities $(q_1^*, q_2^*, ..., q_n^*)$ and transfer prices $(T_1, ..., T_n)$ is that for which the following hold simultaneously for all i:

$$q_i^* = \arg\max_x (v_i(x, q_{-i}^*) + V(\sum_{j \neq i} q_j^* + x)) \tag{7}$$

$$T_i = v_i(x, q_{-i}^*)(1 - \alpha_i) - \alpha_i(V(Q^*) - V(Q^* - q_i^*)) \tag{8}$$

$$\text{if } \textstyle\sum_{j \neq i} T_j + V(Q^* - q_i^*) \geq 0$$

$$T_i = v_i(x, q_{-i}^*)(1 - \alpha_i) - \alpha_i(\sum_{j \neq i} T_j + V(Q^*)) \tag{9}$$

$$\text{if } \textstyle\sum_{j \neq i} T_j + V(Q^* - q_i^*) < 0$$

[4] We assume that the surplus from trade is positive at the optimal quantity for any buyer. This implies that $v_i + V - V_{-i} > 0$ for all i.

[5] Raskovich has the restriction that $V_{-1} \leq V_{-2} \leq ... \leq V_{-n} \leq V$, while we allow V_{-i} to vary across buyers.

$$\sum_{j=1,\ldots,n} T_j + V(Q^*) \geq 0 \tag{10}$$

In what follows, we rank order the $i < k$ buyers such that $(v_i + (V - V_{-i}))(1-\alpha_i) \geq (v_k + (V - V_{-k}))(1-\alpha_k)$. This implies that the buyer with the highest valuation is not necessarily the buyer with the highest transfer price.

Lemma 1: If buyer i satisfies the conditions for being pivotal, then buyer h, such that $h < i$, also satisfies the condition for being pivotal.

Proof of Lemma 1: The proof is by contradiction. Suppose that i is pivotal and that h, $h < i$, is not pivotal. We note that $T_i = (1-\alpha_i)v_i - \alpha_i(V + \sum_{j \neq i} T_j)$ and that $T_h = (1-\alpha_h)v_h - \alpha_h(V - V_{-h})$. Then, $T_h - T_i = (1-\alpha_h)v_h - \alpha_h(V - V_{-h}) - (1-\alpha_i)v_i + \alpha_i(V + \sum_{j\neq i} T_j)$=$(1-\alpha_h)v_h + (1-\alpha_h)(V - V_{-h}) - (V - V_{-h}) - (1-\alpha_i)v_i - (1-\alpha_i)(V - V_{-i}) + (1-\alpha_i)(V - V_{-i}) + \alpha_i(V + \sum_{j \neq i} T_j)$. Let $b_i = (v_i + V - V_i)(1-\alpha_i)$. Next, by substitution, we re-write this expression as $T_h - T_i = b_h - b_k + V_{-h} - V_{-i} + \alpha_i V_i + \alpha_i(\sum_{j\neq h} T_j + T_h - T_i)$ or $T_h - T_i = \frac{1}{1-\alpha_i}(b_n - b_k) + (V_{-h} - V_{-i}) + \frac{\alpha_i}{1-\alpha_i}(\sum_{j \neq h} T_j + V_{-h})$. Noting that $\frac{1}{1-\alpha_i}(b_h - b_k) \geq 0$ and that $\frac{\alpha_i}{1-\alpha_i}(\sum_{j\neq h} T_j + V_{-h}) \geq 0$, we write $T_h - T_i \geq V_{-h} - V_{-i}$ and thus, $V_{-i} - T_i \geq V_{-h} - T_h$. Adding $\sum_j T_j$ to both sides we get $V_i + \sum_{j \neq i} T_j \geq V_{-h} + \sum_{j \neq h} T_j \geq 0$. This implies that $V_i + \sum_{j\neq i} T_j \geq 0$, which is a contradiction. Q.E.D.[6]

Lemma 2: If production is efficient, $\sum_{j=1}^n v_j + V \geq 0$, then the outcome in which all buyers are pivotal satisfies the supplier's participation constraint.

Proof of Lemma 2: $\sum_{j=1}^n T_j + V = ... = \frac{1}{1+\sum_{j\leq p}} \frac{\alpha_i}{1-\alpha_j}(\sum_{j=1}^n v_j + V) \geq 0$

Now, denote by $T_i(p)$ the transfer price for buyer i when first p buyers are pivotal.

[6] Consider a possible equilibrium with p pivotal buyers. Lemma 1 implies that (5) holds for $i > p$ and that (6) holds for $(i \leq p)$. Next, we note that (6) can be written as $T_i = v_i(1-\alpha_i) - \alpha_i(V + \sum_{all j} T_j) + \alpha_i T_i$ or as $T_i = v_i - \frac{\alpha_i}{1-\alpha_i}(V + \sum_j T_j)$. Summing across the i's we see that $\sum_j T_j = \frac{1}{1+\sum_{j \leq p} \frac{\alpha_j}{1-\alpha_j}}(\sum_{j \leq p} v_j + \sum_{j > P}(1-\alpha_j)v_j - \sum_{j\leq p} \frac{\alpha_j}{1-\alpha_j} V + \sum_{j>p} \alpha_j(V_{-j} - V))$ which we can write as:

$$\begin{aligned} T_i = v_i - \frac{\alpha_i}{1-\alpha_i}V - \frac{\frac{\alpha_i}{1-\alpha_i}}{1+\sum_{j\leq p}\frac{\alpha_j}{1-\alpha_j}}(\textstyle\sum_{j \leq p} v_j + \sum_{j>P}(1-\alpha_j)v_j - \\ \textstyle\sum_{j \leq p} \frac{\alpha_j}{1-\alpha_j} V + \sum_{j>p} \alpha_j (V_{-j} - V)) \end{aligned} \tag{11}$$

Lemma 3: If $\sum_{i \neq p} T_i(p) + V \geq 0$ then $\sum_{i \neq p} T_i(p-1) + V \geq 0$

Proof of Lemma 3: By contradiction assume that $\sum_{i \neq p} T_i(p)+V \geq 0$ and $\sum_{i \neq p} T_i(p-1)+V < 0$. Then, $(\sum_{i \neq p} T_i(p)+V)-(\sum_{i \neq p} T_i(p-1)+V) = \sum_{i \neq p} T_i(p)-(\sum_{i \neq p} T_i(p-1) = \sum_{i \neq p-1}(\frac{\alpha_i}{1-\alpha_i}[\sum_{j=1}^{n} T_j(p-1)-\sum_{j=1}^{n} T_j(p)])$. Next, we see that $T_p(p-1) - T_p(p) = (1 + \sum i \leq p - 1 \frac{\alpha_i}{1-\alpha_i})(\sum_{j=1}^{n} T_j(p-1) - \sum_{j=1}^{n} T_j(p))$. Since $T_p(p-1) - T_p(p) < 0$, i.e., the pivotal payment is always greater than the non-pivotal, we get $\sum_{i \neq p} T_i(p)-\sum_{i \neq p} T_i(p-1) < 0$, which is a contradiction. Q.E.D.

Proposition 1: If production is efficient, then there exists an equilibrium where only the first p buyers are pivotal.

Proof of Proposition 1: See Raskovich(2000).[7]

Merger Effects

Using the results from the previous section, we explore the potential effects of merger on bargaining power, and compare these results with Chipty and Snyder (1999) and Raskovich (2000). As we demonstrate, once potential asymmetries are introduced into the bargaining solution, the results of Chipty and Snyder and Raskovich may not hold. In fact, the introduction of even a modest amount of bargaining power can have significant effects on bargaining position.

We begin by assuming there are two non-pivotal merging firms, A and B, and then show the conditions under which a merger between the firms increases their bargaining position.

Note that the net surplus for buyer A before a merger is given by $(v_A + V^S - V^S_{-A})\alpha_A$, and the net surplus for buyer B before a merger is given by $(v_B + V^S - V^S_{-B})\alpha_B$. The net surplus after a merger is $(v_{AB} + V^M - V^M_{-AB})\alpha_{AB}$, assuming, that AB is non-pivotal as in Chipty and Snyder (1999). We note that A and B have the incentive to merge iff:

$$(v_{AB} + V^M - V^M_{-AB})\alpha_{AB} > (v_A + V^S - V^S_{-A})\alpha_A + (v_B + V^S - V^S_{-B})\alpha_B \quad (12)$$

We can write (12) as $v_{AB} + V^M - V^M_{-AB} > (v_A + V^S - V^S_{-A})\frac{\alpha_A}{\alpha_{AB}} + (v_B + V^S - V^S_{-B})\frac{\alpha_B}{\alpha_{AB}}$, letting $DE = v_{AB} - v_A - v_B$ where DE is downstream efficiency, $UE = (V^M - V^M_{-AB}) - (V^S - V^S_{-AB})$ where UE is upstream efficiency, and:

$$\begin{aligned} BP = (v_A + V^S - V^S_{-A})\frac{\alpha_{AB}-\alpha_A}{\alpha_{AB}} + (v_B + V^S - V^S_{-B})\frac{\alpha_{AB}-\alpha_B}{\alpha_{AB}} \\ +(V^S_{-A} + V^S_{-B} - V^S - V^S_{-AB}) \end{aligned} \quad (13)$$

[7] Raskovich notes that the equilibrium may not be unique.

where BP is the firm's bargaining position. Combining these conditions yields:

$$DE + UE + BP > 0 \tag{14}$$

Recall that by assumption (see footnote 4) $v_A + V^S - V^S_{-A}$ and $v_B + V^S - V^S_{-B}$ are positive. Therefore, if $\alpha_{AB} > \alpha_A$ and $\alpha_{AB} > \alpha_B$, then $(v_A + V^S - V^S_{-A})\frac{\alpha_{AB}-\alpha_A}{\alpha_{AB}} + (v_B + V^S - V^S_{-B})\frac{\alpha_{AB}-\alpha_B}{\alpha_{AB}} > 0$. Noting that for Chipty and Snyder (1999), $BP^{CS} = V^S_{-A} + V^S_{-B} - V^S - V^S_{-AB}$, and given our formulation in (13), clearly, $BP > BP^{CS}$. Thus, in the presence of asymmetric bargaining power, Chipty and Snyder's (1999) result under-estimates the positive effect of bargaining power on post-merger bargaining position, since bargaining position in the context of asymmetric bargaining power can be positive even if $BP^{CS} < 0$. Thus, bargaining position can increase even if $V''(Q) > 0$, i.e., even if V is convex.[8]

Next, following Raskovich (2000), assume that buyers A and B merge and become pivotal. The merger is profitable iff:

$$\alpha_{AB}v_{AB} + \alpha_{AB}(\sum_{j \neq AB}(T^M_j + V^M)) > \alpha_A(v_A + V^S - V^S_{-A}) + \alpha_B(v_B + V^S - V^S_{-B})$$

which we note is equivalent to $v_{AB} + \sum_{j \neq AB}(T^M_j + V^M) > (v_A + V^S - V^S_{-A})\frac{\alpha_A}{\alpha_{AB}} + (v_B + V^S - V^S_{-B})\frac{\alpha_B}{\alpha_{AB}}$. We decompose this expression into three parts: $DE = v_{AB} - v_A - v_B$, $UE = (V^M - V^M_{-AB}) - (V^S - V^S_{-AB})$, and

$$\begin{aligned} BP = {} & (v_A + V^S - V^S_{-A})\tfrac{\alpha_{AB}-\alpha_A}{\alpha_{AB}} + (v_B + V^S - V^S_{-B})\tfrac{\alpha_{AB}-\alpha_B}{\alpha_{AB}} \\ & +(V^S_{-A} + V^S_{-B} - V^S - V^S_{-AB}) + \theta(\textstyle\sum_{j \neq AB} T^M_j + V^M_{-AB}) \end{aligned} \tag{15}$$

where $\theta = 1$ if AB is pivotal, and $\theta = 0$ if AB is not pivotal. It is immediately clear that (15) is the general case of (13). Thus, (15) can be written as

$$BP = (v_A + V^S - V^S_{-A})\frac{\alpha_{AB} - \alpha_A}{\alpha_{AB}} + (v_B + V^S - V^S_{-B})\frac{\alpha_{AB} - \alpha_B}{\alpha_{AB}} + BP^R$$

Clearly, $BP > BP^R$. According to Raskovich, if the merged buyer becomes pivotal, its bargaining position worsens, since the last term in (15) is negative. However, this worsening of bargaining position can be offset by an increase in bargaining power that increases the first two terms of (15).

The measures of Chipty and Snyder (1999) and Raskovich (2000) may under-estimate bargaining position because they abstract from any positive effects of bargaining power for the merging firm. Once this effect is accounted for, the curvature of the value function is no longer a reliable

[8] Under Chipty and Snyder, concavity (convexity) of the value function implies the bargaining position of the merged firm improves (worsens).

rule-of-thumb method for evaluating the change in bargaining position and hence the effects of the merger on sellers. Moreover, despite Raskovich's prediction that pivotal buyers would be disadvantaged by merger, we have shown that increasing bargaining power can improve the bargaining position of the, now pivotal, merged firm.

Conclusion

Raskovich (2000) suggested that becoming pivotal through merger worsens the merging buyers' bargaining position. We have shown that these results hold in the case where buyer bargaining power is constant, but not necessarily in the case where bargaining power increases with firm size. We demonstrated that larger buyers, including pivotal buyers, can extract greater gains from trade than smaller buyers when there are asymmetries in bargaining power. Chipty and Snyder (1999) and Raskovich (2000)may under-estimate bargaining position because they abstract from the possibility that bargaining power may increase with firm size. Once this effect is accounted for, the curvature of the value function is no longer a reliable rule-of-thumb method for evaluating the change in bargaining position and hence the effects of the merger on sellers. Moreover, despite Raskovich's prediction that pivotal buyers would be disadvantaged by merger, we have shown that increasing bargaining power can improve the bargaining position of the, now pivotal, merged firm.