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Bargaining Power and the Effects of Joint Negotiation: The "Recapture Effect"

by

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Abstract

This paper considers the effects of joint negotiation when suppliers and intermediaries engage in bilateral negotiation over inclusion of a supplier's product in an intermediary's network. I identify conditions under which joint negotiation by two suppliers increases the suppliers' bargaining power even when the suppliers' products are not substitutes for each other. In particular, joint negotiation increases the suppliers' bargaining power if suppliers face smaller losses from disagreement when they negotiate jointly. If joint negotiation causes an intermediary to lose more of its consumers to competing intermediaries in the event of disagreement, and if the suppliers sell their products through these competing intermediaries, the suppliers will be able to recapture more of the sales that they would otherwise have lost in the event of disagreement. As a result, joint negotiation reduces the suppliers' losses from disagreement, and thus enhances their bargaining power. I show that these conditions arise under a wide range of assumptions about consumer preferences.

1 Introduction

In many industries, suppliers and intermediaries bargain over whether the supplier's product will be included among a range of products that the intermediary makes available to consumers. For example, manufacturers negotiate with retailers for access to shelf space; record companies and publishers negotiate with owners of digital media platforms to have their content available on the platform; producers of video programming negotiate with cable companies; and health care providers negotiate with commercial health insurers for inclusion in the insurer's managed care network. In all of these industries, an intermediary's bargaining leverage derives from the threat that the supplier will make fewer sales to final consumers if it does not reach agreement with the intermediary, and a supplier's bargaining leverage derives from the threat that the intermediary's offering will become less attractive to consumers if it does not include the supplier's products.

A potentially important issue is how the relative bargaining power of the negotiating parties may be affected if two or more suppliers negotiate as a single entity. For example, this issue may arise in the context of a merger between two suppliers. More generally, any arrangement between two suppliers that commits them to negotiating jointly will raise the issue. A substantial literature has investigated the effects of joint negotiation on bargaining power, with industry applications ranging from health care to cable television.[1]

A central conclusion to emerge from this literature is that joint negotiation between two suppliers is likely to enhance the suppliers' bargaining power if the loss to the intermediary from failing to reach agreement with both suppliers is greater than the sum of the losses from failing to reach agreement with each supplier individually; that is, if the intermediary's value function is concave. The most natural reason for the intermediary's value function to be concave is that final consumers view the suppliers as substitutes for one another.

To see the intuition for this, consider a hypothetical example from the health care industry, in which two similar hospitals are located close to one another. If patients view these hospitals as close substitutes, an insurer will be able to offer an attractive network to potential members even if it includes only one of the two hospitals. There will be little cost to the insurer from failing to reach an agreement with one of the hospitals, since potential enrollees will be reasonably satisfied as long as they have in-network access to the other hospital. If, however, the insurer fails to reach an agreement with either hospital, any patients that viewed the two hospitals as their first and second choices will need to switch to a less preferred hospital (or change to a different health plan). Thus, as a direct result of patients' viewing the hospitals as substitutes, the loss to the insurer from dropping both hospitals is greater than the sum of the losses from dropping only one of them, and hence joint negotiation by the hospitals would weaken the insurer's bargaining position.

[1]For example, a large literature, including Town and Vistnes (2001), Capps, Dranove, and Satterthwaite (2003), and Gowrisankaran, Nevo, and Town (2014), considers the effects of hospital mergers on the merged entity's bargaining position. Similarly, Chipty and Snyder (1999) consider the effects of *buyer* mergers on bargaining power in the cable television industry. O'Brien and Shaffer (2005) examine the bargaining power effects of mergers between upstream suppliers who sell differentiated products to a downstream retail monopolist.

Based on this result, the existing literature on identifying the likely competitive effects of hospital mergers has placed considerable importance on measuring the degree of patient substitution between hospitals. Indeed, in many widely used models, a merger's competitive effects are determined entirely by the extent to which patients view the merging providers as substitutes. For example, the discussion of bargaining theory in Farrell et al. (2011) states "If the hospitals are not substitutes, ... the cost of failing to reach an agreement with both hospitals is equal to the sum of the costs of failing to reach agreements with them separately, and so there will be no effect on price."[2]

There is thus a well-established consensus in the literature that the degree of substitution plays an important role in determining the effects of joint negotiation on bargaining power. In some instances, however, two suppliers with little or no consumer substitution between their products may enter into a joint contracting arrangement, and well-informed industry observers and participants nonetheless expect the joint negotiation to result in enhanced bargaining power. For example, in the health care industry, many would expect commercial insurers to pay increased reimbursement rates when a large hospital acquires an independent physician practice, even if patients are not able to substitute between the services of the hospital and those of the physician group.[3] This creates something of a puzzle for economic theory. Either these observers are incorrect about the likely consequences of joint negotiation in these contexts, or there is something important missing from a theoretical framework that relies solely on consumer substitution to produce effects.

A few recent papers, focused on the health care industry, have proposed theories that could address this puzzle. Vistnes and Sarafidis (2013) consider the effects of mergers between hospitals in geographically distinct areas, and identify certain conditions under which an insurer's value function may be concave even if patients do not view the hospitals as substitutes. Under these conditions, "cross-market hospital mergers may reduce competition even in the absence of any significant patient substitution between the merging hospitals."[4] As an alternative explanation for an observed empirical relationship between a hospital's negotiated prices and its membership in a large hospital system, Lewis and Pflum (2014) argue that large systems may have informational or other advantages that enhance their bargaining effectiveness.

In this paper, I describe an alternative mechanism that can explain an increase in bargaining power resulting from joint negotiation by two suppliers that do not offer substitute products. The

[2] Farrell et al. (2011) at 275. See also Gaynor and Town (2012): "The merger will increase price as long as the additional loss in per-patient welfare [from a network without hospitals j and k] is greater than the loss in welfare from hospital network [without k only]. This will be the case if and only if patients view hospitals j and k as substitutes."

[3] Based on interviews with representatives of hospitals, physician groups, health plans, and other health industry participants, Berenson *et al.* (2010) conclude that "one clear goal of an alliance between hospitals and physicians is to improve negotiating clout for both." Similarly, Berenson *et al.* (2012) report that "Respondents from health plans and provider organizations agreed that hospitals negotiating on behalf of their employed physicians are able to obtain higher prices for physician services than can be achieved by independent physician practices. Some plan respondents reported that having a large employed physician contingent also increased hospital leverage over rates for hospital services."

[4] Vistnes and Sarafidis (2013) at 259.

mechanism does not depend on concavity of the intermediary's value function; that is, there is no requirement that the intermediary's losses from failing to reach agreement with both suppliers be greater than the sum of its losses from failing to reach agreement with each one individually. Instead, the mechanism relies on differences in the *suppliers'* pay-offs. In particular, joint negotiation increases the suppliers' bargaining power if suppliers face smaller losses from disagreement when they negotiate jointly. An intermediary's leverage over a supplier is derived from the threat that the supplier will lose access to the intermediary's consumers in the event of disagreement. But if disagreement with one supplier also triggers disagreement with the other (because of joint negotiation), the intermediary will lose more of its consumers to competing intermediaries in the event of disagreement. If the supplier sells its products through these competing intermediaries, the supplier will be able to recapture more of the sales that it would otherwise have lost. As a result, joint negotiation reduces the suppliers' losses from disagreement, and thus enhances their bargaining power.

It is important to note that this mechanism relies on the presence of some degree of competition among intermediaries. That is, consumers that substitute away from one intermediary have the option of choosing an alternative intermediary to access their preferred suppliers. If, instead, suppliers negotiate with a single intermediary and consumers have no alternative means of accessing the suppliers, the effect identified in this paper will not arise. In that setting, concavity of the intermediary's value function is a necessary condition for joint negotiation to increase suppliers' bargaining power.

A natural question is why this effect does not violate the principle of "one monopoly rent." Unsurprisingly, the explanation is that joint negotiation allows the suppliers to internalize contracting externalities. An analogy with suppliers of substitute products illustrates this point. When an intermediary reaches an agreement with one supplier, that agreement has the (external) effect of reducing the value to that intermediary of reaching an agreement with a different supplier that sells substitute products. In the familiar case in which two suppliers of substitute products negotiate jointly, joint negotiation allows the suppliers to internalize that externality and hence increase their bargaining leverage. The effect identified in this paper can be viewed similarly. When an intermediary reaches an agreement with one supplier, that agreement has the effect of increasing the value to another supplier of reaching an agreement with that intermediary, because the volume of consumers that can be accessed only through that intermediary is higher as a result of the initial agreement. Again, joint negotiation allows the suppliers to internalize this externality and thus increase their bargaining leverage.

The intuition behind this idea can be illustrated by an example of a hospital and a physician practice entering into an agreement to negotiate jointly with insurers. Negotiating on its own, the price that the physician practice can negotiate will be constrained by the threat that substantial patient volume will be diverted to competing physicians in the event of disagreement. By contrast, joint contracting between the physician practice and the hospital diminishes this threat, because more of the insurer's members will switch to another health plan rather than forego access to the hospital. In this way, joint negotiation increases the providers' bargaining power by preventing the insurer from threatening to steer as much volume away from each provider in the event of disagreement.

This concept is applicable in a number of settings in which consumers demand access to multiple products. Because the mechanism relies on consumers who value both of the suppliers' products, it will not generally account for any bargaining power effects that may arise when suppliers in geographically distinct areas negotiate collectively. In this sense, the ideas in this paper may be viewed as complementary to the ideas proposed by Vistnes and Sarafidis (2013) and Lewis and Pflum (2014). Earlier work by Gal-Or (1999) considers the effects of hospital acquisitions of physician practices, identifying certain conditions under which such acquisitions increase the providers' bargaining power. Gal-Or's model is in fact a special case of the framework I consider here, but the mechanism underlying its effects does not appear to have been well-understood. I consider the model in detail below.

The remainder of the paper is organized as follows: In Section 2, I describe a general model of bargaining between suppliers and intermediaries, and derive expressions for the effects of joint negotiation on the equilibrium transfer from intermediaries to suppliers in this model. In Section 3, I consider a special case of this framework, the model introduced by Gal-Or (1999); I show that this model's support for the conclusion that joint negotiation enhances bargaining power is in fact more robust than Gal-Or's paper suggests. In Section 4, I consider an alternative model, based on logit demand, illustrating that the effect identified in this paper arises under a wide range of assumptions about the distribution of consumer preferences. Section 5 is a brief conclusion.

2 A general model of bargaining between suppliers and intermediaries

In the general framework for the models in this paper, suppliers produce goods or services that consumers obtain through intermediaries. There are two stages to the analysis: In the first stage, each supplier-intermediary pair engages in simultaneous bilateral negotiations to determine whether the supplier's products will be available to consumers at that intermediary, as well as the terms of any financial exchange between the supplier and the intermediary. The outcome of each negotiation is given by the (asymmetric) Nash bargaining solution. Following the bargaining framework introduced by Horn and Wolinsky (1988), the parties to each negotiation take the equilibrium outcomes of all other negotations as fixed when considering whether to enter into an agreement. Intermediaries simultaneously set the prices that they charge to consumers for access to their portfolio of products (e.g. membership or subscription fees, or insurance premia). If suppliers charge prices directly to consumers, these prices are also determined at the first stage. (I also consider variants of the model in which suppliers do not charge prices directly to consumers, but rather receive reimbursement solely through the terms of their agreement with the intermediary). Under this assumption on the timing of price determination, these prices are also treated as fixed during supplier-intermediary negotiations. (I also consider an extension to the model in which each intermediary expects to be able to adjust its price in the event of a disagreement with a supplier.) In the second stage, consumers observe the set of products available at each intermediary (i.e., the intermediary's "network") and all prices, choose one intermediary, and consume products available at that intermediary. Based on these consumer choices, the intermediaries and suppliers realize profits.

2.1 Lump sum transfers

Consider a bilateral negotiation between an intermediary I and a supplier A. If (and only if) the negotiation ends in agreement, supplier A will be included in intermediary I's network, and the parties agree to the terms of payment between them. In this section, I assume payment consists of a lump sum transfer T_A. T_A is defined to be positive if the intermediary pays the supplier, and negative if the reverse occurs.

Let $V_I(\Omega)$ and $V_A(\Omega)$ denote the gross payoffs for intermediary I and supplier A, excluding the value of T_A, given I's network Ω. Let Ω^* denote the network that both parties expect in the event of agreement (i.e., a network that includes supplier A), and let Ω^{-A} denote the same network without supplier A (the disagreement outcome). The (asymmetric) Nash bargaining solution will solve the following maximization problem:

$$\max_{T_A} \left[V_I(\Omega^*) - V_I\left(\Omega^{-A}\right) - T_A\right]^{(1-\beta)} \cdot \left[V_A(\Omega^*) - V_A\left(\Omega^{-A}\right) + T_A\right]^{\beta}$$

where $\beta \in [0,1]$ is the Nash bargaining parameter indexing the unmodeled bargaining effectiveness of the two parties. If $\beta = 1$, the supplier has all the bargaining power, and so can effectively make a take-it-or-leave-it offer to the intermediary. If $\beta = 0$, the intermediary has all the bargaining power.

The solution to this problem is:

$$T_A = \beta\left[V_I(\Omega^*) - V_I\left(\Omega^{-A}\right)\right] + (1-\beta)\left[V_A\left(\Omega^{-A}\right) - V_A(\Omega^*)\right]$$

Here, the equilibrium transfer is expressed as a weighted average of two extremes: the highest possible transfer that the insurer would be willing to pay $(V_I(\Omega^*) - V_I\left(\Omega^{-A}\right))$ and the lowest possible transfer that the provider would be willing to accept $(V_A\left(\Omega^{-A}\right) - V_A(\Omega^*))$.

The outcome of bilateral negotiations between intermediary I and supplier B produces a similar expression for transfer T_B:

$$T_B = \beta\left[V_I(\Omega^*) - V_I\left(\Omega^{-B}\right)\right] + (1-\beta)\left[V_B\left(\Omega^{-B}\right) - V_B(\Omega^*)\right]$$

I assume that β is the same for every supplier-intermediary pair. (If some suppliers have greater bargaining effectiveness than others, the effects of joint negotiation will partly reflect these differences. For example, if a supplier with high negotiating skill agrees to negotiate on behalf of a less-skilled supplier, the jointly negotiating suppliers may be able to extract greater rents as a result of their contracting arrangement. In this paper, in order to focus on effects of joint negotiation that arise even in the absence of such differences in bargaining effectiveness, I abstract away from this possibility).

Now consider the change in bargaining if suppliers A and B negotiate jointly. In particular, assume that suppliers A and B make a binding commitment to negotiate as a single entity, so that an intermediary must agree to include both of them in its network if it wishes to include either one. In this case, a failure to reach agreement with intermediary I will result in the network Ω^{-A-B}, the network without suppliers A and B. Under Nash bargaining, the combined transfer to the two providers, T_{A+B}, will be given by the following expression:

$$\begin{aligned} T_{A+B} &= \beta \left[V_I\left(\Omega^*\right) - V_I\left(\Omega^{-A-B}\right) \right] \\ &\quad + (1-\beta) \left[V_A\left(\Omega^{-A-B}\right) + V_B\left(\Omega^{-A-B}\right) - V_A\left(\Omega^*\right) - V_B\left(\Omega^*\right) \right] \end{aligned}$$

The expressions for T_A, T_B, and T_{A+B} include terms for the parties' payoffs under the equilibrium network, $V_I\left(\Omega^*\right)$, $V_A\left(\Omega^*\right)$, and $V_B\left(\Omega^*\right)$. In principle, these payoffs may be different depending on whether A and B negotiate jointly. For example, if A and B are able to obtain higher payments from other intermediaries as a result of joint negotiation, $V_A\left(\Omega^*\right)$ and $V_B\left(\Omega^*\right)$ will be higher in the expression for T_{A+B} than in the expressions for T_A and T_B. However, as long as the only effect of joint negotiation is to change the value of lump sum transfers, then under Nash bargaining (in which the terms of other agreements are treated as fixed in the event of disagreement), these differences will cancel out of the expressions above. Thus, for the purposes of the analysis with lump sum transfers, I treat $V_I\left(\Omega^*\right)$, $V_A\left(\Omega^*\right)$, and $V_B\left(\Omega^*\right)$ as invariant to whether A and B negotiate jointly.

Combining these results, the change in the combined transfer that results from joint contracting is:

$$\begin{aligned} \Delta T &\equiv T_{A+B} - \left(T_A + T_B\right) \qquad (1) \\ &= \beta \left\{ \left[V_I\left(\Omega^{-B}\right) - V_I\left(\Omega^{-A-B}\right) \right] - \left[V_I\left(\Omega^*\right) - V_I\left(\Omega^{-A}\right) \right] \right\} \\ &\quad + (1-\beta) \left[V_A\left(\Omega^{-A-B}\right) - V_A\left(\Omega^{-A}\right) + V_B\left(\Omega^{-A-B}\right) - V_B\left(\Omega^{-B}\right) \right] \end{aligned}$$

The first part of this expression (in braces) reflects the effect of the intermediary's payoff. It says that joint negotiation will tend to increase the transfer if the incremental value to the intermediary of adding A to its network is greater when B is not also in the network: $\left[V_I\left(\Omega^{-B}\right) - V_I\left(\Omega^{-A-B}\right) \right] > \left[V_I\left(\Omega^*\right) - V_I\left(\Omega^{-A}\right) \right]$. This is a familiar concavity condition: Joint negotiation by two suppliers will tend to increase bargaining power when the loss of both suppliers is more costly to the intermediary than the sum of the losses of each supplier individually.

The second part of the expression shows that joint negotiation will also tend to increase the transfer if the payoff to A (or B) when it is excluded from the network is greater if B (or A) is also excluded: $V_A\left(\Omega^{-A-B}\right) > V_A\left(\Omega^{-A}\right)$ (or $V_B\left(\Omega^{-A-B}\right) > V_B\left(\Omega^{-B}\right)$). In other words, if an agreement between an intermediary and a supplier has a negative externality on another supplier's payoff under disagreement, coordination by the two suppliers can internalize this effect and allow the suppliers jointly to negotiate higher payment. This externality is the feature of the model that has generally been absent from applied work in the literature.[5] This paper's primary contributions are to introduce this externality as a potential feature of bilateral bargaining environments and to identify conditions under which the externality is likely to be present.

The expression for ΔT above is very general, relying only on the assumption of Nash bargaining with lump sum transfers and constant β. To investigate the conditions that determine the sign and magnitude of ΔT, I introduce the following specification for the players' value functions:

$$V_j\left(\Omega\right) = \pi_j N_j\left(\Omega\right),\ j = A, B, I \tag{2}$$

where π_j is a measure of the profit per consumer for player j, and $N_j\left(\Omega\right)$ represents a number of consumers as a function of network Ω. For intermediaries, π_I is interpreted as the price intermediary I charges consumers for access to its products (less any unit costs), and $N_I\left(\Omega\right)$ is the number of consumers choosing intermediary I when I's network is Ω. Intermediary I is assumed here to set π_I simultaneously with the negotiations over network participation. As a result, π_I does not vary with Ω. (I consider relaxing this assumption below). Also, for the purposes of the analysis with lump sum transfers, π_I is the same whether the suppliers negotiate separately or jointly.

For suppliers, the expression for ΔT depends only on suppliers' payoffs in the event of disagreement. For the purposes of this analysis, then, π_j measures the profit per consumer that supplier j earns from consumers that choose intermediaries other than I. This could reflect profits from prices the supplier charges directly to consumers, or profits from other sources of revenue that vary with the number of consumers. For example, if the supplier is a video programming distributor, π_j may reflect advertising revenues. (In the next section, I consider a variant of this model in which a supplier's profit per consumer is the outcome of the negotiation with the intermediary.) If not all of the consumers with access to supplier j choose to consume its products, π_j should be interpreted as the expected profit per consumer; that is, the profit earned from each consumer that chooses supplier j's products multiplied by the probability that a consumer with access to supplier j does so. For suppliers, $N_j\left(\Omega\right)$ measures the total number of consumers that have access to supplier j through intermediaries other than I, given that I's network is Ω. $N_j\left(\Omega\right)$ varies with I's network because a change in the network may induce consumers to choose a different intermediary. I will restrict attention to scenarios in which any consumers who leave intermediary I in response to a change in network will switch to another intermediary that offers both A and B in equilibrium.

[5] For example, Gaynor and Town (2012) specify a model of hospital-insurer bargaining in which the combined disagreement payoff of two hospitals negotiating jointly is assumed to be equal to the sum of the disagreement payoffs of each hospital when they negotiate separately. Under this assumption, the terms in the second part of equation 3 cancel out, and the effect of joint negotiation depends only on the concavity of the insurer's value function.

This condition will hold, for example, if in equilibrium every intermediary offers a comprehensive network that includes all suppliers.

Under general conditions on consumer preferences (in particular, broader networks are always preferred to narrower), the set of consumers that choose intermediary I in equilibrium, $N_I(\Omega^*)$, can be divided into five mutually exclusive and exhaustive groups as follows:

N_0 = consumers who would choose I even if both A and B are excluded from I's network.

N_1 = consumers who would choose I if and only if A is included in I's network.

N_2 = consumers who would choose I if and only if B is included in I's network.

N_3 = consumers who would choose I if and only if at least one of A or B is included in I's network (I refer to these consumers as "substitute-type").

N_4 = consumers who would choose I if and only if both A *and* B are included in I's network ("complement-type").

The consumers in group 3 are called "substitute-type" because their choice of intermediary is consistent with preferences that treat access to A as a substitute for access to B. It is not necessary that such consumers view A's and B's products as substitutes at the time of consumption. Even if A and B produce distinct types of product (e.g. physician services and hospital services), there may be some consumers where the exclusion of one or the other from a network is not sufficient to induce the consumer to switch intermediaries, but the exclusion of both is. Similarly, the consumers in group 4 are called "complement-type" based on how their choice of intermediary responds to the exclusion of A or B, which need not correspond to complementarity between A's and B's products in the usual sense.

Letting M_j denote the equilibrium number of consumers at other intermediaries that offer supplier j, we can express the number of consumers for each network configuration as follows:

I's Network (Ω)	$N_I(\Omega)$	$N_j(\Omega),\ j = A, B$
Ω^*	$N_0 + N_1 + N_2 + N_3 + N_4$	M_j
Ω^{-A}	$N_0 + N_2 + N_3$	$M_j + N_1 + N_4$
Ω^{-B}	$N_0 + N_1 + N_3$	$M_j + N_2 + N_4$
Ω^{-A-B}	N_0	$M_j + N_1 + N_2 + N_3 + N_4$

Substituting the appropriate values for the players' value functions into equation 1 yields the following expression for ΔT :

$$\Delta T = \beta\pi_I (N_3 - N_4) + (1 - \beta)[\pi_A (N_2 + N_3) + \pi_B (N_1 + N_3)] \tag{3}$$

This expression identifies the key factors that determine the effect on joint negotiation on bargaining power. The first term (multiplied by β) reflects the component of ΔT based on how joint contracting changes the insurer's disagreement payoff. Joint contracting will tend to benefit the suppliers if the number of substitute-type consumers is larger than the number of complement-type consumers (i.e., $N_3 > N_4$). A large number of substitute-type consumers means that the two suppliers can threaten to drive more consumers away from the intermediary when they negotiate jointly than they can when they negotiate separately. The presence of complement-type consumers offsets this effect, because each supplier can individually threaten to divert these consumers away from the intermediary. Under separate negotiation, the value of these consumers to the intermediary is reflected in each of transfers to the two suppliers, while under joint negotiation it is reflected only in a single joint transfer. As a result, if the number of complement-type consumers is large, joint negotiation will tend to reduce the transfer. This is analogous to Cournot's (1838) result that joint ownership of complementary goods reduces prices. In general, there may be some consumers of both types. The net effect of this component of ΔT will depend on which group of consumers is larger.

The second term in equation 3 (multiplied by $(1-\beta)$) reflects the component of ΔT based on how joint contracting changes the suppliers' disagreement payoffs. Consider the first part of this term, $\pi_A (N_2 + N_3)$. The sum of N_2 and N_3 is the number of consumers that stay with intermediary I when A alone is excluded from the network, but that switch to a different intermediary when both A and B are excluded. Under separate negotiation, A will lose access to these consumers in the event of disagreement with I. By contrast, with joint negotiation, A will still have access to these consumers in the event of disagreement with I, through a different intermediary. Joint negotiation thus prevents A from losing access to those consumers in the event of disagreement. As a result, the effect of joint negotiation on A's disagreement payoff is equal to the value that A receives from having access to those consumers, $\pi_A (N_2 + N_3)$. In other words, this is the value of the externality that B's participation in I's network has on A's disagreement payoff. A similar logic applies to B, reflected in the term $\pi_B (N_1 + N_3)$. Because the effect of joint negotiation is that each supplier can expect to "recapture" some consumers that it otherwise would have lost access to in the event of disagreement, I will refer to this component of the effect as the "recapture effect."[6]

A key contribution of this paper is to show how joint negotiation can increase suppliers' bargaining power even if the intermediary's value function is not concave, i.e. even if the loss to the intermediary of both suppliers is no worse than the sum of the losses of each individually. Equation 3 illustrates this point clearly: ΔT may be positive even if $N_3 \leq N_4$, as long as there are consumers whose choice of intermediary depends on access to B (or A) but who are also valuable to A (or B), so that $\pi_A (N_2 + N_3) > 0$ (or $\pi_B (N_1 + N_3) > 0$).

2.2 Negotiated unit prices

In the analysis above, I assumed that suppliers and intermediaries negotiated over a lump sum transfer. At the same time, an important driver of the result was the assumption that suppliers benefit from incremental unit sales, i.e. $\pi_j > 0$ for $j = A, B$. In some contexts, this may be a reasonable assumption; for example, suppliers may charge a price directly to consumers. In other contexts, it may be more appropriate to model suppliers and intermediaries as negotiating over a unit price. As a result, the suppliers' profit per consumer, π_j, will depend on the outcome of

[6] I am indebted to Patrick Greenlee for suggesting this terminology.

the negotiation. In this section, I derive an expression for the effect of joint negotiation on the total payment from an intermediary to the jointly negotiating suppliers, under the assumption that intermediaries and suppliers negotiate over unit prices rather than over a lump sum transfer. (A similar expression can be derived for the case of negotiated *per-consumer* prices, where the total payment to suppliers is proportional to the total number of consumers choosing the intermediary.)

For this analysis, I focus on the *first-order* effect of joint negotiation. That is, I consider how the total payment from an intermediary to the jointly negotiating suppliers would change as a result of joint negotiation, under the assumption that all prices for transactions involving other intermediaries or other suppliers remain fixed at the level of the equilibrium with separate negotiations, as does the per-unit price the intermediary charges directly to consumers. As a result, for the moment I do not solve for a new equilibrium with joint negotiation. Doing so would require accounting for the reactions of other prices, which I will defer for a later section of the paper when I consider a fully specified model of consumer demand. The advantage of focusing on the first-order effect is that it substantially simplifies the analysis and allows for a clear illustration of the primary mechanism driving the effects of joint negotiation. Also, because prices are usually strategic complements, higher order effects are likely to reinforce the effects identified in this section.

As described in the previous section, the consumers that choose intermediary I in equilibrium are divided into five groups, indexed by $k \in \{0, \ldots, 4\}$. Let $\lambda_{jk}(\Omega)$ denote the average number of units of supplier j's products consumed by a consumer in group k, given that intermediary I's network is Ω. The usage level depends on the network because if supplier j is excluded from I's network, any consumers that remain with intermediary I will reduce their usage of supplier j's products to zero, and will generally increase their usage of other (substitute) suppliers' products. Let r_{Ij} denote the negotiated unit price paid by intermediary I to supplier j. Let $\overline{r}_{jk}$ denote the average unit price paid to supplier j by intermediaries other than j for consumers in group k in the event that those consumers switch to another intermediary. In general, this average price may vary across consumer groups because different consumers may switch to different intermediaries and different intermediaries may pay different prices. For simplicity, however, I will treat $\overline{r}_{jk}$ as constant across consumer groups, and so suppress the subscript k. Also for simplicity, I will assume that suppliers have zero costs. Finally, π_I denotes the profit per consumer earned by intermediary I, excluding the costs of any payments to suppliers. For example, π_I could represent the price charged by the intermediary. I assume here that π_I is determined simultaneously with bargaining over network participation, so that the value of π_I is taken as fixed during the negotiations. (In the next section, I consider how the results would vary if the intermediary expects to be able to adjust π_I in the event of disagreement).

The payoffs for intermediary I as a function of its network are given by the following expressions:

$$V_I(\Omega^*) = \sum_{k=0}^{4} N_k \left(\pi_I - \sum_j r_{Ij} \lambda_{jk} (\Omega^*) \right)$$

$$V_I(\Omega^{-A}) = \sum_{k=0,2,3} N_k \left(\pi_I - \sum_{j \neq A} r_{Ij} \lambda_{jk} \left(\Omega^{-A} \right) \right)$$

$$V_I(\Omega^{-B}) = \sum_{k=0,1,3} N_k \left(\pi_I - \sum_{j \neq B} r_{Ij} \lambda_{jk} \left(\Omega^{-B} \right) \right)$$

$$V_I(\Omega^{-A-B}) = N_0 \left(\pi_I - \sum_{j \neq A,B} r_{Ij} \lambda_{j0} \left(\Omega^{-A-B} \right) \right)$$

The payoffs for suppliers A and B are:

$$V_j(\Omega^*) = r_{Ij} \sum_{k=0}^{4} N_k \lambda_{jk} \left(\Omega^* \right), \; j = A, B$$

$$V_A(\Omega^{-A}) = \overline{r}_A \sum_{k=1,4} N_k \lambda_{Ak} \left(\Omega^{-A} \right)$$

$$V_B(\Omega^{-B}) = \overline{r}_B \sum_{k=2,4} N_k \lambda_{Bk} \left(\Omega^{-B} \right)$$

$$V_j(\Omega^{-A-B}) = \overline{r}_j \sum_{k=1}^{4} N_k \lambda_{jk} \left(\Omega^{-A-B} \right), \; j = A, B$$

Under separate negotiation, the price r_{IA} that solves the Nash bargaining problem will satisfy the following expression for the total payment from I to A:

$$\begin{aligned} T_A &\equiv r_{IA} \sum_{k=0}^{4} N_k \lambda_{Ak} \left(\Omega^* \right) \qquad (4) \\ &= \beta \left[\sum_{k=1,4} N_k \left(\pi_I - \sum_{j \neq A} r_{Ij} \lambda_{jk} \left(\Omega^* \right) \right) + \sum_{k=0,2,3} N_k \left(\sum_{j \neq A} r_{Ij} \left(\lambda_{jk} \left(\Omega^{-A} \right) - \lambda_{jk} \left(\Omega^* \right) \right) \right) \right] \\ &\quad + (1 - \beta) \; \overline{r}_A \sum_{k=1,4} N_k \lambda_{Ak} \left(\Omega^{-A} \right) \end{aligned}$$

The first term in the square brackets reflects the profits intermediary I earns on the consumers it would lose if A were excluded from its network. The second term in the square brackets represents the additional payments to other suppliers that intermediary I would have to pay if A were excluded, as a result of its retained consumers increasing usage of other suppliers when they lose access to A. The final term in the expression is the disagreement payoff for supplier A: the earnings from consumers that would switch to alternative intermediaries in order to retain access to A.

Similarly, r_{IB} under separate negotiation will satisfy:

$$
\begin{aligned}
T_B &\equiv r_{IB}\sum_{k=0}^{4} N_k \lambda_{Bk}\left(\Omega^*\right) \qquad (5)\\
&= \beta\left[\sum_{k=2,4} N_k \left(\pi_I - \sum_{j\neq B} r_{Ij}\lambda_{jk}\left(\Omega^*\right)\right) + \sum_{k=0,1,3} N_k \left(\sum_{j\neq B} r_{Ij}\left(\lambda_{jk}\left(\Omega^{-B}\right) - \lambda_{jk}\left(\Omega^*\right)\right)\right)\right]\\
&\quad + (1-\beta)\ \overline{r}_B \sum_{k=2,4} N_k \lambda_{Bk}\left(\Omega^{-A}\right)
\end{aligned}
$$

Under joint negotiation, the total payment from intermediary I to A and B together will be:

$$
\begin{aligned}
T_{A+B} &\equiv \sum_{k=0}^{4} N_k \left(r_{IA}\lambda_{Ak}\left(\Omega^*\right) + r_{IB}\lambda_{Bk}\left(\Omega^*\right)\right) \qquad (6)\\
&= \beta\left[\sum_{k=1}^{4} N_k \left(\pi_I - \sum_{j\neq A,B} r_{Ij}\lambda_{jk}\left(\Omega^*\right)\right) + N_0 \left(\sum_{j\neq A,B} r_{Ij}\left(\lambda_{j0}\left(\Omega^{-A-B}\right) - \lambda_{j0}\left(\Omega^*\right)\right)\right)\right]\\
&\quad + (1-\beta)\ \sum_{k=1}^{4} N_k \left(\overline{r}_A \lambda_{Ak}\left(\Omega^{-A-B}\right) + \overline{r}_B \lambda_{Bk}\left(\Omega^{-A-B}\right)\right)
\end{aligned}
$$

While this expression must be satisfied in equilibrium, a limitation of the Nash bargaining solution for jointly negotiated per-unit prices is that the framework does not yield unique solutions for r_{IA} and r_{IB}. For any set of values for the other prices in the model, there is a continuum of pairs of r_{IA} and r_{IB} that satisfy equation 6. In other words, the model results in one equation with two unknowns. While one might apply some equilibrium refinement to derive an explicit solution for the individual prices, I will focus instead on what we can learn from the analysis without going beyond the implications of the Nash bargaining solution. (As I discuss further below, imposing unrealistic restrictions to obtain a unique solution is a pitfall that can result in misleading conclusions).

The equilibrium values for r_{Ij}, $\overline{r}_j$, and π_I will vary depending on whether negotiation is separate or joint. Accounting for these higher order effects would require more structure on the model. However, as noted above, I focus here only on the first order effects of joint negotiation. Accordingly, I define r_{IA}^{Joint} and r_{IB}^{Joint} to be a pair of values for r_{IA} and r_{IB} that satisfy equation 6 under the assumption that all other prices are equal to their equilibrium level under separate negotiation, and T_{A+B}^{Joint} to denote T_{A+B} evaluated at these values. I use r_{Ij}^*, $\overline{r}_j^*$, and π_I^* to denote the initial equilibrium values, and T_j^* the corresponding values of T_j, for $j = A, B$. The first order effect of joint negotiation on the total payment from intermediary I to A and B is then defined as:

$$
\widehat{\Delta T} \equiv T_{A+B}^{Joint} - \left(T_A^* + T_B^*\right) = \sum_{k=0}^{4} N_k \left[\left(r_{IA}^{Joint} - r_{IA}^*\right)\lambda_{Ak}\left(\Omega^*\right) + \left(r_{IB}^{Joint} - r_{IB}^*\right)\lambda_{Bk}\left(\Omega^*\right)\right]
$$

In order to obtain a parsimonious expression for $\widehat{\Delta T}$, I impose two simplifying assumptions:

$$\text{Assumption (1): } \sum_j \lambda_{jk}(\Omega) = \sum_j \lambda_{jk}(\Omega') \text{ for all } \Omega, \Omega', k$$

$$\text{Assumption (2): } r^*_{Ij} = r^*_{Ij'} \text{ for all } j, j' s.t. \lambda_{jk}(\Omega) > \lambda_{jk}\left(\Omega^{-j'}\right) \text{ for any } k$$

Assumption (1) states that the total number of units consumed by any group of consumers is invariant to network changes. If a supplier becomes unavailable to a group of consumers as a result of its exclusion from a network, those consumers will divert their consumption to other suppliers, with no change in the total number of units consumed. Note that I do not assume that there is any diversion from A to B if A is excluded from the network, or vice versa. For the purposes of this analysis, A and B may or may not be substitutes for one another. Whether the assumption of invariant total consumption is appropriate in an applied setting will generally depend on the application. For example, it is often assumed that patients' overall demand for health care services does not vary with the breadth of the insurance network. Here, the assumption allows me to abstract away from any changes in overall consumption, and focus instead on the effects of consumers switching to alternative suppliers or intermediaries.

Assumption (2) assumes that the equilibrium price for two different suppliers will be the same if those suppliers are substitutes for one another. This is certainly a restrictive assumption; in general, different suppliers may have different costs or demands, so that their equilibrium prices will be different. The effect on an intermediary of excluding a supplier from its network will then depend on whether the retained consumers are likely to substitute to a more or less expensive alternative. By imposing this assumption, I avoid cluttering the analysis with terms that reflect these differences. Note that I do not assume uniformity for the prices of products that are not substitutes for one another. In particular, if consumers do not view A and B as substitutes, they may receive different per-unit payments from intermediaries.

Under these two assumptions, the first order effect of joint negotiation is given by the following expression:

$$\begin{aligned}\widehat{\Delta T} = {} & \beta\left[N_3\left(\pi^*_I - \sum_j r^*_{Ij}\lambda_{j3}(\Omega^*)\right) - N_4\left(\pi^*_I - \sum_j r^*_{Ij}\lambda_{j4}(\Omega^*)\right)\right] \\ & + (1-\beta)\left[\overline{r}^*_A\left(\sum_{k=2,3} N_k\lambda_{Ak}\left(\Omega^{-A-B}\right)\right) + \overline{r}^*_B\left(\sum_{k=1,3} N_k\lambda_{Bk}\left(\Omega^{-A-B}\right)\right)\right]\end{aligned} \tag{7}$$

Not surprisingly, equation 7 is quite similar to equation 3, the expression for ΔT with lump sum transfers. The similarity between these two expressions shows that the basic mechanism driving the effects of joint negotiation on bargaining power is the same whether we model negotiation over lump sum transfers or unit prices. The two effects may of course be different to some extent, but the underlying intuition is the same: The effect of joint negotiation acting through the intermediary's value function depends on the value to the intermediary of substitute-type consumers relative to complement-type consumers (i.e. the concavity or convexity of the intermediary's value function); while the effect acting through the suppliers' value functions depends on the value to each supplier of the consumers it would lose if excluded individually but would recapture if excluded together with the other supplier (i.e. the recapture effect).

2.3 Intermediary price adjustment after disagreement

A key assumption in the analysis above is that the intermediary's profit per enrollee, π_I, is determined simultaneously with the negotiation over network participation. As a result, π_I is treated as fixed across agreement and disagreement outcomes. In this section, I consider the implications of an alternative assumption, that each intermediary expects to be able to adjust its price in the event of disagreement. Returning to the model with lump sum transfers described above, I generalize the expression for the value function for intermediary I as follows:

$$V_I(\Omega) = \pi_I(\Omega) N_I(\Omega)$$

For any set of consumer preferences, the values of $N_I(\Omega)$ will generally be different if π_I is permitted to vary, because the number of consumers that switch intermediaries in response to a change in network will be influenced by the corresponding change in the intermediary's price. In this context, then, the function $N_I(\Omega)$ represents the number of consumers intermediary I expects to have if its network is Ω, after taking into account consumers' response to any change in π_I. Formally, if $\widetilde{N}_I(\Omega, \pi_I)$ represents intermediary I's consumers as a function of both its network and its price, then $N_I(\Omega) \equiv \widetilde{N}_I(\Omega, \pi_I(\Omega))$. Similarly, in the value functions for suppliers A and B, given by equation 2 above, $N_j(\Omega)$ represents the number of consumers after accounting for changes in π_I. The values $N_0, \ldots, N_4$ will be defined as in the previous sections, taking into account consumers' responses to changes in the network.

As before, the values of π_A and π_B are taken as fixed. Recall that these values represent the per-consumer profits that the suppliers earn from intermediaries other than I. Because the Nash bargaining solution takes the outcomes of all other negotiations as fixed, and because π_A and π_B may be interpreted as proxies for the outcomes of negotiations with other intermediaries, allowing the suppliers to adjust π_A and π_B in the event of disagreement would seem to be in tension with the underlying bargaining framework.

Also as before, the values of $\pi_I(\Omega)$ and $N_I(\Omega)$ do not depend on whether suppliers negotiate jointly or separately.

Under these conditions, the effect of joint negotiation on the transfer is given by the following expression:

$$\Delta T = \beta \left\{ \begin{array}{c} \pi_I(\Omega^*)(N_3 - N_4) \\ +\left[\pi_I\left(\Omega^{-B}\right) - \pi_I\left(\Omega^{-A-B}\right) - \left(\pi_I(\Omega^*) - \pi_I\left(\Omega^{-A}\right)\right)\right] N_0 \\ -\left[\pi_I(\Omega^*) - \pi_I\left(\Omega^{-A}\right)\right](N_2+N_3) - \left[\pi_I(\Omega^*) - \pi_I\left(\Omega^{-B}\right)\right](N_1+N_3) \end{array} \right\} \\ +(1-\beta)\left[\pi_A(N_2+N_3) + \pi_B(N_1+N_3)\right] \tag{8}$$

The first line of this expression is a term that appears in equation 3: the effect of joint negotiation depends on the relative numbers of substitute-type and complement-type consumers. The second line is also quite intuitive: For the N_0 consumers that I will retain even in the event of disagreement with both A and B, the effect of joint negotiation depends on whether the exclusion of supplier A from I's network causes π_I to fall by more (or less) if supplier B is also excluded. These effects are straightforward examples of the general principle that the effect of joint negotiation depends on the concavity (or convexity) of the insurer's value function.

The third line of equation 8 is of particular interest. It shows that joint negotiation tends to reduce the transfer to the suppliers, to the extent that the exclusion of A from I's network reduces the profits I earns from the consumers it retains when A (or B) alone is excluded from its network but loses when both A and B are excluded, $N_2 + N_3$ (or $N_1 + N_3$). The intuition is that adding supplier A to the network has two effects on the intermediary's profits: first, the intermediary gains consumers; second, the intermediary earns more profit from consumers that it would have retained even without supplier A. This second category includes consumers that the intermediary would lose if it did not have B in network. Thus, a portion of the profits the intermediary earns from these consumers requires the intermediary to include *both* A and B in its network. In this way, these profits are similar to the profits earned from complement-type consumers. Joint negotiation allows the intermediary to avoid negotiating over this portion of the surplus *twice*, and thus reduces the total amount the intermediary pays in equilibrium. This effect will tend to offset the effect of allowing A and B to internalize the externality that each one's participation in the network has on the other (i.e., the recapture effect, reflected in the fourth line of equation 8).

Because these two offsetting effects work through precisely the same groups of consumers, it is natural to ask whether there is a relationship between their magnitudes. In particular, if $\beta\left(\pi_I(\Omega^*) - \pi_I\left(\Omega^{-j}\right)\right) = (1-\beta)\pi_j$ for $j = A, B$, then the third and fourth lines of equation 8 will exactly cancel each other out. In other words, the relevant comparison is between the incremental effect on I's per-consumer profits of adding A (or B) to its network and the per-consumer profits that A (or B) earns from other intermediaries. It may seem intuitive that these amounts should be closely related. In particular, suppose that adding supplier j to any intermediary's network creates S_j of gross surplus per consumer available to be captured by the intermediary and the supplier. If that surplus is divided between supplier j and the intermediary according to their relative bargaining effectiveness, then we might intuitively expect: $\pi_j = \beta S_j$ and $\pi_I(\Omega^*) - \pi_I\left(\Omega^{-j}\right) = (1-\beta)S_j$. Under these conditions, the equality above will hold, and the two effects will exactly cancel out.

It turns out that this intuition does not hold generally. In the remainder of the paper, I consider two fully specified models that are special cases of the general framework described above. In both models, I find that allowing the intermediary to adjust its price in the event of disagreement will partially, but not fully, offset the recapture effect. I turn now to these specific models.

3 Gal-Or's (1999) model

Gal-Or (1999) introduced a model to study the effects of mergers between hospitals and physician practices on the joint profits of the merged entity. In this model, bilateral bargaining between health care providers and insurers determines the prices of health care services, with the equilibrium prices satisfying the Nash bargaining solution. The model is thus a special case of the general framework outlined above, specifically the variant with negotiated unit prices. In this section, I examine the implications of this model in detail, for four reasons. First, the analysis demonstrates that the recapture effect identified above arises in a fully specified model of consumer demand. Second, while the general framework above allowed me to consider only the first-order effects of joint negotiation in the model with negotiated unit prices, using a full model allows me to derive an expression (which does not appear in Gal-Or's paper) for the full equilibrium effects of joint negotiation on the payment to the combined entity, distinguishing the first-order and higher order components of the effect. Third, I address a shortcoming in Gal-Or's paper: One of the central conclusions of that paper is that joint negotiation by a hospital and a physician group may fail to increase the combined entity's bargaining power if the degree of competitiveness of the two markets is sufficiently different. I show that this conclusion relies on an unstated and arbitrary equilibrium refinement assumption. Under a wide range of alternative assumptions, Gal-Or's model implies that joint negotiation increases the combined entity's bargaining power for any parameter values. Finally, modifying Gal-Or's model to permit the insurer to adjust its premium in the event of disagreement demonstrates that joint negotiation continues to increase bargaining power under this variant of the model.

3.1 Separate negotiation

There are two insurers, m hospitals, and n physicians. Each insurer-provider pair engages in simultaneous negotiation over whether the insurer will include the provider in its network. If the parties to the negotiation reach agreement, they agree to a unit price that the insurer will pay to the provider for each patient that receives treatment from that provider. The agreed-upon prices satisfy the symmetric Nash bargaining solution ($\beta = \frac{1}{2}$). Simultaneously with these negotiations, each insurer sets its premium to maximize its profits. After the networks and premia have been determined, each consumer chooses one of the two insurers. The population of consumers has unit mass and preferences across insurers represented by a uniform distribution around a unit circle with a transportation cost M and with the insurers located on opposite sides of the circle. After choosing an insurer, a consumer becomes sick with probability θ, at which point she chooses the services of one hospital and one physician from among the providers participating in her insurer's network. Preferences across hospitals and physicians are represented by uniform distributions around two respective unit circles, with transportation costs t (for hospitals) and s (for physicians) and with the providers in the insurer's network distributed evenly around the two circles. In choosing among insurers, consumers take into account not only the insurer's premium and its location on the unit circle relative to the consumer, but also the expected transportation cost that the consumer will bear if she becomes sick. In a symmetric equilibrium with separate negotiations, the hospital price is denoted by y^*, the physician price by z^*, and the insurance premium by F^*.

This model is a special case of the model with negotiated unit prices described above. If we treat supplier A as a hospital and supplier B as a physician, the expressions derived above can thus be used to evaluate Gal-Or's model. In equilibrium, each insurer has one-half of the population of consumers, i.e. $N_I(\Omega^*) = \frac{1}{2}$. In the event of disagreement with one hospital, the insurer loses $\frac{\theta t}{2m^2 M}$ members; disagreement with one physician results in a loss of $\frac{\theta s}{2n^2 M}$ members; and disagreement with one of each results in a loss of $\frac{\theta t}{2m^2 M} + \frac{\theta s}{2n^2 M}$ members. These figures imply the following expressions for $N_0, \ldots N_4$:

$$
\begin{aligned}
&N_0 = \tfrac{1}{2} - \left(\tfrac{\theta t}{2m^2 M} + \tfrac{\theta s}{2n^2 M}\right) \\
&N_3 = N_4 = \min\left(\tfrac{\theta t}{2m^2 M}, \tfrac{\theta s}{2n^2 M}\right) \\
&N_1 + N_3 = N_1 + N_4 = \tfrac{\theta t}{2m^2 M} \\
&N_2 + N_3 = N_2 + N_4 = \tfrac{\theta s}{2n^2 M}
\end{aligned}
$$

To ensure that an equilibrium exists, the parameters are assumed to be such that $N_0 > 0$. That is, the insurer must retain at least some portion of its members if it excludes both a hospital and a physician from its network.[7]

$$\text{Assumption (3):} \quad \frac{\theta t}{2m^2 M} + \frac{\theta s}{2n^2 M} < \frac{1}{2}$$

The average number of treatments that a consumer receives from a given hospital is $\frac{\theta}{m}$ if the consumer's insurance network includes all m hospitals, and $\frac{\theta}{m-1}$ if one hospital is excluded from the network (the probability the consumer becomes sick multiplied by the probability the consumer chooses the hospital). Similar expressions ($\frac{\theta}{n}$ and $\frac{\theta}{n-1}$) represent the average number of treatments a consumer receives from a given physician. These expressions correspond to the terms $\lambda_{jk}(\Omega)$ in the general framework. Note that assumption (1) is therefore satisfied in this model. Also, in the symmetric equilibrium, providers' unit prices are equal to $r^*_{Ij} = \overline{r}^*_j = y^*$ if j is a hospital, z^* if j is a physician, so that assumption (2) is satisfied as well. As in the general framework, providers are assumed for simplicity to have zero marginal cost, so y^* and z^* represent providers' profits per

[7] This assumption is equivalent to the restriction in equation (16) in Gal-Or (1999).

treatment. Finally, the equilibrium insurance premium is given by the following expression:

$$\pi_I^* = F^* = \frac{M}{2} + \theta\left(y^* + z^*\right) \tag{9}$$

Thus, each insurer's equilibrium profit per consumer after payments to providers is $\frac{M}{2}$.

Substituting these expressions into equations 4 and 5 above yields the expressions given in Gal-Or's paper for the equilibrium values of y^* and z^* under separate negotiation. Alternatively, these expressions can be manipulated into the following forms:

$$\frac{\theta}{m}y^*\left(\frac{1}{2} - \frac{\theta t}{2m^2M}\right) = \frac{M}{2}\frac{\theta t}{2m^2M} \tag{10}$$

$$\frac{\theta}{n}z^*\left(\frac{1}{2} - \frac{\theta s}{2n^2M}\right) = \frac{M}{2}\frac{\theta s}{2n^2M} \tag{11}$$

In other words, in equilibrium, each provider's average profit per consumer multiplied by the number of consumers the provider will lose if excluded from an insurer's network will be equal to the insurer's average profit per consumer multiplied by the number of consumers the insurer will lose if it excludes the provider from its network. (Under asymmetric bargaining, each side of these equations would be multiplied by the corresponding bargaining weight: $(1-\beta)$ on the left, β on the right).

3.2 Joint negotiation

The terms above can also be substituted into equation 7 to obtain the first-order effect of joint negotiation on the total transfer from each insurer to the jointly negotiating providers. With joint negotiation by hospital k and physician v, these providers' equilibrium prices are denoted by y_k and z_v, respectively, while the equilibrium prices of other providers are denoted by y_{-k} and z_{-v}. In the expression for the first order effect, $\widehat{y}_k$ and $\widehat{z}_v$ denote the prices after taking into account first order effects, which will not be equilibrium prices. Generalizing to the asymmetric bargaining case, the first-order effect is given by the following expression:

$$\widehat{\Delta T} = \frac{\theta}{2}\left(\frac{\widehat{y}_k - y^*}{m} + \frac{\widehat{z}_v - z^*}{n}\right) = (1-\beta)\left(\frac{\theta}{m}y^*\frac{\theta s}{2n^2M} + \frac{\theta}{n}z^*\frac{\theta t}{2m^2M}\right) \tag{12}$$

This expression can also be derived directly from Gal-Or's model, by solving for values of y_k and z_v that satisfy the Nash bargaining solution under the assumption that all other prices are equal to their equilibrium values under separate contracting. Note that because $N_3 = N_4$ in this model, the insurer's value function is linear and the first line of equation 7 is zero. The remaining component of the first-order effect is the recapture effect identified in this paper: hospital k's average profit per consumer multiplied by the number of consumers that the hospital loses access to if excluded alone but not if excluded jointly, plus the corresponding term for physician v. Because this expression is positive for all parameter values, we can conclude that the first-order effect of joint negotiation in Gal-Or's model is unambiguously to increase the bargaining power of the jointly negotiating providers.

Unlike the general framework above with negotiated unit prices, the use of a specific model permits analysis of the full equilibrium effect of joint negotiation. In a Nash bargaining equilibrium with joint negotiation by hospital k and physician v, the change in the transfer must satisfy the following expression:

$$\begin{aligned}\Delta T &= \frac{\theta}{2}\left(\frac{y_k - y^*}{m} + \frac{z_v - z^*}{n}\right) \\ &= \frac{1}{\gamma}(1-\beta)\left(\frac{\theta}{m}y^*\frac{\theta s}{2n^2 M} + \frac{\theta}{n}z^*\frac{\theta t}{2m^2 M}\right) + \beta\frac{\theta}{2}\left(\frac{y_{-k} - y^*}{m} + \frac{z_{-v} - z^*}{n}\right)\end{aligned} \tag{13}$$

where $\gamma = \frac{\frac{1}{2} - \left(\frac{\theta t}{2m^2 M} + \frac{\theta s}{2n^2 M}\right)}{\frac{1}{2}}$

This expression shows that the equilibrium effect consists of the first-order effect combined with two distinct higher order effects. First, the first-order effect is multiplied by $\frac{1}{\gamma}$, where γ is equal to the number of consumers the insurer will retain if it excludes both the hospital and the physician from its network (N_0), expressed as a percentage of the insurer's total equilibrium membership ($\frac{1}{2}$). This term appears because any first-order effect on the payment from insurer to providers has a reinforcing effect on both the insurer's and the providers' disagreement payoff. In particular, an increase (or decrease) in the prices paid by one insurer will be accompanied in equilibrium by a corresponding increase (or decrease) in the prices paid by the other insurer, affecting the providers' disagreement payoff, and in the insurance premium, affecting the insurer's disagreement payoff. The more patients the providers can retain after exclusion from the insurer's network, the larger these reinforcing effects will be.

The second higher order effect is reflected in the term $\frac{\theta}{2}\left(\frac{y_{-k}-y^*}{m} + \frac{z_{-v}-z^*}{n}\right)$, the equilibrium change in payments to any separately contracting physician-hospital pair. These providers' prices adjust in equilibrium in response to any change in the jointly negotiating providers' prices. An increase (or decrease) in these prices alters the insurer's outside option, because it must pay more (or less) to other providers to replace the services of hospital k and physician v in the event of disagreement. The equilibrium changes in other providers' prices are given by the following expressions:

$$y_{-k} - y^* = \frac{y_k - y^*}{m} \tag{14}$$

$$z_{-v} - z^* = \frac{z_v - z^*}{n} \tag{15}$$

In other words, in equilibrium, a price change by one of the jointly negotiating providers will be accompanied by a change in the prices of all other providers of that type, where a rival hospital's (or physician's) price change relative to the jointly negotiating hospital's (or physician's) price change will be equal to the inverse of the number of hospitals (physicians) in the market. Intuitively, the more competing providers there are in the market, the smaller the response to an increase in one provider's price.

As noted previously, the equilibrium conditions defined by equations 13, 14, and 15 do not uniquely identify y_k and z_v. In particular, there is a continuum of (y_k, z_v) pairs that satisfy these conditions. If we do not impose any constraints on the possible prices (including non-negativity constraints), then for any set of parameters with $m \neq n$, there are solutions that increase the transfer and solutions that reduce it. (For the case $m = n$, all solutions imply a unique positive value for ΔT). As a result, it is necessary to impose some criterion in addition to Nash bargaining to refine the predictions of the model. One possible criterion is to consider the payoffs of the providers and insurers. If the continuum of solutions to the Nash bargaining problem are, in effect, multiple equilibria, then one might expect the players to coordinate on an equilibrium that maximizes collective payoffs. Without any constraints, this approach would imply that the price in the market with fewer participants would increase without bound, while the price in the other market falls to compensate. Providers collectively prefer equilibria with higher prices in the market with fewer participants because the jointly negotiating provider's price increase has a larger impact on rivals' prices in this market. Insurers are indifferent among all possible equilibria, because insurers always pass provider price increases through to consumers in the form of a higher premium, with no change in insurer profits. This is sustainable only as long as consumers' aggregate demand for health insurance remains perfectly inelastic. Under the assumptions of the model, this will hold until premia rise to the point that marginal consumers are on the margin between insurance and no insurance, rather than on the margin between the two insurers. Thus, one possible constraint on the set of feasible equilibria could be that prices in the market with fewer participants should not rise so high that consumers begin to drop insurance coverage. Alternatively, we could consider a non-negativity constraint on the prices in the market with more participants, or that prices in this market should not go so low that providers are unable to cover their fixed costs. Regardless of the constraint we impose to prevent prices from rising without bound, if the equilibrium selection criterion is based on the idea that players are more likely to coordinate on an equilibrium with higher payoffs than lower, the transfer to the jointly negotiating providers will increase. (A sufficient condition for the transfer to increase is that price does not fall in the market with fewer participants.)

Alternatively, it could be reasonable to impose an equilibrium selection criterion based on symmetry. For example, one could assume that the jointly negotiating providers' change in hospital price is equal to their change in physician price, on an absolute basis ($y_k - y^* = z_v - z^*$) or on a percentage basis ($\frac{y_k - y^*}{y^*} = \frac{z_v - z^*}{z^*}$). Either of these symmetry conditions will yield a unique equilibrium in which both prices strictly increase for any parameter values. A weaker symmetry condition could be $sign\,(y_k - y^*) = sign\,(z_v - z^*)$, also sufficient to guarantee that both prices increase. Some reasonable asymmetric selection criteria will also yield unambiguous increases in the transfer to providers. For example, either of the two prices could be fixed at the initial equilibrium price while the other adjusts to satisfy the equilibrium conditions.

While any of these criteria support an unambiguous increase in provider bargaining power, Gal-Or imposes a different symmetry condition: $y_k = z_v$. This condition means that, if the equilibrium hospital and physician prices are very different from one another under separate negotiation, the jointly negotiating providers must select an equilibrium in which the higher price is reduced, possibly substantially, to equalize the two prices. If the higher price occurs in the market with fewer participants, as will often be the case (for example, if $t = s$), this equality requirement has the potential to result in an equilibrium in which the jointly negotiating providers are strictly worse off relative to separate negotiation, because the negative second order effects of the lower price in the more concentrated market can outweigh the positive first order effects. Gal-Or's symmetry condition is the basis for her conclusion that "when one provider's market is much more competitive than the other a vertical merger may reduce the joint profits of the merged entity."[8] This conclusion has been cited in subsequent literature on hospital-physician integration,[9] but it appears that the underlying mechanisms behind the results have not been well-understood. Absent the somewhat arbitrary symmetry condition, Gal-Or's model implies the following conclusions: The first-order effect of joint negotiation is always to increase the combined entity's bargaining power; prices always exist that satisfy the Nash bargaining solution and result in higher profits for the jointly negotiating providers; and under a wide range of reasonable equilibrium refinement criteria, including alternative symmetry assumptions, the equilibrium outcome for any set of parameters will be to increase the payment from insurers to providers.

Before turning to the extension of the model with post-disagreement price adjustment, I consider the potential range of magnitudes of the effect on provider profits. Substituting equations 10 and 11 into equation 12 shows that, for any value of the sum $\frac{\theta t}{2m^2M} + \frac{\theta s}{2n^2M}$, the first-order effect on the transfer is increasing in the product $\frac{\theta t}{2m^2M} \cdot \frac{\theta s}{2n^2M}$. Since the sum is constrained by assumption (3) to be strictly less than $\frac{1}{2}$, the first-order effect is bounded above by the value for $\frac{\theta t}{2m^2M} = \frac{\theta s}{2n^2M} = \frac{1}{4}$. I define the first-order *percentage* increase in the transfer as follows:

$$\widehat{\%\Delta T} = \frac{\widehat{\Delta T}}{\frac{\theta}{2}\left(\frac{y^*}{m} + \frac{z^*}{n}\right)}$$

Evaluating this expression at $\frac{\theta t}{2m^2M} = \frac{\theta s}{2n^2M} = \frac{1}{4}$ shows that the upper bound for $\widehat{\%\Delta T}$ is $\frac{(1-\beta)}{2}$. For symmetric bargaining ($\beta = \frac{1}{2}$), then, the maximum possible first-order effect is to increase the payment to providers by 25%.

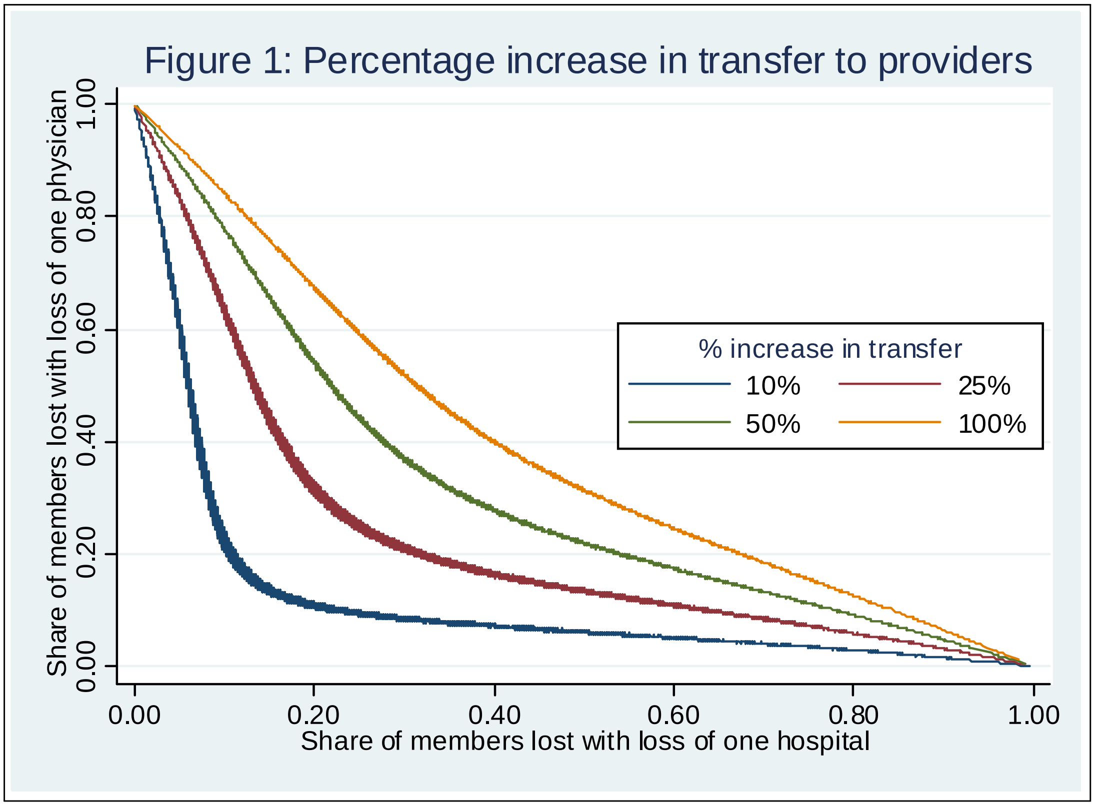
Without imposing additional constraints, there is no upper bound for the *equilibrium* effect for the range of parameters defined by assumption (3), because as $\frac{\theta t}{2m^2M} + \frac{\theta s}{2n^2M}$ approaches $\frac{1}{2}$, γ goes

[8] Gal-Or(1999), p. 623.

[9] See, e.g., Gaynor (2006).

to zero, so that the second-order effects cause prices (and insurance premia) to increase without bound. For some level of premia, marginal consumers would no longer switch to the rival insurer in the event of disagreement, which would eliminate providers' ability to recapture lost patients, thus constraining the effect of joint contracting. Assuming that this constraint does not bind when the jointly negotiating providers' prices increase by up to 100%, the figure below shows the relationship between the percentage increase in the transfer to the jointly negotiating providers and the share of members an insurer would lose with the exclusion of one hospital or one physician. For example, the chart shows that if the loss of one hospital or the loss of physician would cause an insurer to lose 40% of its members (i.e. $\frac{\theta t}{2m^2M} = \frac{\theta s}{2n^2M} = \frac{1}{5}$), then joint negotiation would increase the transfer to the two providers by 100%.

For simplicity, the effects shown in the chart incorporate only the first-order effect and the first of the two higher order effects identified above (division by γ); the second higher order effect depends on the number of providers in each market (m and n), and will vary depending on the equilibrium selection rule used to choose a unique outcome (if $m \neq n$). For a reasonable number of providers in each market, this effect is relatively small; for example, if there are 13 hospitals and 13 physicians, this component of the effect will increase the absolute change in the transfer by 4%). (Also, the chart assumes symmetric bargaining.)



This figure shows, for the Gal-Or (1999) model, isoquant lines for the percentage increase in the total payment from an insurer to the jointly negotiating providers as a function of the share of its members the insurer would lose in the event of disagreement with one physician or one hospital. The increases included in the chart do not include the component of the effect due to competing providers' adjusting their equilibrium prices. This component depends on the number of competing physicians and hospitals, and will vary depending on what criterion is used to allocate the bargaining power effect between hospital and physician prices.

3.3 Insurer price adjustment after disagreement

In this section, I assume that during each bilateral negotiation, the parties expect that in the event of disagreement the insurer will be able to adjust its premium before consumer demand is realized. The new premium will be the profit-maximizing level given that the negotiation ended in disagreement, holding all other prices (including the rival insurer's premium) and all other network participation decisions at their equilibrium levels.

Under separate negotiation, the difference between the equilibrium premium (F^*) and the premium an insurer will set in the event of disagreement with a hospital, denoted F^{-H}, is given by the following expression:

$$F^* - F^{-H} = \frac{M}{2}\frac{\theta t}{2m^2 M} \tag{16}$$

Similarly, the premium reduction in the event of disagreement with a physician is:

$$F^* - F^{-D} = \frac{M}{2} \frac{\theta s}{2n^2 M}$$

The premium reduction in the event of disagreement with a jointly negotiating hospital-physician pair is:

$$F^* - F^{-H-D} = \frac{M}{2} \left(\frac{\theta t}{2m^2 M} + \frac{\theta s}{2n^2 M} \right)$$

In other words, the premium reduction will equal the insurer's average profit per consumer ($\frac{M}{2}$) multiplied by the number of consumers the insurer would lose in the event of disagreement absent the premium reduction.

The effect of this premium reduction is to reduce by one-half the number of members that switch insurers in the event of disagreement. That is, in the event of disagreement with one hospital, the insurer loses $\frac{1}{2} \frac{\theta t}{2m^2 M}$ members; disagreement with one physician results in a loss of $\frac{1}{2} \frac{\theta s}{2n^2 M}$ members; and disagreement with one of each results in a loss of $\frac{1}{2} \left(\frac{\theta t}{2m^2 M} + \frac{\theta s}{2n^2 M} \right)$members.

The equilibrium hospital price under separate bargaining, y^*, will satisfy the following expression:

$$(1-\beta) \frac{\theta}{m} y^* \left(\frac{1}{2} - \frac{1}{2} \frac{\theta t}{2m^2 M} \right) = \beta \left[\frac{M}{2} \frac{1}{2} \frac{\theta t}{2m^2 M} + \frac{M}{2} \frac{\theta t}{2m^2 M} \left(\frac{1}{2} - \frac{1}{2} \frac{\theta t}{2m^2 M} \right) \right] \tag{17}$$

This expression is analogous to equation 10: Just as in that expression, the left-hand side is the hospital's average profit per consumer multiplied by the number of consumers it would lose access to in the event of disagreement (multiplied by the bargaining weight), and the first term in the brackets on the right-hand side is the insurer's equilibrium profit per consumer multiplied by the number of consumers it would lose in the event of disagreement. The second term in the brackets on the right-hand side shows an additional effect due to post-disagreement price adjustment: the change in the insurer's profit per consumer ($F^* - F^{-H}$) multiplied by the number of consumers the insurer will retain in the event of disagreement. This expression shows that equilibrium price is strictly lower when the insurer is able to adjust its premium in the event of disagreement. (A similar expression can be derived for the physician price, z^*).

Turning now to the effect of joint negotiation, recall that in the discussion of the general framework above, equation 8 showed that post-disagreement price adjustment would fully offset the recapture effect if $(1-\beta)\pi_j \leq \beta \left(\pi_I \left(\Omega^* \right) - \pi_I \left(\Omega^{-j} \right) \right)$, where the left-hand side is the supplier's per-consumer profit and the right-hand side is the change in the intermediary's per-consumer profit in the event of disagreement. In the notation of the Gal-Or model, the left-hand side is $(1-\beta) \frac{\theta}{m} y^*$

and the right-hand side is $\beta\left(F^{*}-F^{-H}\right)$. Equations 16 and 17 show that the condition does not hold:

$$(1-\beta)\frac{\theta}{m}y^{*}=\beta\left(F^{*}-F^{-H}+\frac{M}{2}\frac{\frac{1}{2}\frac{\theta t}{2m^{2}M}}{\frac{1}{2}-\frac{1}{2}\frac{\theta t}{2m^{2}M}}\right)>\beta\left(F^{*}-F^{-H}\right) \tag{18}$$

This indicates that the recapture effect will outweigh the effect of post-disagreement price adjustment, so that the net effect of joint negotiation will be to increase the profits of the jointly negotiating providers. This conclusion can be verified in the expression for the first-order effect of joint negotiation on the transfer:

$$\begin{aligned}\widehat{\Delta T} &= \frac{\theta}{2}\left(\frac{y_{k}-y^{*}}{m}+\frac{z_{v}-z^{*}}{n}\right) \\ &= (1-\beta)\frac{1}{2}\left(\frac{\theta}{m}y^{*}\frac{\theta s}{2n^{2}M}+\frac{\theta}{n}z^{*}\frac{\theta t}{2m^{2}M}\right)-\beta\frac{M}{2}\frac{\theta t}{2m^{2}M}\frac{\theta s}{2n^{2}M}\end{aligned} \tag{19}$$

The first term in the second line is the recapture effect, equal to one-half the effect in the case with no post-disagreement price adjustment (as given in equation 12), since price adjustment allows the insurer to retain half he consumers it would otherwise lose in the event of disagreement. The second term in the second line is equal to $\beta\left[\left(F^{*}-F^{-H}\right)(N_{2}+N_{3})+\left(F^{*}-F^{-D}\right)(N_{1}+N_{3})\right]$, which corresponds to the term in the third line of equation 8. By the same logic as in inequality 18, this expression is strictly positive. A similar expression for the equilibrium change in the transfer can be easily derived by extending equation 19 to include higher order terms as in equation 13.

We can therefore conclude, based on both the first-order effect and the equilibrium effect (subject to the caveat above about equilibrium selection), joint negotiation in this model unambiguously increases the transfer to the jointly negotiating providers, even when the insurer is able to adjust its premium in the event of disagreement.

4 A logit-based model

The Gal-Or model described above is useful for demonstrating that the recapture effect can arise in a fully specified model of consumer demand, and for investigating the properties of the Nash equilibrium in a model with negotiated unit prices. While the model is convenient in that it allows for closed form solutions, some of the restrictive features of the model may raise questions about how general the conclusions are. In particular, the assumption that consumer preferences are distributed uniformly gives rise to the linearity of the insurer's value function, so that the only effect of joint negotiation occurs as a result of changes in the providers' value functions. Since the prior literature on the effects of joint negotiation has focused on the curvature of the insurer's value function, it is natural to ask whether the recapture effect that arises in Gal-Or's model also plays an important role in models with alternative assumptions about consumer demand.

In this section, I introduce a simple model in which consumer preferences across different suppliers and intermediaries are distributed according to the logit model. While I do not obtain closed form solutions to the model, I numerically solve for the effects of joint negotiation on the profits of the jointly negotiating suppliers. In particular, I consider the effects of joint negotiation by two suppliers of products that are not substitutes for one another, but that are consumed by the same consumers. Under the logit demand assumption, the intermediary's value function is generally *convex*: the number of consumers the intermediary stands to lose from the loss of both suppliers is strictly *less* than the sum of its losses from losing each supplier individually. As a result, under asymmetric bargaining with sufficient weight on the intermediary's value function (i.e., when the suppliers have greater bargaining effectiveness), the effect of joint negotiation is to *reduce* the profits of the suppliers. However, the recapture effect arises in this model as well: each supplier has less to lose from disagreement when negotiating jointly with the other. Under symmetric bargaining, this effect predominates, so that the net effect of joint negotiation is to increase the suppliers' profits, in spite of the convexity of the intermediary's value function. While the percentage increase in the suppliers' profits is generally smaller in magnitude than the changes that arise in Gal-Or's model, the positive net effect demonstrates that the recapture effect can play an important role under alternative demand specifications.

4.1 The model

There are two types of product, A and B. Suppliers A1 and A2 (B1 and B2) each produce a differentiated product of type A (B). Each consumer demands exactly one unit of each type of product. In order to obtain these products, each consumer chooses one of two differentiated intermediaries, I1 and I2. Consumers always use the same intermediary to obtain both products. Consumers have heterogeneous preferences across the two types of product and across intermediaries. In particular, consumer i's utility from consuming product j of type A, product k of type B, obtained through intermediary m, is given by the following expression:

$$u_{ijkm} = \delta_j^A + \delta_k^B + \delta_m^I - \mu\left(p_j^A + p_k^B + p_m^I\right) + \sigma^A \varepsilon_{ij}^A + \sigma^B \varepsilon_{ik}^B + \sigma^I \varepsilon_{im}^I$$

where δ_j^A, δ_k^B, and $\delta_m^I$are the mean utilities from consuming product j of type A, consuming product k of type B, and using intermediary m, respectively; p_j^A, p_k^B, and p_m^I are the prices the consumer must pay for product j of type A, product k of type B, and intermediary m, respectively; μ is the marginal utility of income; ε_{ij}^A, ε_{ik}^B, and ε_{im}^I are idiosyncratic components of consumer i's utility function, distributed i.i.d. extreme value; and σ^A, σ^B, and σ^I are parameters indexing the variance in the distribution of these idiosyncratic components. In all of the following analysis, μ is normalized to one; other values would simply scale the units of prices without affecting any other results. Similarly, I normalize the sum of the mean utilities for each product type and for intermediaries to be equal to zero: $\delta_1^A + \delta_2^A = \delta_1^B + \delta_2^B = \delta_1^I + \delta_2^I = 0$. Since there is no outside good in this model (consumers always consume one product of each type), this normalization is equivalent to the usual practice of normalizing the utility of one product to be equal to zero.

As in the general model described above, each supplier-intermediary pair initially engages in simultaneous bilateral negotiations over whether the supplier's product will be included in the intermediary's network, and a lump sum transfer is exchanged. Suppliers and intermediaries simultaneously set the prices that they charge to consumers. (Each supplier charges a single price that is charged to consumers at any intermediary that carries that product.) Next, consumers observe the set of products available at each intermediary and all prices, choose an intermediary, and consume products available at that intermediary.

I consider equilibria in which both intermediaries carry both products of each type. (In principle, there may also be equilibria in which intermediaries and suppliers differentiate themselves by specializing, but I do not consider those here). While the model does not allow for closed form solutions under the disagreement scenarios, I numerically solve for equilibrium prices, then calculate profits for each agent under each scenario by simulating a population of consumers and identifying their optimal choices. (For the moment, I assume that agents treat prices as fixed in the event of disagreement).

To illustrate the effects of joint negotiation, I construct a simple numerical example by making the following baseline assumptions: $\delta_1^A = \delta_1^B = \delta_1^I = 0$, so that each market is divided equally among the two firms; and $\sigma^A = \sigma^B = \sigma^I = 1$, so that the A, B, and I markets all have an equal degree of differentiation. Under these assumptions, the profit-maximizing price for all suppliers and intermediaries is 2. In equilibrium one-half of the consumers choose each intermediary, and one-half of the consumers at each intermediary choose each product of each type. In the event of disagreement between an intermediary and a supplier of either type, each of the two parties will lose 25% of its customers, and thus 25% of its gross profits (i.e. profits before accounting for the lump sum transfer). In particular, if intermediary 1 fails to reach agreement with supplier A1, one-half of the consumers that initially purchased product A1 and intermediary 1 will prefer to stay at intermediary 1 and switch to product A2, while the other half will switch to intermediary 2 and continue to purchase product A1. Since both B products are available at both intermediaries, the disagreement has no effect of the B suppliers' profits. Under symmetric bargaining, there will be no transfer between intermediaries and suppliers, since each stands to lose the same amount from disagreement. In the extremes of asymmetric bargaining ($\beta = 0$ or $\beta = 1$), the party with all of the bargaining power will receive a lump sum transfer equal to 25% of the other party's gross profits.

If the intermediary fails to reach agreement with suppliers A1 and B1 (when they are negotiating jointly), the intermediary will lose roughly 44% of its customers (and thus profits). Note that this is less than the sum of its losses from losing each supplier individually (50%), so that the intermediary's value function is convex. These customers switch to the other intermediary, and continue to purchase the same products as before. Because a greater number of consumers switch intermediaries, the two suppliers lose fewer customers than when only one is excluded from the intermediary's network. In particular, each supplier loses roughly 18% of its customers, rather than 25%. The effect of joint negotiation on the lump sum transfer depends on the assumed bargaining parameter. For the case of $\beta = 0$ (the intermediary has all of the bargaining power), joint negotiation means that the intermediary's ability to steer consumers away from the suppliers is diminished. Instead of extracting 25% of each supplier's profits as it would under separate negotiation, the intermediary can extract only 18% of the two suppliers' joint profits. Joint negotiation thus allows the suppliers to increase their combined profits, net of the transfer to the intermediary, by 9%.

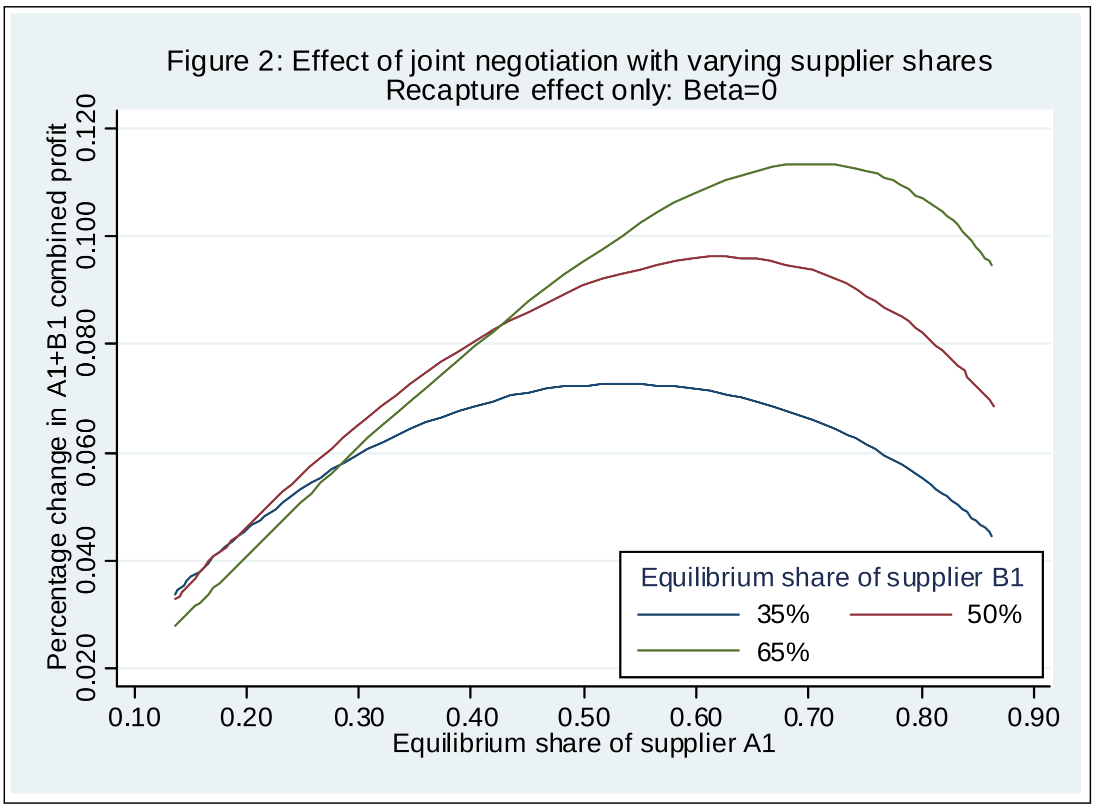
By contrast, if $\beta = 1$ (suppliers have all of the bargaining power), the jointly negotiating suppliers can extract only 44% of the intermediary's profits, rather than a combined 50% under separate negotiation. Thus, the suppliers' combined profits will fall (by just over 2%) as a result of the joint negotiation. As a practical matter, the Nash bargaining solution makes little sense when the intermediary's value function is convex and the suppliers have all of the bargaining power. Under these conditions, the intermediary would be better off refusing to contract with both of the suppliers than paying each one its full marginal value. This is a general limitation of the Nash bargaining solution in the case of complements, and could be viewed as putting an upper bound on the value of β. Nonetheless, considering the polar case of $\beta = 1$ is useful in isolating the components of the net effect that will arise for intermediate bargaining parameters.

Under symmetric bargaining, the recapture effect outweighs the effect of convexity in the intermediary's value function: the net effect of joint negotiation in this example is to increase the suppliers' combined profits by roughly 2%. This is substantially smaller in magnitude than in the comparable example for the Gal-Or model. Figure 1 in the previous section showed that when the loss of a single provider would cause the insurer to lose 25% of its members, joint negotiation by a physician and a hospital would result in an increase in the providers' profits of roughly 25%. In part, this reflects the higher order effects that arise only when negotiating unit prices rather than a lump sum transfer, and in part, the linearity of the insurer's value function that results from the assumed uniform distribution of consumers. The difference may also reflect the fact that in the current model, suppliers independently choose their prices, giving them a source of profits that is not subject to negotiations. Overall, this suggests that the magnitude of the effect of joint negotiation may be quite sensitive to specific assumptions about the nature of competition. Nonetheless, the results for both models support the conclusion that the recapture effect can be an important determinant of the effect of joint negotiation.

4.2 Comparative statics

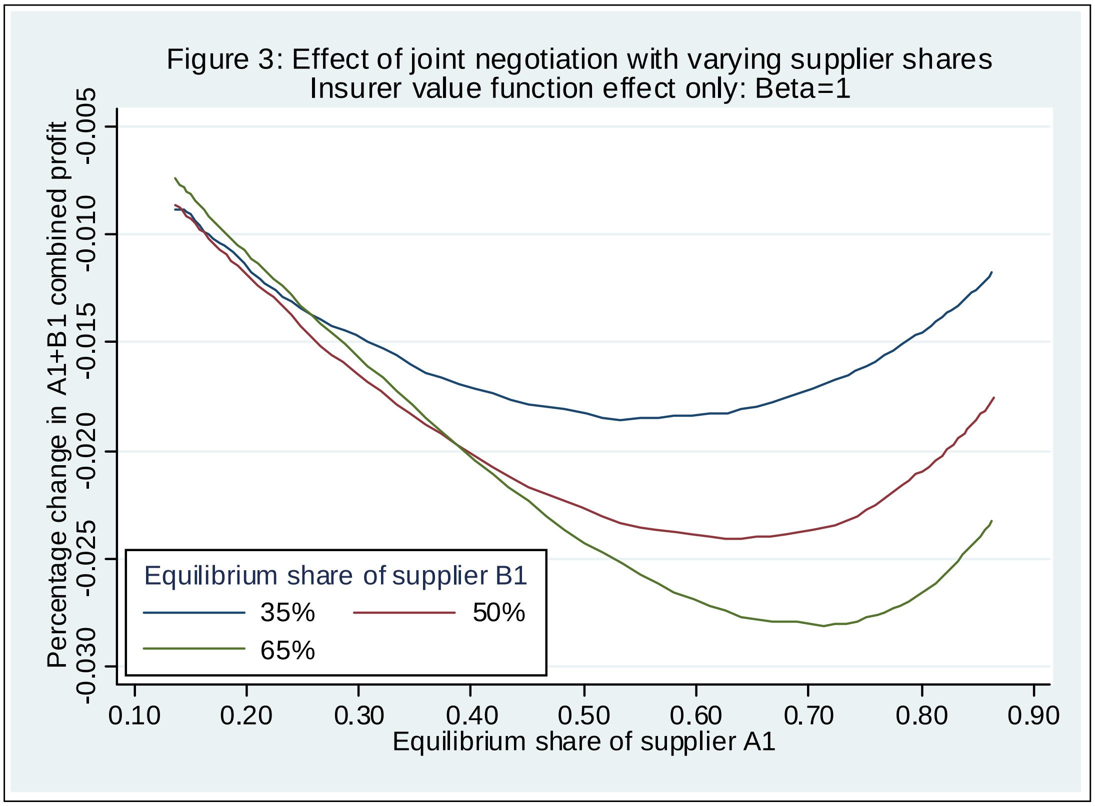
To examine the implications of this model in more detail, I consider how the effect of joint negotiation varies with the parameters of the model. In particular, I consider three comparative statics exercises. First, I vary the mean utility parameters of the suppliers, and hence their market shares; second, the mean utility (and thus market share) of the intermediary; and third, the degree of differentiation in the suppliers' markets relative to the intermediary market. For each exercise, I report results for the symmetric bargaining case and for the two polar asymmetric cases.

Figures 2-4 depict the percentage increase in the suppliers' joint profits due to joint negotiation as a function of the suppliers' market shares.[10] Figure 2, illustrating the case where the intermediary makes take-it-or-leave-it offers ($\beta = 0$), shows that the recapture effect, expressed as a percentage of joint profits, does not increase monotonically with the suppliers' shares. The inverted U-shape reflects the fact that, as a supplier becomes the first choice for a large majority of consumers, its bargaining power is relatively large even under separate negotiation. As supplier A1 grows large, the incremental value of joint negotiation with a smaller supplier B1 diminishes because many of the consumers that switch when both suppliers leave the intermediary would also switch when only A1 leaves. The largest recapture effect occurs when *both* suppliers are relatively large: for the ranges depicted in the chart, the percentage increase in profits peaks at more than 10% when both suppliers have roughly 65-70% share of their respective markets.



[10] For these charts, δ_1^I and all of the variance parameters are fixed at the baseline values. δ_1^B takes one of three possible values, -1, 0, and 1, corresponding to market shares for supplier B1 of 35%, 50%, and 65%, respectively. δ_1^A takes on a range of values from -4 to 4, in increments of 0.1. For each pair (δ_1^A, δ_1^B), I simulate a population of 1,000,000 consumers and calculate the equilibrium profits and disagreement payoffs; then for each bargaining parameter in $\{0, \frac{1}{2}, 1\}$, I calculate the transfers under separate and joint negotiation. The curves in the chart reflect the percentage change in net profits for each set of parameters, smoothed using a lowess smoother with bandwidth 0.1.

Figure 3 shows the effect of convexity of the intermediary's value function. As before, the absolute magnitude of the effect of joint negotiation on the suppliers' profits is greatest when both suppliers are large, but tapers as any one supplier becomes significantly larger than the other. Figure 4, depicting the net effect under symmetric bargaining, shows that the recapture effect predominates, with the net effect always positive with an inverted U shape as in Figure 2, but with effects smaller in magnitude as a result of the offsetting effect of convexity.



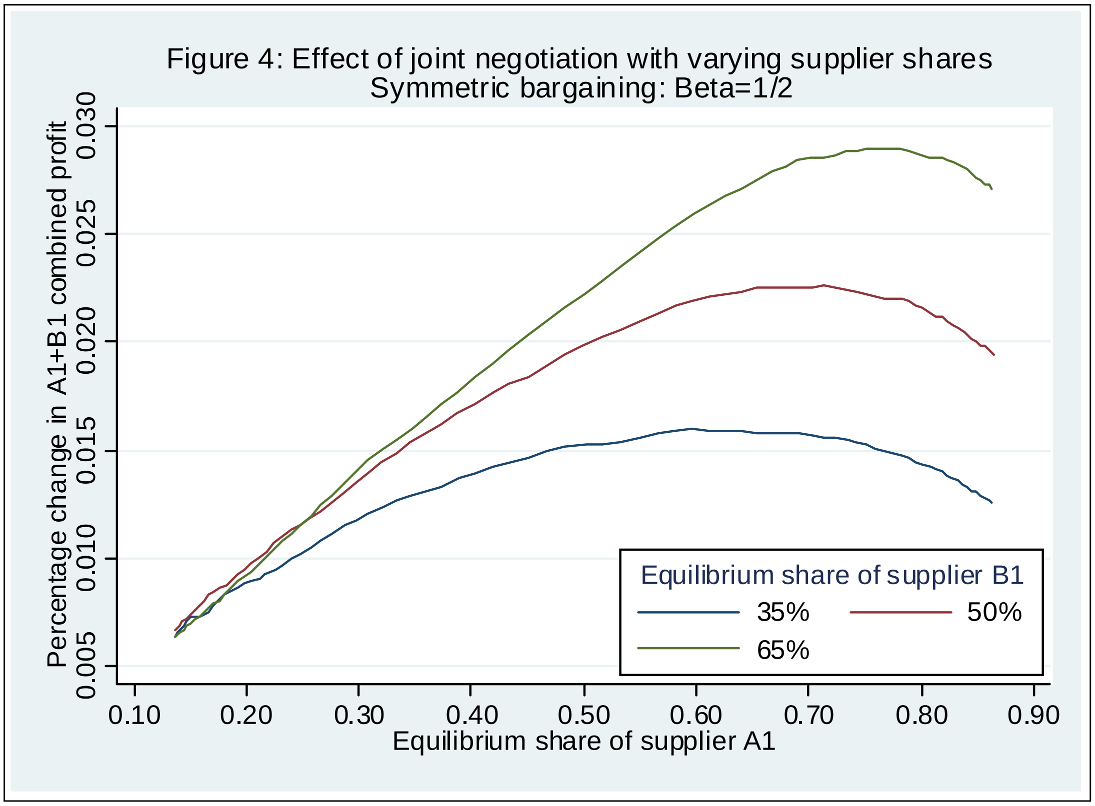
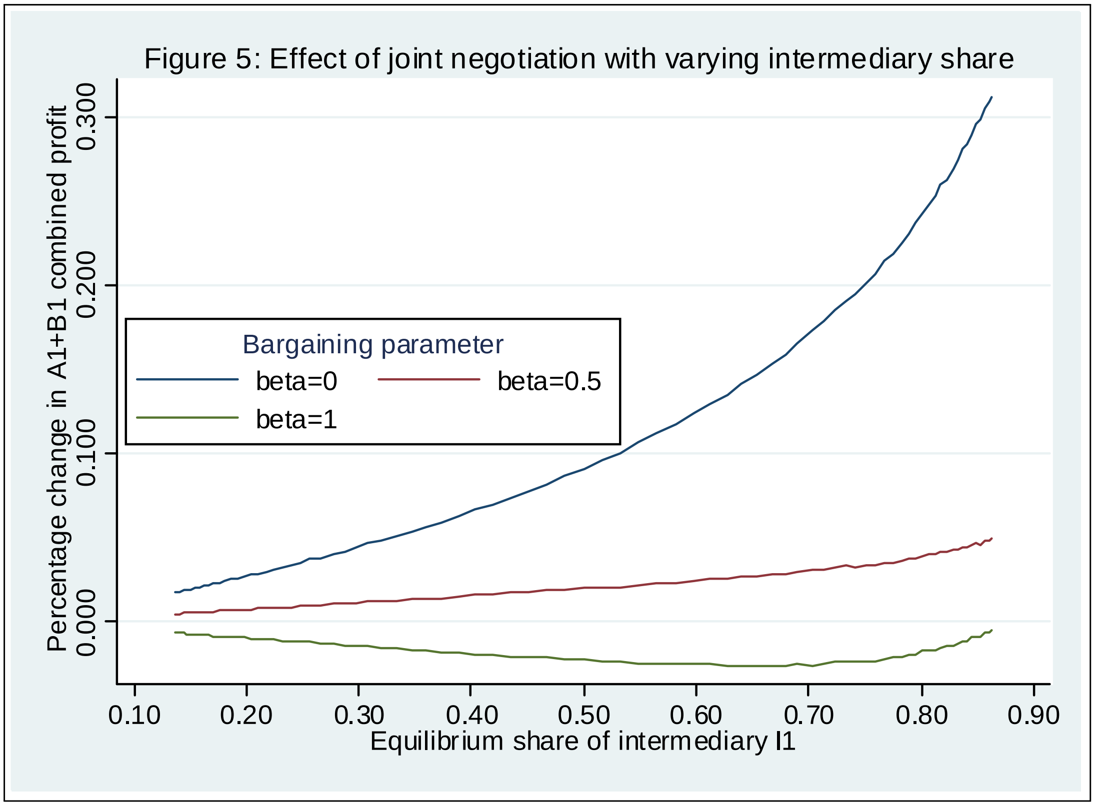


Figure 5 depicts the effect of joint negotiation as a function of the *intermediary's* market share.[11] For the case with $\beta = 0$, the recapture effect in percentage terms is always increasing in the intermediary's share, rising to above 30% for the range of parameters considered here. The intuition is that, when the intermediary has a large share and is able to make take-it-or-leave-it offers, it is able to extract a large share of the suppliers' profits. In this setting, the value of joint negotiation is particularly valuable to the suppliers as a means of retaining some portion of the surplus. The net effect for symmetric bargaining remains relatively small, however, generally less than 5%.

[11] For this chart, δ_1^A, δ_1^B, and all variance parameters are fixed at the baseline values, while δ_1^I takes on a range of values from -4 to 4, in increments of 0.1. Construction of the chart then follows the description in the previous footnote.



Finally, Figures 6-8 show how the effects vary when the suppliers' markets have different degrees of differentiation relative to the intermediary's market.[12] In these charts, the degree of differentiation is indexed by the equilibrium prices in each supplier market (A and B), relative to the prices in the intermediary market. Each supplier and intermediary has a share fixed at 50%, but competing suppliers may be closer or more distant substitutes compared to the intermediaries, so that their relative prices may be lower or higher, respectively. Figure 6 shows that, again, the recapture effect does not vary monotonically. The largest effects (in percentage terms) occur when the supplier markets have roughly the same intensity of competition as the intermediary market, or modestly more. As the supplier markets become either substantially more or substantially less competitive than the intermediary market, the percentage effect of joint negotiation drops significantly. Figure 7 shows that a reverse relationship holds for the effect caused by the curvature of the intermediary's value function, while Figure 8 shows that the recapture effect predominates across the full range of parameters.

[12]For these charts, σ^I and all mean utilities are fixed at the baseline level. σ^B takes one of three possible values (0.5, 1, and 2), while σ^A takes on a range of 80 different values between 0.25 and 4. For each set of parameters, construction of the chart proceeds as before.

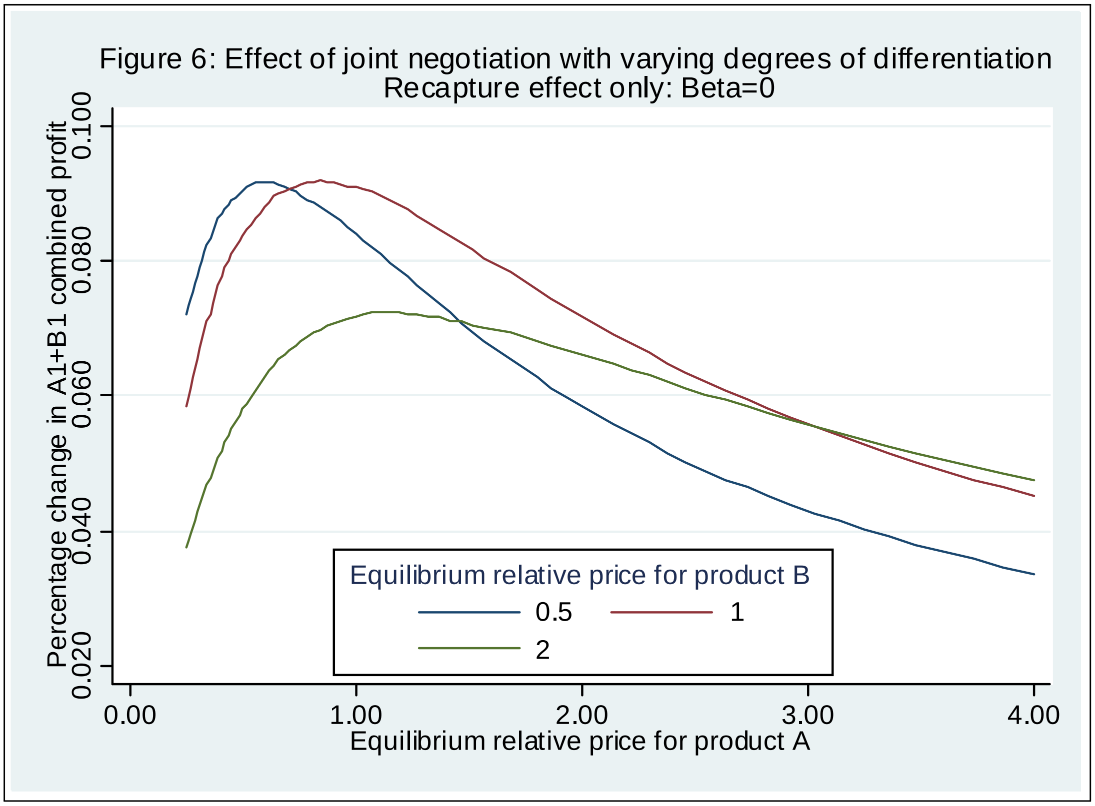


Figure 6: Effect of joint negotiation with varying degrees of differentiation
Recapture effect only: Beta=0
Percentage change in A1+B1 combined profit
0.020
0.040
0.060
0.080
0.100
Equilibrium relative price for product B
0.5
1
2
0.00
1.00
2.00
3.00
4.00
Equilibrium relative price for product A

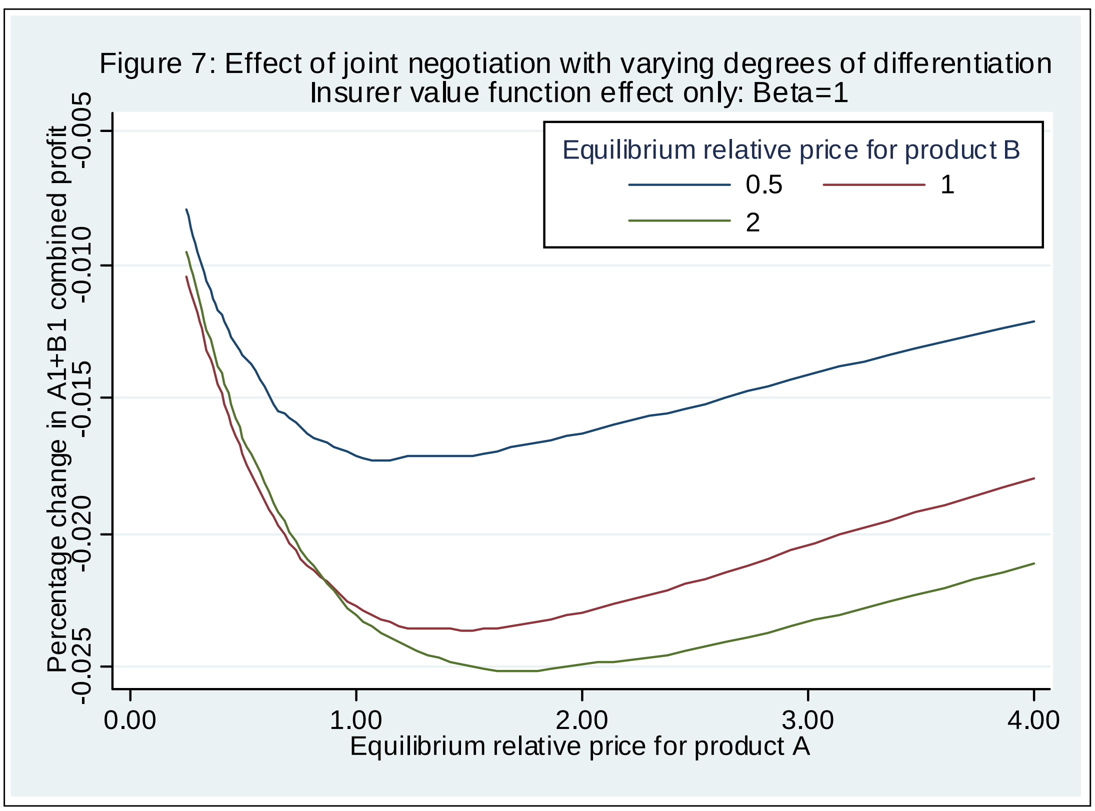
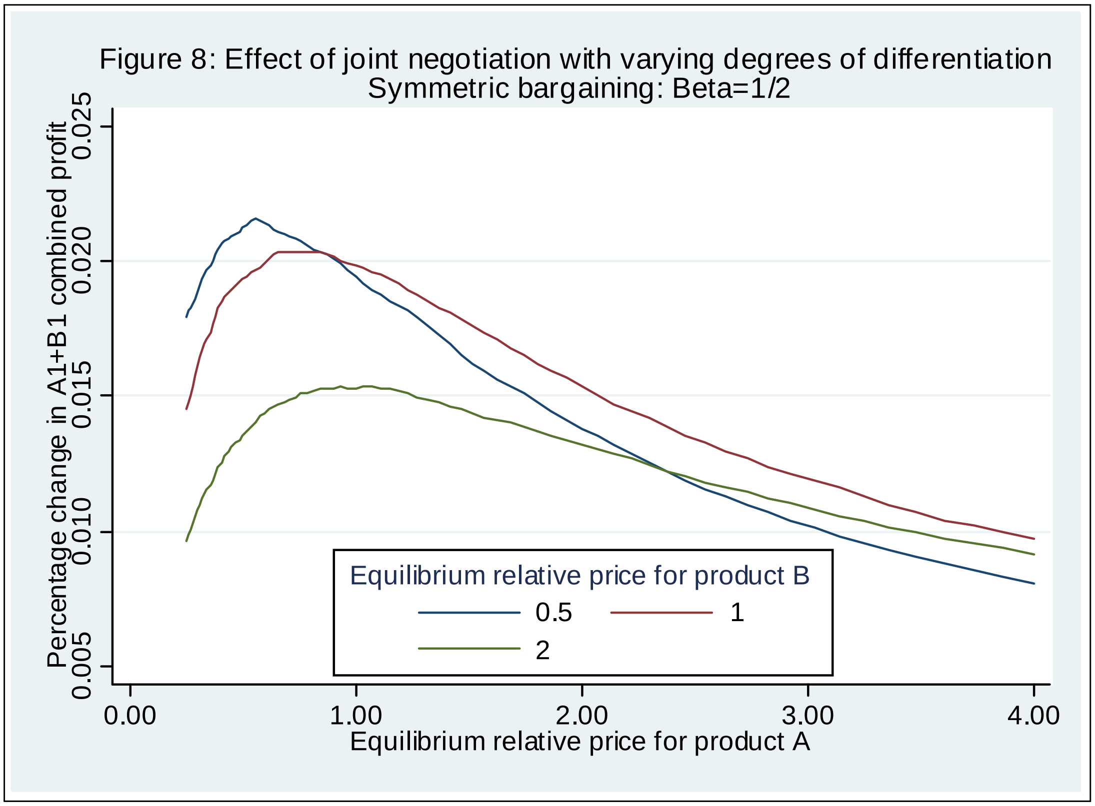


Figure 7: Effect of joint negotiation with varying degrees of differentiation
Insurer value function effect only: Beta=1
Percentage change in A1+B1 combined profit
-0.025
-0.020
-0.015
-0.010
-0.005
Equilibrium relative price for product B
0.5
1
2
0.00
1.00
2.00
3.00
4.00
Equilibrium relative price for product A



These comparative statics results show that the effects of joint negotiation by two suppliers that do not sell substitute products can have a modest impact on the bargaining power of the suppliers, with a magnitude that varies with the specific features of the market in ways that are not always predictable. But a robust feature of these results is that, under symmetric bargaining, the impact of joint negotiation on suppliers' profits is positive for any parameter values, despite the presence of a convex intermediary value function.

4.3 Post-disagreement price adjustment

In the analysis above, prices were set simultaneously with negotiation over networks, so that prices were treated as fixed in the event of disagreement. In this subsection, I relax this assumption. In particular, I assume that, in the event of disagreement, the intermediary is able to re-optimize its price to offset the deterioration in its network. As discussed above, this is the particular re-optimization that will tend to offset the recapture effect, so I restrict attention to this issue only. Suppliers' prices and the other intermediary's price are held fixed at the equilibrium level. Under the baseline parameters in the numerical example described above, I find that the effect of relaxing this assumption is quite modest. Under separate negotiation, if intermediary I1 fails to reach an agreement with supplier A1, instead of losing 25% of its consumers, the intermediary reduces its price so that on net it loses only about 20%. However, some of the consumers that the intermediary gains as a result of the price reduction would otherwise have used intermediary I2 to purchase product A2. Thus, A1's losses due to disagreement are only slightly greater than the 25% it would lose if the intermediary's price were fixed at the equilibrium level. Under joint negotiation, in the event of disagreement, the intermediary cuts its price so that instead of losing 44% of its consumers, it loses only 38% (on net). Again, many of the consumers gained as a result of the price decrease are switching intermediaries, not switching products, so the suppliers lose roughly the same number of consumers as before. The net effect of joint negotiation in this example is to increase the suppliers' profits by roughly 1.6%, somewhat less than the 2% increase that occurs when prices are held fixed. This result is consistent with the conclusion from the Gal-Or model, that allowing alternative beliefs about prices in the event of disagreement will partially, but not fully, offset the positive effect of joint negotiation on suppliers' profits.

5 Conclusion

The recapture effect introduced in this paper appears to be a fairly robust outcome of joint negotiation, under the assumption that the equilibrium is characterized by the Nash bargaining solution. One limitation of this bargaining framework is its essentially static nature. Recent work, such as Lee and Fong (2013), has begun to explore alternative bargaining frameworks that feature explicit modeling of dynamic bargaining environments. It would be an interesting topic for future work to consider whether similar effects arise in these alternative models. In the mean time, the analysis in this paper suggests that it may be desirable for applied researchers relying on the workhorse Nash bargaining framework to allow for bargaining power effects to arise when suppliers negotiate jointly, even when the suppliers do not sell products that consumers view as substitutes. It would be interesting to learn the extent of empirical support for the effects identified in this paper.

6 References

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