The Impact of Vertical and Conglomerate Mergers

on

Competition

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Executive Summary

1.   Objectives

The objectives of this study are the following:

(i) To provide a review of the economic literature on vertical and conglomerate mergers.

(ii) To provide a synthesis of this literature that can be used as a foundation for determining appropriate antitrust enforcement policy towards vertical and conglomerate mergers.

2.   Definitions

A horizontal merger occurs when the products of the merging firms are in the same antitrust market, i.e., are significant competitive constraints upon each other pre-merger. Non-horizontal mergers occur when the products of the parties to the transaction are in separate antitrust markets. A useful taxonomy for non-horizontal mergers is to distinguish between vertical and conglomerate mergers.

In a vertical merger, pre-transaction, the firms are located at different stages of production or distribution, with one producing an input used by the other. Post-merger, the result is vertical integration and a single firm now performs both stages of production. Conglomerate mergers are neither horizontal or vertical. It is useful to adopt a three-way classification for conglomerate mergers based on the relationship of the products involved. These are mergers between complementary products, neighboring products, and unrelated products.

In a merger involving complementary products, customers "assemble" complements into systems that are ultimately consumed.   A second type of transaction involving related products occurs when the products of the firms are not complements, but are in "neighboring" markets. In some cases there may be advantages associated with

providing consumers with a range of products. While the products in a range are substitutes or independent, demand at the level of the firm may depend on the extent of its product range. Where the locus of competition between firms involves consumers considering the range of products produced by a firm, then from the perspective of the firm the products will be complements.[1]   A "pure" conglomerate merger involves the acquisition of products that are not related on the demand or supply side: it is a merger in which there is not a horizontal, vertical, complementary or neighborhood relationship between the products.

3.   Antitrust Concerns

Antitrust concerns typically arise only if a non-horizontal merger results in an increase in market power. Just as in a horizontal merger, a non-horizontal merger can result in an increase in market power because of either a unilateral or a coordinated effect.   A unilateral effect occurs in a non-horizontal merger if products of other producers post-merger are no longer as attractive substitutes as they were pre-merger, thereby creating market power for the merging firm. This might result because the products of competitors post-merger have lower quality or higher prices, or because competitors are excluded or prevented from entry.   A coordinated effect occurs if, post-merger, it is easier for the remaining firms, or some subset, to enhance coordination and the collective exercise of market power. The literature on the anticompetitive rationales and effect of non-horizontal mergers surveyed in this report are based on identifying how the transaction changes incentives and/or constraints on the merged firm, thereby enhancing its market power.

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[1] In addition, it may be the case that the products are independent of each other, but are generally sold to the same set of consumers, i.e., they are not substitutes but they share the same distribution channels and as a result are sold to the same pool of consumers. Here the "consumers" might be retailers and because of fixed costs associated with dealing with a manufacturer/wholesaler, retailers have a preference to minimize the number of manufacturers/wholesalers they deal with.

4.   Foundation for Non-Horizontal Merger Guidelines

The foundation that economic analysis can provide for enforcement guidelines depends on its conclusions.   There are two possibilities:

(i)   the economic analysis allows for the development of rules which define the circumstances when a non-horizontal merger is presumed to raise antitrust concerns and when it is not.   The economic analysis identifies structural variables that can be observed and measured pre-merger and the relationship between the magnitude of those variables and the market power implications of the merger. On the basis of this analysis it is possible to map the structural variables into enforcement policy.[2]

(i)   the economic analysis indicates situations when a non-horizontal merger raises antitrust concerns, but does not indicate the structural conditions pre-merger under which the enforcement agencies would challenge the transaction. Instead the economic foundation provided is a set of theories of anticompetitive harm and an indication of the circumstances consistent with those theories which suggest when further investigation might be warranted.

Based on the review of the economic literature it does not appear to be possible or practical to develop "structural guidelines"—the first alternative—which would not be both over and under inclusive. However, the economics literature can be used to inform guidelines based on the second alternative. The literature can be used to identify circumstances where antitrust analysis of a non-horizontal merger is warranted. Guidelines based on this alternative would consist of a framework for analysis and the circumstances which raise concerns.

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[2] An example of this is the presumption in the Department of Justice and Federal Trade Commission Merger Guidelines in the United States that a transaction in which the Herfindahl-Hirschman Index (HHI) post-merger exceeds 1800 is anticompetitive if it leads to an increase in the HHI of 100. See Section 1.51.

The proposed framework for analyzing the competitive implications of non-horizontal mergers recognizes the ubiquity and efficiency rationales for non-horizontal mergers, yet is designed to identify those limited sets of circumstances when a non-horizontal merger can have anticompetitive effects. The framework involves three stages: (i) a market power screen; (ii) identifying a coherent theory of anticompetitive harm (profit maximizing behaviour in theory) and its factual relevance (profit maximizing behaviour in practice); and (iii) assessment of the nature and magnitude of efficiencies.   The last stage involves a balancing exercise and is only relevant if the first two stages indicate a concern.

The primary role of this study is the identification of the theories of anticompetitive harm associated with non-horizontal mergers and the factual circumstances when they are applicable.   Four sets of case theories are identified and discussed. These sets are (i) vertical mergers leading to either input or customer foreclosure; (ii) unilateral effects associated with conglomerate mergers; (iii) coordinated effects arising from non-horizontal mergers; and (iv)   financial implications of conglomerate mergers for product market competition.

5.   Vertical Mergers

The traditional concern with vertical mergers focused on the potential for a monopolist upstream to leverage its market power downstream by vertically integrating. The learning associated with the Chicago school was that concerns regarding monopoly leverage were likely misplaced.   Instead vertical merger was both efficiency enhancing and beneficial for consumers because it internalized a vertical pricing externality (double marginalization) if there was monopoly power downstream or, if there was competition downstream, was motivated by efficiency considerations, since there was only a single monopoly profit and that could be extracted by appropriate pricing upstream.[3] The monopoly leverage model is based on restrictive assumptions, and it is well known that

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[3] Double marginalization occurs when downstream firms marks up over their marginal cost, which because of market power upstream exceeds the marginal cost of the upstream producer. Hence there is a markup on a markup or double marginalization. A vertical merger in these circumstances would eliminate the wholesale market transaction and one of the markups, reducing the marginal cost downstream, resulting in both a lower price downstream and increased profits.

if they do not hold then a vertical merger could be motivated by its potential to enhance or exercise market power.[4] These situations, however, did not suggest a compelling rationale for widespread concern over the competitive effects of vertical mergers, especially because of the benefits from eliminating double marginalization.

More recent theories consider the competitive impact of a vertical merger in a framework that does not assume monopoly upstream and either perfect competition or monopoly downstream. These theories assume imperfect competition up and downstream pre-merger and thus are able to address the effects of a vertical merger on competition, in particular the issue of foreclosure.

Theories of the anticompetitive effect of a vertical merger depend on either raising the costs of rivals or reducing the revenue of rivals. The hypothesis associated with raising rivals' costs typically involves input foreclosure. Input foreclosure occurs when the integrated firm either stops supplying competing downstream firms (complete foreclosure) or does so at a higher price (partial foreclosure), resulting in both cases in an increase in the price of the upstream input post-merger, raising the costs of competing downstream firms. This relaxes the competitive constraint on the integrated firm that has access to the input at marginal cost. The hypothesis is that the integrated firm has an incentive to change the behaviour of its upstream division post-merger because it will internalize the effect on downstream prices when setting its optimal price in the market for the input, i.e., it will recognize that there is an additional benefit from raising its input price, which is higher downstream profits from an increase in prices and market power downstream.

The hypothesis associated with reducing rivals' revenues typically involves customer foreclosure. Customer foreclosure occurs when, post-merger, the downstream division of

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[4] The single profit critique assumes fixed proportions of production, homogenous uses downstream, and the absence of price regulation. The result is not robust to changing these assumptions, i.e., variable

the integrated firm no longer sources supply from independent upstream firms.   If this leads to a reduction in sales volume and that sales volume reduction leads to an increase in the average cost or marginal cost of upstream competitors, then, to the extent there is exit (from higher average costs) or reduced competitive vigor (from increased marginal costs) the competitive constraint these firms exert on the upstream division of the integrated firm will be reduced, leading to greater market power upstream and higher input prices. The higher input prices, in turn, can result in input foreclosure downstream.[5]

Input Foreclosure

The literature on input foreclosure that has implications for identifying circumstances when vertical mergers give rise to antitrust concerns consists of two branches:[6] (i) the Raising Rivals' Costs branch assesses the potential for vertical merger to raise the input costs of rivals and increase market power downstream; and (ii) the Preemption branch

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proportions of production, heterogeneous uses downstream, or price regulation. See the discussion below in Section 3.1.2.

[5] Normally we would expect the downstream price to increase, but in the case where input markets are local and the downstream market global, the effect of the increase in cost will be a reduction in output in the local market, not an increase in price. On the other hand, input foreclosure could lead to customer foreclosure. Input foreclosure gives the vertically integrated firm a cost advantage downstream, which leads to an expansion in its market share. This increase in market share reduces the demand for its unintegrated rivals upstream. If there are economies of scale upstream, this indirect demand effect, combined with a commitment by the integrated firm not to buy from upstream rivals, could induce their exit. See the discussion of Avenel and Barlet (2000) *infra*.

[6] A third branch is also discussed in the report. This branch is associated with Hart and Tirole (1990) and focuses on a potential commitment problem that an upstream monopolist may have when it sells to downstream firms and its contracts are unobservable or unverifiable. The idea is that a monopolist upstream cannot credibly commit not to supply more than one downstream firm under these contracting conditions.   As a result vertical integration arises as a means for the upstream monopolist to commit not to supply other competing downstream firms, thereby preserving its monopoly power upstream by monopolizing the downstream market. The implications of this model for vertical merger policy are unlikely to be significant. It is difficult to see this monopoly commitment problem as a justification for vertical merger. It is much more likely that this commitment problem would be solved through exclusive contracts rather than vertical merger. Moreover, the actions taken here by the monopolist to solve the commitment problem are designed to preserve its monopoly power, not by excluding competitors downstream, but by placing constraints on its own behaviour. While it is true that a vertical merger in these circumstances would preserve its market power, that preservation is not achieved by relaxing a constraint on its market power by reducing competition. Hence it is not clear that this type of behaviour is a legitimate target for antitrust enforcement, provided, of course, the monopoly upstream has been obtained legitimately, through superior competitive performance.

finds the harm in vertical merger when a downstream monopolist integrates backwards to exclude competing downstream firms from access to inputs that would enable entry.   In the preemption branch, the harm to downstream competitors is not an increase in the price of the input, but a complete denial of access.

RRC

The RRC branch can be further subdivided by whether competition downstream involves homogeneous output and firms compete over quantities (strategic substitutes (SS)) or products downstream are differentiated and firms compete over price (strategic complements (SC)).

RRC-SS

The RRC-SS literature suggests the following implications for antitrust enforcement:

- A vertical merger will eliminate double marginalization giving the integrated firm a cost advantage downstream.

- In general vertically integrated firms will have an incentive to behave differently in the upstream market than their unintegrated competitors. They will have an incentive to supply less at the margin or even engage in overbuying in the upstream market in order to raise the price of the upstream good.

- Complete foreclosure—withdrawal from the input market as a buyer or seller— might be credible when integration allows for adoption of a specific technology. However, the profitability of adopting the specific technology depends on a trade off between gains in the downstream market and losses in the upstream market. This trade off depends on concentration in the downstream market. When it is concentrated the trade off favors foreclosure.

- Downstream rivals disadvantaged by a vertical merger may have an incentive to counter-merge, gaining access to the upstream input at marginal cost.   An initial vertical merger may set off a wave of vertical mergers, a wave which makes the initial vertical merger unprofitable.

- The welfare effects depend on the credibility of complete foreclosure. If foreclosure is not credible, then increasing the extent of vertical integration is efficiency enhancing and leads to lower prices for consumers. The literature suggests that, if anything, there are *too few* vertical mergers when complete foreclosure is not credible.

- When complete foreclosure is credible and entry not an issue, the welfare effects are in general ambiguous and difficult to assess ex ante. The effect of a vertical merger on the downstream price depends on whether the increase in output from the elimination of double marginalization by the integrating firm is greater or less than the decrease in output from the increase in the costs of its unintegrated downstream rivals *if* the vertical merger results in an increase in the upstream price. Such a price increase depends on whether the supply effect of the integrated firm withdrawing from the upstream market exceeds the demand reduction as the unintegrated downstream firms contract in response to the increase in output by the integrating firm downstream.   However, such welfare decreasing integration is not often profit-maximizing: it is only profit maximizing if it results in the elimination of the wholesale market and exclusion of unintegrated downstream firms and only then if there are relatively many such firms which are excluded.

The one set of circumstances in which it is unambiguous that a vertical merger leads to anticompetitive harm to consumers downstream involves a monopolist upstream in which a vertical merger deters entry upstream and where technology makes foreclosure

credible.[7] In particular under the following circumstances a vertical merger leads to anticompetitive harm to consumers in the form of higher prices: (i) vertical integration enables adoption of a specific technology that precludes participation by the integrated firm in the upstream market, i.e., input foreclosure; (ii) there is an incumbent monopolist upstream threatened by entry; (iii) the downstream market is concentrated; (iv) integration and foreclosure reduce the entrant's profits such that it is deterred from entering; and (v) entry into both the upstream and downstream market by the entrant is not profitable, nor a counter merger involving the entrant and an unintegrated downstream firm. Vertical merger and foreclosure is more likely to have a significant effect on the profits of the entrant: (i) the larger the market share of the downstream firm that integrates; (ii) the greater the cost differential downstream post-integration; and (iii) the more significant economies of scale upstream (fixed costs of entry).

When there is entry, foreclosure provides the integrated firm with a cost advantage downstream. The profits of the incumbent from integration and foreclosure increase because it avoids double marginalization and has a cost advantage downstream. The effect of this cost advantage on profits depends on the extent of competition downstream. If there are only a few competitor's downstream, then a cost advantage provides a firm with a significant advantage, leading to higher market share and profits.   On the other hand, foreclosure means that the vertically integrated firm no longer participates as a duopolist in the upstream market, and the greater the number of firms downstream, the greater the forgone profits in the upstream market. Taken together, these two effects both mean that the greater the extent of competition downstream, the less profitable integration, or conversely, the fewer the number of firms downstream the greater the incentive to integrate and foreclose.

Foreclosure affects the profitability of entry.   It increases the profitability of entry because it eliminates competition in the upstream market—the entrant will be a

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[7] This case theory is based on Avenel and Barlet (2000).

monopolist. On the other hand it reduces the profitability of entry by reducing demand in the upstream market. Demand is reduced for two reasons: (i) the downstream subsidiary engages in customer foreclosure and (ii) the competitive effect of input foreclosure reduces the market shares of the unintegrated downstream firms. The demand effect will depend on the number of downstream firms. If there are only a few, then the demand effect will be significant, but if there is extensive competition downstream, the demand effect will be minimal. There are a critical number of firms downstream, beyond which vertical integration and foreclosure results in greater profits for the entrant. That is, in these cases vertical integration does not raise barriers to entry, but facilitates entry upstream.

RRC-SC

The RRC-SC literature has many of the same implications for antitrust enforcement as the RRC-SS literature. A key insight highlighted by the strategic complement models is the profitability of a counter vertical merger and establishing that a counter merger—which would eliminate the raising rivals' cost effect of a vertical merger—may not be profitable if there are externalities associated with the vertical merger that benefit the non-integrated firms. This literature also highlights the importance of commitment on the part of the vertically integrated firm not to participate, or to be able to commit to a price, in the upstream market.   The critical issue is why a vertical merger would create market power by lowering the cost of commitment not to participate in the upstream market. Scheffman and Higgins (2003) observe, that a vertical merger can enhance market power if it makes commitment profitable when it has a cost. It might be the case that the cost of the commitment can only be recovered by a vertically integrated firm and would not be recovered by a pair of stand alone firms.

The literature suggests that if there is existing market power upstream, then a vertical merger leading to the elimination of double marginalization is likely beneficial for consumers and efficiency. While it is true that a vertically integrated firm will have an incentive to reduce supply to raise the costs of its rivals downstream and therefore its

prices and profits, this is typically offset, in whole or in part, by a reduction in demand by the unintegrated rivals downstream. The analysis points out the importance of looking not just at the incentives of the integrated firm, but performing an equilibrium analysis which incorporates the responses of other firms both up and downstream, including the possibility of counter strategies.

Two hypotheses have explored how a vertical merger can create market power upstream because of asset specificity.[8] In both cases a vertical merger improves incentives for investments in specific assets, and while these investments may lower costs they also limit or eliminate participation in the upstream market—as either a buyer or seller—by the vertically integrated firm.   The two hypotheses that suggest the potential for antitrust concerns are due to Choi and Yi (2000) and Chen (2001).

In Choi and Yi there are two upstream and two downstream firms: the upstream firms have access to two different technologies, one general and one specific. If an upstream firm adopts a specific input, it can only trade with, or supply, the downstream firm that can use that input. Input costs upstream are stochastic and correlated if both upstream suppliers adopt the general technology. From the upstream suppliers' perspective correlation is undesirable because it makes it more likely that each will have low costs, which under price competition implies zero profits.

There are two positive effects on the profits of others when an upstream firm adopts the specific technology. Its upstream rival benefits because cost correlation is reduced and it is now a monopoly supplier of the other downstream firm. The downstream competitor of the firm with the monopoly supplier also benefits since its rival will have higher costs

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[8] An asset is specific to a trading relationship (i.e., between a given buyer and a given seller) if it has no value either to alternative buyers or sellers. More generally, there is some degree of asset specificity if the asset is less valuable when redeployed to another use (i.e., an alternative trading partner). The degree of asset specificity is related to the extent to which the cost of the asset is sunk, i.e., non-recoverable if the trading relationship is terminated. Asset specificity can be created, as in Avenal and Barlet, by technological incompatibility with external parties.

as its input price rises. Vertical integration makes it more likely that the specific technology will be adopted since the positive effect on the downstream firm is internalized by integration.   This is not costless, however. The vertically integrated firm that forecloses will forgo profits from supplying the other downstream firm if it is the low cost supplier.

A counter merger may not arise because it may well reestablish cost correlation if, in a vertically integrated structure, both firms adopt the generic technology. A counter-merger eliminates double marginalization and the raising rivals' cost effect. But by doing so it eliminates the benefit to foreclosing firms from adopting the specific technology. If cost correlation is sufficiently large it can outweigh the benefits from preventing foreclosure and therefore eliminates the incentives for a counter merger.

The Choi and Yi theory is consistent with the following: (i) pre-merger upstream firms have adopted a generic technology and are willing to supply all downstream firms; (ii) the possibility post-merger that an integrated firm can, and will, adopt a specific technology that; (iii) prevents it from supplying unintegrated rivals downstream and creates market power among the remaining upstream suppliers; and (iv) creates some benefit that accrues to the unintegrated firms, thereby precluding a counter merger. These circumstances are fundamental to a demonstration that adoption of the specific technology becomes profitable post-merger for the integrating firm and that a counter merger will not be profitable. Of course, the vertical merger that leads to foreclosure could still be beneficial for consumers and increase total surplus. A showing that foreclosure will be harmful to consumers requires a plausible case that the effects of raising rival's costs and enhancing cost asymmetry dominate the elimination of double marginalization.

The Choi and Yi model appears to be difficult to apply since it depends critically on the extent of cost correlation, and assessing empirically the extent of cost correlation is likely to be difficult.   The Choi and Yi model presents a Goldilocks' story: cost correlation has

to be sufficiently large that a single vertically integrated firm would find it profitable to adopt the specialized technology, but it cannot be too large otherwise there will be specialization when both firms are vertically integrated.

Application of the model is based on recognizing that cost correlation is a "stand-in" for either innovation or an efficiency advantage. In the innovation interpretation, the low cost realization represents successful innovation by an upstream firm. The upstream firms have a choice between two innovation strategies: one generic and one specific. The generic strategy if successful results in an innovation useful to both downstream firms. Following a specific strategy implies that a successful innovation will only be useful to the relevant downstream firm. In this case "cost correlation" corresponds to the likelihood that both will be successful when they follow the same research strategy. Alternatively, under the efficiency advantage interpretation the probability of a low cost realization is higher for adoption of the specific input.

Chen (2001) identifies a separate incentive effect associated with vertical merger that can result in higher prices both upstream and downstream. Chen's insight is that an unintegrated downstream firm will choose the vertically integrated firm to be its supplier, even if it charges a higher price, because that leads to less aggressive competition by the vertically integrated firm downstream. By sourcing its supply from the vertically integrated firm at a price greater than marginal cost, the unintegrated downstream firm provides the integrated firm with an incentive to maintain sales in the upstream market.

Chen's results depend on there being a cost associated with switching suppliers and an efficiency advantage associated with vertical merger. This switching cost commits the unintegrated downstream firm to purchase from the integrated firm even though its price is greater than other upstream suppliers. The size of this switching cost determines how high the integrated firm can raise its input price before the unintegrated firm switches to an unintegrated supplier. Without an efficiency advantage from the vertical merger, the merged firm will not have an incentive to lower its price in the downstream market.

Without this incentive, the unintegrated rival has no incentive to mitigate this incentive by sourcing supply of the input from the vertically integrated firm. The size of the switching cost determines how high the integrated firm can raise its input price before the unintegrated firm switches to an unintegrated supplier. The welfare effects in Chen's model depend on the size of the switching cost. If it is large and the two downstream differentiated products relatively close substitutes, then the prices of the downstream goods will rise. If the switching cost is small and the products relatively differentiated, then prices will fall since the vertical merger eliminates double marginalization for the integrated firm.

There is not an incentive for a counter-merger in Chen's model because of the assumptions made regarding the capabilities of the upstream firms. Chen assumes that marginal cost is constant, but that the integrating firm has a lower cost than its upstream competitors. Hence a counter-merger does not change the price at which the unintegrated downstream firm can access the upstream input.

The anticompetitive effect associated with a vertical merger in the model of Chen occurs in the following circumstances: (i) multiple upstream firms, but the upstream firm involved in the merger has an efficiency advantage or the integrated firm will have a cost advantage post-merger; (ii) this efficiency advantage has to be relatively small to insure that the integrated firm will actually have an incentive to raise its price to take full advantage of any switching cost; (iii) relatively large switching cost on the part of the downstream firm; and (iv) strategic complements downstream.   The less differentiated the downstream products, the smaller the switching costs must be for the vertical merger to result in a price increase downstream.

Preemption

Antitrust concern over backward integration by a monopolist or dominant firm is warranted when the downstream firm acquires all of the input available that likely allows entry and that input is inelastically supplied.   There are two versions of this theory.   In

the simplest case (Gilbert and Newbery 1982) there is a monopolist downstream, an essential input is required for entry downstream, that essential input is in very scarce supply upstream, and the downstream monopolist acquires all of the scarce supply upstream. In doing so it deters entry downstream and preserves its monopoly power to the detriment of consumers.

However the downstream firm will not outbid an entrant if the resource/assets/facilities are not scarce (or inelastically supplied). If the facility is not scarce then forestalling entry by preemption will not be profitable: investments in new facilities can always be made by new entrants and the cumulative investment in preemption will eventually become unprofitable. Therefore a complementary interpretation is that for a vertical merger to have an anticompetitive effect in these circumstances, there must be relatively large disadvantages associated with firms that attempt to enter without access to the inputs acquired by the dominant firm. Conversely, if an entrant were to acquire the assets preempted by the incumbent, they could enter and compete effectively.

The more complex version (Riordan 1998) posits a dominant firm downstream whose market power is constrained by a fringe of small producers and competitive supply upstream of an input produced with increasing marginal cost. The greater the extent of integration by the dominant firm, the greater its incentive to engage in strategic purchases in the input market.[9] Doing so raises the costs of the competitive fringe downstream, relaxing their constraint on its market power and leading to higher prices downstream.

Customer Foreclosure

Under the "customer foreclosure" hypothesis, the integrated firm no longer sources supply from upstream competitors, but continues to supply other downstream firms. Indeed the profitability of foreclosure depends on being able to supply competing downstream firms at higher prices post merger. Notice that this concern is the exact

opposite of the "input foreclosure" hypothesis. The concern with input foreclosure was that the integrated firm would no longer supply downstream firms, creating market power for its rivals upstream, which increases its market power downstream. Under customer foreclosure the objective is to create market power upstream for the integrated firm: depending on competitive conditions downstream this might also lead to increased prices downstream.[10]

The theories suggesting harm from a vertical merger are of two sorts. In one set there is competition between upstream firms to merge with a single downstream firm (competition for exclusivity). In the second there is a first-mover advantage, an incumbent upstream firm can merge before its competitors enter the market (first-mover advantage and exclusivity).

Competition for Exclusivity

The literature here focuses on a situation where there are two upstream firms that produce a differentiated input and one downstream firm. There are two foreclosure possibilities. In one, post integration the vertically integrated firm raises the price downstream of the unintegrated product in order to divert demand to its integrated product (Salinger 1991). This story depends on inefficient contracting between the up and downstream firms. The second story is applicable when there is efficient contracting.[11] In it the profitability of a vertical merger requires a noncoincident market effect: precluding sales to the downstream firm in market one because of the merger allows the integrated firm to monopolize supply upstream to a second market (Bernheim and Whinston 1998).

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[9] Riordan's model involves preemption because it is able to acquire capacity from the upstream sector (when it integrates) prior to its rivals downstream entering the input market.

[10] Normally we would expect the downstream price to increase, but in the case where input markets are local and the downstream market global, the effect of the increase in cost will be a reduction in output in the local market, not an increase in price.

[11] Efficient contracting means that the contracts between up and downstream firms maximize their joint profits. It precludes, in particular, double marginalization.

A key requirement for both case theories of customer foreclosure is market power downstream. The sets of circumstances differ in one key respect: the nature of contracting between up and downstream firms pre-merger. If contracting is efficient and double marginalization is not an issue, then anticompetitive effects upstream (from customer foreclosure) will not arise unless there are noncoincident market effects. If on the other hand, there is double marginalization, then the Salinger model suggests the potential for a vertical merger to have foreclosure effects that harm consumers.

In general the price effects associated with a downstream monopolist integrating backwards in the Salinger model depend on conditions of demand, marginal cost differences, and the extent of double marginalization pre-merger. Since these all interact to determine the incentives for the downstream monopolist to price the two goods ex ante and ex post, untangling analytically the impact of each is impossible. However, if a demand system can be estimated, then a vertical merger simulation, similar to a horizontal merger simulation could be performed and the effect on prices downstream post-merger predicted.

Note, however, that backwards integration by a monopolist is not likely to result in complete foreclosure: the monopolist downstream will have incentives to carry both products unless there are large product specific fixed costs or the marginal cost of one of the goods exceeds the willingness to pay of consumers. Instead there is partial foreclosure, the vertical merger will provide the integrated firm with an incentive to raise the price of its unintegrated rival's product. Whether this incentive will overcome the price reducing effects of eliminating double marginalization of the integrated product depends on the circumstances. However, if the products are relatively close substitutes and pre-existing market power upstream small, it is more likely that the price of one or both downstream products will rise. Confirmation could then be sought through merger simulation.

If contracting is efficient then for an anticompetitive effect there must be noncoincident market effects.   Moreover, here the foreclosure by integration will be complete, with the integrated firm refusing to buy the input of its upstream rival.   The Bernheim and Whinston model is consistent with the following fact circumstances: (i) efficient contracting between up and downstream firms; (ii) monopoly downstream, sustained by barriers to entry that preclude two-stage entry; (iii) differentiated products upstream; (iv) noncoincident markets; (v) exclusion must be profitable—the gain in profits from monopolizing the noncoincident market must exceed the loss in the market in which there is a vertical merger (from the lost sales from not handling/using the rival's product)—this is more likely the less differentiated the products; (vi) exclusion is effective—the vertical merger will result in an increase in market power in the noncoincident market, either because it results in the exit of upstream competitors or because a reduction in volume raises the marginal cost of upstream competitors in those markets.

First Mover Advantages and Exclusivity

The case theories here involve an incumbent upstream monopolist merging with downstream firms in order to deter entry of rivals upstream capable of producing an identical input. There are two possible case theories depending on whether the downstream firms compete against each other or not. In the first, downstream firms do not compete with each other, perhaps because they are in different geographic markets. Then if economies of scale are sufficient upstream a vertical merger between the upstream incumbent and, at the margin, one more downstream "buyer" could result in deterrence of a competitor upstream, allowing the incumbent to monopolize the non-integrated buyers (Rasmussen, Ramseyer, and Wiley 1991; Segal and Whinston 2000).

Because the upstream product here is homogenous, the threat not to source from an entrant is not so obviously non-credible. If the entrant's costs are identical or greater than the integrated firm, then the threat not to source from the entrant is credible. If the entrant's costs are lower however, then the credibility of customer foreclosure will

depend on whether the profits of the vertically integrated firm post merger from not sourcing from the entrant at a price less than its costs, but acting as a monopoly supplier to all other buyers are greater than the profits from sourcing from the entrant at a lower cost and earning duopoly profits in the competition with the entrant for supplying the other downstream firms.

If the buyers compete with each other, an adaptation of Stefanadis (1998) is applicable. In this case theory the upstream good is homogenous, supplied by an incumbent monopolist, and used as an input downstream by a differentiated duopoly. Integration downstream by the upstream monopolist to preclude entry and maintain market power is possible when (i) economies of scale preclude entry if an entrant is not able to capture sufficient market share downstream; (ii) vertical merger by the incumbent and foreclosure precludes the entrant from realizing economies of scale necessary for profitable entry; (iii) foreclosure must be credible—credibility is possible either because the integrated firm can design its downstream products to be incompatible with the upstream input of the entrant or it is profitable, in which case the gains from monopolization upstream and raising rivals' costs downstream are greater than the lost profits downstream from not sourcing supply from the low cost entrant; (iv) the entry deterring effects of vertical merger are reduced if the entrant expects that it can use its cost advantage post-entry to make the threat of foreclosure non-credible through negotiations—this is facilitated if the entrant can price discriminate between the integrated and unintegrated downstream firms.

6.   Unilateral Effects and Conglomerate Mergers

A conglomerate merger may involve the acquisition of complements, products in neighboring markets, or unrelated (independent) goods. The acquisition of these products provides the acquiring conglomerate with the opportunity to engage in (i) tying, (ii) bundling, or (iii) foreclosure.   Tying occurs when purchase of good *A* (the tying good) requires that consumers also purchase good *B* (the tied good). Requirements tying

occurs when consumers have to purchase all of their *B* requirements (now and in the future) in order to buy *A*.

Pure bundling occurs when consumers cannot buy products individually, but instead are required to purchase a group of products collectively. In the case of mixed bundling, consumers can buy the individual products separately, or pay in total a lower price if the goods are bought as a bundle. Often in the literature it is assumed that there are two goods where consumers demand a single unit *each* of *A* and *B* making a tie indistinguishable from a bundle. More generally a tie differs from bundling because a tie is more likely to involve divisibility. For instance a tie requiring two units of *B* be purchased for every unit of *A* is not the same as offering to sell a package consisting of four units of *B* and two units of *A*.

The potential for foreclosure arises when the conglomerate firm, post-merger, has a greater variety of products. This provides it with the opportunity to foreclose by not making its products compatible with the products of its competitors. If it forecloses then it will have a portfolio or range advantage, because it can supply a greater variety of products. If consumers value variety, then a variety advantage can provide the conglomerate with market power or lead to monopolization.

The report considers the potential for tying, bundling, and foreclosure made possible by a conglomerate merger to create or maintain market power. It also considers the traditional view that tying and bundling are either typically beneficial or a means to implement price discrimination.

The Traditional View of Tying and Bundling: Efficiency Benefits and Price Discrimination

The traditional view of tying and bundling is that they are typically beneficial or associated with price discrimination.

Efficiency Benefits: The Cournot Effect and Inability to Leverage

The view that tying of complementary products is beneficial is based on the Cournot effect and the application of the single profit theory to complements. The Cournot effect is the reduction in prices for two complements that occurs when they are sold under common ownership rather than by separate monopolists. Integration leads to a reduction in the price for both complements since the integrated firm captures the increase in demand for a good's complement when it lowers the price of the good. The single profit critique applied to complements holds that a monopoly supplier of one complement can extract all of the monopoly profit through the price of its product and it need not monopolize competitively supplied complements by tying or bundling when consumers are homogenous. Indeed tying or bundling its monopoly supplied component with a complement which is competitively supplied could decrease its profits if the competing suppliers offer a differentiated product or are lower cost producers. Because these alternatives provide value to consumers, their presence means that the monopolist can charge a higher price for its monopoly good if it does not tie.

Similarly, if the two goods are independent, tying a monopoly supplied good to a second good in an attempt to monopolize it will typically reduce the profits of the monopolist: some consumers who would have purchased the monopoly good but have a low willingness to pay for the tied good will forgo buying either if there is a tie. If a tie is observed, it cannot be for market power reasons, but instead has an efficiency rationale.

Price Discrimination

A considerable complicating factor in the analysis of the implications of tying and bundling is that—when consumers have heterogeneous demands—the rationale for their adoption by a firm with market power may not be to create or maintain its market power, but instead to enhance its effectiveness through price discrimination. Tying and bundling can be effective means for a firm with market power to implement price discrimination and extract more surplus from consumers.

Metering Consumption

In the case of complements, tying can be used as a means to meter consumption when a monopolist's primary good uses a complementary good to produce services for consumers. In this case, high intensity/high value users use more of the product complementary to the monopolist's product.   Tying allows the monopolist to become the sole supplier of the complementary product and it will find it profitable to charge a markup over the competitive price in order to extract more surplus from the high intensity users.

Requirements Tying

When the two goods are independent and demand for the monopoly product varies with its price, requirements tying can be used to extract more surplus from the monopoly product than can be extracted under monopoly pricing.[12] Under requirements contracting consumers are willing to forgo surplus from consuming the competitively supplied good in order to continue to enjoy surplus from the monopolist's product. Hence the monopolist can raise the price of the product in which it faces competition if it implements a tie. Consumers will only substitute away from the requirements tie when their surplus under it is less than just purchasing the tied good at competitive prices and forgoing consumption of the monopoly tying good, i.e., the lost surplus from the increase in price of the competitive good becomes greater than the surplus from the monopoly product.

Bundling

Bundling is a means to reduce demand heterogeneity across goods. This can be profitable for the monopolist since selling bundles then allows the monopolist to extract more surplus than it can when it prices the goods separately, but optimally. In the absence of bundling the profit-maximizing prices for two goods often reflects those with lower willingness to pay. If the monopolist can bundle, then demand will reflect average

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[12] In the metering case, it is assumed that each consumer requires only one unit of the monopoly product.

willingness to pay across the goods, allowing the monopolist to charge a bundle price that implies higher individual prices for the goods in the bundle. By doing so the monopolist is able to extract surplus from consumption of the good from those with a higher willingness to pay without forgoing sales to those with a lower willingness to pay for that good.

Unilateral Effects: Tying, and Bundling

Tying and bundling, however, can be used to enhance market power. Examination of the hypotheses when this is true can provide insights into the incentive of a firm to tie products after a non-horizontal merger (the goods are either independent or complements). However, these theories typically do not provide for counter-strategies by a disadvantaged rival. They are applicable to a setting where there is a dominant firm, protected by entry barriers. These entry barriers not only preclude a counter merger — since there is not a second firm with which to merge — they also implicitly preclude a disadvantaged rival from entering the dominant firm's market. In any event, these barriers to entry preclude a disadvantaged rival from replicating the structure of the merging firm.

Tying

There are two classes of theories under which tying can harm consumer welfare.[13] They differ in terms of which market there is an anticompetitive effect. In the first class the anticompetitive effect is found only, or primarily, in a secondary market (the tied good market), not the primary market in which the conglomerate has a monopoly (the tying good market). In the second the harm is in the primary market.

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[13] The report also considers a number of recent contributions that explore the effect tying has on the incentives for R&D. In particular, these theories establish that under certain conditions tying by a dominant firm will lead to a reduction in R&D by its rivals.

Harm in the Secondary Market

Whinston (1990) presents two scenarios in which tying by a monopolist can lead to an anticompetitive effect in another market. The first involves tying an independent good, the second a complement to its monopoly good.

The Chicago School critique based on a single monopoly profit is not robust if there is imperfect competition in the tied product and tying affects the market structure in the tied good. In the case of independent products, tying commits the monopolist to price its independent product aggressively. In order to earn its profit on its monopoly good, it has to convince consumers to buy its tied product and is willing to provide a cross-subsidy on every sale equal to the margin on its monopoly product.

Tying to monopolize an independent good is applicable under the following circumstances: (i) monopoly in the tying good; (ii) differentiated duopoly in the tied good; (iii) economies of scale in the production of the tied good; (iv) the monopolist's commitment to only offer the two goods under a tie is credible;[14] (v) tying will result in the exit of the independent producer or prevent its entry; (vi)   tying is profitable. For tying to be profitable two things must be true: (a) its price reducing effect in the event of competition must be sufficient to either induce the rival in the tied product to exit or not to enter, giving market power to the monopolist in the tied market; (b) the extent of differentiation between the tied goods must be limited insuring that consumers do not make tying unprofitable even if it results in monopolization by substituting away from the monopolist's tied good (by forgoing the monopoly tying good). For tying to have the lead to lower prices, two additional requirements are: (i) there cannot be a large number of consumers with a willingness to pay for the tying good less than its marginal cost and (ii) the effect of bundling can only have limited impact on the demand for the tying good.

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[14]If the rival were to enter, the Chicago critique of leverage theory means that the profits of the monopolist would go up if they were to offer the two goods independently: tying reduces profits because some who might have purchased the monopoly good forgo it because they have a low willingness to pay for the tied good of the monopolist. A credible commitment means that the monopolist cannot undo the tie if there is entry.

The larger the margin on the tying good, the more effective tying is at lowering the price of the complement.

Tying may also be exclusionary even if the monopolist cannot commit to tie *if* consumers valuations are heterogeneous. In these circumstances Whinston (1990) has shown that the monopolist may find it profitable to bundle the two goods and also offer the monopoly good separately regardless of whether it is exclusionary.   Instead the monopoly good is priced separately such that those with a high willingness to pay—but who prefer the tied good offered by the rival—will still buy the monopoly good. However, for those with a low willingness to pay for the monopoly good, the effect of tying is exclusionary, reducing the rival's sales and profits for the same reasons discussed above that apply to the case when the monopolist can commit to the tie, i.e., only offer its monopoly good as part of the tie.

The set of circumstances when a monopolist has an incentive to tie its monopoly product to a complement is when there is demand for the complement based on a use that does not require the monopoly product. In this case the monopolist cannot extract all of the surplus created by competing complements through its price of the monopoly product. If the market for the use of the complement independent of the monopoly product is large and tying by the monopolist is sufficient to make the competing complement supplier unprofitable, then tying can be profitable because it results in monopolization of the independent use market. Tying forecloses the competing complement supplier from selling into the systems market (the market where the two goods are consumed together) and if economies of scale are such that the sales into the independent market are too small to sustain the competing complement supplier, it will either exit or not enter.

Harm in the Primary Market

There are two situations under which a monopolist ties a complement to its monopoly good in order to maintain or enhance its market power in the primary market. Whinston (1990) considers when tying complements enhances its market power in the primary

market, Carlton and Waldman (2002) when tying to a complement prevents entry into its primary market, thereby maintaining its market power.

A monopolist may have an incentive to tie its monopoly good to a complement to reduce competition in its primary market when there is an inferior substitute for its "monopoly" good (Whinston 1990). The presence of this substitute puts a limit on the surplus it can extract by raising the price of its "monopoly" product in the absence of tying. Hence the monopolist may have an incentive to tie its monopoly product and complement: doing so provides it with an incentive to lower the price of its complement since the only way to earn its monopoly margin is to convince consumers to buy its pair of goods, or system, not the rival system. If there are fixed costs associated with the production of the complement, then the increase in price competition for it and loss of market share to the monopolist might induce the rival producer of the complement to exit the market. As a result, of course, the inferior system ceases to exist and the inferior substitute for the monopoly good is also excluded.

Tying to monopolize a complement and reduce competition in the primary market is applicable under the following conditions: (i) dominant in the tying complement with market power restricted by the presence of inferior substitutes; (ii) differentiated duopoly in the complementary (tied) product; (iii) economies of scale in the tied product;   (iv) the threat to only offer the two goods under a tie is credible.   (v) tying will result in the exit of the independent tied good producer or prevent its entry, therefore also inducing the exit of the inferior competitor in the tying good market; (vi)   tying is profitable. The profitability of tying complements in these circumstances depends on whether the rival system is in fact excluded and whether the gain from removing the limit on the price of the monopoly good makes up for its lost sales as some consumers who dislike the monopolist's complementary product leave the market for the monopoly product. It will be profitable if the constraint on pricing by the inferior alternative is significant, i.e. they are close substitutes, and the differentiation in the complementary products limited, so that the exodus from the market do to tying is limited. The extent to which tying reduces

the price of the tied complementary product depends on the margin for the tied product and the willingness of the consumers of the competing complementary product to substitute away from the tied good as its price changes. The larger either of these the greater the incentive the monopolist has to lower its price when it ties.

Carlton and Waldman (2002) consider how a dominant firm might use tying of complementary products to deter future entry into its monopoly or primary market.[15] Carlton and Waldman consider systems composed of two goods, that are consumed in fixed proportions. In one variant there are fixed costs associated with the introduction of both products. In the second variant, the fixed costs of introducing the complementary product are zero, but it is characterized by direct network effects.[16] The key assumption is that a rival system producer can enter into the complementary product today (with a product superior to that of the incumbent), but its entry into the primary good is delayed into the future.

When faced with the threat of entry into its primary market, the monopolist has an incentive to sell its two products as a bundle or system. This tie precludes sales of the complementary product offered by its rival today, and because that reduces its profits, may preclude the entrant from entering. For tying to be effective, it must be the case that the entrant is not able to recover the fixed costs of entry associated with simultaneously entering both markets in the future. Tying is necessary to deter entry if in its absence the rival would have found it profitable to enter today with the complement and introduce the primary good in the future.   Tying is profitable for the incumbent when it deters entry and the loss in profits today from not sharing in the surplus created by the entrant's superior complement—whose presence would allow the incumbent to charge a higher

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[15] The analysis of Carlton and Waldman is similar to Whinston's discussion of tying complements when there is an inferior alternative in the tying good market,   but instead of eliminating an inferior rival in the primary market (the market in which the firm is a monopolist), the focus is on preserving that power by deterring entry.

[16] A direct network effect exists if the benefit from a product is increasing in the number of consumers who purchase compatible or same product. The classic example is a telephone exchange.

price for the primary good—is less than the monopoly profits it preserves in the future by deterring the entrant and not being replaced. Finally, the tie must be a commitment not to provide the primary good independently.

Tying is more likely to be profitable for the incumbent when the size of the market in the future is large relative to its size today, the superiority of the complementary product of the entrant relatively small, the surplus associated with the system large, and the discount factor close to one. Tying will be effective and is required to exclude entry of a competing system when the size of the market today is relatively large and/or the discount factor close to one, i.e., the entrant patient. When the market size is large today, tying eliminates substantial profits for the entrant from entering the complementary product in the first period. When the discount factor is close to one, the profits from introducing the primary good in the second period are valuable, hence providing the entrant with an incentive to enter with its complementary good in the first period.   If the market size today is relatively large and/or the discount factor close to one, then the effectiveness of tying will also be increasing in the quality advantage of the entrant. Tying is also more likely the smaller the fixed costs of entering the primary product market.

Carlton and Waldman also consider an extension in which there is no longer fixed costs associated with the complementary product, but it is instead characterized by a direct network externality: the more consumers who buy the same complementary product the greater their benefit.   Then by tying in the first period, the monopolist is able to create an installed base of users for its complementary product in the second period. This serves to deter entry of the competing system, since without sales in the first period, the introduction of a competing system by the entrant may not be profitable.

Bundling

Two types of case theories have been advanced under which bundling can harm consumer welfare. In one set of circumstances, bundling is exclusionary: it reduces

demand and revenues for rivals and increases the market power of the bundling firm by changing the willingness of consumers to substitute.[17] The second focuses on how bundling can relax price competition between firms by introducing or increasing product differentiation.

Bundling as a Mechanism to Relax Price Competition

The general result is that if a monopolist is able to commit to pure bundling—offering its monopoly good with a good which has substitutes—the monopolist is able to relax price competition. Price competition is relaxed since the effect of bundling is to introduce product differentiation and segment the market of the product which faces competition. Three such cases, all relying on the same mechanism have been considered:

(i)   Monopoly and Duopoly.[18] A multiproduct firm produces one product in which it is a monopolist and a second homogeneous good in which it competes with another firm over prices. Bundling allocates the high valuation consumers to the monopolist and those with intermediate valuations are served by its competitor, i.e., those who are willing to pay more for the duopoly good than the competitor's price, but whose willingness to pay for the monopoly good is not greater than the price difference between the bundle and the price of the duopolist. Since the bundle commits the bundling firm not to participate in the market for these consumers, its competitor can raise its price above marginal cost. This in turn gives the monopolist room to raise the price of its bundle above the sum of its monopoly price and the marginal cost of the duopoly good—the implicit price of the bundle when the goods are sold separately.

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[17] Throughout this report we refer to behaviour that reduces the profits of a rival as exclusionary even if it does not lead to the exit of a rival.
[18] Carbajo et al (1990).

(ii) There are three products, two of which are produced by separate monopolists, but both of which can produce the third product.[19] In the absence of bundling, each monopolist charges the monopoly price for its monopoly good while price competition between the two of them drives price in the common market down to their (common) marginal cost. If one of the monopolist bundles its monopoly good with the common good, the effect is to partition the market for the common commodity by type. Each firm would like to be able to credibly commit to act less aggressively in the market for the common commodity. This occurs when there is bundling since for the bundling firm it effectively raises their costs of competing for the third good: the cost of providing the bundle is greater than the cost of the third commodity by the marginal cost of the monopoly product it provides. Moreover, the strategic response by the other firm is to raise its prices for the third commodity to monopoly levels for consumers who prefer its monopoly good and not to compete for sales of the third good to consumers of the opposite type.[20] Bundling under these circumstances partitions the market, leading to an increase in market power, and reducing consumer and total surplus. It will be profitable for the bundling firm if the extra surplus extracted from the higher bundle price exceeds the lost profits from some of its monopoly consumers who forgo its product because their surplus on the common commodity is low.

(iii) Two firms are duopolists in one market, but one of many competitors in a second.[21] Bundling can differentiate and segment the market when one of the duopolists offers a bundle. The effect of the bundle is to allocate those in the duopoly market who also like the competitive product to the firm that bundles,

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[19] Seidmann (1990).

[20] The firm which does not bundle will not try and sell the third commodity to the customers of the bundling monopolist if the surplus (willingness to pay less marginal cost) on the monopoly good is sufficiently high: the price it has to offer to induce them to forgo the surplus from the monopoly good in the bundle makes it unprofitable when this is the case.

[21] Chen (1997).

and the consumers who do not like the competitive good are allocated to the firm that does not bundle.

Bundling as an Exclusionary Practice

Two sets of circumstances consider the exclusionary effect of bundling. The circumstances are distinguished by the relationship between the goods included in the bundle. In the most general modeling the two goods can be either complements, independent, or substitutes, but not perfect complements, i.e., consumed in fixed proportions.[22]   As explained below, competition between bundles insures that competition involves strategic substitutes even if the two goods are complements. In the second set of circumstances the focus is on the exclusionary potential for bundling in systems markets: the goods ultimately consumed are systems of complements, i.e., perfect complements.

Strategic Substitutes

In Martin (1999) and Carbajo et al (1990) there are two differentiated products. A monopolist produces one good, while it faces a competitor in the market for the second good. The decision to bundle in Martin (1999) and Carbajo et al (1990) links the two markets by creating or enhancing substitution between the two firms. If the two goods are substitutes, the effect of bundling is to reduce the extent of product differentiation and the bundles are closer substitutes than the two products themselves. Even if the two products were complements or independent, the bundle of the monopolist and the product of its competitor will be substitutes.

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[22] This analysis, attributable to Martin (1999), is similar to Whinston (1990) except that competition is Cournot and demand is not restricted to unit demands for the two goods. Notice that the effect of bundling on competitors, but not consumer welfare, depends on the nature of competition in the duopoly market. It is exclusionary when competition in the duopoly market is Cournot, i.e., over quantities.   It benefits the bonding firm's rival in the duopoly market when competition is Bertrand, i.e., over prices as in the discussion of Carbajo et al (1990) *supra*.

By creating or enhancing substitution the decision to bundle has two effects. The demand effect arises as bundling reduces demand of the monopolists' competitor in the duopoly market and increases its demand in the same market.[23] Intuitively, the effect of the bundle is to reduce the willingness to pay of consumers for the duopoly good separately since when they buy a bundle to get a unit of the monopoly good, they also get a unit of the duopoly good. Moreover, there is a price effect, similar to that of Whinston, with the monopolist in *A* having once again an additional incentive to produce more in *B* since the effect of bundling is to effectively reduce the costs of producing a unit of *B* by the margin earned on *A*. This provides the bundling firm with a competitive advantage in *B*, implying that it has an incentive to increase its output, which results, in equilibrium, in a reduction in production by its competitor.

Relative to the case when the two products are supplied separately, the effect of bundling is to reduce the output of the monopoly product, raise total output and the output in market *B* of the bundling firm, and reduce the output of the firm that only produces in market *B*. The profits of the bundling firm increase, while the profits of its rival in market *B* are reduced. The monopolist forgoes output in market *A* in order to increase its output and profits in market *B*. The exclusionary effect—the reduction in the rival's profits—is more pronounced the greater the extent to which the two products are complements. In the absence of bundling, increases in the monopoly output would increase the profitability and output of the rival firm. With bundling, however, increases in bundle production by the monopolist reduce the profitability and output of the rival firm.

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[23] In this report we define the demand effect associated with bundling as being a reduction in demand for the rivals of the firm that bundles: a demand effect exists if at the pre-bundle prices the demand for the rival's product is less when there is bundling.

Provided products are not relatively close substitutes, the effect of bundling is to reduce consumer welfare and total surplus. While profitable, bundling is inefficient. [24] However, if the two goods are relatively close substitutes, bundling might increase the profits of the bundling firm and at the same time increase consumer surplus.

The theories here assume a dominant firm in one of the products, implicitly protected by barriers to entry. This precludes the possibility of a counter-merger by definition. It also implicitly excludes the disadvantaged competitor from entering into the dominant firm's protected market.

Bundling and Systems

A system is composed of compatible components. A functioning system requires a single unit of each component. In the models considered the components are differentiated and the systems that consumers can assemble depend on whether the components of different firms are compatible. In the extreme case the components of different firms are incompatible and firms compete over systems. In this case a system corresponds to pure bundling on the part of the firm. The issue is whether a firm has an incentive to acquire at least one of every component so that it can sell a system, either by only offering a pure bundle or by mixed bundling. In the situations considered, it is assumed that after a merger there are two "pure" competing systems, one which is provided by the conglomerate who through merger is able to provide one of each component, the other by a group of firms that, collectively, but independently, provide consumers with a competing system.

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[24] The formal analysis of Martin is for the case when the two products are independent. Preliminary simulations indicate that his results (bundling firm's profits increase and consumers welfare is reduced) are robust in the case of substitutes provided the two products are relatively differentiated. If the two goods are close substitutes consumers gain from bundling. Carbajo et al (1990) find that bundling is not always profitable. Their analysis shows that differences in marginal costs between the two products can reduce the profitability of bundling. For their specification of preferences (indivisible unit demands and perfect correlation) bundling will not be profitable if the marginal cost of the monopoly good is sufficiently less than the duopoly good. In this case bundling is unprofitable because the expansion in the output of the duopoly good is too large, given its high marginal cost and the reduction in the monopoly good very costly, given its relatively low marginal cost.

Consider the simplest case in which a system consists of two components and before any merger there is duopoly supply of each component and the components are differentiated. Post-merger one firm can offer a system.[25] Pre-merger there are four possible systems, while post-merger the number of systems depends on whether the conglomerate engages in pure or mixed bundling.   It engages in pure bundling when its components are incompatible with those of its rival. In this case, post-merger, there are only two systems as systems which only use one of the conglomerate's components can no longer be created, (we call these the mix and match systems). When it engages in mixed bundling, its components are compatible with those of its rivals and all four systems remain available post-merger.

When the merged firm engages in mixed bundling it has an incentive to lower the price of the bundle (system) due to the Cournot effect. Moreover, it has an incentive to raise the price of the individual components, since some of the consumers of the mix and match systems—which incorporate one of its components and a component from another firm—in the face of a higher price, will substitute to its bundled system. On the other hand, because of the increase in the price of the components provided by the merged firm and the decrease in price of the system provided as a bundle by the merged firm, the independent suppliers of components reduce their prices.

In equilibrium, the demand for the bundle and the demand for the outside system increase, while demand for the mix and match systems decreases (relative to the premerger equilibrium). The total demand for a component of the merged firm increases, while the demand for a component supplied independently falls, again relative to the premerger equilibrium. The profits of the merged firm increase, the profits of the independent suppliers falls. The increase in profits for the merged firm provides it with an incentive to merge and bundle.

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[25] The following is based on Choi (2004).

The welfare effects depend on the extent to which systems are substitutes. If the systems are very close substitutes it is likely that total surplus will fall. On the other hand, if the systems are not very close substitutes, then the effect of the merger and mixed bundling is to increase total surplus as the Cournot effect dominates.   The ambiguity extends to the effects of bundling on the welfare of consumers. The price effects mean that some consumers will benefit—those who consume the pure systems including the bundled system of the merging firm—while others will lose. In particular, consumers of the mix and match systems in the absence of bundling will be made worse off from the increase in the price of the merged firm's individual components.

Pure bundling, whereby the merged firm is able to commit not to provide its two components independently is much more exclusionary. In this case, only two systems are available. Unlike the mixed bundling case, in the pure bundling case, bundling has both demand and price effects. When the merged firm is able to commit to only offer its two components as a bundle, the effect is to significantly reduce demand (at pre-bundling prices) for all four components since two of the systems are no longer available.

Under pure bundling the merged firm has an incentive to lower the price of its system for two reasons: (i) because the demand effect means fewer inframarginal units and (ii) because of the Cournot effect. The effect of bundling is to make the demand for independent suppliers more inelastic, giving them an incentive to raise their prices.[26]

A complementary products merger—leading to foreclosure through bundling—will be an equilibrium outcome if (i) it is profitable and (ii) it is not met with retaliation.   This is the case when the two systems are relatively homogeneous. Foreclosure—in this case through pure bundling—arises in equilibrium when it introduces asymmetries in demand post-merger that result in price increases for the merged firm.   The price of the merged

firm rises because of the change in the incentives of its rivals: when systems are undifferentiated their demand becomes much more inelastic under pure bundling by the conglomerate—this induces them to raise their prices, which the conglomerate follows. Moreover, the internalization of the Cournot effect on the part of both firms when the systems are relatively undifferentiated leads to prices that make retaliation unprofitable. A counter-merger does not restore the initial situation.

When the systems are relatively differentiated, mixed bundling is significantly more profitable than pure bundling for the merging firms. This is because the demand effect is very large when the systems are differentiated. Pure bundling that precludes the mix and match systems results in significant sales losses because the mix and match consumers do not substitute to the pure systems. When the systems become more homogeneous, then the pure bundling strategy is more profitable than mixed bundling. The reason is that under mixed bundling the independent firms lower their prices, but under pure bundling they raise their prices, while at the same time the demand effect is mitigated since consumers will substitute the pure systems for the mix and match systems no longer available.

When the systems are differentiated, the profits of the independent firms are significantly less under pure bundling compared to mixed bundling. Again this is due to the demand effect of the removal of the mix and match systems. When the systems are less differentiated the demand effect is reduced, since consumers will substitute from the mix and match systems to the pure systems. Moreover, pure bundling results in higher prices when systems are less differentiated. Both factors mean that the profits of the independent firms are greater under pure bundling relative to mixed bundling when the systems are relatively undifferentiated.

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[26] Any decrease in price by an unintegrated component supplier will result in a smaller increase in demand under pure bundling because of the absence of the mix and match systems.

Even when mixed bundling is more profitable than pure bundling, the merged firm might engage in pure bundling because it is much more effective at reducing the profits of the independent firms. Thus pure bundling might be preferred to mixed bundling if it results in a change in market structure—the exit or deterrence of the independent suppliers.

The exclusionary effect of pure bundling in system cases due to the internalization of the Cournot effect has been confirmed when systems consist of more than two components (Nalebuff 2000) or the extent of product differentiation across components differs (Denicolo 2000).[27]

In Denicolo, there are two types of firms. The "generalist" firm (firm 1) produces both components that comprise the two-component system. It faces competition for each component from one of two specialist firms (firms 2 and 3). In Nalebuff (2000), systems can comprise more than two components. One firm is capable of providing all of the components that comprise a system, while the components of the other system are supplied individually by separate firms. The analysis in both cases focuses on the incentives for the multiproduct firm to bundle, i.e., make its components incompatible with competing components.

In Denicolo, the issue is whether the generalist firm will bundle its two components as a system, making them incompatible with the components of its two rivals. Instead of component by component competition, the decision to bundle creates system versus system competition. In this the generalist firm has an advantage due to the Cournot effect: it can set the price for its system to maximize system profits, unlike the rival system where the specialist firms are interested in maximizing component profits, not system profits. The Cournot effect provides it with an incentive to price its components more aggressively. On the other hand because the decision by the generalist firm to bundle expands the extent of product differentiation, the price of the competing system

increases.   Whether the generalist firm finds it profitable to bundle depends on the extent of differentiation between its components and its rivals.   If the components are sufficiently differentiated it will not engage in pure bundling since the Cournot effect dominates. On the other hand, if the components are relatively close substitutes, the generalist firm will bundle in order to increase the extent of differentiation.

Bundling reduces the profits of the independent component producer whose component is more differentiated, since the increase in product differentiation leads its partner to increase the price of its component.   If its fixed costs are sufficiently large and avoidable, this will either deter its entry or induce its exit. In either of these cases, the other component producer will also be induced to exit or not enter, since its component is useless except as part of a system. Moreover, because of the Cournot effect the two nonintegrated firms will not find it profitable to engage in a counter merger and bundle/coordinate pricing. The profits of the two specialist firms are always greater when they are provided separately and compete against the system of the generalist firm than if they coordinate pricing and there is system competition. The reason is clear: when provided separately, a lower price benefits the other component provider of the system and hence when they are supplied separately the incentive to reduce prices is reduced.

Bundling by firm 1 is inefficient. Since the market is covered—all consumers always purchase a system—allocative efficiency is not an issue. What is at issue is whether the costs of provision, in particular mismatch costs are minimized. These costs are the reduction in utility when consumers are not able to consume their most preferred system. In this model they are minimized under compatibility (no bundling). When firm 1 bundles, it induces some consumers to purchase from it who prefer (under no bundling) the competing system.

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[27] The specification of demand in these models assumes that consumers have indivisible demands for each component. Hence there is not a demand effect, only a price effect.

In Nalebuff (2000) consumers assemble systems comprised of *n* components. Each component is differentiated and a duopoly.   When the *n* components are supplied separately, then the components are not linked. Instead price competition between the two suppliers of each component results in a symmetric equilibrium where each of the two differentiated brands for each component share the market equally.

Suppose, however, that firm 1 acquires one of each components and offers them as a bundle. Its components can only be acquired by purchasing all of its components together as a system. The Cournot effect means that firm 1 internalizes the pricing externality between its components, providing it with an incentive to implicitly price each more aggressively, leading to a lower system price.

The pricing behaviour of the independent component suppliers of the competing system is also affected by the decision by firm 1 to bundle.   The decrease in the price of the bundled system in the first instance reduces the sales of the unbundled components, providing them with an incentive to lower their prices in response. This is mitigated, however, by the fact that bundling by firm 1 also decreases the elasticity of demand of the unbundled components. Bundling, by eliminating the mix and match systems, reduces the increase in sales of an individual component supplier from a reduction in its price. Moreover, the effect of bundling on the elasticity of the individual component suppliers is increasing in the number of components bundled. That is, the more components in a system, the more inelastic the demand for the individually supplied components becomes when firm 1 bundles. This is because the number of mix and match systems that are eliminated by bundling by firm 1 increases as the number of components in a system rises. As a result the price reduction of the individual component suppliers in equilibrium will be less the greater the number of components. As long as the system and the independent components are strategic complements the internalization of the Cournot effect will result in lower prices for both the bundle, each component, and the price of the rival system.   It is possible, however, that if the effect on the demand elasticity of the individual components is large enough, that the price of the system and

the price of an individual component become strategic substitutes. In this case it is possible for the price of the individual components to rise in the bundling equilibrium.

For all values of n the effect of bundling is to reduce the profits and market share of the independent component suppliers. The exclusionary effect—the decrease in the market share and profits of the unbundled components—from bundling is increasing as the number of components increase. The advantage of the Cournot effect increases with the number of components, widening the difference in price between the bundled system and the rival system as n increases.

The profitability of bundling for firm 1 depends on the number of components. When there are only 2 or 3 components, the Cournot effect and the price response of the individual component suppliers is sufficiently severe that bundling is unprofitable unless it results in a change in market structure. Such a change would occur and firm 1 would become a monopolist if the (gross) profits of the individual component suppliers are reduced below their fixed costs.   However, when the number of components is greater than 3, bundling is profitable even without inducing a change in market structure.

A counter merger by the unbundled suppliers is not profitable. This creates competition between two rival systems, with each internalizing the Cournot effect.   Though a counter merger is effective in restoring market share for the unbundled system, the resulting increase in price competition makes it less profitable than being foreclosed.

Bundling in the Nalebuff model results in a reduction in total surplus and consumer welfare. The optimal industry structure is competition between components, since then consumers have the most choice between systems. System competition between a bundled system and a system with independently supplied components reduces choice of systems and because of price asymmetries induces some consumers to adopt a less preferred system.

Equilibrium Foreclosure Models: Portfolio Effects

A portfolio, or range, effect arises if consumer demand is responsive to variety differentials. If consumers value variety then a variety differential, where one firm has a broader product range than another, raises its demand and in doing so also reduces the demand and revenues of its rivals. A conglomerate firm could end up with a variety advantage if post-merger it forecloses. Foreclosure here means not supplying a rival with access to the complements controlled by the conglomerate: if consumers value variety, then the variety advantage can provide the conglomerate with market power or lead to monopolization.

Two situations have been considered in which a firm has a competitive advantage when it has a larger range, or portfolio, of products than its rivals.   In the first situation (Church and Gandal 2000) consumption is of systems of complements. These systems consist of two components which are combined to provide consumption benefits: on their own the components provide zero or very little value.   In the systems of interest, one component ("hardware") can be combined with many different varieties of the second component ("software") to produce benefits.

A key attribute of hardware-software systems its that the willingness of consumers to pay for a hardware technology is increasing in the variety of compatible software. In such a market foreclosure could arise, if after a merger between a hardware firm and a software firm, the integrated firm ceased to supply compatible software for rival hardware technologies or systems, giving it a variety advantage. This advantage creates market power for the integrating and foreclosing firm in the market for hardware. If the variety advantage is of sufficient magnitude it can result in monopolization of the hardware component.

In Ma (1997) consumers sign up with service providers before their preferences are known over a group of substitutes. After selecting a service provider, the uncertainty is resolved. This gives a firm with a broader range of products an advantage ex ante, since

it is more likely they will have a consumer's most preferred product, and if consumers recognize this, their demand for service from a firm with a broader range of products will be greater. The service provider with the widest variety of products will have a variety advantage in these circumstances since it is more likely that they will have a better match between available products and preferences once they are known. This raises the possibility that an integrated firm may decide not to make its products available to other service providers. In the Ma model, products are complements ex ante, but substitutes ex post—after uncertainty over preferences is resolved.

Both the Ma and Church and Gandal models are equilibrium foreclosure models. That means that the merger and foreclosure decision are endogenous and foreclosed rivals have the opportunity to counter merge, thereby potentially undoing the disadvantage associated with being foreclosed. Even so, in both, foreclosure can arise in equilibrium. In Church and Gandal it is inefficient and harms consumer welfare. In Ma the effect on consumer welfare depends on how the upstream prices of nonintegrated firms change in response to a merger.

The insights of these two models on the value of a variety advantage likely apply to other settings where there is a fixed cost associated with providing (or obtaining) service and consumers value variety.   In particular, they point out the importance of counter strategies: explicit consideration of whether the foreclosed firm can also merge and foreclose with a complement supplier and/or whether barriers to entry into the complementary products are sufficient that a rival cannot introduce its own set of complements.

Portfolio Effects: Indirect Network Effects

The work of Church and Gandal shows that foreclosure can arise when it creates market power in the hardware market and there is not a counter-merger. Foreclosure involves a trade-off between lost software profits—from lost sales to the other system—in exchange for increased hardware sales and profits. A counter merger by the foreclosed system and

foreclosure by it would restore software parity, however, that creates an environment where the Cournot effect provides both firms with an incentive to aggressively price hardware and adversely affects profits. This precludes retaliation by foreclosure. Instead integration, but not foreclosing, is a more profitable form of retaliation. This partially harnesses the Cournot effect allowing credible lower hardware prices to offset a software disadvantage. Church and Gandal find that foreclosure arises when either hardware or software is relatively undifferentiated. When hardware and software are differentiated, foreclosure results in retaliation or is unprofitable.

Portfolio Effects: Complements Ex Ante, Substitutes Ex Post

Ma considers the competitive effect of vertical integration when downstream firms compete by bundling upstream products and enter into contracts with consumers under which consumers have the right to buy one of the products from the bundle.   In Ma's terminology consumers select option contracts from the downstream firms. Consumers are willing to select option contracts because they are uncertain, at the time they enter into the contracts, which of the goods in the bundle they will prefer.

The justification for consumers entering into contracts prior to knowing their valuation of the goods in a bundle is due to the fixed costs of providing consumers with any products. These fixed costs of providing consumers' access—or a connection—imply that there will not be a spot market in products that operates once valuations are revealed, since that would require consumers to have a connection with all service providers. For instance in cable television, consumers typically have access to only one cable distributor and cannot switch between multiple cable distributors who compete to provide television services at any instance. Instead, because of the fixed costs of connection, different providers of video programming compete by offering a range of programming and consumers make their selection on the basis of the range of potential programming and the cost of the connection.

Competition between service providers downstream is based on the expected value of their bundles. The value of a bundle depends on the prices and the variety of products offered. Assuming homogenous consumers, the downstream firm selected to provide service (by all consumers) is the firm that can offer the greatest expected surplus when it earns non-negative profits. This provides an integrated firm with an incentive to foreclose its rival, since that reduces the expected surplus of its rival's bundle and allows the integrated firm to charge a higher price and still monopolize the downstream market.

The foreclosed downstream firm could counter merge, putting it in a position to foreclose in retaliation and potentially restoring parity in the product offerings. However, Ma assumes that the expected value of one of the two products is greater. It follows that in a bilateral foreclosure equilibrium, the integrated firm with the inferior product would not be able to price sufficiently low to assure adoption without incurring loses. Consequently, the integrated firm with the inferior product will find it profitable to sell to its rival, rather than be shut out at retail. Retaliation does not restore the ex ante situation, just as it does not in Church and Gandal.

Whether foreclosure occurs depends on its profitability. Ma shows that foreclosure is profitable if at the pre-merger prices it is more profitable for the superior upstream product provider to foreclose and integrate, rather than supply both downstream firms. This is more likely to be true, the more competitive the upstream market and the lower pre-merger markups upstream.   If it is true that at premerger prices integration and foreclosure is profitable, then integration and foreclosure will likely be profitable, since integration lowers the costs of the integrated firm—by eliminating double marginalization—and the price response by its upstream rival is unlikely to make integration unprofitable.

7.   Coordinated Effects

The collective exercise of market power occurs when a group of firms coordinate their price increases to reduce the extent of substitution by their customers to each other. A

coordinated effect arises from a non-horizontal merger if post-merger firms, either upstream or downstream, are able to more effectively coordinate, either because it makes reaching a (tacit) agreement easier or makes enforcement more effective.

Vertical Merger

The hypotheses found in the economics literature on coordinated effects and vertical merger discussed are:

(i) *Elimination of a Disruptive Buyer and Enhanced Incentives to Coordinate*
The vertical merger eliminates a disruptive buyer, facilitating coordination upstream. The relevant fact set is (i) that the upstream market is sufficiently concentrated and has characteristics conducive to coordination; (ii) sales to the buyer are particularly important to upstream suppliers, perhaps due to its volume; and (iii) there is evidence that the buyer has been able to disrupt coordination by fostering price competition.

The reason for the enhanced incentive to cooperate created by vertical merger follows more generally from the fact that post-merger the integrated firm has more of an interest in raising the price upstream: higher input prices raise the costs of its rivals downstream, relaxing their competitive constraint on its downstream division, leading to enhanced market power and profits downstream. Vertical integration provides it with less incentive to deviate since it benefits more from upstream coordination. A vertically integrated firm is more likely to incur the costs of coordinating—lost profits from deviating today—because its benefit from doing so in the long run is greater—higher profits both up and downstream. While an unintegrated firm might not be willing to incur the costs of commitment (reduced output in the short-run), an integrated firm might be willing to do so. Dynamic considerations might make commitment profitable for an integrated

firm, even though it is not profitable for an unintegrated firm.[28] The greater the benefit of the downstream division from raising the costs of its rivals, the greater the effect a vertical merger will enhance incentives for an integrated firm to cooperate with coordinated pricing upstream.

(ii) *Enhanced Monitoring*

 Increased vertical integration may contribute to the ability of upstream firms to monitor each others pricing and identify deviations from coordinated outcomes. Coordination at the upstream level may be difficult because prices are not transparent. If transaction prices at the wholesale level (upstream market) are secret, then detection and punishment of deviations from the coordinated outcome will be difficult. Retail prices (prices in the downstream market), however, may be more visible, in which case extensive integration that allows for firms to monitor adherence to coordination through visible retail prices instead of unobservable wholesale prices will enhance coordination. Alternatively, if the extent of vertical integration is less, retail prices could be used to detect cheating at the wholesale level *if* variations in the retail price are attributable to fluctuations in wholesale prices. However, retail price fluctuations could also be attributable to changes in the costs of retailing. Vertical integration presumably provides the firm with information on the costs of retailing, allowing it to extract more information regarding wholesale prices from retail prices. Implicit in this argument are one of two assumptions: either the retail costs of different products/manufacturers differ or the costs of retailers differ and retailers are exclusive.

(iii) *Information Exchange*

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[28] Alternatively, an integrated firm might be willing to build a reputation for not supplying its downstream rivals, i.e., foreclosure, even though an unintegrated firm would choose not to because its benefit from doing so is less.

A vertical merger could enhance transparency by creating a conduit (the downstream subsidiary) for the exchange of information between upstream firms. Provided the downstream subsidiary post-merger continues to purchase from the upstream rivals of the vertically integrated firm, the potential exists for the downstream division to transfer information regarding the prices and offers of those rivals to its upstream division.[29] There are three necessary conditions for information exchange under these circumstances to facilitate coordination. These are that the information has to be projectable (believed to be an accurate indication of prices offered to other buyers), it must be unique (not readily and verifiably available from other sources), and the input market must be conducive to coordination. Even if these three conditions are satisfied, it is not clear how useful the information will be for coordinating upstream input suppliers if the conduit is one way—from rival upstream firms through the downstream subsidiary to the upstream subsidiary of the vertically integrated firms—and only the information set of the vertically integrated firm is enhanced.

On the other hand a vertical merger might well create a maverick firm that disrupts coordination upstream. This will be the case if the vertical merger creates asymmetries among the upstream firms.

Conglomerate Merger

Two hypothesis are explored on how a conglomerate merger could enhance the effectiveness of coordination.   The first is that an acquisition of complements can change bundling and tying opportunities, and by doing so, change the sustainability of coordination.   If the outcome from tying or bundling has a negative impact on the profits

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[29] The focus here is on one way communication—from the rival upstream firm, through the downstream subsidiary to the upstream subsidiary of the vertically integrated firm. The possibility exists that the downstream subsidiary acts as a two way conduit that facilitates explicit collusion. We do not consider this further, based on the recognition that this type of behaviour is reachable under the antitrust laws. The concern here is with the vertical merger creating conditions which facilitates coordination which is not reachable—typically—under laws prohibiting conspiracy to lessen competition.

of a rival, then regardless of whether it is profitable for the conglomerate, the use of bundling/tying makes credible punishment for deviation from a coordinated outcome more severe.

The second hypothesis is that a conglomerate merger might give rise to multimarket contact. Multimarket contact arises when firms compete against each other in multiple markets. Multimarket contact makes coordination easier by making reaching an agreement easier and/or making enforcement more effective. It makes coordination easier because it makes firm more symmetric and increases the extent of their interaction. It enhances the sustainability of coordination by either allowing for more severe punishments, since punishments can be across more than one market, or by enhancing detection when prices or output are not public information.

If markets differ with respect to any factor that influences the coordinated payoffs, the punishment payoffs, or the detection of deviations, there is the potential for multimarket contact to enhance coordination provided perfect coordination is not possible in it is absence in each market alone. Factors that allow for multimarket contact to promote coordination, include differences in the number of firms; differences in market growth rates; differences in detection lags; random demand fluctuations; and cost asymmetries.

As the number of markets in which the firms interact increases, the less an impediment imperfect monitoring of rivals' prices and outputs is to coordination.   Increases in multimarket contact increase the amount of information available and by facilitating detection of cheating enhance the expected strength of punishment, and thereby make coordination more effective.

Caveat

The difficulty with the application of coordinated effects theories, but especially those involving a conglomerate merger, is demonstrating that in any particular transaction coordination will be enhanced by the identified avenue. This requires identification pre-

merger of the firm that is the limit on the extent of coordination—because it is just indifferent between coordinating and deviating—and then showing that that after the merger through one of the avenues identified above its incentives have changed, i.e., it is now willing to support a more coordinated outcome, while at the same time no other firm is willing to support a less coordinated outcome.

8. Conglomerate Mergers: Financial Implications

The implications for competition are explored when a conglomerate merger eliminates a capital constraint on the acquired entity. The acquired firm post-merger has access to internally generated funds and no longer needs to access capital markets, or can do so on substantially better terms than its rivals. The literature on the interaction between product and financial markets is extensive. The report focuses on two hypotheses that link financial structure (financial leverage) of a firm and capital constraints to product market competition.

Financial Leverage

The first hypothesis relates to the effect of financial leverage. Leverage occurs when a firm finances its activities not just through shareholder equity, but also by issuing debt. Consideration of the firm's financial structure has implications for the objective of the firm.   Rather than maximize the profits of the firm, the argument is that the firm will instead be interested in maximizing the return to equity.   Exploring when this is true and what its implications are for firm behaviour is an active research agenda.   An assessment of this literature suggests, however, that the initial hypothesis—that leverage makes a firm more aggressive—is likely not the case. The theoretical and empirical consensus appears to be that leverage makes firms less aggressive, in which case the elimination of capital constraints will likely enhance competition.

Financial Predation

The second hypothesis is that capital market imperfections that result in limits to firms access to finance makes them vulnerable to predation. In order to continue to access

capital markets their financial performance must be satisfactory. Hence if a conglomerate merger eliminates the capital constraint in a market where the rivals of its acquisition are capital constrained, the conglomerate may have incentives to engage in predation. The factual circumstances consistent with financial predation are (i) the prey depends on external financing; (ii) the financing of the prey depends on its performance; (iii) predation reduces the prey's performance sufficiently to threaten continued financing of the prey and therefore its viability; (iv) the predator is aware and understands the reliance of the prey's external financing on its initial performance; (v) the predator can finance its predatory activities internally or does not have the similar constraints as the prey.

The difficulty in bringing suit to enjoin a conglomerate merger case based on a theory of financial predation is that the action is prospective. This means that the enforcement agency has to demonstrate *not* that the merged firm has engaged in a "scheme of predation and supporting evidence" ((i) to (v) above). Rather it will have to demonstrate that post-merger the firm will have the *ability* and the *incentive* to engage in predation: (i) to (v) must be established ex ante, not ex post, and the profitability of predation demonstrated, i.e., recoupment. Finally, the initial condition for considering such a case theory is that the conglomerate merger creates an asymmetry in access to internal funds which creates the precondition for financial predation.

Efficiencies

The focus of the report is on   identifying theories of anticompetitive harm associated with non-horizontal mergers. The last section of the report briefly discusses some of the efficiency advantages associated with vertical integration, exclusive dealing, and tying. The proposed framework suggested for dealing with non-horizontal mergers requires that after an anticompetitive effect is indicated, the parties to the transaction have an opportunity to demonstrate that the efficiency benefits from the transaction are greater than, and will offset, the harm associated with the increase in market power—according to either a consumer welfare standard or a total welfare standard. Much of the

controversy associated with non-horizontal merger enforcement arises from the widely held view that anticompetitive harm from such a transaction is unlikely (and if present is difficult to identify) and therefore that the motivation for non-horizontal mergers is not to enhance or preserve market power, but to realize efficiencies. In general efficiencies can arise because enhanced coordination made possible by the non-horizontal merger allows for (i) production efficiencies and savings; (ii) internalization of vertical externalities and alignment of incentives; and (iii) transaction cost savings, including mitigating opportunistic behaviour.

Table of Contents

Section

1.0   Introduction

The European Commission, as an initial step towards the publication of enforcement guidelines with respect to vertical and conglomerate mergers, has commissioned this study on the economics of vertical and conglomerate mergers. The objectives of this study are the following:

(i) To provide a review of the economic literature on vertical and conglomerate mergers.

(ii) To provide a synthesis of this literature that can be used as a foundation for determining appropriate antitrust enforcement policy towards vertical and conglomerate mergers.

1.1   Definitions

A horizontal merger occurs when the products of the merging firms are in the same antitrust market, i.e., are significant competitive constraints upon each other pre-merger. Non-horizontal mergers occur when the products of the parties to the transaction are in separate antitrust markets. A useful taxonomy for non-horizontal mergers is to distinguish between vertical and conglomerate mergers.

In a vertical merger, pre-transaction, the firms are located at different stages of production or distribution, with one producing an input used by the other. Post-merger, the result is vertical integration and a single firm now performs both stages of production. A vertical merger replaces market transactions, where an input is traded between firms, with a transfer within the same firm.   As Perry (1989, p. 186) observes, while the replacement of a market transaction with internal exchange is the "observational content of vertical integration, it does not fully capture the essence of vertical integration. Vertical integration, also means the ownership and complete control over neighboring stages of production or distribution."

Conglomerate mergers are neither horizontal or vertical. It is useful to adopt a three-way classification for conglomerate mergers based on the relationship of the products involved. These are complementary product mergers, neighboring markets, and unrelated products.

Closely related to vertical mergers, is the case where merging firms produce complements.[30] In these instances, customers "assemble" complements into systems that are ultimately consumed. The distinction between vertical and complementary mergers is based on the assembler. In vertical mergers it is a downstream firm that buys complements from upstream producers and "packages" them for consumers. In a complementary product merger, it is the consumer that buys the set of complements and assembles them for consumption. Because both vertical and complementary product transactions involve acquisition of complements—which the various stages in a production chain can be viewed as—the economics of mergers between producers of complements is often alleged to be similar to that of vertical mergers.

A second type of transaction involving related products occurs when the products of the firms are not complements, but are in "neighboring" markets. In some cases there may be advantages associated with providing consumers with a range of products. While the products in a range are substitutes or independent, demand at the level of the firm may depend on the extent of its product range. Where the locus of competition between firms involves consumers considering the range of products produced by a firm, then from the perspective of the firm the products will be complements. In addition, it may be the case that the products are independent of each other, but are generally sold to the same set of

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[30] Complementary goods are consumed together: this distinguishes them from substitute goods. In the case of substitute goods the consumer at the margin makes an either or choice: one more unit of good i or one more unit of good j. If goods i and j are complements then they are consumed together and a decision to increase consumption of i is typically associated with an increase in the consumption of j as well. Technically, in the case of complements when the price of i decreases consumers will buy more of good i and good j. In the case of substitutes when the price of i decreases consumers will buy more of good i and less of good j. In what follows we often assume that i and j are perfect complements in which case they are consumed in fixed proportions.

consumers, i.e., they are not substitutes but they share the same distribution channels and as a result are sold to the same pool of consumers.[31]

A "pure" conglomerate merger involves the acquisition of products that are not related on the demand or supply side. The products involved are not significant substitutes (i.e., do not have a horizontal relationship), the products are not part of a customer/supplier transaction between the parties to the transaction (a vertical relationship), and the products are not complements or in neighboring markets.

1.2   Overview of the Report

This report consists of six sections besides this introductory section. Section 2 considers the competition policy concerns and a framework for analysis of non-horizontal mergers. Section 3 considers the economics and competition policy analysis of vertical mergers. Section 4 brings together a number of literatures to consider the economics and competition policy implications of transactions involving complements and/or neighboring products. The analysis in Sections 3 and 4 considers only how a non-horizontal merger would increase the market power of the merging firm. Section 5 considers the implications of non-horizontal mergers for the coordinated exercise of market power. Section 6 considers the implications of conglomerate mergers on the incentives for predation and the implications for competition if such a merger affects financial leverage. Section 7 briefly considers efficiency rationales for non-horizontal mergers.

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[31] Here the "consumers" might be retailers and because of fixed costs associated with dealing with a manufacturer/wholesaler, retailers have a preference to minimize the number of manufacturers/wholesalers they deal with.

2.0 Competition Policy and Non-Horizontal Mergers

2.1 Antitrust Concerns

Antitrust concerns typically arise only if a non-horizontal merger results in an increase in market power. A firm's ability to exercise market power is constrained by its customers' ability to substitute to products supplied by competing firms. The extent of demand-side substitution depends on whether consumers can, and will, switch to other products in response to a price rise (or other manifestation of market power). The extent of supply-side substitution depends on whether consumers can find alternative suppliers of the same good in response to a price increase (or other manifestation of market power). A firm can exercise market power if these possibilities for substitution are limited, and likely to remain so, for an extended period of time. Both substitution possibilities are summarized by a firm's elasticity of demand.[32]

A horizontal merger may lead to an increase in market power if the effect of the merger is to eliminate a significant avenue of substitution. A unilateral effect arises if the products of the merging firms place significant competitive constraints on each other. If substitution to products produced by *B* constrains the market power of the brands produced by *A*, then by eliminating that constraint, a merger between *A* and *B* might lead to an increase in market power by the combined firm and a substantial lessening of competition. Post-merger the merged firm will internalize cross-price effects: it will have an additional incentive to increase the price of the products of *A* which are substitutes for the products of *B* since doing so will raise demand for, and profits from, the *B* firm substitutes. A similar incentive exists for the pricing of the products of *B*—to the extent they are substitutes for the products of *A*.

Alternatively, a horizontal merger might facilitate the interdependent exercise of market power if the elimination of a competitor facilitates the ability of the remaining firms in

the market to more effectively coordinate their behaviour and limit supply side substitution.   The collective exercise of market power occurs when a group of firms coordinate their price increases to reduce the extent of substitution by their customers to each other. The ability of a supplier to increase its price by reducing the amount it supplies depends on the ability of other suppliers to make up for the reduction in supply and the demand-side substitution possibilities available to the customers of the firm. The ability and incentive for a supplier to increase its output at prevailing prices imposes a similar constraint on the ability of other suppliers to exercise market power. However, if all suppliers simultaneously raise their prices they relax the constraints exerted on the ability of each to profitably raise prices. In the context of merger analysis the issue is whether a merger makes it easier, post-merger, for the remaining firms, or some subset, to enhance coordination and the exercise of market power.

For non-horizontal mergers the two possible avenues for the increase in market power are the same, but the mechanisms are not as obvious. For instance, in a unilateral effects case the non-horizontal merger must result in the products of other producers no longer being as attractive substitutes as they were pre-merger, resulting in a decrease in the integrated firm's elasticity of demand. This might result because the products of competitors post-merger have a lower quality or higher prices. The literature on the anticompetitive rationales and effect of non-horizontal mergers surveyed in this report are based on identifying how the transaction changes incentives and/or constraints on the merged firm, thereby enhancing its market power.

2.2   Historical Context

In proposing a framework for the analysis of vertical mergers, Riordan and Salop (1995, p. 513) observed that the antitrust treatment of vertical mergers "has been highly controversial." In the 1960's and early 1970's the antitrust treatment of vertical mergers in the United States was very restrictive, highlighted by court decisions such as *Brown*

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[32] The elasticity of a firm is the percentage decrease in its sales quantity when it increases its price by one percent.

Shoe[33] and *Ford-Autolite*[34] and formalized in merger guidelines issued by the U.S. Department of Justice.[35] The antitrust treatment of vertical mergers was based on the idea of market foreclosure: after a vertical merger, some buyers and some sellers would be precluded from the market. Buyers would not have access to the vertically integrated firm's supply and sellers would not have access to the vertically integrated firm's downstream demand.

By the late 1970's and early 1980's, the legal hostility towards vertical mergers had withered under criticism that the economic foundations of the prevailing foreclosure theory were dubious at best. This cumulated with a marked reversal in the U.S. Department of Justice merger guidelines issued in 1982 and 1984 in which foreclosure theory was abandoned. Instead those guidelines identify three types of concern: (i) potential for the vertical merger to raise entry barriers by requiring two-stage entry;[36] (ii) the possibility that the vertical merger will enhance coordination and the collective exercise of market power; and (iii) that the vertical merger is a means to evade effective price regulation.[37] In the 1980s enforcement by the antitrust agencies was limited to a handful of cases.[38]

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[33] *Brown Shoe Co. v. United States,* 370 U.S. 294 (1962).

[34] *Ford Moter Co. v. United States,* 286 F. Supp. 401 (1968), affirmed 405 U.S. 562 (1972).

[35] In *Brown Shoe and Ford-Autolite* the U.S. Supreme Court prohibited vertical mergers between two shoe companies, Brown Shoe (the third largest retailer and fourth largest shoe manufacturer, its market share in manufacturing was 4%) and Kinney (the largest retailer with a 1-2% share of national shoe sales and the twelve largest manufacturer with a 0.5% market share); and a maker of ignition systems (Autolite with a 15% share of sparkplug production) and an automobile manufacturer (Ford with a 10% share of sparkplug purchases). The 1968 U.S. Merger Enforcement Guidelines suggested that a merger between a supplier with a 10% market share and a purchaser who accounted for 6% of demand upstream would be challenged unless there were no barriers to entry. See Morse (1998) for a detailed history of vertical merger enforcement in the United States.

[36] The two-stage entry theory could be viewed as a "reconstituted foreclosure theory". Morse (1998, p. 1225).

[37] See Fisher and Sciacca (1984) for a detailed discussion of the history of enforcement in the United States and an analysis of the 1968, 1982, and 1984 merger guidelines.

[38] Morse reports two FTC cases (1998, p. 1224), while Riordan and Salop mention one Department of Justice case and a separate FTC case (1995, p. 514).

Under the Clinton administration, however, there was renewed interested in vertical merger enforcement. This enforcement has, to some extent, been based on theoretical developments in economics associated with Post-Chicago analysis. The rise in enforcement has been contentious among both practitioners and academic observers. In Europe recent non-horizontal merger enforcement in a number of high profile cases, not the least of which was General Electric's attempted acquisition of Honeywell, has resulted in considerable controversy.

Within this debate, the objective of this report is to identify logically consistent theories of anticompetitive harm in the economics literature and consider the circumstances under which they are applicable. In this respect, the foundation that economic analysis can provide for guidelines depends on its conclusions. There are two possibilities, the difference between which is illustrated by considering the difference between the guidelines governing horizontal and vertical mergers in the United States.

The horizontal guidelines map concern over the competitive implications of a horizontal merger from pre-merger observable indicators of market structure—the Herfindahl-Hirschman Index (HHI) and, to a lesser extent, barriers to entry. The link from these structural characteristics to the exercise of market power is often interpreted as a presumption, a presumption that is based on the average behaviour expected in a market with those characteristics.[39] The presumption underlying the link between structure and the competitive implications of the merger can be challenged on the basis that the structural evidence is inconsistent with expected behavior post-merger. The vertical merger guidelines on the other hand, indicate situations when a vertical merger would raise concerns and why, but does not indicate the structural conditions pre-merger under which the enforcement agencies would prosecute. Instead they present a set of theories

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[39] The Cournot model predicts a link between the HHI and the exercise of market power in an industry. The link, however, depends on the elasticity of demand. See Church and Ware (2000, p. 239). The presumption in the horizontal guidelines, however, is predicated on the relationship between concentration and the coordinated exercise of market power.

of anticompetitive harm and indicate circumstances consistent with those theories which suggest further investigation might be warranted.

It has been suggested that because of their nature, the vertical merger guidelines are not guidelines at all. In this view guidelines should encapsulate rules which define the circumstances when a vertical merger is presumed to raise antitrust concerns and when it is not. That is, the guidelines should identify key variables that can be observed pre-merger and the relationship between those variables and the market power implications of a vertical merger. Unfortunately, it does not appear to be possible to provide such a mapping for vertical mergers.[40] Indeed the validity of this approach to horizontal mergers has been questioned.[41] An alternative to this approach is instead to base antitrust enforcement guidelines, but especially those applicable to vertical mergers, on a "structured" rule of reason approach.[42] This approach recognizes the fact that vertical integration is ubiquitous and, whether through growth or merger, typically efficiency enhancing. However, it also recognizes that per se legality is inappropriate. There are circumstances where antitrust analysis of a non-horizontal merger is warranted. The role of guidelines is to inform the antitrust community and businesses of those circumstances.

2.3   A Framework for Analysis

The analytical approach under a structured rule of reason consists of the following stages:

(i) *Market Power Screen*

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[40] Not that it has not been tried. See Riordan and Salop (1995) for a recent attempt and the reaction by Reiffen and Vita (1995). An earlier attempt is Fisher and Sciacca (1984). The difficulty with following such an approach are (i) that the empirical relationships applicable to any situation are simply not available; (ii) they are not likely to be available because the search for such regularities is not a very active research agenda and the differences across markets likely matter.

[41] See the discussion below in Section 6 on coordinated effects.

[42] See Beckner and Salop (1999) and Hylton and Salinger (2001) for a discussion of designing optimal rules for decision making in antitrust that reflect the costs of decision making, especially uncertainty regarding facts. The structured rule of reason approach has recently been proposed to determine the legality of tying arrangements. See Evans, Padilla, and Salinger (2003). In the context of vertical mergers, see Scheffman and Higgins (2003).

The first stage involves assessing whether exercise of market power is possible post-merger. This will involve market definition and assessment of barriers to entry. The concern here is not with market power as conventionally defined by economists—the ability to raise price above marginal cost—but with antitrust market power. Antitrust market power is significant and durable, where significant means prices exceed average cost and durable means that these prices can be sustained in the long-run. In the context of non-horizontal mergers the focus will usually be on the exercise of market power in which consumers participate, i.e. downstream, or retail, markets.

(ii) *Theory of the Case and Factual Screen*

The second stage involves identifying a coherent theory explaining why the non-horizontal merger would maintain, enhance, or create market power downstream (i.e., higher prices, reduced variety, etc. for consumers). Coherence means that the firm will find it profit-maximizing to engage in the conduct made possible by the merger that gives rise to the anticompetitive effect. Moreover, the facts of the case must be consistent with the theory. Consistency with the theory will require demonstrating that the behaviour of the firm post-merger alleged to be anticompetitive is in fact profit-maximizing.

(iii) *Efficiencies*

The third stage involves an assessment of offsetting efficiencies realized because of the non-horizontal merger. Only if the efficiencies do not offset the anticompetitive effects of the non-horizontal merger is antitrust enforcement warranted. In this context the anticompetitive effects depend on whether it is a consumer welfare standard or a total welfare standard that is the relevant objective for competition policy. If it is a consumer welfare standard, then the trade off between efficiencies and market power

depends on the net effect on consumer surplus, which in the absence of changes to quality or product variety, involves an assessment of the effect on the price paid by consumers.[43]   If it is the total welfare standard, then the trade off between efficiencies and market power depends on the effect of the vertical merger on total surplus.[44]

Stages one and two have been presented sequentially. In practice they are likely to constitute a simultaneous exercise: the theory hypothesized to be applicable will indicate the relevant market in which to look for market power.

The balancing exercise in stage three is likely to be costly and subject to error. As a result it should only be entered into if both of the first two stages indicate a concern. The primary role of this study is to identify the theories of anticompetitive harm associated with non-horizontal mergers (stage two) and the factual circumstances when they are applicable.

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[43] Consumer surplus is a measure of the gains from trade that accrue to consumers. It is the sum over all units of the difference between what a consumer was willing to pay for a unit less what they actually had to pay for that unit.

[44] Total surplus is the sum of producer and consumer surplus. Producer surplus is the difference between revenues and avoidable costs: it is a measure of the gains from trade that accrue to firms. When economists observe that a conduct is inefficient, they mean that it results in a decrease in total surplus. Because consumer and producer surplus are dollar measures of changes in welfare, when total surplus decreases from a change, for instance a vertical merger, then those made better off by the change—the winners— could not compensate those harmed by the change—the losers—and still be better off, i.e., winners. An efficiency enhancing change increases total surplus, implying that winners could compensate losers and still be better off. It does not imply that compensation will be paid, only that the change creates enough wealth that it could be.

3.0   Vertical Mergers

In this section the literature on the anticompetitive effects of vertical mergers is surveyed and assessed. Theories of the anticompetitive effect of a vertical merger depend on either raising the costs of rivals or reducing the revenue of rivals. A third alternative, not formally modeled in the economics literature, locates the harm from a vertical merger in enhanced coordination.[45]

The hypothesis associated with raising rivals' costs typically involves input foreclosure. Input foreclosure occurs when post-merger the price of the upstream input rises, raising the costs of competing downstream firms. This relaxes the competitive constraint on the integrated firm that has access to the input at marginal cost. The price of the input rises because the integrated firm either stops supplying competing downstream firms (complete foreclosure) or does so at a higher price (partial foreclosure). The hypothesis is that the integrated firm has an incentive to change the behaviour of its upstream division post-merger because it will internalize the effect on downstream prices when setting its optimal price in the market for the input, i.e., it will recognize that there is an additional benefit from raising its input price, which is higher downstream profits from an increase in prices and market power downstream. In either the complete or partial case, the increase in the input price can be due either to a unilateral effect or a coordinated effect attributable to the change in behaviour of the integrated firm upstream.

The hypothesis associated with reducing rivals' revenues typically involves customer foreclosure. Customer foreclosure occurs when, post-merger, the downstream division of the integrated firm no longer sources supply from independent upstream firms. If this leads to a reduction in sales volume and that sales volume reduction leads to an increase in the average cost or marginal cost of upstream competitors, then, to the extent there is exit (from higher average costs) or reduced competitive vigor (from increased marginal

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[45] At least not until very recently. Nocke and White (2004) formally model the role of vertical mergers in facilitating coordination upstream. See Section 5.0 and discussion therein.

costs) the competitive constraint these firms exert on the upstream division of the integrated firm will be reduced, leading to greater market power upstream and higher input prices. The higher input prices, in turn can result in input foreclosure downstream.[46]

Figures 1 and 2 illustrate the simplest case.[47] Suppose there are two upstream producers (U_1 and U_2) and two downstream firms (D_1 and D_2). Initially all four firms are independent from each other and both downstream firms can source supply from either or both upstream firms. In Figure 1 a commercial relationship is illustrated with an arrow. Suppose there is a merger between U_1 and D_1. Then in Figure 2 the two dotted arrows correspond to input and customer foreclosure. Input foreclosure occurs when U_1 ceases to supply or discriminates in its supply to D_2. Customer foreclosure occurs when D_1 ceases to source supply from U_2.

In both cases—input and customer foreclosure—the traditional antitrust concern regarding foreclosure, as described above, is based on the concern that vertical merger and the resulting integration allows a firm with market power in one market to *leverage* that power into a separate market. Input foreclosure, for instance, would involve a monopolist upstream integrating downstream and then discriminating in the supply, or refusing to supply, the input to competing downstream firms.

The models discussed in this section assume that upstream and downstream are identifiable. Identifying whether firms are upstream or downstream is usually

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[46] Normally we would expect the downstream price to increase, but in the case where input markets are local and the downstream market global, the effect of the increase in cost will be a reduction in output in the local market, not an increase in price. On the other hand, input foreclosure could lead to customer foreclosure. Input foreclosure gives the vertically integrated firm a cost advantage downstream, which leads to an expansion in its market share. This increase in market share reduces the demand for its unintegrated rivals upstream. If there are economies of scale upstream, this indirect demand effect, combined with a commitment by the integrated firm not to buy from upstream rivals, could induce their exit.

[47] All figures and tables are found at the end of the report.

unambiguous when it is based on the timing of production.   Two alternative suggestions have been made by Salinger (1989): (i) when there are variable proportions in the final good, the firm that chooses the input proportions should be the downstream firm; and (ii) based on the direction of trade. The problem with (ii) is that trade might be two way. One of the examples provided by Salinger is that crude oil refineries purchase crude oil, but some oil producers purchase refining services. In this case, however, the ambiguity disappears if up and downstream are instead identified on the basis of the timing of production—oil is upstream and refined products are the downstream industries.

If, however, the downstream market is perfectly competitive, i.e., downstream services are available at marginal cost and the upstream firm(s) have market power, where up and downstream are based on the timing of the production process, then the economic analysis is identical regardless of which stage of production is treated as up or downstream.   Suppose that the two activities involved in producing a final good for consumers are X and Y, where X is produced prior to Y and hence is an input. Let X be monopolized and Y be perfectly competitive. Then the upstream (inverse) demand for X is simply the (inverse) market demand for Y less the marginal cost of production of Y.[48] Alternatively, let X be downstream, in the sense that X buys Y from the competitive Y sector. The downstream (inverse) demand for X will be final market (inverse) demand, but the X monopolist's marginal cost curve will be shifted up by the marginal cost of Y. The profit maximizing price and output chosen by the X monopolist will be invariant to whether it is considered upstream or downstream. In one case its (inverse) demand curve shifts down by the price of Y, while in the other case its marginal cost shifts up by the price of Y.[49]

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[48] The demand curve shows the amount willing to be purchased at a given price. The inverse demand curve shows what the price must be for that amount to be purchased voluntarily.

[49] Rey and Tirole (2003) identify up and downstream in the case of perfect complements by which firms sell to final consumers, i.e., those that sell to other firms are upstream, those that sell to final consumers are downstream.

In the following sections these allegations regarding the anticompetitive effect of a vertical merger are critically assessed by considering whether, and when, they correspond to equilibrium outcomes in the economics literature. Section 3.1 considers the traditional/Chicago view that vertical mergers are likely welfare enhancing. The remaining two sections consider recent game theoretic contributions that relax the assumptions underlying the models upon which the Chicago view is based. Section 3.2 focuses on input foreclosure, while Section 3.3 considers customer foreclosure.

3.1   The Traditional/Chicago View

The evaluation of the competitive effects of vertical mergers has traditionally been based on two models. These are "the successive monopoly" model where pre-merger there is a monopoly both upstream and downstream and the monopoly leverage model where there is a monopolist upstream, perfect competition downstream, and the technology fixed proportions.[50]   The implications of both of these models are that the effects of a vertical merger are likely welfare enhancing.

3.1.1   The Successive Monopoly Model

The successive monopoly model is applicable when there is a monopolist up and downstream.[51] It shows that vertical integration is a Pareto Improvement: both consumers and the firms are made better off if there is a vertical merger.   Both are made better off for the same reason. Under vertical integration the downstream division faces the true marginal cost of production for the upstream input, while under vertical separation, the marginal cost of the downstream firm is larger because the price it pays for the upstream input, to the extent the upstream monopolist exercises market power, includes a mark-up over cost. The decrease in the marginal cost downstream due to

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[50] Perfect competition means that the downstream firms are not able to exercise any market power. Instead they are price takers who believe that the price they receive is independent of the amount they produce and sell. A common assumption made in the literature on vertical mergers is that downstream production involves fixed proportions. This means that a unit of downstream output requires 1 unit of the upstream product and X units of other inputs, where typically $X = 1$, i.e., only one unit of the other input is required.
[51] The double marginalization model originates with Spengler (1950).

vertical integration provides the firm with a profit incentive to expand output and lower prices.

To see this formally, suppose that there is a monopolist upstream and a monopolist downstream. Production downstream involves fixed proportions. A unit of downstream output requires a single unit of the upstream input and a bundle of other inputs whose cost is c. If the price of the input is p^{US}, then in the absence of integration, the marginal cost downstream, mc^{DS}, equals $p^{US} + c$. Suppose that the cost of producing the input is constant per unit and equal to mc^{US}. The model assumes that the downstream monopolist is a price taker in the input market.[52]

The downstream monopolist profit maximizes by producing an output level that equates its marginal revenue to its marginal cost:[53]

$$MR^{DS}(Q^{DS}) = p^{US} + c \qquad (1)$$

The assumption of fixed proportions means that the quantity of the input demanded by the downstream firm equals its output: $Q^{US} = Q^{DS}$. As a result we can rewrite (1) as

$$p^{US} = MR^{DS}(Q^{US}) - c \qquad (2)$$

which is the derived (inverse) demand curve for the upstream monopolist. It shows how much the downstream monopolist is willing to pay for the input as its quantity demanded changes.

The upstream monopolist will set its profit-maximizing price by producing the level of output that equates its marginal revenue, based on (2), equal to its marginal cost of

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[52] This is a common assumption made in the literature. It abstracts away from issue of bargaining in the case when both the upstream (monopoly) and downstream (monopsony) firm attempt to exercise market power in the upstream market.

[53] The profit maximizing level of output is found by setting the marginal revenue—the increase in total revenue from selling another unit—equal to its marginal cost. The marginal revenue for the monopolist is less than price, since revenues increase from the price received for the marginal unit, but decrease because in order to sell the marginal unit, price has to fall on it and all previous units to induce consumers to purchase one more unit.

production.   The equilibrium in the successive monopoly model is shown in Figure 3 where the demand downstream is indicated by $p^{DS} = D(Q^{DS})$.

If there is a vertical merger, leading to vertical integration between the upstream and downstream firm, the marginal cost of the integrated firm will be the sum of $mc^{US} + c$. The effect of the vertical merger is to reduce the marginal cost of downstream production and, as expected, this leads to a decrease in the price of the downstream good.

The integrated firm profit maximizes by producing where its marginal revenue equals its marginal cost:

$$MR^{DS}(Q^{VI}) = mc^{US} + c. \tag{3}$$

Since marginal revenue is declining in quantity, comparing (1) to (3) shows that a vertical merger leads to an increase in output and a lower price to consumers. The increase in joint profits from the output expansion equals the difference between marginal revenue and marginal cost downstream summed up over the increase in output.

The vertically integrated equilibrium is also shown in Figure 3. The increase in aggregate profits is the lightly shaded area. This area is the sum for each of the units of output between Q^{DS} and Q^{VI} of the difference between the integrated firm's marginal revenue and marginal cost, i.e., marginal profit. The increase in output results in a decrease in price, which benefits consumers, from P^{DS} to P^{VI}.

In this model vertical integration benefits both the firms and consumers, since it leads to a decrease in downstream marginal cost. When the firms are separate there is double marginalization. The upstream monopolist sets her price above marginal cost. The downstream monopolist also marks his price up above his marginal cost, which includes the upstream monopolist's mark-up.   Intuitively, the problem is a vertical pricing externality. When the downstream firm raises its price, it compares its marginal benefit—the increase in revenues from inframarginal units—to its marginal cost of

raising price—the decrease in profits from the marginal units lost due to the price increase.[54] It does not take into account that the upstream firm also loses profits on the lost marginal units. It takes into account only its lost margin, $p^{DS} - (c + p^{US})$, but not the lost margin of the upstream firm on the same unit, $p^{US} - mc^{US}$. The integrated firm when setting its profit-maximizing price realizes that the lost margin equals $p^{DS} - (c + p^{US}) + p^{US} - mc^{US} = p^{DS} - (c + mc^{US})$, the sum of the upstream and downstream margin. Because the vertically integrated firm realizes that the lost profit per unit from a higher price for it is larger than the lost profit per unit of the downstream firm under vertical separation, it has an incentive to charge a lower price.

3.1.2 Monopoly Leverage

The monopoly leverage model establishes "the single profit theorem". This result states that there is only one monopoly profit and therefore that a monopolist cannot increase its profits by leveraging its monopoly power into a competitive downstream market. It can realize its monopoly profits by charging the appropriate price in the market in which it is a monopolist: integrating downstream into a competitive market does not increase its market power or profits, and if anything might reduce its profits if it is a high-cost supplier downstream.

The monopoly leverage model associated with the Chicago School assumes (i) identical downstream firms; (ii) downstream production is fixed proportions; (iii) an upstream monopolist; (iv) the absence of price regulation; and (v) perfect competition downstream. The model is not robust to changing any one of these assumptions. As

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[54] Inframarginal units are units of output that it continues to sell at the higher price. The marginal units are units lost because of the price increase. The marginal benefit of the price increase—the increase in profits from raising the price is Q. The marginal cost of the price increase equals $[p - c]\dfrac{dQ}{dp}$, the product of the margin and lost sales. At the profit-maximizing price, the sum of these two has to equal zero. This rule for the profit-maximizing price is equivalent to finding the profit-maximizing quantity by finding the quantity for which marginal revenue equals marginal cost.

discussed relaxing any one of these assumptions destroys the single profit result, providing an incentive for vertical integration based on market power.

Denote the price charged downstream by a vertically integrated monopolist as p^{VI}. Then the profit per unit of the vertically integrated firm equals $p^{VI} - mc^{US} - c$. Suppose instead that the upstream monopolist is not vertically integrated and there is perfect competition downstream. Then the downstream price will equal the marginal cost of production downstream: $p^{DS} = c + p^{US}$, where p^{US} is the upstream firm's price.

In these circumstances the profit maximizing price of the upstream monopolist is to set its upstream price such that the downstream price is the same as if it was vertically integrated downstream: $p^{US} = p^{VI} - c$. If it charges this price, the marginal cost of the downstream firms will equal p^{VI} — and since the assumption of fixed proportions insures that sale of the upstream input equals sales of the downstream good, the quantity demanded will be the same as the vertically integrated quantity. Its profit per unit will be $p^{US} - mc^{US} = p^{VI} - c - mc^{US}$, which is identical to the profit per unit it would earn if it were vertically integrated. The downstream price, quantity, and the profits of the monopolist are identical whether the monopolist integrates or not. If it integrates it provides the downstream services and incurs cost c. If there is vertical separation, competitive downstream firms provide the downstream activity and incur c. The monopolist earns the monopoly profit by raising the input price and hence their costs of production.

This model forms the basis for the single monopoly profit critique of the leverage theory of vertical integration. There is only one monopoly profit (based on the firm's position as the sole supplier of the upstream input), vertical integration does not increase profits, and a vertical merger is not required to realize monopoly profits. Intervention to stop the vertical merger would not benefit consumers and in fact is likely to be detrimental.

The reason is that if the vertical merger is not motivated by the incentive to increase profits through leverage, the rationale for the vertical merger must be based on realizing efficiencies that lead to lower per unit costs. Lower per unit costs, whether upstream or downstream, lead to an increase in the monopolist's profit and it can further increase its profits by increasing sales, which it can do only by lowering the price to consumers, thereby making them better off as well.

The single monopoly profit theory is not robust to changes in its underlying assumptions. We have already seen that market power downstream (a monopolist) provides an incentive for integration, though again it appears to be welfare improving.   In what follows we consider the robustness of the critique of leverage theory to (i) variable proportions in downstream production; (ii) homogenous downstream firms; and (iii) price regulation.

Rationalizing Input Usage

If production downstream involves variable proportions, cost minimizing downstream firms will choose their input ratio on the basis of relative factor prices.[55] Cost-minimizing downstream firms will substitute away from higher priced inputs to lower priced inputs to minimize their costs.[56]   When an upstream monopolist exercises market power, it raises the cost to downstream firms of its input above its marginal cost of production. If there are variable proportions, downstream firms try to mitigate this increase in the cost to them of the monopolized input by substituting to other inputs, leading to a reduction in demand (and utilization of the monopoly supplied input). Compared, however, to the case where the monopolized input is priced at its marginal cost, the marginal cost of the downstream product will still be higher, despite input substitution, when market power is exercised by the upstream monopolist. Consequently, vertical separation results in higher

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[55] For a more detailed summary and cites to the literature see Perry (1989).
[56] Cost minimization requires that the input ratio be chosen where the ratio of factor prices equals the ratio of marginal products.

costs and a reduction in aggregate profits. A vertical merger would eliminate this cost inefficiency and raise aggregate profits.

A vertical merger between the upstream monopolist and one of the downstream firms will result in the downstream good being produced efficiently: the input will be provided at its marginal cost without a mark-up and the integrated firm will not have an incentive to substitute away from efficient input proportions. As a result its costs will fall relative to the other downstream firms. However, if this is true with respect to one of the downstream firms, it is true with respect to all of them. Hence we would expect that the upstream firm would merge with all downstream firms to minimize costs of production by forestalling inefficient input substitution. If this were the only effect, the benign view of vertical mergers would be maintained.

Unfortunately, it is not the only effect. The input substitution by the unintegrated firms also limited the exercise of market power by the upstream monopolist. Eliminating the downstream firms ability to substitute lowers the cost of production downstream, but also replaces competition downstream with a monopolist who can exert market power in the downstream market. If the cost decrease from reversing the inefficient input substitution is larger (smaller) than the market power effect, prices downstream will decrease (increase). The gain associated with using efficient input proportions depends on the elasticity of substitution in production. The price increase in the downstream market depends on the elasticity of demand. Even in the case where prices downstream rise and consumer welfare (surplus) decreases, total surplus might also increase: the loss to consumers from higher prices is less than the gain to the vertically integrated firm from reducing costs and raising prices.

Heterogeneous Uses for the Input
If the input supplied by the upstream monopolist is used in many different industries and the value marginal product—which determines willingness to pay for the input—varies across industries, then the input monopolist will have an incentive to integrate to effect

price discrimination. [57] In the absence of integration and effective arbitrage the upstream monopolist will not be able to charge higher prices for the input to high value users and lower prices to low value users. It is restricted to charging both groups the same price.

Vertical integration or vertical merger into the low value use can eliminate arbitrage and enable the monopolist to price discriminate. If it is a monopolist in the input, then it can monopolize the low value use by implementing a price squeeze on the independent downstream firms in the low value use.   A price squeeze involves lowering the price of the downstream good with the low value use, while raising the price of the input. The input monopolist only offers the input for sale at the higher price, based on the willingness to pay of the high value users. In conjunction with the low price that the monopolist charges low value users, this makes it unprofitable for independent downstream firms to supply low value users and they are forced out of the market.

In general the welfare effects of a vertical merger motivated by, and which implements, price discrimination are ambiguous. [58] Profits increase, and assuming competition downstream, prices downstream in the low value market fall and prices in the high value downstream market rise. Efficiency may rise or fall: a necessary condition for total surplus to rise is an increase in output.[59] In general, the effect on consumers in aggregate

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[57] The monopolist in this case will find it profit maximizing to engage in third-degree price discrimination. It would like to charge a higher price to groups with relatively inelastic demands and a lower price to groups with relatively elastic demands. This pricing pattern reflects the difference in demand side substitution possibilities across different groups. The assumption in most of this literature is that the downstream markets are perfectly competitive. More recent contributions, including Katz (1987) and Yoshida (2000) consider downstream market structures which are imperfectly competitive. However, their focus is on the effects of price discrimination within a market based on cost differences of the downstream firms, not differences in substitution across downstream markets.

[58] See Varian (1989) for a summary of the welfare effects of third-degree price discrimination.

[59] The technical condition for when output will expand—a necessary but not sufficient condition for total surplus to increase—is found in Varian (1989, p. 623). It depends on the curvature of the demand curves. An increase in output is necessary: if aggregate output was unchanged —which is true if demand curves are linear—then total surplus must fall since under price discrimination, gains from trade are still possible, while under uniform pricing they are exhausted. These unexhausted gains from trade arise because under price discrimination, the distribution of output across markets is not efficient. The last unit sold to the high value users has a greater value than the last unit sold to the low value users. Under uniform pricing these values are equal.

is also ambiguous, but we do know that the surplus of the high type falls and the surplus of the low value users rises.

However, if under monopoly pricing, one of the markets is not served, then price discrimination will be a Pareto improvement. In this case, the uniform monopoly price is based on the willingness to pay of the high types only: the low types are excluded by the high price. Hence under price discrimination the price charged the high types is the same, but the low types are now also served, increasing their surplus and the profits of the firm. This case arises when there are large differences in willingness to pay across groups and the size of the low value users is small.

Evading Price Regulation

If the market power of the upstream monopolist is effectively controlled by price regulation, then it has an incentive to try and circumvent this restraint on its market power and profit by vertically integrating downstream.[60] Vertically integrating downstream gives it the ability to realize its monopoly profits in a downstream unregulated market by (i) discriminating against other downstream firms in the provision of the input or (ii) engaging in cost misallocation whereby the costs of the downstream division are "attributed" to the regulated upstream division.

Escaping an effective regulatory constraint in the regulated market using anticompetitive discrimination by vertical merger involves (i) merging with a downstream firm that uses the regulated product as an input; (ii) discriminating against competitors in the downstream market by lowering the quality of their input, raising their costs of using the input, or, in the extreme, not supplying them altogether. If the regulated firm is able to do these two things, it will be able to raise its price for the downstream good above the level that would prevail in the absence of its integration and discrimination strategy. It is

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[60] See Church and Ware (2000) Chapter 26 and references therein for a more detailed discussion.

through its profit margin on sales of the downstream good that it exercises its upstream market power and earns monopoly profits.

An alternative strategy available to a monopolist that subverts effective cost-based regulation is to enter a downstream market with the intent of reallocating costs from the downstream market to the regulated upstream market. This has the effect of relaxing the price constraint in the regulated market and increasing profits—provided costs are only reallocated from competitive markets and not increased. Transferring costs increases the price in the regulated market and the profits from doing so are realized in the unregulated market. The transferring of costs creates or widens the differential between the revenues and accounting costs of the regulated firm in the unregulated market.

Efforts by the regulated upstream monopolist to escape a regulatory constraint on its monopoly power, by vertical merger with a downstream firm that enables it to engage in discrimination or cost misallocation are typically inefficient, leading to either higher prices for consumers in the downstream market (discrimination) or in the upstream market (cost misallocation).   In addition since both strategies can put competitors in the downstream market at a disadvantage, they can result in a transfer of market share from the independent downstream firms to the vertically integrated firm that is inefficient if the independent firms have lower costs downstream than the integrated firm. The cost misallocation strategy puts competitors in the downstream market at a disadvantage if it involves marginal costs. In this case the regulated market provides a "cross-subsidy" to the downstream market with the result that the monopolist can behave downstream as if its marginal cost is lower. This may be an effective means for the regulated firm to commit to aggressive behavior post-entry and result in entry deterrence or exit in the downstream markets leading to higher prices downstream for consumers as well.

3.1.3   *Antitrust Policy Implications of the Traditional Models*
The successive monopolization model suggests that a vertical merger between monopolies up and downstream is efficiency enhancing. The leverage model suggests a

potential concern with a vertical merger when there are (i) variable proportions downstream, (ii) it is a potential means to implement third degree price discrimination, or (iii) when it is a means to evade price regulation.

Variable Proportions

In the case of variable proportions, Perry (1989) concludes that while we should not expect the downstream price to fall thereby benefiting consumers, the loss in total surplus is likely relatively small. He argues, "it is not clear that variable proportions raises a major policy issue on vertical integration." (p. 192) Fisher and Sciacca (1984, p. 21) conclude that a determination of the impact of a vertical merger on consumers is difficult since

> . . . the final product price may increase or decrease as the net result of both efficiencies and increased market power, depending on some highly complex relationships. Indeed, the conditions are so complex and the measurement problems so formidable that it is virtually impossible to forecast reliably which result is more likely in any given case. Certainly the technical conditions do not seem to relate to any obvious or measurable quantity that one could translate into usable merger guidelines . .

Given the costs associated with increased firm size from vertical integration,[61] vertical integration "is a relatively drastic solution to what is primarily a pricing problem." (Perry 1989, p. 192) Perry's point is that there are many just as effective vertical restraints and alternative pricing schedules, e.g. a two-part tariff, that eliminate the inefficiencies associated with variable proportions and avoid the costs of vertical integration.

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[61] The inefficiencies from expanding the size of the firm are typically related to incentive problems created by increased firm size. See Church and Ware (2000, Chapter 3) for a summary of the costs associated with increasing the size of a firm.

Price Discrimination

Vertical merger is consistent with the implementation of price discrimination under the following conditions: (i) there are a number of different uses for the upstream input, with differing elasticities of demand; (ii) arbitrage between firms in different markets is effective, thereby preventing the monopolist upstream from being able to institute price discrimination without incurring the costs associated with vertical merger. The price discrimination rationale is more likely to the extent that there is in fact a monopolist upstream. If there is an oligopoly upstream, then the prevention of arbitrage requires some minimal level of integration industry wide, a level which depends positively on the capacity constraints of the unintegrated firms. Without this level of integration, arbitrage from unintegrated suppliers upstream to unintegrated elastic buyers downstream would prohibit the price squeeze of the vertically integrated firms implicit in price discrimination. Moreover, in the oligopoly case, it requires a commitment by the integrated firms not to supply the elastic/low value market.[62]

Evading Effective Price Regulation

The use of a vertical merger to escape effective price regulation is a legitimate concern. However, it is not clear that it is necessarily a legitimate concern on which to base antitrust enforcement. Presumably concerns regarding the behaviour of a firm to escape regulatory constraint on its market power can be more easily addressed by the regulatory authority. In some instances, however, this may not be within their authority or, alternatively, this authority is not being exercised. In these instances antitrust action might be warranted.[63]

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[62] The issue of whether the vertically integrated firm will sell to downstream competitors in the elastic market is central to the modern analysis of the competitive effectives of vertical merger. See Section 3.2 for details and analysis.

[63] This seems to be the policy stance in Section 4.23 of the *Non-Horizontal Merger Guidelines* (1984) in the United States. Interestingly, the example provided there is based on transfer pricing and the incentive for a downstream monopolist to integrate backwards into an input supplier. The regulated firm is able to evade the regulatory constraint downstream by engaging in cost misallocation through transfer pricing. It

3.2   Input Foreclosure: Creating Market Power Downstream

Recent developments in the economics literature of vertical mergers have been based on the observation that the two traditional models do not address the effect of a vertical merger on remaining unintegrated competitors, since in neither model are there unintegrated firms either upstream or downstream post vertical merger. Hence these models are not able to address concerns regarding foreclosure: How does a vertical merger affect competition in the upstream and downstream markets? The modern theories of the anticompetitive effects of foreclosure address this question by assuming imperfect competition both up and downstream.

There are three main branches to the modern literature that consider input foreclosure. The first of these explores the hypothesis that a vertical merger leads to an increase in the price of the input to non-integrated downstream firms, thereby increasing market power and profits downstream for the integrated firm.   These papers consider the potential for vertical integration to raise rivals' costs downstream, and in doing so create market power for the vertically integrated firm downstream. The seminal works in this branch are Salinger (1988) and Ordover, Saloner, and Salop (1990).   The key distinction between these two, and the literatures that follow each, is the nature of the competition in the downstream market. Salinger, and the contributions which follow it, assumes that competition in the downstream market involves strategic substitutes, while Ordover, Saloner, and Salop assume that competition in the downstream market involves strategic complements.[64]

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pays inflated prices and only buys from its upstream affiliate, thereby relaxing any cost-based regulatory constraint downstream and earning its monopoly profits on sales of the input.

[64] Competition involves strategic substitutes when an increase in the activity level of firm i reduces the marginal profitability of the activity level of firm j. When competition involves strategic substitutes an increase by i will result in a decrease by j. Competition involves strategic complements when an increase in the activity level of firm i increases the marginal profitability of the activity level of firm j. When competition involves strategic substitutes an increase by i will result in an increase by j. Typically the activity level will be either output if there is Cournot competition or price level if competition is Bertrand. Moreover, it is usually the case that under Cournot competition, output levels are strategic substitutes and under Bertrand competition, prices are strategic complements.

The second branch follows from the work of Hart and Tirole (1990) and is based on the idea that a monopolist upstream cannot credibly commit not to supply more than one downstream firm when the contractual terms between the monopolist and the downstream firms are unobservable or unverifiable. As a result vertical integration arises as a means for the upstream monopolist to commit not to supply other competing downstream firms, thereby preserving its monopoly power upstream by monopolizing the downstream market.

The third branch considers situations where a downstream monopolist or dominant firm is able to preserve its market power by monopolizing the upstream market for a key input. In particular, this literature exams the incentives for an existing firm with market power downstream to outbid potential entrants to acquire control of inputs that would enable entry. These models, which focus on the potential and profitability of existing downstream firms to preempt entry by maintaining control of essential inputs required for entrant, consider the potential for vertical acquisitions to maintain the market power of the vertically integrated firm downstream.

3.2.1　Raising Rivals' Costs: Strategic Substitutes

In this section, the literature that begins with Salinger (1988) and includes Gaudet and Long (1996), Schrader and Martin (1998), Higgins (1999), and Avenel and Barlet (2000) is discussed. The assumptions of these models are similar to those that underlie the Chicago critique, except that the up and downstream market structure is oligopolistic. Competition both up and downstream is assumed to be over quantities: the firms are Cournot competitors.[65] The focus of the models is on considering the incentives and effects of vertical integration when there is market power up and downstream pre-merger and post-merger, there will be unintegrated competitors.

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[65] When competition is over quantities, firms simultaneously make an output choice. It is referred to as Cournot competition after A. Cournot, who was the first to consider quantity competition between oligopolists.

The simplest case is shown in Figures 1 and 2. There are only two firms up and downstream and initially all firms are independent. The effects of a vertical merger between U_1 and D_1 are determined by comparing the equilibrium prices in Figure 1 with the equilibrium prices in Figure 2. The Salinger model assumes that the integrated firm does not participate in the upstream market as either a buyer or seller.

The effect of the vertical merger is to introduce a cost asymmetry between the two downstream suppliers. The marginal cost of the integrated firm falls since it now acquires the input at marginal cost. The marginal cost of its unintegrated competitor will be larger, since it will continue to pay a mark-up to the upstream supplier. Indeed, it might appear that its marginal cost should increase: prior to the merger the two upstream firms competed to supply it, but post-merger it is only supplied by U_2.

The effect of the vertical merger on the upstream price depends not only on the supply effect associated with U_2 becoming a monopolist. It also depends on the demand by D_2 for the input. The elimination of double marginalization means that the integrated firm will expand its output downstream. Ceteris paribus this reduces the residual demand and marginal revenue of its unintegrated downstream rival, which in turn reduces its profit maximizing downstream output and hence demand for the input. This demand effect suggests that the upstream price could fall. Whether the upstream price increases or decreases depends on whether the supply effect—the increase in market power of the unintegrated upstream firms—dominates the demand effect—the decrease in demand from the unintegrated downstream firms. Moreover, even if the upstream price increases—which Salinger defines as foreclosure—the downstream price might still decrease: the output expansion of the integrated firm could be greater than the output contraction of its unintegrated downstream rival.

The Salinger model has served as the base for a number of extensions. These extensions consider the sensitivity of the Salinger model: (i) to the assumption that vertically integrated firms will not participate in the upstream market (Gaudet and Long 1996; Schrader and Martin 1998; Higgins 1999); (ii) endogenizing the decision to merge—rather than consider the effect of, and incentives for, a vertical merger using comparative statics, the decision to merge is a choice made by firms and a vertical merger will occur only if it is profitable, based on its effects (Gaudet and Long 1996; Higgins 1999); and (iii) considering whether the commitment by the vertically integrated firm not to participate in the upstream market can be the result of vertical integration changing the incentives for firms to adopt specific technologies that preclude upstream market participation (Avenel and Barlet 2000). Endogenizing the merger decision based on its profitability also introduces the possibility of counter-mergers by foreclosed firms.

Salinger

The Salinger model assumes that the upstream output is produced at constant unit cost (mc^{US}), production downstream is fixed proportions, requiring one unit of the upstream input and one unit of a competitively supplied input whose cost is c. There are N^{US} upstream firms and N^{DS} downstream firms. Of these, there are n integrated firms where $n \leq \min[N^{DS}, N^{US}]$. The marginal cost of an integrated firm is $mc^{US} + c$, while the marginal cost for an unintegrated downstream firm is $p^{US} + c$. The exercise of market power upstream by the unintegrated firms that supply their downstream counterparts means that $p^{US} > mc^{US}$ and is the source of the cost asymmetry downstream. Demand downstream is assumed to be linear: $p^{DS} = a - bQ^{DS}$.

Salinger assumes that competition upstream and downstream is Cournot: firms compete by simultaneously selecting output. The Salinger model makes two assumptions regarding "vertical conjectures". A vertical conjecture pins down the vertically integrated firms' beliefs regarding the behaviour of other firms upstream and downstream

when they transact in the upstream market. Salinger assumes (i) that if a vertically integrated firm sells another unit of the upstream good, that, consistent with Cournot, the other upstream producers' output is unchanged, but the output of a downstream firm increases by one; and (ii) that if a vertically integrated firm buys another unit of the upstream input, its demand is met by an expansion of output upstream by one and downstream production by the other firms is unchanged. This last assumption is similar to assuming that downstream producers are price takers in the upstream market and expect supply to be perfectly elastic. The effect of this assumption is to preclude the downstream firms from raising the cost of their rivals by acquiring all of the upstream suppliers. Cournot competition both up and downstream implies that in equilibrium market power will be exerted in both markets and hence that $p^{DS} > p^{US} + c$ and $p^{US} > mc^{US}$ or $p^{DS} - c > p^{US} > mc^{US}$.

The effect of the assumptions regarding vertical conjectures and equilibrium exertion of market power is that integrated firms will not participate in the market for the upstream good. Buying a unit of the intermediate good is not profit maximizing, since a vertically integrated firm can produce the good at marginal cost and market power upstream implies that the price of the upstream good exceeds its marginal cost. Moreover, selling a unit of the intermediate good is not profit maximizing. If the firm were to sell one less unit of the intermediate good and instead use it to increase its sales by one unit in the downstream market, total output downstream would not be changed nor would the downstream price. The change in the integrated firm's profits will be $\Delta\pi = p^{DS} - c - p^{US}$ which is positive, indicating that it makes greater profits selling a unit of output in the downstream market than in the upstream market. This is true not just for the marginal unit, but for all units supplied by the integrated firm in the upstream market. Hence the integrated firm can increase its profits by not selling in the upstream market.

Since the unintegrated downstream firms are price takers in the market for the upstream good, the downstream Cournot equilibrium will depend on the upstream price p^{US}. As it

increases, the output of unintegrated downstream firms will decrease and the output of integrated firms downstream will increase. Since there are fixed proportions, the equilibrium output of the unintegrated downstream firms equals their demand for the upstream input. The upstream equilibrium among the unintegrated upstream suppliers is Cournot based on the demand of the unintegrated downstream firms. Consequently, the downstream equilibrium price and quantities depends on the number of unintegrated upstream suppliers, the number of unintegrated downstream firms, and the number of integrated firms.

The effect of a vertical merger is found by asking how the equilibrium price in the upstream market, and the equilibrium price and quantity in the downstream market change, as the number of vertically integrated firms change. The effect on the upstream price of having another integrated firm depends on three effects. The loss of a supplier suggests that the upstream price should rise, however this is offset by two factors. First, the integrated firm is no longer a demander of the upstream input. Second, the derived demand by the remaining unintegrated firms decreases since the elimination of double marginalization means that the integrated firm's downstream output will increase. This increase decreases the residual demand of the unintegrated downstream firms. Whether the upstream price rises or falls depends on the interplay of these three factors.[66]

Salinger defines input foreclosure from a vertical merger as an increase in the price of the upstream good. He argues that it is an economically meaningful definition since it captures the harm done to downstream firms from the elimination of an input supplier attributable to a vertical merger.

However, even if the price upstream increases, so there is foreclosure, the price downstream still might decrease. The increase in the upstream price when there is foreclosure results in a contraction of output by the unintegrated downstream firms.

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[66] The customer foreclosure effect is not formally in Salinger's model because it assumes linear demand.

However, the elimination of double marginalization for the integrated firm (it now acquires the upstream good at marginal cost rather than p^{US}) means that its output will increase. The effect on the downstream price depends on which effect dominates. Of course if the intermediate good price falls, then the effect of the vertical merger is to lower the downstream good price, as the costs of both the integrated and unintegrated firms downstream will decrease. Salinger shows that if the number of downstream firms is less than the number of upstream firms, a vertical merger leads to lower prices downstream. For the downstream price to rise, the number of downstream firms must be sufficiently larger than the number of upstream firms and more than half of the upstream firms must already be integrated. In these circumstances the effect of raising downstream rivals' costs has a significant effect on downstream market power.

Of considerable interest in the Salinger model is that most vertical mergers are not profitable: the profits of a vertically integrated firm are less than the sum of the stand-alone profits of the upstream and downstream firm premerger. For instances when the number of final (downstream) goods producers is between 5 and 10 and the number of intermediate (upstream) goods producers is between 3 and 15, Salinger reports that there is not a single vertical merger that is profitable *and* leads to a higher price downstream *except* when there is complete foreclosure, and even then only if the number of upstream firms is 7 or less and more than a single firm downstream is excluded. The non-profitability of vertical merger indicates that typically the reduction in profits upstream—from discontinuing sales upstream—exceeds the gain in profits downstream from raising rivals' costs and cost reduction from elimination of double marginalization.

Complete foreclosure occurs when the number of integrated firms is one less than the number of upstream firms, i.e., prior to integration there is a monopolist upstream. Another vertical merger eliminates the only remaining unintegrated upstream firm and reduces the number of firms downstream to the (smaller) number of upstream firms. The equilibrium when there is complete foreclosure corresponds to the Cournot equilibrium where all firms have the same marginal cost equal to $mc^{US} + c$. Integration is profitable

and has negative implications for downstream consumers in this case when the exit of unintegrated downstream suppliers that it induces creates sufficient market power downstream.[67] Whether sufficient market power will be created depends on the number of firms induced to exit. It is more likely the greater the number of unintegrated downstream firms.

3.2.2   Raising Rivals' Costs: Extensions to the Salinger Model

The extensions considered here, as indicated above, consider the robustness of Salinger's results to alternative vertical conjectures for the integrated firms that do not imply that participation in the upstream market is not profitable; endogenizing the vertical merger decision based on profitability; and considering whether the commitment to complete foreclosure—by not participating in the upstream market can result from a profit-maximizing decision by the vertically integrated firm(s) to adopt a specific technology that precludes participation in the upstream market.

Endogenizing the Merger Decision and the Credibility of Complete Foreclosure:
Extensions by Gaudet and Long and Higgins

Gaudet and Long (1996) and Higgins (1999) [GLH hereafter] examine whether it is credible for the vertically integrated firms to withdraw from the upstream market. They suggest that more reasonable vertical conjectures adopted by the vertically integrated firms imply that withdrawal is not credible: the vertically integrated firms have an incentive to participate in the upstream market. The integrated firms do have an incentive, however, to decrease supply relative to unintegrated firms in order to increase the price in the upstream market and, through the effect on their rivals' costs, their profits downstream. Moreover, it might be the case that rather than withdrawal from the upstream market as suppliers, the vertically integrated firms will instead have an incentive to engage in strategic purchases. Strategic purchases mean that they

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[67] Salinger's assumption of complete foreclosure by each integrated firm means that when all upstream firms are integrated, there is no supply for unintegrated downstream firms. The assumptions are similar to a perfect group boycott by the integrated firms of the unintegrated downstream firms.

deliberately overbuy in the upstream market in order to raise the price of the upstream input, and hence the costs of their downstream unintegrated rivals.   This has more of an effect on the upstream input price than simply withdrawing.

GLH also allow for the endogeniety of vertical mergers. This means that they must be profit-maximizing and that unintegrated firms disadvantaged by vertical mergers by their rivals can adopt a counter-strategy. In the simplest case, shown in Figure 2, suppose there is a vertical merger by U_1 and D_1. The counter-strategy available to U_2 and D_2 is to also vertically merge.   If the stand alone profits of U_2 and D_2 —their aggregate profits from remaining separate—are less than the profits they would realize by responding to a vertical merger by also vertically merging, then they can and will respond to foreclosure by doing so. This will affect the profitability of, and therefore the incentives for, a merger by U_1 and D_1.

The GLH analysis demonstrates that the equilibrium market structure depends on the relative number of firms up and downstream. Regardless of the pattern of firms, their combined analysis suggests, however, that from the perspective of either consumers or total welfare, there are too few vertical mergers. This result has obvious implications for antitrust policy.

The work of GLH suggests that vertical integration in this model is always efficiency enhancing and beneficial to consumers. Holding the number of downstream firms constant, while increasing the extent of vertical integration leads to fewer producers subject to double marginalization and reduces the incentives for the vertically integrated firms to engage in strategic behaviour to raise the price in the upstream market.   Both mean that the price downstream is decreasing in the extent of vertical integration.

The GLH setup is identical to that of Salinger, with the following exceptions: (i) the model consists of two stages and (ii) the nature of the vertical conjectures. In the first

stage firms choose whether to vertically integrate. In the second stage upstream (integrated and unintegrated) firms first play a Cournot game (simultaneously select quantities) based on anticipated downstream demand, and then the downstream firms, given the price set for the upstream input, engage in Cournot competition. In contrast to Salinger, the integrated firms participate in the upstream market and *in fact not only are they allowed to participate, the modeling is general enough that they are allowed to either be sellers or buyers in the upstream market*. The key difference is that the vertically integrated firms do not believe that the price of the upstream good is invariant to their sales and purchases. Instead rather than this price taking (Bertrand) assumption, they assume that the other producers of the input will hold their output fixed (Cournot). If the vertically integrated firm sells one more unit upstream, the price will have to fall such that an unintegrated downstream firm will be induced to buy it. If it buys an additional unit, the price of the upstream good will rise to clear the market, reducing supply downstream.[68]

The models of GL and Higgins differ in the timing of the first stage. In GL the firms make their merger decisions simultaneously. In Higgins the merger decisions are sequential.

Following the logic of the GLH model, we discuss it in two stages, beginning with the second stage where the firms compete in quantities given the pattern of vertical integration and then the first stage where firms make their integration decisions, anticipating the effect of their decisions on the incentives for other firms to integrate and on equilibrium output, prices, and profits in the second stage. The equilibrium to the first stage requires first determining the equilibrium in the second stage for all possible combinations of integrated and unintegrated firms.

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[68] See also Schrader and Martin (1998) and Higgins (1999). Schrader and Martin characterize the assumptions made by Salinger as Cournot conjectures by vertically integrated firms to their input sales and Bertrand conjectures by vertically integrated firms to their input purchases. The Gaudet and Long, Schrader and Martin, and Higgins assumptions are Cournot conjectures by the vertically integrated firm to both upstream sales and purchases.

GLH—Second Stage Quantity Equilibrium

In the absence of any integrated firms the equilibrium to the production stage is relatively straightforward. The N^{DS} downstream firms' marginal cost is $c + p^{US}$ and given linear demand and homogenous output, the Cournot equilibrium determines each firm's output and aggregate output as a function of marginal cost, and, in particular, p^{US}. Given fixed proportions, aggregate downstream output equals the demand for the upstream input. Increases in p^{US} raise marginal cost downstream, reducing each downstream firm's output and demand for the upstream good. Given the derived demand, quantity competition by the upstream firms determines the upstream price and quantity supplied. In the non-integrated case, oligopoly in both the upstream and downstream markets implies the exercise of market power in both markets and the vertically separated structure involves double marginalization.

When there are more upstream firms than downstream firms and full integration, i.e., every downstream firm has a source of internal supply for the upstream good, then there are no transactions in the upstream market. Downstream firms can acquire the upstream good internally at marginal cost, the unintegrated upstream firms have zero sales, and the downstream equilibrium corresponds to the Cournot outcome with N^{DS} firms who each have marginal cost $c + mc^{US}$. Relative to the situation where all firms are separate, the fully vertically integrated outcome has a lower downstream price, precisely because double marginalization is eliminated by integration for all downstream firms.

The interesting case corresponds to the so-called off diagonal when there are some integrated firms and some unintegrated firms. In this case, the integrated and unintegrated firms compete in quantities in the downstream market. The marginal cost of the integrated firms is $c + mc^{US}$. The marginal cost of the unintegrated firms is $c + p^{US}$. The Cournot equilibrium will be asymmetric: the quantity and profits of the integrated firms will be greater, because of their lower costs, than the unintegrated firms. The

greater p^{US}, the greater the marginal cost of the unintegrated downstream firms and the larger their relative disadvantage vis-à-vis the integrated firms. The Cournot equilibrium quantities will be functions of p^{US}. Denote the equilibrium output of an integrated firm as $q_i^{DS}(p^{US})$ and aggregate downstream output of the integrated firms as $Q_i^{DS}(p^{US})$. Denote the equilibrium output of an unintegrated firm downstream as $q_s^{DS}(p^{US})$ and aggregate downstream output of the unintegrated firms as $Q_s^{DS}(p^{US})$. Aggregate output downstream is $Q^{DS}(p^{US}) = Q_i^{DS}(p^{US}) + Q_s^{DS}(p^{US})$.[69]

The market demand for the upstream good equals the aggregate output of the unintegrated firms. In the upstream market, the profits of unintegrated upstream supplier j are

$$\pi_j^{US} = [p^{US}(Q_s^{DS}) - mc^{US}]q_j^{US}$$

where $p^{US}(Q_s^{DS})$ is the inverse demand of the downstream-unintegrated firms for the upstream input. The profits of vertically integrated firm i are

$$\pi_i^{VI} = [p^{DS} - mc^{US} - c]q_i^{DS} + [p^{US} - mc^{US}]s_i$$

where s_i are its sales in the upstream market. However, s_i is not restricted to be positive, if it is negative, then the integrated firm is a net buyer of the input, realizing a loss of $[p^{US} - mc^{US}]$ per unit bought in the upstream market. Equilibrium in the upstream market requires that demand equal supply or:

$$\sum_i s_i + \sum_j q_j^{US} = \sum_k q_k^{DS}.$$

By increasing s_i, the vertically integrated firm will increase supply in the upstream market, reducing p^{US}. If it instead it buys the upstream good, it raises demand, leading to an increase in p^{US}.

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[69] We expect, given normal stability conditions, that while increases in p^{US} will increase $Q_i^{DS}(p^{US})$ the decrease in $Q_s^{DS}(p^{US})$ will be greater such that $Q^{DS}(p^{US})$ is decreasing in p^{US}.

In the upstream Cournot equilibrium, the unintegrated firms will profit maximize by producing a level of output which equates their marginal revenue equal to their marginal cost:[70]

$$p^{US} + \frac{dp^{US}}{dq_s^{US}} q_s^{US} = mc^{US} \tag{4}$$

In the upstream market, the choice variable for an integrated firm is the nature and extent of its participation in the upstream market s_i. It knows that it will choose q_i^{DS} optimally in the Cournot stage downstream and that in equilibrium, q_i^{DS} and p^{DS} will depend on p^{US}. Hence its profit at the time of the upstream choice over the extent of participation in that market is

$$\pi_i^{VI} = \pi^{DS}\left(q_i^{DS}(p^{US}), Q^{DS}(p^{US})\right) + [p^{US} - mc^{US}]s_i. \tag{5}$$

Its optimal choice for s_i will incorporate not only its marginal revenue and marginal cost in the upstream market, but also that changes in s_i will, through the equilibrium condition, affect p^{US}, and through it, the vertically integrated firm's profit in the downstream market. The profit maximizing condition for a vertically integrated firm is

$$\frac{\partial \pi_i^{VI}}{\partial s_i} = p^{US} + \frac{dp^{US}}{ds_i} s_i - mc^{US} + \frac{\partial \pi^{DS}}{\partial Q^{DS}} \frac{\partial Q^{DS}}{\partial p^{US}} \frac{\partial p^{US}}{\partial s_i} = 0. \tag{6}$$

The first three terms in (6) are marginal revenue and marginal cost in the upstream market. The last term is the effect increases in supply by the integrated firm have on its profits downstream. It is negative, since increases in s_i reduce p^{US}, increases in p^{US} reduce aggregate output, and increases in aggregate output reduce downstream profits. The vertically integrate firm therefore has an incentive to produce less than an unintegrated firm upstream: compare (4) to (6) with its extra negative term. Moreover if the effect on downstream profits are significant enough, it has an incentive to be a buyer in the upstream market, even though this involves paying more for a unit of the upstream

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[70] The first term on the left-hand side of (4) is the price from the marginal unit, the second term is the reduction in price required to sell one more unit multiplied by the number of units.

good than it costs it to produce a unit of the upstream good itself. In general it is willing to forgo profits in the upstream market to increase its profits downstream—in the extreme it is willing to incur losses in the upstream market to increase its profits downstream. The vertically integrated firms profits are higher than the sum of an unintegrated upstream and downstream firm. Its profits are larger because it obtains the input at marginal cost (thereby avoiding double marginalization) and because its strategic behaviour increases the cost to downstream producers.

The effect of increasing the extent of integration on the behaviour of the vertically integrated firms in the upstream market depends on the relative number of firms up and downstream. Gaudet and Long focus on the symmetric case ($N^{US} = N^{DS}$). When there are an equal number of upstream and downstream firms, a sufficient condition for net purchases in the upstream market by the integrated firms is that the number of non-integrated firms be at least as large as the number of integrated firms. The smaller the number of integrated firms vis-à-vis the number of unintegrated firms, the greater the benefit downstream from raising the costs of the unintegrated rivals. As the number of non-integrated firms downstream decreases, the effect on an integrated firm's profits of raising their costs is reduced. Hence as the number of integrated firms increases, holding constant the number of firms up and downstream, the integrated firms initially are net demanders, but eventually become net suppliers, with this supply first rising and then falling to zero as the industry is characterized by universal vertical integration.

Higgins also considers the asymmetric case where $N^{DS} > N^{US}$. The pattern of supply by the integrated firms is similar to the symmetric case, except that even with full integration the vertically integrated firms continue to supply their unintegrated downstream rivals. Complete withdrawal by all of the vertically integrated firms—the vertically integrated firms do not participate in the upstream market at all— only occurs when there is a single upstream firm that is integrated downstream. Thus as long as there is more than one upstream supplier, there will be net supply even if all upstream firms are integrated, provided the number of downstream firms exceeds the number of vertically integrated

firms.   The case of complete withdrawal corresponds to the successive monopoly model in that integration eliminates competition downstream and double marginalization, maximizing industry profits.[71]

The strategy of non-participation (complete foreclosure) in the upstream market is more profitable in equilibrium for the vertically integrated firm than overbuying (strategic purchases), but it is not credible. Consider the case of a duopoly upstream. Then if the vertically integrated firm declined to participate in the upstream market, the unintegrated upstream firm would be a monopolist. At the monopoly price upstream, however, the integrated firm finds it profit-maximizing at the margin to participate in the upstream market as a buyer.   However, this increases demand in the upstream market and the unintegrated monopoly supplier responds by increasing its output and price. In equilibrium the vertically integrated firm is made worse off than if it was able to commit not to purchase in the upstream market. While its downstream profits increase with the increase in the upstream price, their increase is not enough to compensate the vertically integrated firm for the reduction in profits from over-buying relative to non-participation.[72]

Gaudet and Long do not explicitly characterize the welfare results of vertical mergers. Higgins does, but only for the case when the number of downstream firms equals or exceeds the number of upstream firms.[73] Higgins shows that the price downstream is decreasing and total surplus is increasing in the extent of vertical integration.[74] The case when $N^{DS} < N^{US}$ is not as clear. Salinger shows that downstream price is decreasing if

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[71] As in the model of double marginalization, however, when a vertical merger leads to complete withdrawal it is efficient and beneficial for consumers.

[72] Of course its profits from overbuying would be higher if the unintegrated firm did not change its price. It is the incentive for the unintegrated firm to respond to the buying by raising its price which makes overbuying unprofitable relative to non-participation.

[73] Recall that in the Salinger model it is only in these circumstances when the downstream price might rise.

[74] Higgins demonstrates that this is true using simulation results for all n, N^{US} , and N^{DS} satisfying $1 \leq N^{DS} \leq 10$, $N^{US} \leq N^{DS}$, and $0 \leq n \leq N^{US}$ where n is the number of vertically integrated firms.

$N^{DS} < N^{US}$, but his analysis depends on the assumption of complete withdrawal. The conjecture is that the effect of allowing the vertically integrated firms to participate optimally in the input market will, just as it did for the case when $N^{DS} \geq N^{US}$ (compare Salinger to Higgins), make vertical merger more likely to be beneficial for consumers and total welfare. Simulation results show this to be true for $N^{US} = 2, 3, 5,$ and 10. If the number of integrated firms rises, holding the number of downstream producers constant, the number of downstream producers subject to double marginalization and the raising rivals' cost activities of the integrated firms declines, and so to therefore does the downstream price.

GLH assume that all firms up and downstream have the same marginal costs. In a Cournot equilibrium this means that they will all have the same output and market share. It is of some interest to consider the sensitivity of their results to asymmetric firm sizes ex ante. In Appendix 3 we consider the effect of a vertical merger when firms upstream have different marginal costs, in which case firms with lower marginal costs will have an advantage that translates into a larger market share and profits. The simplest case in which there are two upstream and two downstream firms is considered.

The analysis in the Appendix demonstrates that if the low cost dominant firm merges with one of the downstream firms, price downstream will fall. Three forces are at work which determine what happens to the downstream price. The elimination of double marginalization for the integrated firm lowers its marginal cost to that of the low cost upstream firm, which provides the integrated firm with an incentive to increase output downstream. The integrated firm also has an incentive to act strategically in the input market, either by reducing its supply or engaging in overbuying. This raises the costs of its rivals, reducing their output and pushes prices downstream upwards. Finally, the unintegrated rival downstream reduces its output in response to the expansion in output by the vertically integrated firm, and as a result its demand for the upstream good falls. If the low cost firm upstream integrates, the demand effect and elimination of double

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marginalization dominate the raising rivals' cost effect and the price downstream falls. As in the symmetric case of GLH a vertical merger is beneficial for consumers.[75]

GLH-Integration Decision in the First Stage the Symmetric Case

In the first stage of Gaudet and Long, the firms simultaneously decide whether to vertically integrate. The equilibrium in integration decisions requires that the profits of a vertically integrated firm would not increase if it were not integrated and the profits of a non-integrated upstream and downstream firm would also not increase if they vertically integrated.

For an equilibrium in which n firms are vertically integrated, the following two conditions are required:

$$\Pi^{VI}(n) \geq \Pi^{SA}(n-1) = \pi^{US}(n-1) + \pi^{DS}(n-1) \tag{7}$$

and

$$\Pi^{SA}(n) = \pi^{US}(n) + \pi^{DS}(n) \geq \Pi^{VI}(n+1)$$

where n is the number of vertically integrated firms, $\Pi^{VI}(n)$ the profits of an integrated firm when n firms are vertically integrated, $\Pi^{SA}(n)$ is stand alone profits for an independent up and downstream firm (it is the sum of the profits of an unintegrated upstream and downstream firm when n firms are vertically integrated), $\pi^{US}(n)$ the profits of an unintegrated upstream firm when n firms are vertically integrated, and $\pi^{DS}(n)$ the profits of an unintegrated upstream firm when n firms are vertically integrated. The first condition in (7) establishes that vertical integration is profitable relative to the stand alone profits of not merging. The second condition in (7) establishes that a pair of unintegrated firms do not have an incentive to vertically merge.

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[75] Moreover, it is also shown in Appendix 3 that a merger involving the high cost upstream firm will also result in a reduction in the price downstream.

When the number of firms upstream and downstream is equal, it is always an equilibrium for all firms to integrate. When there are four or fewer firms up and downstream it is a dominant strategy to integrate and all firms integrating is the unique equilibrium. When there are more than five firms up and downstream, there are two equilibria: either all are integrated or none are integrated. The profits of a pair of firms (one up and one downstream firm) are greater in the unintegrated equilibrium industry structure than in the integrated industry structure. Gaudet and Long demonstrate numerically that an industry structure where some, but not all firms are vertically integrated, is never an equilibrium.[76]

Whether foreclosure is an equilibrium phenomena depends on considering the incentive of all firms to vertically merge, not just the incentives of a single pair of upstream and downstream firms. To see this, suppose, for instance, that there are two upstream and two downstream firms. Consistent with the analysis above, if a pair of firms vertically integrate, their joint profits will rise since that eliminates double marginalization for that pair, and increases the cost of the input to the other downstream firm. However, this is not an equilibrium outcome. The profits of the unintegrated pair will increase if they too merge, thereby undoing the foreclosure effect of the first vertical merger. Post-merger the second pair will also transfer the upstream good at marginal cost and the upstream market will disappear. In this two by two case, downstream prices fall with each vertical merger. That is, the downstream price is the highest under complete vertical separation, falls with the first vertical merger, and then falls again when the second pair of firms find it profitable to counter merge.

Gaudet and Long show that vertical integration is a dominant strategy when the number of firms up and downstream is equal to or less than four. In these circumstances the structure of the model is similar to the Prisoners' Dilemma. Profits would be greater if

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[76] Gaudet and Long also investigate the equilibrium structure when there are equal up and downstream firms under the assumption that $s_i = 0$, i.e., complete foreclosure is assumed. They conclude that in these circumstances the only equilibrium is complete vertical integration.

neither pair of firms integrated, but each has an incentive to integrate regardless of what the other pair does. When the equilibrium industry structure is complete vertical integration, joint profits are less than when the structure is complete vertical separation. With successive n-firm oligopolies, the stand-alone profits of a pair of firms are always greater in the vertically separated industry structure than the profits of a vertically integrated firm when all pairs of firms are vertically integrated. However, as expected the transfer of the upstream input at marginal cost is good for consumers and efficiency: the downstream price is less in the vertically integrated structure than when there is complete vertical separation.

When there are five or more firms however, the structure of the game is no longer a Prisoners' Dilemma. Instead it is now a coordination game: there are two equilibria, either all firms are vertically integrated or none are. The firms, for the reasons discussed above, prefer the unintegrated industry structure.   When there are more than four firms downstream, a single integrated firm would engage in strategic overbuying: this is not to its advantage however, the profits of the integrated firm are less than its stand alone profits. The relatively large number of independent firms up and downstream mean that overbuying is not very effective upstream and its effect downstream is small. Consequently when all other firms are unintegrated, a strategy of vertical separation is more profitable: it commits the firm not to engage in costly overbuying in the upstream market.[77]

GLH-Integration Decision in the First Stage the Asymmetric Case
Gaudet and Long, briefly and incompletely, consider asymmetric cases when the number of firms upstream is not equal to the number of firms downstream. The effect of introducing asymmetries in the number of firms depends on which market has more competitors. When there are only two upstream firms and more than two downstream firms, then the equilibrium to the integration game depends on the number of downstream

firms. When there are three, full integration is the equilibrium; when there are four, then the result will be that one pair integrates; when there are five or more, the equilibrium entails complete vertical separation. When there is complete integration, the integrated firms continue to sell to the independent downstream firms (though the upstream price is greater than in the absence of integration). In the partially vertically integrated equilibrium, the vertically integrated firm is a net buyer in the upstream market. From the perspective of consumers, there is too little vertical integration. Recall that when the number of firms upstream is equal to or less than the number downstream, the downstream price is decreasing in the extent of integration.

In the opposite case when the number of downstream firms is limited to two and there are more than two upstream firms, the equilibrium to the integration game is quite different. Full integration is the only equilibrium, and unlike the other asymmetric case, the profits of the integrated firm are always greater than the combined profits of an unintegrated pair when no firms are integrated. Relative to the vertically separated industry structure, prices are also lower since in the vertically integrated industry structure, both downstream firm's have lower marginal cost. Before the merger wave there was double marginalization for both, which is eliminated through integration by both firms. Consumers are clearly made better off by the merger wave, the downstream price is minimized with two integrated firms accessing the input at marginal cost.

Gaudet and Long's modeling of the integration game assumes that both merger and non-merger decisions are irreversible. Higgins adopts a different specification, where firms make their decision sequentially in an arbitrary order, but only merger decisions are irreversible.[78] This means that if a pair of firms early in the sequence decides not to merger, it can change its decision after observing the decisions of other pairs of firms. In this formulation firms not only consider whether (7) is positive for them, but whether it

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[77] Gaudet and Long show that when complete foreclosure is imposed the equilibrium involves complete vertical integration.

will be positive for firms that follow. If it is, then the first pair of firms will not use (7) to determine the profitability of a vertical merger, but instead will compare its present stand alone profits to its profits in the equilibrium structure when (7) is no longer satisfied. If these are less, it will not (and neither will any other firm) initiate a wave of vertical integration. The difference in timing in the Higgin's model and the reversibility of non-merger decisions eliminates the Prisoners' Dilemma structure of Gaudet and Long. Complete vertical integration is never an equilibrium, since it leads to lower profits.[79]

The only case in which integration is an equilibrium involves integration by a single pair of firms, and this is always the case when there is a single upstream producer, leading to industry wide complete foreclosure.   When there are between 2 and 5 producers upstream and a greater number of downstream firms, a single vertical merger is the equilibrium structure.   If there are too many firms downstream and there are more downstream than upstream firms, a single vertical merger is not profitable.   On the other hand if there are too few downstream firms (again when the number downstream is greater than the number upstream) none of the upstream firms are willing to integrate, since they understand this will result in counter mergers and the ultimate industry structure will be full vertically integration and lower profits. For an intermediate range of firms, a single vertical merger is profitable and does not invite retaliation. The reason is that if a second pair integrated, it would invite retaliation by all others and a fully integrated structure, with profits less than the sum of stand alone profits when there is a single vertically integrated firm.

From the perspective of consumers, there is too little vertical integration.   Recall that when the number of firms upstream is equal to or less than the number downstream, the downstream price is decreasing in the extent of integration.

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[78] Higgins also only considers the case when the number of upstream firms equals or exceeds the number of downstream firms.

Avenel and Barlet

The extensions of the Salinger model by GLH suggest that the assumption of complete foreclosure is not credible, i.e., profit-maximizing. Instead in equilibrium the vertically integrated firm would engage in partial foreclosure (reducing supply to raise the price) or strategic purchases (becoming a net demander in the upstream market). The model by Avenel and Barlet (2000) explores the link between the technology of production and vertical integration to suggest circumstances when a commitment to foreclose might be credible.

The set up in Avenel and Barlet is very similar to the models discussed previously: competition both up and downstream is Cournot, downstream output is homogenous, and its production is fixed proportions. The two innovations are (i) to recognize that the choice of technology might depend on whether there is vertical integration; and (ii) to consider the incentives for entry upstream. In the absence of entry upstream the single incumbent firm is a monopolist.

Avenel and Barlet argue that integrated firms have available a choice of technologies that non-integrated firms do not. Non-integrated firms are restricted to choosing the "standard technology", since if they want to participate successfully in the upstream market they will have to supply and buy an input that is standardized. On the other hand, a vertically integrated firm can choose between the standardized technology and a specific technology. If it chooses the standardized technology, it produces upstream an input that non-integrated downstream firms can utilize and its downstream affiliate can utilize the upstream input produced by non-integrated upstream firms. Choosing the standard technology means that the integrated firm can participate, as either a net buyer or seller in the upstream market. However, integrated firms can also elect to adopt a technology that is "specific". This type of technology is characterized by an investment that "locks" upstream and downstream producing units together, in the sense that once a

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[79] Recall that Higgins restricts his discussion to situations where the number of downstream firms is at least

pair of upstream and downstream firms adopt the specific technology they cannot trade with other firms in the upstream market. However, non-vertically integrated firms are unlikely to adopt the specific technology since this exposes them to the threat of opportunistic behaviour and expropriation of their investment.[80]

A pair of up and downstream firms that vertically integrate and adopt the specific technology will not only foreclose supplying the upstream market, they will also be foreclosed from buying in the upstream market.[81] Technological choice provides the basis for complete foreclosure to be credible: adoption of the specific technology makes it impossible for the integrated firm to participate in the upstream market.[82]

The profitability of foreclosure depends on a trade off. Foreclosure results in an increase in downstream profits for the integrated firm as it will have a cost advantage. On the other hand it will involve an opportunity cost: the integrated firm will forgo sales and profits in the upstream market. The greater the number of downstream firms, the less favorable this trade off and the less likely the incumbent will integrate and foreclose. A larger number of downstream firms decreases the advantage of having a cost advantage, limiting the benefits of foreclosure, while at the same time increasing the costs of integration and foreclosure since the upstream market will be larger.

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as large as the number of upstream firms.

[80] The idea here is that in the absence of vertical integration, firms will be reluctant to invest in a specific asset that binds them to a specific trading partner because instead of paying average total cost to induce supply, a buyer can choose to offer only average variable cost—which excludes the sunk expenditures associated with the specific investment. The sunk component of the specific investment is not recovered by the seller, but instead is surplus that the seller expected to receive—or they would not have invested—which instead the buyer is able to retain. Vertical integration is thought to be a mechanism to encourage specific investment since the possibility of expropriation of sunk expenditures should not be, or is much less likely to be, an issue under common ownership. See Church and Ware (2000, Chapter 3) and cites therein.

[81] For this reason the model of Avenel and Barlet involves both input foreclosure and customer foreclosure.

[82] A second advantage to the vertically integrated firm not formally explored by Avenel and Barlet is that the costs of using the specific technology are likely less than the standard technology, reflecting that the assets required to support trade can be tailored to a specific trading partner. Avenel and Barlet assume that the costs of production upstream and downstream are independent of the technology utilized.

The second difference is that competition in the upstream market depends on whether there is entry. The decision to integrate and foreclose by the incumbent affects the profitability of entry. On the one hand it increases the profits of the entrant, since the entrant will be the only supplier for the unintegrated downstream firms. On the other hand it decreases the profitability of entry since demand is reduced. Which effect dominates depends on the number of downstream firms. When there is a small number, the foreclosure effect will dominate the market power effect. When there is a large number, the market power effect will dominate the foreclosure effect and foreclosure facilitates entry!

Avenel and Barlet consider a four-stage game. In the first stage, the only incumbent upstream producer makes both an integration (integrate downstream or not) and a technological adoption decision (if integration then specific or standard technology). In the second stage, an entrant after observing the choices in the first stage by the incumbent, can enter upstream production by incurring a fixed cost of entry. In stage three, upstream production occurs and upstream prices are determined: if there is entry and the incumbent adopted the standard technology then the two upstream producers engage in Cournot competition. In the final stage, downstream producers act like price takers in the upstream market and engage in Cournot competition in the downstream market.

Avenel and Barlet demonstrate that for fairly general demand conditions, when there is but a single integrated firm and one other upstream producer, that the integrated firm when it participates in the upstream market (adopts the standard technology), will always engage in strategic purchasing in the upstream market. The profits from raising the costs of its downstream rivals always exceed the costs of buying the upstream input at a price greater than its marginal cost of production and forgoing the profits from selling into the

upstream market at a price greater than marginal cost.[83] However, as with the other models discussed here, the vertically integrated firm will find it more profitable to foreclose than participate and engage in strategic purchases.[84] The net profits from foreclosing are greater than the net profits from engaging in strategic purchases—while profits in the downstream market are greater when it engages in strategic purchases, the benefit of doing so relative to complete foreclosure does not make up for the costs of the strategic purchases. Moreover, since integrating and adoption of the standard technology results in strategic purchases, which would facilitate entry, the optimal strategy for a vertically integrated firm is to foreclose, whether its objective is accommodation of entry or its deterrence.

Given entry the profits of the incumbent from integration and foreclosure increase because it avoids double marginalization and has a cost advantage downstream. The effect of this cost advantage on profits depends on the extent of competition downstream. When there are asymmetric costs, the output of a firm when competition is Cournot is increasing in the costs of its rivals (a cost reduction by firm i means that the output of $i's$ competitors falls), while the output of a firm is decreasing in its own marginal cost (a cost reduction by firm i means its output rises, both because its marginal cost has decreased—a direct effect—but also because the output of its competitors has fallen—an indirect effect). If there are lots of competing firms then the effect of the cost advantage on both downstream rivals' output and a firm's own output is much less than when there are relatively few firms downstream. On the other hand, foreclosure means that the vertically integrated firm no longer participates as a duopolist in the upstream market, and the greater the number of firms downstream, the greater the forgone profits in the upstream market. Taken together, these two effects both mean that the greater the extent

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[83] For the case of linear demand this is also shown by Gaudet and Long. Avenel and Barlet show it to be true for any decreasing and concave inverse demand function.

[84] Avenel and Barlet have a constructive proof based on the assumption of linear inverse demand. This assumption is maintained in all of their derivations except for the overbuying result.

of competition downstream, the less profitable integration, or conversely, the fewer the number of firms downstream the greater the incentive to integrate and foreclose.

Foreclosure affects the profitability of entry. It increases the profitability of entry because it eliminates competition in the upstream market—the entrant will be a monopolist. On the other hand it reduces the profitability of entry by reducing demand in the upstream market. Demand is reduced for two reasons: (i) the downstream subsidiary engages in customer foreclosure and (ii) the competitive effect of input foreclosure reduces the market shares of the unintegrated downstream firms. The demand effect will depend on the number of downstream firms. If there are only a few, then the demand effect will be significant, but if there is extensive competition downstream, the demand effect will be minimal. There are a critical number of firms downstream, beyond which vertical integration and foreclosure results in greater profits for the entrant. That is, in these cases vertical integration does not raise barriers to entry, but facilitates entry upstream.

The equilibrium to the Avenel and Barlet model depends on the size of the fixed costs of entry and the extent of competition downstream. When the downstream market is fairly concentrated ($2 \leq n \leq 5$, where n is the number of downstream firms) the incumbent always integrates: the cost advantage trumps the lost sales upstream regardless of whether there is entry. If the downstream market is less concentrated ($6 \leq n \leq 9$) integration and foreclosure are not profitable when there is entry. Integration and foreclosure result if they deter entry—foreclosure preserves its market power upstream and extends it downstream, since given complete foreclosure and no entry upstream it is also now a monopolist downstream, or if the fixed costs of entry are very large so that entry is not an issue, since integration and foreclosure allows the incumbent to eliminate double marginalization. If integration results in entry, then the incumbent would not integrate, since its losses upstream from entry are greater than its profits downstream from extending its market power. When the downstream market is not concentrated

$(9 < n)$ the upstream incumbent integrates and forecloses only when fixed costs are very large, so that entry is not profitable.

While the Avenel and Barlet model is important for introducing and considering a mechanism which allows for complete foreclosure, it is incomplete in two important regards. The first is that it does not consider the possibility of a counter-merger between an entrant and a downstream firm. However, the analysis of GL suggests that a counter strategy would be profitable, i.e. post-entry the entrant would merge with a downstream firm. The profits, however, of the entrant would still be reduced compared to what they would be if the incumbent had not integrated and foreclosed.

Second, the welfare effects of integration and foreclosure are not considered. However, if the fixed costs of entry are zero, then the welfare effect of integration and foreclosure are given by the Salinger model. In the Salinger model when there two upstream firms, a vertical merger always leads to a decrease in the price of the downstream good, i.e., is beneficial in terms of total surplus and consumer welfare. Hence in the Avenel and Barlet model integration and foreclosure could only be problematic when it leads to entry deterrence: entry deterrence will increase the price of the downstream good, but will result in a fixed cost savings. While the higher downstream price will have negative effects on consumer welfare, total surplus might increase.

3.2.3 Antitrust Implications of Strategic Substitute Models

When competition downstream can be characterized as Cournot (strategic substitutes), our discussion above indicates the following points relevant to assessing the antitrust implications of a vertical merger:

    1.   *Double Marginalization*

    The presence of market power upstream means that unintegrated downstream firms are at a cost disadvantage vis-à-vis integrated firms. The price paid for the upstream good by the unintegrated firm will exceed its marginal cost, while the

input will be supplied internally at marginal cost by the integrated firms. This asymmetry in costs results in an asymmetric equilibrium downstream: vertically integrated firms, because of their cost advantage, will have greater market shares.

2.   *Integrated Firm's Behaviour Upstream*

In general vertically integrated firms will have an incentive to behave differently in the upstream market than their unintegrated competitors. They will have an incentive to supply less at the margin or even engage in overbuying in the upstream market in order to raise the price of the upstream good.

3.   *Credibility of Complete Foreclosure*

Complete foreclosure—withdrawal from the input market as a buyer or seller by the integrated firm—might be credible when integration allows for adoption of a specific technology. However, the profitability of adopting the specific technology depends on a trade off between gains in the downstream market and losses in the upstream market. This trade off depends on concentration in the downstream market. When it is concentrated the trade off favors foreclosure.

4.   *Counter-Mergers*

The models of GLH suggest, however, that disadvantaged downstream firms may have an incentive to counter-merge, gaining access to the upstream input at marginal cost. An initial vertical merger may set off a wave of vertical mergers, a wave which makes the initial vertical merger unprofitable.

5.   *Welfare Effects of Vertical Merger*

The welfare effects depend on the credibility of complete foreclosure. If foreclosure is not credible, then increasing the extent of vertical integration is efficiency enhancing and leads to lower prices for consumers. The literature suggests that, if anything, there are *too few* vertical mergers.

When complete foreclosure is credible, the welfare effects are in general ambiguous. Salinger's analysis shows that the effect of a vertical merger on the downstream price depends on whether the increase in output from the elimination of double marginalization by the integrating firm is greater or less than the decrease in output from the increase in the costs of its unintegrated downstream rivals *if* the vertical merger results in an increase in the upstream price. Such a price increase depends on whether the supply effect of the integrated firm withdrawing from the upstream market exceeds the demand reduction as the unintegrated downstream firms contract in response to the increase in output by the integrating firm downstream. However, such welfare decreasing integration is not often profit-maximizing: it is only profit maximizing if it results in the elimination of the wholesale market and exclusion of unintegrated downstream firms and only then if there are relatively many such firms which are excluded.

The welfare effects in Avenel and Barlet depend on whether foreclosure deters entry. If entry is deterred consumers will be harmed by higher downstream prices.

The one set of circumstances in which it is unambiguous that a vertical merger leads to anticompetitive harm to consumers downstream involves a monopolist upstream in which a vertical merger deters entry upstream and where technology makes foreclosure credible.[85] In particular under the following circumstances a vertical merger leads to anticompetitive harm to consumers in the form of higher prices: (i) vertical integration enables adoption of a specific technology that precludes participation by the integrated firm in the upstream market; (ii) there is an incumbent monopolist upstream threatened by entry; (iii) the downstream market is concentrated; (iv) integration and foreclosure reduce the entrant's profits such that it is deterred from entering; and (v) entry into both

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[85] This case theory is based on Avenel and Barlet (2000).

the upstream and downstream market by the entrant is not profitable, nor a counter merger involving the entrant and an unintegrated downstream firm. Vertical merger and foreclosure is more likely to have a significant effect on the profits of the entrant: (i) the larger the market share of the downstream firm that integrates; (ii) the greater the cost differential downstream post-integration; and (iii) the more significant economies of scale upstream (fixed costs of entry).

When there is entry, foreclosure provides the integrated firm with a cost advantage downstream. The profits of the incumbent from integration and foreclosure increase because it avoids double marginalization and has a cost advantage downstream. The effect of this cost advantage on profits depends on the extent of competition downstream. If there are only a few competitor's downstream, then a cost advantage provides a firm with a significant advantage, leading to higher market share and profits.   On the other hand, foreclosure means that the vertically integrated firm no longer participates as a duopolist in the upstream market, and the greater the number of firms downstream, the greater the forgone profits in the upstream market. Taken together, these two effects both mean that the greater the extent of competition downstream, the less profitable integration, or conversely, the fewer the number of firms downstream the greater the incentive to integrate and foreclose.

Foreclosure affects the profitability of entry.   It increases the profitability of entry because it eliminates competition in the upstream market—the entrant will be a monopolist. On the other hand it reduces the profitability of entry by reducing demand in the upstream market.[86] Demand is reduced for two reasons: (i) the downstream subsidiary engages in customer foreclosure and (ii) the competitive effect of input

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[86] In this respect the model of Avenel and Barlet is similar to the models of customer foreclosure discussed in Section 3.3 *infra*. And while it involves a credible commitment not to be a buyer in the upstream market, it also involves input foreclosure, a credible commitment by the integrated firm not to supply other downstream firms in the upstream market. This commitment raises their cost since they are unable to source supply and are forced to exist from the market when entry upstream is unprofitable due to customer foreclosure.

foreclosure reduces the market shares of the unintegrated downstream firms. The demand effect will depend on the number of downstream firms. If there are only a few, then the demand effect will be significant, but if there is extensive competition downstream, the demand effect will be minimal. There are a critical number of firms downstream, beyond which vertical integration and foreclosure results in greater profits for the entrant. That is, in these cases vertical integration does not raise barriers to entry, but facilitates entry upstream.

3.2.4   Raising Rivals' Costs: Strategic Complements

In this section we consider the controversial contribution of Ordover, Saloner, and Salop (OSS). OSS develop an equilibrium model of vertical foreclosure that is closely related to Salinger (1988), but it differs in a number of important respects. In particular, it considers only successive duopoly, downstream products are differentiated, competition both up and downstream is over price (Bertrand), merger and foreclosure decisions are endogenous (i.e., must be profitable), and counter-strategies by foreclosed firms are considered.   In the OSS model a vertical merger and foreclosure are strategies not to extend the exercise of market power into another market, but like the Salinger model, are strategies to relax constraints on existing market power, by disadvantaging rivals through raising their costs. As in the Salinger model, production upstream is at constant unit cost, the upstream product is homogeneous, and production downstream is fixed proportions.

OSS model is based on the situation shown in Figures 1 and 2, where competition up and downstream is over price. When the situation is as in Figure 1, i.e., premerger, competition in the upstream market over price implies marginal cost pricing— there is no pre-existing market power upstream and double marginalization is not an issue. Post-merger (Figure 2), OSS show that provided the upstream price does not increase by too much, the stand-alone profits of the two (remaining) independent firms exceeds the vertically integrated profits if they counter-merge even though a counter merger restores the ex ante situation. With a counter merger, both downstream firms would have access to the input at marginal cost—the ex ante situation—and the market power created by

U_1's withdrawal from the upstream market is eliminated. If the upstream price for the unintegrated downstream firm increases sufficiently, however, a counter merger will be profitable. If a counter merger is not profitable then integration and foreclosure—limiting supply in the upstream market—will be profitable for U_1 and D_1. The increase in the upstream price will raise the costs of D_2 and hence its price. The increase in the price by its rival will give the integrated firm room to increase its price and hence profits downstream. Since integration and foreclosure results in an increase in market power and prices downstream it is inefficient and reduces the welfare of consumers.

The key to the OSS rests on the creation of market power for U_2 in the upstream market. Creation of any market power requires that the integrated upstream firm, U_1, withdraws from the market, making U_2 a monopolist. However, if its exercise of market power is too great, then a counter merger will be possible. OSS introduce a number of alternatives to discipline the market power of the unintegrated monopolist. The assumption of foreclosure by the integrated firm in particular, as well as the possible mechanisms to discipline the market power of U_2 have been the source of considerable controversy. After reviewing the OSS model, we consider the criticisms of Reiffen (1992), Reiffen and Vita (1995), and Gilbert and Hastings (2001). The next section considers extensions to the OSS model that introduce technological considerations—much like Avenel and Barlet—to make foreclosure credible.

Ordover, Saloner, and Salop

OSS assume that downstream market prices (over which the downstream firms compete) are strategic complements: the profit maximizing response by firm *i* to an increase in the price of firm *j* is to increase its price.[87] This occurs when the differentiated products are imperfect substitutes, so that an increase in the price of *i* increases demand for product *j*,

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[87] An introduction to the Bertrand model of price competition when products are differentiated is presented in Appendix 4.

thereby providing firm *j* with an incentive to increase its price.[88] Moreover, if the upstream good is a normal input,[89] increases in its price increase the marginal cost of a downstream firm. The profit-maximizing response to an increase in its marginal cost is to increase price—a direct effect. Moreover, there will be an indirect effect. The increase in price for firm *i*, from the increase in its marginal cost, gives firm *j* an incentive to increase its price as its demand rises. This in turn provides firm *i* with an incentive to *further* increase its price. Downstream Bertrand equilibrium prices will be increasing functions of the upstream input prices.

In the absence of a vertical merger, price competition in the upstream market results in marginal cost pricing. The assumption of Bertrand pricing and constant marginal costs upstream eliminates the problem of double marginalization and eliminates an efficiency incentive for vertical merger.

The OSS model has four stages. The first is a "bidding" stage where downstream firms can out bid each other to acquire an upstream firm. In the second stage, input prices are determined. In the third stage, a downstream firm that was unsuccessful in the first stage can bid for, or acquire, the remaining upstream supplier. Taking input prices as given, the two downstream firms engage in price competition in the downstream market in the fourth stage.

Suppose that there is a vertical merger and that the integrated firm withdraws from the upstream market. This means that the remaining unintegrated upstream firm is a monopoly supplier for the unintegrated downstream firm and we would expect the upstream price to increase.

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[88] Downstream prices are strategic complements if $\dfrac{\partial \pi_i}{\partial p_i \partial p_j} > 0$. This will be true if the goods are imperfect substitutes and $\dfrac{\partial Q_i}{\partial p_i \partial p_j}$ is not "too" negative.

[89] An input is normal if its demand is positively correlated with output.

However, the possibility of a counter-merger in the third stage means that the unintegrated firms can restore the ex ante situation. A counter merger results in a fully vertically integrated industry structure where both downstream firms have access to the upstream good at marginal cost, just as in the fully non-vertically integrated structure. However, the incentive to merge in the third stage depends on whether the stand-alone profits of the two unintegrated firms—assuming foreclosure, i.e., that the integrated firm does not participate in the upstream market—are greater or less than their profits if they were to merge. The profits if they were to merge would equal the downstream firms' profits ex ante, since a counter merger restores marginal cost parity between the two downstream firms.[90] The condition for no retaliation by counter-merger is that stand-alone profits, equal to

$$\Pi^s(p^{US}) = \pi_s^{DS}(p^{US}, mc^{US}) + \pi_s^{US}(p^{US}) \tag{8}$$

where $\pi_s^{DS}(p^{US}, mc^{US})$ are the profits of the unintegrated downstream when it pays p^{US} for the input and its integrated rival can obtain the input at mc^{US} and $\pi_s^{US}(p^{US})$ are the profits of the unintegrated upstream firm when it supplies the input at price p^{US}, must be greater than

$$\pi^{DS}(mc^{US}, mc^{US}) \tag{9}$$

the profits obtainable if the two unintegrated firms merge. If $p^{US} = mc^{US}$, then (8) and (9) are identical.

To avoid retaliation by counter-merger, there must exist a price p^{US} such that (8) is greater than (9) and that price must be an equilibrium to the second stage of the game. To see that a price exists such that (8) is greater than (9), consider the effects of increasing p^{US} on (8). There are two effects: (i) the increase in p^{US}, increases the marginal cost of the unintegrated downstream firm, leading it to increase its price and

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[90] Upstream firms marginal costs are assumed to not only be constant, but zero. Hence their profits in the unintegrated industry structure, where Bertrand pricing upstream implies marginal cost pricing, are also zero.

thereby allowing the integrated firm to profitably increase its downstream price; and (ii) the unintegrated downstream firm's demand for the upstream input decreases. The first leads to an increase in the profits of the downstream firm because of the indirect effect—the increase in the price of the integrated downstream firm's product increases demand for the unintegrated firm's product. This increases profits for the unintegrated downstream firm. The second effect reduces the profits of the unintegrated upstream firm by an amount equal to the change in demand for the upstream good multiplied by its margin. In summary

$$\frac{\partial \Pi^s}{\partial p^{US}} = \frac{\partial \pi_s^{DS}}{\partial p_{vi}^{DS}} \frac{\partial p_{vi}^{DS}}{\partial p^{US}} + [p^{US} - mc^{US}] \frac{dq_s^{US}}{dp^{US}}, \qquad (10)$$

where the first term is positive and the second is negative.

The key point made by OSS, is that starting at marginal cost pricing upstream, i.e., $p^{US} = mc^{US}$, then the second term in (10) is zero, and the first term is positive. Hence there does exist a small increase in p^{US}, such that the unintegrated firms will not have a profit incentive to retaliate by counter-merger. While a counter merger can restore the ex ante situation, as a group the unintegrated firms benefit from the vertical merger and foreclosure. This benefit is lost if there is a counter merger.

The effect of increasing p^{US} on the unintegrated downstream firm is shown in Figure 4. The initial equilibrium is at *A* where the best-response functions of the two downstream firms intersect.[91] The increase in the upstream input price shifts the best-response function of the unintegrated downstream firm upwards. The new equilibrium corresponding to the increase in the price of the upstream input for the unintegrated

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[91] The best-response function for firm *i* gives its profit-maximizing price given its anticipated price of its rival *j*. Firm *i* 's expectation of *j*'s price allows it to forecast its demand for any price that it charges. Based on that forecast of demand, its profit-maximizing price is the price that sets the loss on marginal units from increasing its price equal to the gain on inframarginal units from increasing the price. The assumption of strategic complements means that as *i* anticipates a higher price from *j* its demand increases and it finds it to profitable to charge a higher price: the price best-response functions slope upwards in Figure 4. The Nash equilibrium is where each is charging a profit-maximizing price, given the price of the other. This is where the two best-response functions intersect in Figure 4.

downstream firm is at *C*. Drawn through *A* is the isoprofit contour for the unintegrated downstream firm when $p^{US} = mc^{US}$, i.e., the ex ante situation. [92] This also corresponds to the sum of stand-alone profits when $p^{US} = mc^{US}$, since upstream profits are then zero.

The equilibrium at *C* is on a higher isoprofit contour, indicating that revenues downstream have increased and that stand-alone profits have increased (the increase in downstream firm costs from the increase in the upstream price are a transfer to the upstream firm). If the best-response function for the unintegrated firm was to shift up so that the equilibrium downstream was at point *B*, then stand-alone profits would equal ex ante profits. A larger increase in p^{US} would mean that a counter-merger was profitable: the equilibrium would be above *B* on the integrated firm's best-response function and a less profitable iso-profit contour.

The maximum possible price in the upstream market that would not lead to a counter merger is defined by the shift in the unintegrated downstream firm's best-response function that establishes *B* in Figure 4 as the Bertrand price equilibrium. Denote this price as $\overline{p}^{US}$. Price increases greater than this result in a counter merger, since prices downstream become too high, and the revenues of the downstream firm start to fall: the profits earned by the upstream firm are not sufficient to compensate the downstream firm for its lost profits.

In stage two, the upstream market price is determined. If there is not a vertical merger at stage one, then Bertrand competition results in marginal cost pricing, $p^{US} = mc^{US}$. If there has been a vertical merger in stage one, then the equilibrium may involve higher prices, depending on the ability of the integrated firm to commit not to participate in the upstream market. If it cannot commit, then price competition will once again result in marginal cost pricing and no foreclosure. If on the other hand, the integrated firm can

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[92] An isoprofit contour is defined as all combinations of the two downstream prices that result in the unintegrated downstream firm earning the same level of profits. Different isoprofit contours correspond to

commit not to participate in the upstream market, the unintegrated upstream firm will be a monopolist. In this case the upstream price will be the lesser of the monopoly price or, perhaps, the unintegrated downstream firm has access to an inferior substitute that limits the market power of the unintegrated upstream firm. Denote this price as $\dot{p}^{US}$. The third possibility considered by OSS is that the integrated firm can commit to stand ready to supply if the price in the upstream market increases above a price ceiling. In this case the commitment to supply disciplines the pricing behaviour of the unintegrated upstream monopolist. The price ceiling adopted will be $\overline{p}^{US}$, i.e., the highest possible upstream price that avoids a counter-merger.

In the first stage, OSS assume that the two downstream firms can bid for one of the upstream firms. Positive bids will be forthcoming only if the anticipated upstream price that follows is less than $\overline{p}^{US}$. Otherwise, there will be a counter merger and the vertical merger will not increase profits, insuring that there is not an increase in joint profits to share between the two integrating firms. The winning bid will be equal to the difference between the profits of the vertically integrated firm and the unintegrated downstream firm.

For vertical merger and foreclosure to result in equilibrium in the OSS model, the input price when the integrated firm forecloses must be greater than marginal cost but less than $\overline{p}^{US}$. When it occurs, it is inefficient: downstream prices are raised, making consumers worse off. Moreover, both downstream firms are made worse off, since all the benefits of foreclosure are captured by the upstream firm that integrates. The model has a Prisoners' Dilemma structure in the first stage: both downstream firms would be better off if there was not a vertical merger. However, each is better off if they can acquire the upstream firm at a low price and foreclose their rival. Competition to foreclose, and avoid being foreclosed, mean that all of the profits from foreclosure accrue to the upstream firm that is acquired in the first stage. The winners in a foreclosure equilibrium are the two

different profit levels.

upstream firms, with the firm being acquired earning greater profits than the unintegrated upstream monopolist.

If, instead of Bertrand competition and differentiated products, output in the downstream market was homogenous and competition over quantities, vertical merger and foreclosure would not be an equilibrium. The reason is that for the case of quantity competition downstream (10) becomes

$$\frac{\partial \Pi^s}{\partial p^{US}} = \frac{\partial \pi_s^{DS}}{\partial q_{vi}^{DS}} \frac{\partial q_{vi}^{DS}}{\partial p^{US}} + [p^{US} - mc^{US}] \frac{dq_s^{US}}{dp^{US}} \qquad (11)$$

and the first term is negative. With strategic substitutes, the increase in the unintegrated firm's marginal cost results in an increase in the output of the integrated firm downstream, which harms the unintegrated downstream firm.   Hence the unintegrated pair of firms will always respond to a vertical merger and foreclosure by counter-merging. Intuitively, under Cournot competition, the two unintegrated firms do not gain from maintaining double marginalization (by not counter merging) since it harms them and induces more aggressive behaviour from their rival, unlike the case of Bertrand competition when it induces less aggressive behaviour downstream from the integrated firm.[93]

The OSS model has been subject to considerable criticism.[94] The basis of this critique is the assumption that the vertically integrated firm is either able to commit not to participate in the upstream market *or* is prepared to supply the unintegrated downstream firm if the upstream price rises above $\bar{p}^{US}$. As OSS themselves point out, if there is Bertrand competition post-merger upstream, equilibrium prices are equal to marginal cost. Committing not to participate or to supply at price $\bar{p}^{US}$ is not profit-maximizing

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[93] This is why in the model of Gaudet and Long (with equal number of firms up and downstream) the integrated industry structure is always a, possibly not unique, equilibrium.

[94] See for instance Hart and Tirole (1990), Reiffen (1992), Reiffen and Vita (1995), and Choi and Yi (2000).

behaviour by the vertically integrated firm. It could increase its profits by slightly undercutting the upstream-unintegrated firm. This would have no effect on its profits downstream, but would increase its profits upstream, provided the upstream price was greater than its marginal cost. Of course the vertically integrated firm charging a price less than $\overline{p}^{US}$ is not an equilibrium either. The upstream-unintegrated firm has an incentive to, in turn, undercut it. The process does not end until prices are driven down to marginal cost.

Reiffen's (1992) conclusion is that it is commitment in the upstream market (i.e., the exercise of market power upstream) that drives the results of the OSS model, but there is nothing in the model that provides an explanation for why the exercise of market power upstream is not possible ex ante, but is made possible ex post by the vertical merger. Left unmodeled by OSS is the connection between vertical merger and the commitment not to supply (which creates market power upstream).[95]

The response by OSS (1992) is that the incentives for the vertically integrated firm to under cut should differ from that of an unintegrated competitor in the upstream market. The integrated firm will understand that undercutting is a slippery slope that, once started, reduces its profits downstream. When the two firms are not integrated, the effect of the upstream price on downstream profits will not be internalized. Once integrated, however, the upstream firm should internalize the effects of its pricing on downstream profitability.   OSS formalize this in their response to Reiffen by modeling the determination of prices in the upstream market as a descending price auction. The upstream firms "bid" for the unintegrated downstream firm's custom, with their price falling continuously until they drop out. The equilibrium price and supplier are determined when the last firm drops out. They show that the equilibrium price will be $\overline{p}^{US}$ and the downstream firm will be supplied by the unintegrated upstream firm,

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[95] Reiffen also remarks on the particular difficulty involved in committing to supply only at a certain price, as opposed to not at all and that this commitment is likely more difficult than that required by an unintegrated upstream firm to raise price above marginal cost.

corresponding to the case when the integrated firm could commit to supply at price $\overline{p}^{US}$ in their original model.

Reiffen and Vita (1995) remain critical of the OSS model, noting that introducing dynamic considerations post merger, but having a static Bertrand pricing game pre-merger is a logical inconsistency. Introducing dynamic considerations pre-merger means that the relevance of the OSS analysis depends on whether vertical integration makes coordination of prices in the upstream market more likely, leading to an increase in market power and prices upstream.[96] However, it also likely means that there was pre-existing market power upstream, reintroducing double marginalization and a potential for efficiency gains from vertical merger.

Riordan and Salop (1995) emphasize that vertical merger does change incentives for the integrated firm—an integrated firm would have more of an incentive to raise the price upstream since it would benefit from increased profits downstream. However, Scheffman and Higgins (2003) observe that this incentive is only relevant if the commitment to foreclose has a cost and this cost can be recovered only if there is vertical integration. In this case the cost is greater than the profits of a pair of stand alone firms when the upstream firm incurs the cost of commitment, but less than the profits of a vertically integrated firm that imposes commitment.[97]

It is commitment which is the source of market power in the upstream market. Perspective on the effect of allowing the unintegrated firm to be able to commit is provided by investigating the consequences of pre-existing market power in the upstream market. Reiffen and Vita (1995) and Gilbert and Hastings (2001) consider the profitability and welfare effects of a vertical merger when competition in the upstream market is Cournot, but downstream producers produce differentiated products and compete over prices. These models are identical to that of OSS except that by assuming

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[96] See Section 5.2 *infra*.

Cournot competition upstream pre-merger rather than Bertrand, there is pre-existing market power. In the first stage, upstream quantities (and prices) are determined, in the second stage downstream prices downstream.

The downstream price equilibrium will depend on p^{US}, i.e., $p_{vi}^{DS}(p^{US})$ and $p_s^{DS}(p^{US})$, where p_{vi}^{DS} is the downstream price of the vertically integrated firm and p_s^{DS} the downstream price of the unintegrated (separate) downstream firm. The demand for the upstream input from the unintegrated downstream firm will be $q_s^{DS}\left(p_{vi}^{DS}(p^{US}), p_s^{DS}(p^{US})\right)$ and equilibrium upstream requires supply by the vertically integrated firm and the unintegrated upstream firm equal demand:

$$q_s^{US} + q_i^{US} = q_s^{DS}\left(p_{vi}^{DS}(p^{US}), p_s^{DS}(p^{US})\right).$$

The profit maximizing choice for the unintegrated upstream firm is given by (4). The profits of the integrated firm in the first stage are similar to (5), adjusted for the fact that competition downstream is Bertrand:

$$\pi_i^{VI} = \pi_i^{DS}\left(p_i^{DS}(p^{US}), p_s^{DS}(p^{US})\right) + [p^{US} - mc^{US}]q_i^{US}. \tag{12}$$

Its optimal choice for q_i^{US} will incorporate not only its marginal revenue and marginal cost in the upstream market, but also that changes in q_i^{US}, will, through the equilibrium condition, affect p^{US}, and through it, both downstream prices and thus the vertically integrated firm's profit in the downstream market. The profit maximizing condition for the vertically integrated firm is

$$\frac{\partial \pi_i^{VI}}{\partial q_i^{US}} = p^{US} + \frac{dp^{US}}{dq_i^{US}}q_i^{US} - mc^{US} + \frac{\partial \pi_i^{DS}}{\partial p_s^{DS}}\frac{\partial p_s^{DS}}{\partial p^{US}}\frac{\partial p^{US}}{q_i^{US}} = 0, \tag{13}$$

which is very similar to (6). The last term is the strategic effect of vertical integration. By limiting q_i^{US}, the vertically integrated firm raises p^{US}, which in turn raises the price of its rival downstream, and thus in turn the profits of the vertically integrated firm

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[97] As in the models of Choi and Yi (2000) and Chen (2001) discussed below.

downstream. In the upstream market, internalizing the effect of a decrease in output on the downstream market gives the vertically integrated firm an incentive to lower its supply, resulting in an increase in the price of the upstream good.[98]

However, the net effect on the upstream and downstream markets depends not only on the incentive for the vertically integrated firm to reduce its supply to the upstream market. Prior to the vertical merger, the downstream affiliate of the integrated firm paid a price greater than marginal cost for the upstream input (i.e., there was double marginalization). After the vertical merger, the upstream input is provided at marginal cost to the downstream unit of the vertically integrated firm. This provides it with an incentive to lower its price and increase output.   Since the two downstream products are (imperfect) substitutes, one effect of this is to reduce the demand for the upstream good supplied by its unintegrated competitor.   The reduction in demand downstream flows back to reduce demand in the upstream market. If this demand effect is larger than the strategic effect (the reduction in supply) the upstream price will fall.

Reiffen and Vita demonstrate the interplay between the strategic and demand effect in the linear demand system used by OSS (in their numeric example). There are two cases.   In the first the upstream monopoly price is greater than the upstream price that induces a counter-merger. To forestall a counter merger, they assume the price is set equal to $\overline{p}^{US}$, the highest price in the upstream market which does not induce a counter merger.   In this case the effect of vertical integration is to always *lower* the costs of the downstream rival: the demand effect dominates the strategic effect, leading to a lower upstream price. Since the upstream price falls for both downstream firms, so too do downstream prices: a foreclosing vertical merger is efficiency enhancing.

When counter-integration is not possible, so that the monopoly price can be charged by the unintegrated upstream firm without inducing a counter merger, the effect of a vertical

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[98] The quantity best-response function of the integrated firm upstream shifts inward.

merger on the upstream price depends on how substitutable the downstream products are. If they are close substitutes, then the demand effect will dominate, and the upstream price will fall. The price of the unintegrated product downstream might rise or fall—it will fall if the price of the upstream input decreases and it might fall even if the price of the upstream input rises. However, Reiffen and Vita demonstrate that the sum of the downstream prices must fall, indicating that consumers will be better off with a vertical merger since they will be able to replicate their premerger consumption with less expenditure.[99]

3.2.5   *Raising Rivals' Costs: OSS Extensions*

In this section two extensions to the basic OSS model are considered. Both of the extensions address the issue of price commitment in the upstream market by introducing asset specificity between trading partners. In both cases a vertical merger improves incentives for investments in specific assets, and while these investments may lower costs they also limit or eliminate participation in the upstream market—as either a buyer or seller—by the vertically integrated firm. The two extensions are Choi and Yi (2000) and Chen (2001).

In Choi and Yi the upstream firms have access to two different technologies, one general and one specific. If an upstream firm adopts a specific input, it can only trade with, or supply, the downstream firm that can use that input. As in Avenal and Barlet, technological incompatibility is the mechanism that can preclude an integrating firm from supplying a downstream rival. Input costs upstream are stochastic and correlated if both upstream suppliers adopt the general technology. From the upstream suppliers' perspective correlation is undesirable because it makes it more likely that each will have low costs, which under Bertrand competition means that they will have zero profits.

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[99] Linnemar (2003) identifies an additional welfare effect if the vertically integrated firm has lower marginal costs downstream. In this case it is possible, if the marginal cost is low enough, that the output shift associated with foreclosure in an OSS type setting is efficiency enhancing.

Bertrand competition implies that an upstream supplier will only make profits if it is the *only* low cost supplier.

There are two positive externalities from adoption of the specific technology. Suppose that U_1 adopts the specific input. Then U_2 benefits since cost correlation is reduced and it is a monopolist supplier for D_2. D_1 benefits because its rival has higher costs. Vertical integration makes it more likely that the specific technology will be adopted since the positive effect on the downstream firm is internalized by integration. This is not costless, however. The vertically integrated firm that forecloses will forgo profits from supplying the other downstream firm if it is the low cost supplier.

A counter merger may not arise because it may well reestablish cost correlation if, in a vertically integrated structure, both firms adopt the generic technology. A counter-merger eliminates double marginalization and the raising rivals' cost effect. But by doing so it eliminates the benefit to foreclosing firms from adopting the specific technology. If cost correlation is sufficiently large it can outweigh the benefits from preventing foreclosure and therefore eliminates the incentives for a counter merger. Choi and Yi show that it is possible for a vertical merger to result in foreclosure because integration provides the integrated firm with incentives to adopt the specific technology. They also note that the efficiency effects of foreclosure are ambiguous. The foreclosure equilibrium is inefficient if the raising rivals' cost effect and increased cost asymmetry dominates elimination of double marginalization.

Chen (2001) also presents a model where vertical mergers can be inefficient and the result does not rely on the assumption of price commitment. Chen identifies a separate incentive effect associated with vertical merger that can result in higher prices both upstream and downstream. The insight of the Chen model is that an unintegrated downstream firm will choose the vertically integrated firm to be its supplier, even if it charges a higher price, because that leads to less aggressive competition by the vertically integrated firm downstream. By sourcing its supply from the vertically integrated firm

at a price greater than marginal cost, the unintegrated downstream firm provides the integrated firm with an incentive to maintain sales in the upstream market.

Chen's results depend on there being a cost associated with switching suppliers and an efficiency advantage associated with vertical merger. This switching cost commits the unintegrated downstream firm to purchase from the integrated firm even though its price is greater than other upstream suppliers. The size of this switching cost determines how high the integrated firm can raise its input price before the unintegrated firm switches to an unintegrated supplier. Without an efficiency advantage from the vertical merger, the merged firm will not have an incentive to lower its price in the downstream market. Without this incentive, the unintegrated rival has no incentive to mitigate this incentive by sourcing supply of the input from the vertically integrated firm.

The welfare effects in Chen's model depend on the size of the switching cost. If it is large and the two downstream differentiated products relatively close substitutes, then downstream goods prices will rise. If the switching cost is small and the products relatively differentiated, then prices will fall since the vertical merger eliminates double marginalization for the integrated firm.

There is not an incentive for a counter-merger in Chen's model because of the assumptions made regarding the capabilities of the upstream firms. Chen assumes that marginal cost is constant, but that the integrating firm has a lower cost than its upstream competitors. Hence a counter-merger will be ineffective: it does not change the price at which the unintegrated downstream firm can access the upstream input.

Choi and Yi

Choi and Yi adopt the OSS model with two wrinkles: (i) the upstream inputs can be either general or specific; and (ii) unit costs are stochastic and correlated if upstream firms supply the same type of input. Following OSS, there are two input suppliers and two downstream firms. The downstream firms produce differentiated products.

Production downstream requires one unit of upstream input. The upstream input can either be general, in which case it can be used by both downstream firms, or specialized, in which case it can only be used by one of the downstream firms.

The Choi and Yi model is a five-stage game. In stage 1 the downstream firms can bid to acquire an upstream firm. If there is a successful acquisition in the first stage, the two remaining unintegrated firms can merge in stage 2. In stage 3, upstream firms (or divisions) make an irreversible choice in their input specification. Input costs are realized and prices upstream determined in stage 4. In stage 5, given input prices, downstream prices are determined.

Choi and Yi do not explicitly assume any downstream pricing game. Instead they make standard assumptions regarding the effect changing marginal costs has on profits and output of a firm and its rival, i.e., profit and output of firm *i* is decreasing in its own marginal cost, but increasing in the marginal cost of firm *j*.

Input costs are stochastic and can either be high or low, with equal unconditional probability. However, costs are positively correlated (the extent is given by ρ) when both firms provide the generalized input, i.e., they are more likely to have the same costs when they both provide the generalized input. The cost differential between the high and low cost realizations is not so large that the monopoly price for the low cost supplier is less than the high cost realization.[100] A competitive fringe capable of supplying the generalized input at the high cost realization is assumed to exist. These last two assumptions mean that in the upstream equilibrium the price will equal the high cost realization, unless both firms adopt the same input specification and realize low costs.

To find vertical merger and foreclosure as an equilibrium, there has to be a reason why the foreclosed firms will not find it profitable to "undo" the effect of the vertical merger

by counter merging.   As in OSS this arises because the unintegrated firms benefit from integration and adoption of the specific technology, i.e. there are positive externalities from adoption by one firm upstream of the specific technology. These externalities are lost after a counter-merger if both integrated firms adopt the general technology.

In the Choi and Yi model, the key assumption that generates the appropriate externalities is that aggregate industry profit downstream is larger, the more asymmetric costs — holding average costs constant. Technically, the assumption is

$$\pi\left(p^{H},p^{L}\right)+\pi\left(p^{L},p^{H}\right)>\pi\left(p^{H},p^{H}\right)+\pi\left(p^{L},p^{L}\right)$$

where $\pi\left(p^{i},p^{j}\right)$ is the profit of a firm when it pays p^{i} for the input and its rival pays p^{j}. This assumption is consistent with a number of oligopoly models and reflects that competition is more intense the more symmetric the costs of firms. A sufficient condition for it to hold is:

$$\frac{\partial^{2}\pi\left(p^{i},p^{j}\right)}{\partial p^{i}\partial p^{j}}<0.$$

This condition says that the effect on a firms profits of a cost decrease — from an input price decrease — is less the lower its rival's input price (i.e., costs), which is sensible since the value of a cost decrease is increasing in a firm's output, and the lower its rival's costs, the more likely its output is small.

The upstream price equilibrium in the fourth stage depends on the input specifications chosen in stage three. There are four relevant input specifications. These are $\left(G,G\right)$, $\left(S_{1},G\right)$, $\left(G,S_{2}\right)$, and $\left(S_{1},S_{2}\right)$, where G indicates choice of the generic input specification, S_{i} choice of the input specific to downstream firm *i*, and the first entry is the choice by upstream firm 1 $\left(U_{1}\right)$ and the second by upstream firm 2 $\left(U_{2}\right)$.[101]

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[100] This corresponds to the assumption often made in the innovation literature that the lower cost innovation is not drastic.

[101] For simplicity we assume that if an upstream firm chooses S_{1} it is upstream firm 1.

If the input choices are (G,G) then upstream firms are not specific to a downstream firm. Both U_1 and U_2 can supply D_1 and D_2. The upstream price will equal p^H unless both upstream firms realize low costs. An upstream firm only makes profits if it realizes low costs and its competitor does not. In this case it sells to both firms. If the input choices are (S_1,S_2) then the upstream firms do not compete with each other, the only competition comes from the competitive fringe. Hence both are sole suppliers to their downstream partner, with the upstream price paid by both D_1 and D_2 equal to p^H. An upstream firm only makes profits if it is a low cost supplier, but it will make sales only to one downstream firm. If the input choices are (S_1,G) then both U_1 and U_2 compete for sales to D_1, but U_2 competes only with the competitive fringe to supply D_2. This means that D_2's price will always be p^H and U_2 will make profits when its costs are low from sales to D_2 regardless of U_1's costs. On the other hand the price D_1 pays will only be p^L if both upstream firms are low cost. Otherwise it will pay p^H, and if only one of the upstream suppliers is low cost, including U_2, it will make profits. The input choice (G,S_2) is the mirror image.

When both firms are unintegrated, the equilibrium in the third stage (the input specification stage) is for both upstream firms to supply the generalized input for cost correlation parameters less than or equal to 1/2. When the firms both adopt the generic technology, a firm makes profits when it is the only low cost producer. As cost correlation rises, this becomes less likely. Hence to avoid both having low costs and competing for sales to both downstream firms, as cost correlation increases, one firm mitigates the extent of competition by adopting a specific input. For a low value of cost correlation, the competitive effect is reduced and the cost of forgoing half the market for certain precludes specialization: both firms adopt the generic input specification and compete for sales to both D_1 and D_2.

The firm that adopts the specific input specification confers positive benefits on its competitor. If it is U_1, then U_2 gains since it will have market power over D_2 and realize economic profits if it is the low cost firm regardless of U_1's cost (this is the benefit of a reduction in cost correlation). The effect on the downstream firms is asymmetric. D_1 benefits and D_2 loses since D_2's upstream price will always be high, i.e., its cost is raised. Hence in the absence of vertical integration, U_1 is less likely to incur the costs of adopting the specific input since it incurs costs (inability to compete for D_2) and some of the benefits accrue to its upstream competitor and downstream buyer. Integration will internalize the benefits downstream.

To see how the choice of input specifications is affected by vertical integration, suppose that U_1 and D_1 merge. Then the integrated firm (I_1) will always transfer the input internally at marginal cost, eliminating the inefficiency associated with double marginalization when U_1 was the sole low cost upstream supplier. If both upstream suppliers have adopted the generic input specification, then the price upstream for D_2 will be p^H, unless both U_2 and I_1 are low cost, in which case competition between them will drive the price D_2 pays for the upstream good to p^L. Unlike in OSS, Choi and Yi assume a Nash equilibrium in the upstream market and if it is profitable for the integrated firm to supply, it will do so.

The case of interest is whether I_1 would have an incentive not to adopt the generic input specification, but instead foreclose sales to D_2 by adopting the specific input technology. The advantage of adopting the specific technology is that it commits it not to supply to D_2, raising D_2's expected costs and I_1's expected downstream profits. More specifically, when both upstream suppliers have low costs under the generic input specification, the price for both downstream firms will be p^L, but when the integrated firm has adopted the specific technology, for the same cost realizations upstream, the price D_2 pays will be p^H. The disadvantage is that it forecloses the possibility of

supplying D_2 and earning positive profits if it is the low cost supplier. The greater the extent of cost correlation under mutual adoption of generic technologies, the more likely both downstream firms have low costs: hence the greater the advantage of avoiding cost correlation by I_1 adopting the specific technology and raising the cost of D_2. Increasing cost correlation also means that the costs of foreclosing D_2 are less, since it is profitable only to supply D_2 when I_1 is the only low cost supplier.

For sufficient cost correlation, the integrated firm is willing to forgo ex ante the opportunity to sell to the unintegrated downstream firm by specializing since it internalizes the effect on downstream profits. *Without* the change in input specification, vertical merger is efficiency enhancing since it eliminates double marginalization and the integrated firm cannot commit not to supply its rival if it is profitable.

Vertical integration will be profitable in the absence of a counter merger when the integrated firm produces the specialized input, if the positive effects from eliminating double marginalization and raising rival's costs exceed the lost profits from not supplying the competing downstream firm.[102] However, if there is a counter merger, then for low enough values of the cost correlation, the unique equilibrium to the choice of input is for both firms to produce the general input. Counter merging undoes the raising rival's cost effect, but because that provided the incentive for specialization, the counter merger means that firms will not specialize. This has two negative effects on the profits of the retaliating unintegrated firms relative to unintegrated stand alone profits: (i) downstream competition is intensified due to an increase in cost symmetry and (ii) the increase in

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[102] If firms' strategic variables downstream are strategic complements, then eliminating double marginalization will reduce profits. Bonnano and Vickers (1988) demonstrate that double marginalization increases profits when competition downstream is between strategic complements (differentiated products with price competition). In this case double marginalization raises the profits of an integrated pair of firms. This result echoes the no retaliation result in OSS. Similarly in the model of Gaudet and Long with strategic substitutes, aggregate profits in the symmetric case are greater when there is complete vertical separation compared to when all pairs of firms are vertically integrated.

market power of the upstream firm is eliminated. If the effect of cost correlation is large enough, there will not be a counter merger.

Finally, Choi and Yi derive a condition demonstrating that the maximum willingness to pay by a downstream firm for the acquisition of an upstream firm, which is equal to the difference between its profits from foreclosing and being foreclosed, is greater than what an unintegrated upstream supplier receives in the foreclosure equilibrium. When this condition is satisfied, then there is no holdout problem: upstream suppliers prefer to be acquired as opposed to being the upstream firm that remains independent.

In summary, in the Choi and Yi model a vertical merger involving foreclosure in the upstream market is possible if the following five conditions hold:

> (i) cost correlation is large enough that in the partially vertically integrated structure, the integrated firm chooses to specialize.
>
> (ii) cost correlation is small enough that in the fully vertically integrated structure, both integrated firms choose not to specialize.
>
> (iii) vertical integration with specialization is profitable.
>
> (iv) counter merging is not profitable.
>
> (v) there is no holdout.

The foreclosure equilibrium is inefficient if the raising rivals' cost effect and increased cost asymmetry dominates elimination of double marginalization. However, the advantages of specialization are limited to the elimination of cost correlation. It is expected that there would be a cost advantages from specialization, but in Choi and Yi the generalized and the specific input are actually homogenous for the relevant downstream firm. Presumably the advantages to foreclosure would be greater if adoption of the specific input resulted in a cost reduction.

Chen

Chen's (2001) model is identical to that of OSS except for the following two aspects: (i) one firm has a marginal cost advantage upstream; and (ii) the two downstream firms select a supplier at zero cost, but if they change suppliers they incur a switching cost. Upstream costs are constant and competition over price (Bertrand). As a result the equilibrium price upstream in the unintegrated industry structure equals the marginal cost of the inefficient upstream firm. The switching cost is motivated by the observation that firms often have to make relationship-specific investments, which support trade only with specific trading partners.

Chen finds that a vertical merger only occurs if there is an upstream firm with a cost advantage and a positive switching cost. The efficient upstream supplier merges with one of the downstream firms. The integrated firm has an incentive to lower its price, because it avoids double marginalization on the upstream input that it can now access at marginal cost. The second downstream firm then has an incentive to select the integrated firm as its supplier, locking it in to the integrated firm. The unintegrated downstream rival does this because it knows that this will give the integrated firm an incentive to raise its price downstream, offsetting the incentive to lower it provided by the elimination of double marginalization. The reason the integrated firm will have an incentive to raise its price when its rival sources supply is that a higher downstream price will increase demand for the unintegrated firm's product and hence derived demand for the upstream good. The value of maintaining volumes of the upstream good to the unintegrated rival depends on the cost of switching suppliers. The greater this cost, the higher the input price that can be charged by the unintegrated rival, and thus the less competitive the integrated firm's downstream prices.

The incentive effect on the integrated firm's downstream pricing makes a counter-merger unprofitable: the unintegrated downstream firm would lose more than the foreclosed upstream firm gains. This is so even though the unintegrated firm is made worse off by the vertical merger: its profits and market share fall and its input price rises. If the

switching cost is relatively small, then prices for both downstream products fall and consumers are made better off. If the switching cost associated with changing suppliers is relatively large, then vertical merger increases the price of both downstream products. The size of the critical switching cost is decreasing in the extent to which the two downstream goods are substitutes.

The profits of the integrated firm are

$$\pi^{vi} = (p^{DS} - mc^{US} - c)q_{vi}^{DS} + \left(p^{US} - mc^{US}\right)q_s^{DS}$$

and while p^{US} is set prior to downstream competition, the vertically integrated firm will recognize when it sets is downstream price that increases in its downstream price will raise demand for its competitor and hence its upstream demand: p^{DS} determines q_s^{DS}. The added incentive for the integrated firm to charge a higher price downstream can be seen by noting the following:

$$\frac{\partial \pi^{vi}}{\partial p^{DS}} = (p^{DS} - mc^{US} - c)\frac{\partial q_{vi}^{DS}}{\partial p^{DS}} + q_{vi}^{DS} + (p^{US} - mc^{US})\frac{\partial q_s^{DS}}{\partial p^{DS}}.$$

The last term on the right-hand side is positive if the integrated firm has a positive margin upstream, indicating that the vertically integrated firm has an incentive to charge a higher price downstream: prior to integration the effect on the downstream profits of increasing the downstream price is given by the first two terms on the right-hand side. The greater the margin upstream, the more effective the strategy by the unintegrated rival (sourcing from its rival) at mitigating competition downstream. The margin available is determined by the size of the switching cost.

Four assumptions are critical to Chen's results. The first is that the integrated firms profits are increasing in its input price when it sells to its unintegrated rival for input prices in the neighborhood greater than the Bertrand upstream equilibrium price when it is not integrated. This is true if its efficiency advantage is small.

The second is that the switching cost must be positive. If the unintegrated downstream firm can switch without cost, then integration has no effect on the upstream pricing equilibrium. The switching cost plays the role of creating commitment for the integrated firm to be able to exercise market power upstream.   If it is zero, then the unintegrated firm will find it profit-maximizing to switch to alternative suppliers unless the integrated firm matches their price.

The third is that the downstream costs of the integrating firm must decline post-merger. This can either be because of the elimination of double marginalization or a merger specific cost reduction. It is the implications of this cost reduction for competition downstream and the profits of its unintegrated downstream rival which provides its rival downstream with the incentive to source its supply at a higher price from the integrated firm.

Fourth, vertical mergers will still arise in equilibrium if the downstream good is homogeneous and competition Cournot. However, in this case the vertical merger will be welfare improving and the choice of supplier by the unintegrated firm does not matter. Cournot competition breaks the link between the upstream and downstream markets for the integrated firm, since under Cournot competition, q_s^{DS} is taken as given by the vertically integrated firm when it determines its profit maximizing output.

3.2.6 Antitrust Implications of Strategic Complement Models

The literature that begins with OSS has many of the same implications for antitrust enforcement as the models that start with Salinger and assume strategic substitutes downstream.   A key insight highlighted by the strategic complement models is the profitability of a counter vertical merger and establishing that a counter merger—which would eliminate the raising rivals' cost effect of a vertical merger—may not be profitable if there are externalities associated with the vertical merger that benefit the non-integrated firms. This literature also highlights the importance of commitment on the part of the vertically integrated firm not to participate, or to be able to commit to a price, in the

upstream market. Extensions to the OSS framework have focused on the ability of switching costs on the part of buyers (Chen) or asset specificity (Choi and Yi) for a vertical merger to create market power upstream. Without some mechanism for how a vertical merger makes commitment profitable—commitment which was not profitable when the upstream firm was independent— it is very unclear how a vertical merger will create market power.

Existing market power upstream likely means that a vertical merger, because it eliminates double marginalization, is good for consumers and efficiency. While it is true, as Riordan and Salop identify, that a vertically integrated firm will have an incentive to reduce supply to raise the costs of its rivals downstream and therefore its prices and profits, this is typically offset, in whole or in part, by a reduction in demand by the unintegrated rivals downstream. This analysis points out the importance of looking not just at the incentives of the integrated firm, but performing an equilibrium analysis which incorporates the responses of other firms both up and downstream, including the possibility of counter strategies.

Two models that suggest antitrust concerns are Choi and Yi and Chen. The Choi and Yi model appears to be difficult to apply since it depends critically on the extent of cost correlation, and assessing empirically the extent of cost correlation is likely to be difficult. Choi and Yi argue, however, that cost correlation is a modeling device. Application of the model is based on recognizing that cost correlation is a "stand-in" for either innovation or an efficiency advantage.

In the innovation interpretation, the low cost realization represents successful innovation by an upstream firm. The upstream firms have a choice between two innovation strategies: one generic and one specific. The generic strategy if successful results in an innovation useful to both downstream firms. Following a specific strategy implies that a successful innovation will only be useful to the relevant downstream firm. In this case "cost correlation" corresponds to the likelihood that both will be successful when they

follow the same research strategy. Alternatively, Choi and Yi argue that cost correlation could be dispensed with entirely and instead the probability of a low cost realization be higher for adoption of the specific input. This is the efficiency advantage interpretation.

The Choi and Yi theory is consistent with the following: (i) pre-merger upstream firms have adopted the generic technology and are willing to supply all downstream firms; (ii) the possibility post-merger that an integrated firm can, and will, adopt a specific technology that; (iii) prevents it from supplying unintegrated rivals downstream and creates market power among the remaining upstream suppliers; and (iv) creates some benefit that accrues to the unintegrated firms, thereby precluding a counter merger. These circumstances are fundamental to a demonstration that adoption of the specific technology becomes profitable post-merger for the integrating firm and that a counter merger will not be profitable. Of course, the vertical merger that leads to foreclosure could still be beneficial for consumers and increase total surplus. A showing that foreclosure will be harmful to consumers requires a plausible case that the effects of raising rival's costs and enhancing cost asymmetry dominate the elimination of double marginalization.

The anticompetitive effect associated with a vertical merger in the model of Chen occurs in the following circumstances: (i) multiple upstream firms, but the upstream firm involved in the merger has an efficiency advantage or the integrated firm will have a cost advantage post-merger; (ii) this efficiency advantage has to be relatively small to insure that the integrated firm will actually have an incentive to raise its price to take full advantage of any switching cost; (iii) relatively large switching cost on the part of the downstream firm; and (iv) strategic complements downstream. The less differentiated the downstream products, the smaller the switching costs must be for the vertical merger to result in a price increase downstream.

3.2.7   Commitment and Leveraging: Hart and Tirole

A very different perspective on the anticompetitive effects of a vertical merger is provided by Hart and Tirole (1990).   Rey and Tirole (2003) define vertical foreclosure as a situation in which an upstream monopolist supplier of an input essential for production in the downstream market, seeks to restrict output in the downstream market, typically by restricting downstream production by denying or limiting access to the essential input. In the Hart and Tirole model, vertical merger and foreclosure is one way for an upstream monopolist to preserve its market power in the upstream market by eliminating competition downstream.

The intuition for the Hart and Tirole approach is to observe that when the terms of trade, or contracts, between an upstream and downstream firm are unobservable (by others) or unverifiable, the monopolist has a commitment problem. After contracting with a retailer downstream to sell the monopoly quantity in exchange for a fixed fee equal to the monopoly profits, it can increase its profits by contracting with additional retailers in the same market. The reason is that the loss on the monopoly quantity is borne by the first retailer, not the monopolist. Consequently the monopolist will have an incentive, and will be able to reach a mutually profitable agreement with a second retailer to expand its sales. Anticipating this, the first retailer will not enter into a contract under which it sells the monopoly quantity in return for a fixed fee equal to the monopoly profits. Unable to commit not to expand output, because it is profitable, the monopolist is not able to even earn her monopoly profit. Vertical integration has been suggested as one way that the monopolist could internalize the loss from expanding output downstream, thereby eliminating its incentive to find alternative downstream buyers and preserving its monopoly power and profits.[103]

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[103] The commitment problem identified here is very similar to that associated with a durable goods monopolist. A durable goods monopolist has an incentive to engage in intertemporal price discrimination, since the loss on inframarginal units from lowering the price through time is borne by consumers who purchased in earlier periods. Anticipating this, consumers have an incentive to act strategically and substitute between periods. This reduces the monopoly power of the durable good monopolist. Here the discrimination is not over time, but over downstream firms. See Church and Ware (2000, Chapter 4) and cites therein for discussion of durable goods monopoly.

Formally, the Hart and Tirole model assumes a single monopolist upstream (U) who produces an input used by two downstream producers at constant marginal cost.[104] Two downstream firms, D_1 and D_2, produce a homogenous good. The production process downstream is fixed proportions and they assume that the cost of transforming the upstream input into the downstream good is zero.

The timing of trade and production involves two stages. In the first stage, U offers each of the downstream firms a tariff that specifies what a downstream firm will pay as a function of its quantity. The tariffs can be firm specific: denote the tariff offered to D_i as $T_i(q_i)$, where q_i is the quantity demanded by firm i. On the basis of the tariff, D_i orders q_i and pays $T_i(q_i)$. In the second stage, the two downstream firms come to market with q_i of the downstream good and prices are set to clear the market. The use of non-linear pricing means that double marginalization is not an issue.

The equilibrium depends on whether $T_i(q_i)$ are observable. If they are observable then U can implement the following contract to each which does not involve foreclosure: offer each downstream firm $q_i = Q^m/2$ in return for $T_i = \pi^m/2$ where Q^m is the vertically integrated monopoly output and π^m the associated monopoly profits. Both downstream firms would accept, the price downstream would be the monopoly price, and the upstream firm would earn the same profits as if it foreclosed and acted as a vertically integrated monopolist.

However, the tariffs may not be observable or might be secretly renegotiated. Given that one firm has accepted $q_i = Q^m/2$ in return for $T_i = \pi^m/2$, the monopolist can increase its profits by offering the other a quantity and transfer that maximizes its profits. Essentially the monopolist regards itself in competition with the first downstream firm and given that

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[104] The presentation of Hart and Tirole (1990) follows Rey and Tirole (2003).

it will produce $q_i = Q^m / 2$, the monopolist has an incentive to increase output to where *its* marginal revenue equals marginal cost. Since it will not internalize the loss on the units already committed to the first downstream firm, it will offer to sell more to/through the second downstream firm. Its profit-maximizing quantity to sell to the second downstream firm is $Q_2 = R(Q^m / 2) > Q^m / 2$ where $R()$ is the Cournot best response function. If the first downstream firm anticipates this, it will realize that it will not earn $T_i = \pi^m / 2$ and will decline to accept the tariff that implements the monopoly outcome.

The equilibrium when contracts are secret, or not verifiable, depends on the beliefs the downstream firms have regarding the contracts offered their rival. If the downstream firms assume that rivals receive identical offers, i.e., beliefs are symmetric, then the monopoly outcome is implementable since for any quantity firm *i* is offered, it expects a similar quantity to be offered to firm *j*. Hence the profit-maximizing quantity for U to offer a downstream firm is based on internalizing the loss on industry inframarginal units, which leads it to offer half the monopoly output in exchange for a payment equal to half monopoly profits.

Alternatively, if the downstream firms have passive beliefs, they do not revise their beliefs regarding the contract offered to their rival when their offer changes. As a result, the equilibrium offers are for each firm to accept the following contract: $q_i = q^C$ in return for $T_i = \pi^C$ where q^C is the equilibrium Cournot output for a downstream firm and π^C the corresponding firm profit. As a result, the equilibrium contracts institute the Cournot equilibrium downstream, with the upstream monopolist able to only extract Cournot industry profits instead of monopoly profits. As the number of firms downstream increase, Cournot industry profits decline, and the commitment problem of the monopolist becomes more costly. In the perfectly competitive limit, the downstream price goes to marginal cost and the market power and profits of the monopolist are eliminated.

A vertical merger between the upstream monopolist and a downstream firm would restore its market power. If it "cheated" on its downstream firm by supplying product to another downstream firm, it would reduce its own profit. Integration is a means for it to internalize the losses on inframarginal units, and when it does so it has no incentive to supply more than the monopoly output downstream.

The implications of this model for vertical merger policy are unlikely to be significant. It is difficult to see this monopoly commitment problem as a justification for vertical merger. It is much more likely that this commitment problem would be solved through exclusive contracts rather than vertical merger. Moreover, the actions taken here by the monopolist to solve the commitment problem are designed to preserve its monopoly power, not by excluding competitors downstream, but by placing constraints on its behaviour. While it is true that a vertical merger in these circumstances would preserve its market power, that preservation is not achieved by relaxing a constraint on its market power by reducing competition. Hence it is not clear that this type of behaviour is a legitimate target for antitrust enforcement, provided, of course, the monopoly upstream has been obtained legitimately, through superior competitive performance.

3.2.8 *Preemption and Raising Rivals' Costs of Entry*

The strategic literature on entry prevention through preemption has relevance to the analysis of vertical mergers. Suppose that there is a downstream vertically integrated monopolist. Entry downstream is not possible without access to an essential upstream input. Initially the vertically integrated incumbent controls all of the upstream input. However, there has been entry upstream and thus there is potential for entry downstream. The incumbent monopolist can maintain its monopoly downstream if it can acquire the new source of input supply. To do so it will have to outbid, or preempt, an entrant. This situation is analyzed by Gilbert and Newbery (1982) and Reinganum (1983). More recently, Riordan (1998) considers the incentives for a dominant firm to preemptively acquire an upstream input in scarce supply, thereby raising the costs of its competitive fringe downstream.

The work of Gilbert and Newbery established the efficiency effect. The efficiency effect is that industry profits under monopoly are at least as large as industry profits under duopoly. A monopolist would be willing to pay the difference between monopoly profits and duopoly profits to remain a monopolist. An entrant would only be willing to pay up to its duopoly profits for the input and the ability to enter. Because of the efficiency effect this establishes a bias in favor of monopolization by the incumbent. Reinganum shows that the willingness of the monopolist to outbid an entrant for the scarce input is mitigated by the replacement effect. The replacement effect affects the incentives of the incumbent to purchase the input when there is uncertainty regarding the potential for entry if the input is acquired by the entrant. If the entrant was not in the market for the input, because even with the input it could not enter, then the monopolist would only be willing to pay the difference between monopoly profits with the input and monopoly profits without, i.e., the incremental benefit of remaining a monopolist, but perhaps with more productive inputs.

Riordan (1998) builds on the model of Gilbert and Newbery. Rather than a monopolist downstream, Riordan assumes a dominant firm—whose market power is constrained by the existence of a price taking fringe—and rather than a completely inelastic supply of the input upstream, assumes that the key input is supplied by a competitive industry, with increasing marginal cost, i.e., upward sloping marginal costs. This second difference means that the input upstream is divisible, i.e. sold on a per unit basis, and that difference introduces double marginalization into the analysis. In Gilbert and Newbery, the upstream input for sale is indivisible: it is an all or nothing transaction.

Riordan shows that backwards integration by the dominant firm results in an increase in the price of the input for the fringe: the greater the extent to which the dominant firm is integrated, the greater its incentive to "over-buy" in the input market. Increasing its purchases in the input market does two things: (i) it raises the costs of the fringe downstream and (ii) it provides the dominant firm with an incentive to expand its output

downstream. Both of these effects result in a decrease in the output and hence the competitive constraint of the fringe downstream. [105] The result is an increase in market power for the dominant firm and an increase in the downstream price. The effect on total surplus, however, is ambiguous.

The rationale for why the incentive for the dominant firm to increase its purchases upstream is increasing in the extent of vertical integration arises from the fact that vertical integration eliminates, for the units supplied internally, double marginalization. The double mark up problem is mitigated by vertical integration since those units of capacity are not subject to the increase in price upstream when the dominant firm raises the price upstream by overbuying.   The larger the initial capacity of the dominant firm, the greater is its incentive to acquire capacity, leading to foreclosure of the competitive fringe.

Gilbert and Newbery

The analysis of Gilbert and Newbery (1982) considers the following situation. Suppose that production of the downstream good requires access to an input that is in finite supply. Denote the finite supply of this resource, which could be raw materials, human capital, or technology, by X. Suppose initially that the current stock is controlled by a downstream monopolist (firm 1).   Assume an additional finite amount of the input becomes available, equal to E.

If E is acquired by the incumbent monopolist, then its monopoly will be preserved. If on the other hand, the incremental supply of E is acquired by another firm, it can enter downstream and compete with the monopolist. The maximum that an entrant (firm 2) would be willing to pay for E is the net present value of duopoly profits: $\pi_2^D(X, E)$. The maximum that the incumbent would be willing to pay is equal to the difference between

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[105] See Salop and Scheffman (1987) as well for a discussion of the incentives for a vertically integrated firm to "over-buy" in the input market. Salop and Scheffman highlight the incentives for overbuying by the dominant vertically integrated firm when its downstream affiliate is a less intensive user than its downstream rivals.

the net present value of its profits if it acquires E (and remains a monopolist) and the net present value of its profits if it does not acquire E and there is successful entry: $\pi^M(X+E) - \pi_1^D(X,E)$. The incumbent will be willing to pay more for E if

$$\pi^M(X+E) - \pi_1^D(X,E) > \pi_2^D(X,E)$$

or

$$\pi^M(X+E) > \pi_1^D(X,E) + \pi_2^D(X,E) \tag{14}$$

We would normally expect that (14) would be true. The left-hand side is industry profits when the incumbent monopolist has control over both its stock of the resource and E. The right-hand side equals industry profits when there is duopoly competition between the incumbent and the entrant. The expectation is based on the fact that a monopolist by setting the same prices and outputs as when there is a duopoly could at least replicate the duopoly equilibrium, and in general, will be able to do better since competition is eliminated. The result that a monopolist will outbid an entrant for access to an essential input required to enter the monopolist's downstream market is known as the "efficiency effect". The two sets of circumstances when (14) does not hold are (i) perfect collusion between the entrant and the incumbent and (ii) if E is of sufficiently higher quality that it renders X economically redundant, i.e., acquisition of E allows the entrant to become a monopolist and displace the incumbent. In this case both the incumbent and the entrant are bidding to be the next monopolist.

Reinganum

The work of Reinganum (1983) suggests how the introduction of uncertainty affects the conclusion that the monopolist incumbent, because of the efficiency effect, will remain a monopolist by acquiring E. The uncertainty introduced concerns whether in fact there will be entry if the entrant acquires E. If there is considerable uncertainty regarding whether acquisition of E will in fact result in entry, then the incumbent will not be as concerned with entry deterrence, but with the impact of the acquisition of E on its monopoly profits. Because it is already a monopolist, the value to it of E (when there is

no possibility of entry) is equal only to the difference between monopoly profits with *X* and monopoly profits with stock $X + E$: $\pi^M (X + E) - \pi^M (X)$. That is, the monopolist is willing to pay the difference between being a monopolist with access to input *X* or being replaced by a monopolist with access to input *X+E*. The value of *E* is reduced to the incumbent since that value is based only on its use (to the extent it lowers costs or enhances demand), not on both the value of *E* in deterring entry and use.

In the limiting case when *E* might allow the entrant to replace the incumbent as a monopolist, the entrant would be willing to spend more than the incumbent: it acquires all of the monopoly profit, the incumbent just the difference between the two monopoly profit streams. The result, that an entrant would spend more because it will receive all of the monopoly profit, not just the increment created by acquiring *E* is known as the replacement effect.[106] The replacement effect will continue to be large if *E* does not allow the entrant to displace the incumbent, but does allow for it to capture a significant share of the market: the result is that the entrant will outbid the incumbent.

If it is reasonably certain that acquisition of *E* will result in entry, the efficiency effect will dominate the replacement effect and the incumbent will outbid the entrant. If on the other hand the probability that *E* will lead to actual entry is small, the replacement effect will dominate and the entrant will out bid the incumbent.

In summary: when there is a large replacement effect relative to the efficiency effect—either because of displacement or because of uncertainty regarding the quality of *E*—the entrant will out bid the incumbent monopolist. On the other hand, when the

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[106] Arrow (1962) considered the effects of market structure in the downstream market (monopoly or competition) on the incentives for a monopolist in cost-reducing R&D to innovate. He found that a monopoly downstream provides less of an incentive for the monopolist in R&D upstream than if there was perfect competition downstream. The reason is the replacement effect: the gain to innovating when there is monopoly downstream equals the difference in monopoly profits. The gain to innovating when there is competition downstream is the entire monopoly profit created.

replacement effect is small relative to the efficiency effect, the incumbent will remain a monopolist by monopolizing the upstream input market.

Riordan

Riordan (1998) develops a theory of anticompetitive backwards integration by a dominant firm. Downstream there is a dominant firm whose market power is constrained by a competitive fringe. Output of the fringe and the dominant firm is homogenous, but the dominant firm has a per unit cost advantage. Production downstream requires a fixed input—capacity—which is combined with variable inputs. Short-run marginal cost is increasing, but in the long-run there are constant returns to scale. Expanding capacity lowers the marginal cost of the dominant firm: the fringe firms are assumed to employ a single unit of capacity. The downstream industry is supplied with capacity (k) by the upstream sector. Production upstream of capacity is by a competitive industry which has an upward sloping supply function, i.e., has increasing marginal cost. Free-entry, i.e., a zero profit condition determines the size of the competitive fringe.

The Riordan model has four stages:

(i)   The dominant firm acquires capacity from the upstream sector.

(ii)   Fringe firms enter.

(iii)   Dominant firm sets the price downstream.

(iv)   The fringe take the dominant firm's price as given and produce where price equals marginal cost.

In stage (iii) the dominant firm will set its price anticipating the response of the competitive fringe in (iv). Moreover, when it selects capacity in (i), it will incorporate the response of the fringe in (ii), and the resulting price equilibrium. Specifically, when the dominant firm determines the extent of its capacity acquisitions in (i), it determines the price of capacity for the fringe and will take into account that a higher price—induced by increasing its purchases—will reduce the profitability and hence the size and output of

the fringe. By assumption the dominant firm has market power as a buyer in the capacity market and as a seller in the downstream (output) market. Riordan assumes that the dominant firm is vertically integrated: it initially has k_0 units of capacity that it does not have to acquire from the upstream competitive fringe. The focus of the model is on the sensitivity of the equilibrium to the extent of vertical integration—the magnitude of k_0.

Consider the consequences when the dominant firm increases its purchases of capacity. This raises the price of capacity (the upstream price) and shrinks the size of the competitive fringe, enhancing the market power downstream of the dominant firm. Moreover, because its marginal costs decrease as its capacity increases, the dominant firm has an incentive to increase its output, which further reduces the output (and profits) of the fringe. However, the net effect downstream is an increase in price: the foreclosure of the fringe more than offsets the expansion of the dominant firm.

The key result is that as the extent of integration increases (k_0 rises) both the upstream and downstream prices increase. In the absence of integration the dominant firm creates a double mark-up: its exercise of market power upstream results in its marginal factor cost—the amount it pays for a unit, which is the sum of the price per unit plus the increase in price to elicit another unit of supply multiplied by its total purchases—being above the marginal cost of supply and, in turn, it raises the price downstream above its costs (based on the purchase price of capacity). When it its vertically integrated ($k_0 > 0$), the double mark up problem is mitigated since it is "protected" against the increase in price upstream of its activities for the units of capacity that it owns. The larger the initial capacity of the dominant firm, the greater is its incentive to acquire capacity, leading to foreclosure of the competitive fringe.

The increase in downstream price means that increases in the extent of integration harm consumers. On the other hand, it may not result in a decrease in total surplus if the net external benefits are positive. While consumers lose from an increase in vertical integration from the price increase downstream, capacity suppliers gain from the increase

in the input price.[107] Riordan demonstrates that total surplus is likely to decrease if the dominant firm's share of capacity post-merger is large or if its output market share—pre-merger—is substantially larger than its share of capacity.

A key factor in the analysis is that the supply curve of the upstream firms is increasing: marginal cost rises as output expands. If this were not the case, if instead marginal cost was constant and the supply curve of capacity horizontal, the dominant firm would not have monopsony power and vertical integration would not have an affect on the equilibrium—there would not be a double mark-up.

One of the interesting points that arises from Riordan's model is the importance of the competitive fringe downstream on the efficiency effects of vertical integration. If the dominant firm was instead both a monosponist upstream and a monopolist downstream, then it would have an incentive to integrate backwards to eliminate the double mark-up it creates. This would raise both its profits and lead to lower prices—as suggested above by our analysis of the chain of monopoly model. In Riordan's model if the cost advantage of the dominant firm or the extent of vertical integration are sufficiently large, then the fringe may be foreclosed completely and the dominant firm becomes a monopolist/monopsonist. In this case any further integration increases both consumer surplus and total surplus.[108]

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[107] The effect of increasing capacity by the dominant firm leads to a higher price for consumers, reducing their surplus. It also results in an increase in capacity purchases, which increases the surplus of capacity producers in the input market.

[108] Rey and Tirole (2004) observe that the Riordan model is incomplete: the initial level of integration (k_0) is exogenous to the model. The profitability of acquiring this initial stake is not considered. Instead the analysis is based on considering how the equilibrium changes as the initial extent of integration changes. The changes in the equilibrium—higher prices for capacity in particular— might well impact on the profitability of increasing k_0. If the anticipated higher capacity prices increase the cost of k_0, then the dominant firm may not benefit from its overbuying in the input market and may not find it profitable to integrate.

Antitrust Implications

The results of Gilbert and Newbery indicates backward integration by a monopolist can be problematic when a downstream monopolist can acquire all of the input available that likely allows entry and that input is in perfect inelastic supply. Riordan has expanded this framework to allow for some elasticity of supply upstream and competition downstream. Indeed with perfectly elastic supply upstream there is no reason for antitrust concern. The Gilbert and Newbery analysis is very similar to a horizontal merger, i.e., the market power exercised downstream is preserved by the integrated firm remaining a monopolist upstream. Riordan's analysis expands the analysis to allow for competition from price-taking firms up and downstream. Increases in the extent of vertical integration in his model also can be interpreted as a horizontal merger that increases market power upstream. And while, like in Gilbert and Newbery it results in higher prices for consumers, it might also result in an increase in total surplus.

The key result in Riordan is that as the extent of integration increases (k_0 rises) both the upstream and downstream prices increase. In the absence of integration the dominant firm creates a double mark-up: its exercise of market power upstream results in its marginal factor cost—the amount it pays for a unit, which is the sum of the price per unit plus the increase in price to elicit another unit of supply multiplied by its total purchases—being above the marginal cost of supply and, in turn, it raises the price downstream above its costs (based on the purchase price of capacity). When it its vertically integrated ($k_0 > 0$), the double mark up problem is mitigated since it is "protected" against the increase in price upstream of its activities for the units of capacity that it owns. The larger the initial capacity of the dominant firm, the greater is its incentive to acquire capacity, leading to foreclosure of the competitive fringe.

The factual context for Gilbert and Newbery:

       (i)   Monopoly downstream.

(ii)   Essential input required for entry downstream.

(iii)   Essential input is in scarce supply upstream.

(iv)   Monopolist downstream acquires all of the scarce supply upstream.

The downstream dominant firm will not outbid an entrant if the resource/assets/facilities are not scarce (or inelastically supplied). If the facility is not scarce then forestalling entry by preemption will not be profitable: investments in new facilities can always be made by new entrants and the cumulative investment in preemption will eventually become unprofitable. Therefore a complementary interpretation is that for a vertical merger to have an anticompetitive effect in these circumstances, there must be relatively large disadvantages associated with firms that attempt to enter without access to the inputs acquired by the dominant firm. Conversely, if an entrant were to acquire the assets preempted by the incumbent, they could enter and compete effectively.

The factual context for Riordan's analysis:

(i)   Dominant firm downstream.

(ii)   Competitive supply upstream and a competitive fringe downstream

(iii)   Increasing marginal cost of production upstream.

3.3   Customer Foreclosure: Creating Market Power Upstream

In this section we consider the economics of reducing rivals' revenues. The hypothesis investigated is that a vertical merger results in a reduction in demand for unintegrated upstream suppliers. The demand of the downstream firm that integrates is now captured by the upstream division of the integrated firm. The hypothesis is that this reduction in demand reduces volumes of the upstream competitors of the integrated firm, leading to an increase in either their marginal cost or average cost. An increase in the marginal cost of its upstream competitors reduces the competitive constraint they impose on the supply upstream division of the integrated firm. If, instead, there is a sufficient increase in the average cost of the upstream competitors, they will exit, again leading to an increase in

the market power of the integrated firm upstream.   Customer foreclosure in Figure 2 arises when D_1 ceases to source supply from U_2. As a result, U_2 imposes a less effective constraint/discipline on the price U_1 is able to charge D_2. For consumers to be harmed, this must lead to an increase in downstream prices: the effect of customer foreclosure on downstream prices depends on competitive conditions downstream.[109]

Under the "customer foreclosure" hypothesis, the integrated firm no longer sources supply from upstream competitors, but continues to supply other downstream firms. Indeed the profitability of foreclosure depends on being able to supply competing downstream firms at higher prices post merger. Notice that this concern is the exact opposite of the "input foreclosure" hypothesis. The concern with input foreclosure was that the integrated firm would no longer supply downstream firms, creating market power for its rivals upstream, which increases its market power downstream! Under customer foreclosure the objective is to create market power upstream for the integrated firm.

We address the economics of customer foreclosure by considering the foreclosure effects of exclusionary agreements. An exclusionary agreement between a buyer and a seller requires buyers not to purchase from other sellers.   In the literature on exclusionary agreements, or exclusive dealing, the contract creates a commitment on the part of the downstream firm not to buy from other suppliers. In the case of a vertical merger, there will not be an enforceable legal constraint.   The applicability of the insights of the literature on exclusive dealing will depend on whether it is profit-maximizing for the integrated firm to forgo sourcing supply from unintegrated upstream firms. Alternatively, vertical integration must provide a commitment that precludes sourcing supply from unintegrated upstream firms. [110]

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[109] Normally we would expect the downstream price to increase, but in the case where input markets are local and the downstream market global, the effect of the increase in cost will be a reduction in output in the local market, not an increase in price.

[110] In the models of input foreclosure considered in the last section the model of Avenel and Barlet was characterized by both input and customer foreclosure. In the strategic substitute models, the incentive was for the opposite of customer foreclosure, i.e., strategic overbuying. Even if commitment not to buy was

The next subsection considers the Chicago view that exclusionary agreements are unlikely to have an effect on market power, but rather that they are motivated by efficiency considerations. This view arises from the fact that exclusionary agreements are not imposed, but must be voluntarily agreed to, and hence are unlikely to make any party to the agreement worse off. If it did, presumably the party made worse off would not have agreed to enter the agreement. In the next subsections, the Chicago critique is shown to break down if there are contracting externalities: third parties not part of the agreement are harmed by the exclusionary agreement.

The contracting externality literature is comprised of two literatures: (i) those that consider competition between upstream firms for exclusives downstream; (ii) those in which there is a first-mover advantage—one of the upstream firms is able to enter into an exclusivity agreement with a downstream firm before the other upstream firm enters. The literature in which there is a first-mover advantage distinguishes between buyer and seller externalities. When there is a seller externality, it is a potential rival of the upstream firm that is harmed. When there is a buyer externality, it is another downstream firm/buyer who is harmed.

3.3.1   The Chicago Critique

The exclusionary effects of exclusionary agreements appear to be readily understood. By locking up a large enough share of buyers, a seller maybe able to "foreclose" rival sellers from the market. Denying market access to rival sellers, it is typically alleged, raises rivals' costs thereby reducing any competitive constraint on the market power of the seller they exert, and in the extreme raises their costs sufficiently that rivals exit the market or are prevented from entry. The elimination of firms upstream may, in turn, result in input foreclosure for unintegrated firms downstream.

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assumed, there was not a customer foreclosure effect because of the assumption of constant marginal cost

The difficulty with this argument was recognized long ago by scholars of the Chicago school of antitrust.[111] Their key insight was recognizing that exclusionary agreements cannot be imposed on buyers—rather they have to agree—and they will only agree if they are not made worse off. In this view of the world buyers should be able to anticipate if agreeing to an exclusionary contract increases the market power of a seller and if that means the price they pay will increase, or they are otherwise harmed, they will not agree to the exclusionary agreement without compensation. Compensation is only profitable for the seller if there are efficiencies attributable to exclusive dealing. Consequently, exclusive agreements are never entered into to create, enhance, or maintain market power. They are entered into realize efficiencies.[112] Moreover, a similar analysis holds if the exclusionary agreements are between manufacturers and retailers, since the retailer's profits depend on meeting the demands of consumers. The retailer, in this view, acts as the agent of the consumers.

The point is easily made with reference to Figure 5. Suppose that the downward sloping demand curve of the buyer is $D(P)$ and the (constant) unit cost of provision for the incumbent is c_I. The monopoly price is P^M and the "competitive price"—the price if there is competition—P^D. Optimal purchases by the buyer at the monopoly and competitive price are, respectively, Q^M and Q^D.

If the buyer signs an exclusive contract that precludes competition, she will understand that the price she will face will be P^M and not P^D. As a result her benefit from trade, or *surplus* (the difference between what she was willing to pay and what she had to pay, the price), will be reduced by area $A+B$. Hence she will not sign the exclusive contract without compensation equal to area $A+B$: area A is the wealth transfer from this consumer to the firm as a result of the exercise of market power, while area B is the deadweight loss of that exercise. However, a firm attempting to monopolize through

upstream. Changes in sales volumes upstream did not affect costs or viability.
[111] For example see Posner (1976, p. 203) and Bork (1978, pp. 306-307).

exclusive contracts cannot afford to pay *A+B:* the maximum it would be willing to pay to exclude its rivals is its monopoly profits which are area *A*.   The inefficiency of monopoly pricing means that the gain to the monopolizing firm is *less* than the lost surplus of buyers. The excluding firm will only find it profitable to enter into exclusive contracts if doing so creates efficiencies, efficiencies which generate additional profits/surplus that exceed the deadweight loss of monopoly.

3.3.2   Exclusive Dealing and Market Power

A number of recent contributions to the economics literature have addressed the Chicago critique and shown that it is not applicable to circumstances in which there are contracting externalities. A contracting externality exists if the welfare of others not party to the exclusive contract is affected adversely. In these circumstances it is possible that exclusive contracts can be a profitable strategy to exclude rivals. The deadweight loss is more than recovered from others not party to the exclusive contract. There are two branches to this literature. In the first there is competition between the upstream firms for exclusivity. In the second branch the entrant is not able to compete for exclusivity since it is not yet in the market.

3.3.3   Competition for Exclusivity

In this section we consider Mathewson and Winter (1987), Salinger (1991), and Bernheim and Whinston (1998). All three consider situations in which there are two upstream firms and a single retailer. They differ in that Mathewson and Winter (1987) and Bernheim and Whinston (1998) investigate the incentives for exclusive dealing, while Salinger (1991) addresses the consequences of vertical merger.

The two upstream firms can require exclusivity, but whether exclusivity arises in equilibrium depends on whether it is profitable for the upstream firms and it cannot be imposed on the retailer. The retailer will only accept it if it is at least as good as its next

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[112] Efficiency rationales are discussed in Section 7.

best alternative. Though the two models are very similar, they differ in that Mathewson and Winter restrict the set of feasible contracts to linear pricing, while Bernheim and Whinston allow for efficient pricing. The difference in feasible contracts, for the prevalence and effects of exclusive dealing, is significant.

In Mathewson and Winter, exclusivity is purchased by offering a lower upstream price. The lower upstream price compensates the downstream firm for its lost profits when it no longer deals with the competing upstream firm. The upstream firm with a cost or product differentiation advantage (the dominant firm) is the only upstream firm that can profitably compensate the downstream firm for exclusivity. It will find it profitable to do so if it does not have to drop its wholesale price much below the equilibrium wholesale price that would prevail in the absence of exclusivity. In this case it will be willing to lower its price in order to become a monopolist.

Salinger (1991) considers the effect of a vertical merger when there is initially two upstream firms who produce differentiated product, but only one downstream firm. The focus of Salinger's analysis is the incentive for the vertically integrated firm to raise the price downstream of the unintegrated product in order to divert demand to its integrated product. Would the merged firm have an incentive to raise the price of its upstream rival downstream in order to *increase* the sales and maybe even the price of its own product? Salinger (1991) is very closely related to Mathewson and Winter: the difference is that MW assume complete foreclosure—whose credibility is based on the strength of the contract—while Salinger explores partial foreclosure, the credibility of which is based on profit-maximization.

Bernheim and Whinston introduce efficient contracting between the upstream and downstream firms: the terms of trade between the upstream firm and the downstream

retailer maximize joint profits.[113] If efficient contracting is possible, then the downstream firm, by entering into efficient contracts with both upstream firms is able, to maximize industry profits. If exclusivity is profit-maximizing for the dominant firm (the upstream firm with a cost or product differentiation advantage), de facto exclusivity will arise even with common representation by the downstream firm. There is no reason for an explicit exclusive dealing arrangement. The contracting externality in Mathewson and Whinston is based on double marginalization and that disappears with efficient contracting.

Bernheim and Whinston reintroduce a contracting externality by assuming that there is a second downstream retailer in a separate market. This second downstream firm is not present at the time that the upstream firms contract with the first downstream firm. Bernheim and Whinston demonstrate that in these circumstances it is possible that an exclusive contract could arise between an upstream firm and the first downstream firm which is profit maximizing and anticompetitive.   The exclusionary agreement is anticompetitive if there is a fixed cost upstream and sales to the second downstream firm are insufficient to insure their recovery. In these circumstances an exclusive deal between an upstream firm and the first downstream firm precludes the second upstream firm from supplying the second downstream firm. As a result the first upstream firm is a monopolist supplier of the second downstream firm. The monopoly profits from the second downstream firm can be used to insure that the first downstream firm finds it profitable to agree to exclusivity.

The model of Bernheim and Whinston can be applied to Figure 5. Assume that the entrant (manufacturer B) can make a counter offer to the buyer for not signing an exclusive contract with the incumbent (manufacturer A) and that it must pay f to remain active in the market. Moreover, assume that there is a second market, in which the two manufacturers compete to supply. If signing an exclusive with the first buyer increases

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[113] A note of caution: we follow established usage in referring to contracts that maximize the joint profits of the retailer and a manufacturer as efficient. These contracts are privately efficient, not socially efficient. They maximize joint profits, not total surplus.

the profits of A more than it reduces the profits of B in the second market, and the increase in profits of A is greater than the deadweight loss in Figure 5, then firm A will find it profitable to compensate the first buyer for accepting the exclusive deal and firm B will exit.

Mathewson and Winter

Mathewson and Winter (1987) were the first to formally investigate the claim by Bork that the retailer would act efficiently as an agent of consumers and only accept an exclusive contract if consumers where made better off by reducing variety in exchange for a lower price. They considered a setting where there are two manufacturers who produce differentiated products and a single retail outlet that has local monopoly power.

In the first stage, the manufacturers (upstream firms) simultaneously choose whether to "impose", or require, exclusive dealing. In the second stage, the two upstream firms compete over prices. If neither required exclusive dealing, then their wholesale prices are determined in a Bertrand equilibrium based on the derived demand of the downstream monopolist: denote the Bertrand prices as (w_i^B, w_j^B).

On the other hand, if one of the upstream firms requires exclusivity, competition will be all or nothing. The retailer will select the supplier, which given the offered wholesale price, gives it the most profit. Rather than not make any sales, each of the manufacturers will be willing to price as low as marginal cost. In the competition to win the exclusive contract the manufacturer that can offer the retailer the lowest wholesale price without incurring losses will be selected by the retailer. In equilibrium this firm will price such that the retailer is just indifferent between purchasing from it at a price greater than its marginal cost and the other firm at a price equal to its marginal cost. If the profits of the retailer when it sources only from a single firm at wholesale price w_i are $R_i(w_i)$, then firm i is the winning firm if $R_i(c_i) > R_j(c_j)$ where c_i is the marginal cost of firm i, and the equilibrium price (w_i^*) is such that $R_i(w_i^*) = R_j(c_j)$. Mathewson and Winter refer to

the winning firm as the dominant firm: either it has a lower marginal cost and/or the
pattern of product differentiation is biased in its favor. Only the dominant firm will find
it profitable to require exclusivity and then only if its profits under exclusivity are greater
than under duopoly.

Whether exclusive dealing is profitable depends on how much the dominant firm will
have to discount its price below the Bertrand price in order to make the retailer
indifferent when its rival prices at marginal cost. If $R_i(w_i^B) < R_j(c_j)$ then the dominant
firm will have to discount its price below the Bertrand equilibrium level when there is no
exclusivity. It will be profitable, however, if the difference between $R_i(w_i^B)$ and $R_j(c_j)$
is relatively small.   In this case it can capture the entire market in exchange for a small
decrease in its price: the increase in demand more than makes up for the decrease in
price. On the other hand exclusive dealing will be profitable and lead to an increase in
the wholesale price if $R_i(w_i^B) \geq R_j(c_j)$.

The effect of exclusivity on the retail price depends on the change in the wholesale price
and the substitutability between the two goods. The retail price will rise if the wholesale
price rises, but it may rise even if the wholesale price falls (if the products are close
substitutes the increase in demand will more than offset the decrease in the wholesale
price). For large enough decreases in the wholesale price, the retail price will fall. The
reduction in product variety clearly harms consumers, and if there is an increase in the
retail price or only a small drop their surplus will fall.   If the retail price drop is large
enough, consumer surplus and total surplus may increase.   The private incentives for
exclusive dealing are enhanced by asymmetries between the two products. On the other
hand, exclusive dealing will be socially optimal when the asymmetries are limited.

The Mathewson and Winter model relevance to an understanding of vertical mergers is
limited by three factors. First, the profitability of exclusive dealing is based not on
integrated profits, but instead the profits of the dominant firm. Second, it assumes that

exclusivity is credible.   Relaxing both of these means that an integrated firm would typically find it profit-maximizing to sell the product of the foreclosed upstream manufacturer, provided it is not a perfect substitute and the upstream price is less than the highest willingness to pay of at least some consumers.   Hence the threat of foreclosure—not selling an upstream rival's product post merger—is not credible. Third, under exclusive dealing, but not likely vertical merger, double marginalization persists. Salinger (1991) has the same formal model as Mathewson and Winter, but rather than consider exclusive dealing, instead considers a vertical merger between the single downstream firm and one of the upstream suppliers.

Salinger (1991)

Salinger's focus is on whether the merged firm would have an incentive to raise the price of its upstream rival downstream in order to *increase* the sales and maybe even the price of its own product. Unlike Mathewson and Winter, Salinger's focus is on partial foreclosure—limiting the sales of the rival, not eliminating them.

In this situation a vertical merger eliminates the double marginalization for the upstream brand of the merging firm, reducing its cost to the monopolist downstream to marginal cost. Salinger shows that provided the upstream price of the other product does not change, the effect of eliminating double marginalization for one product can result in the downstream prices for both goods falling, rising, or the price of the good no longer subject to double marginalization falling and the price of the unintegrated brand rising.

The effect of the reduction in the upstream price of the integrated product affects directly its marginal cost for that product. The profit maximizing response of the integrated downstream firm is to increase its output of the integrated product and reduce its price. However, the decrease in the cost to the downstream firm for the integrated product increases the margin for that good and therefore affects the profit-maximizing condition for the price of the unintegrated product. To further benefit from the increased margin of the integrated product, the integrated firm will have an incentive to increase the price of

the unintegrated product, since this raises demand for the integrated product. If the fall in marginal cost is small and the effect from diversion of demand small, then the price of both products will decrease. If the fall in marginal cost is large and the diversion effect relatively small, then the price of the integrated good will fall, and the price of the independent good will rise. If the diversion effect is large enough relative to the fall in marginal cost, then the prices of both goods will rise. The diversion effect depends (positively) on the post-merger margin of the integrated good and the sensitivity of demand to the price of substitutes—the greater $\dfrac{\partial q_i}{\partial p_j}$ where q_i is the sales of the integrated product downstream and p_j the price downstream of the unintegrated product, the greater the diversion effect.

However, the upstream price of the independent good is not fixed. Instead the unintegrated firm will set its price optimally, given that the price of its substitute/competitor is now set in the upstream market at marginal cost. For the case of linear demand, Salinger shows that when the downstream price of the unintegrated firm rises, its supplier will have an incentive to reduce its upstream price to increase demand: lowering its price creates a larger margin for its product downstream, partially offsetting the incentives created by the elimination of double marginalization for the integrated product.[114] This may or may not lead to lower downstream prices for the independent products. In a numeric example, Salinger shows that even though the upstream price for the independent product falls, cutting its margin by almost fifty percent, the downstream prices of both products increase post merger. The net impact on prices depends in a complicated manner on the demand system, i.e., all own and cross price elasticities of demand, marginal costs, and the level of double marginalization pre-merger for the integrated good.

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[114] If the two products are strategic complements and there is linear pricing, the upstream price of the non-integrated product will fall.

Clearly consumers benefit when integration results in a decrease in both prices and their welfare is harmed when both prices increase. In aggregate their welfare may go up or down—as measured by consumer surplus—when the price of one product rises and the price of the other falls. Moreover, the profits of the independent upstream firm fall when the downstream price of its product rises: its price is reduced and so too is its volume. If it has avoidable fixed costs, this could result in its exit or preclude its entry.

It is straightforward to see that complete foreclosure is not an equilibrium unless even in its absence the integrated firm would find it optimal not to sell any of the unintegrated competing, but differentiated product. To see this, suppose that the integrated firm forecloses. Because the products are differentiated, the effect of this is to raise the demand for its downstream product as consumers substitute to its product and away from the (now unavailable) competing product. However, because the two goods are imperfect substitutes, some consumers will not substitute to the product of the integrated firm. Provided the willingness to pay of these consumers exceeds the marginal cost of the unintegrated product, the joint profits of the unintegrated supplier and the integrated firm will increase if they sell at last one unit of the rival's product.[115]

Bernheim and Whinston I

Bernheim and Whinston assume that that contracts between the retailer and the manufacturers need not be restricted to simple uniform pricing as in Mathewson and Winter. In Mathewson and Winter the payment by the retailer to a manufacturer as a function of quantity is linear in the wholesale price, i.e., the payment to manufacturer *j* as a function of quantity (x_j) is $P_j(x_j) = w_j x_j$, where w_j is the wholesale price of manufacturer *j*. Instead Bernheim and Whinston assume that a contract between the retailer and a manufacturer can be based on the quantity supplied by the manufacturer

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[115] Moreover, if marginal consumers for the integrated product switch to the unintegrated product, profits will rise since the profit on the marginal consumers of the integrated product was essentially zero, but it is positive on the unintegrated product.

and whether there is exclusivity.[116] Denote the payment by the retailer when it purchases

quantity x_j from manufacturer j as $P_j^e(x_j)$ when it has entered into an exclusive deal

with j and $P_j^c(x_j)$ when the retailer serves both manufacturers. The generality of the

contract allows for the retailer and a manufacturer to enter into contracts that insure that

the joint profits of the two parties are maximized. In this respect, the incentives for

exclusive dealing will be similar to a vertical merger.

Let Π^A denote the maximum joint profits attained when the retailer only deals with

manufacturer A. Let Π^B denote the maximum joint profits attained when the retailer

only deals with manufacturer B. Let $\hat{\Pi}^C$ denote the aggregate profits attained when the

retailer acts as the common representative for both manufacturers, i.e., the profits in the

absence of any exclusivity. Suppose further that the product of manufacturer A is

dominant, in the sense that $\Pi^A > \Pi^B$ and that the two products are substitutes, so that

$\Pi^A + \Pi^B > \hat{\Pi}^C$.

Bernheim and Whinston demonstrate that in a competition for exclusivity, the

winner—as in Mathewson and Winter— will be the dominant firm, here manufacturer A.

Denote the costs incurred by the manufacturers at the profit maximizing outputs (x_j^*) as

$c(x_j^*)$. Then the equilibrium payments from the retailer to the manufacturers are

$P_A^e = \Pi^A - \Pi^B + c(x_A^*)$ and $P_B^e = c(x_B^*)$. The equilibrium *payoffs* are $\Pi^A - \Pi^B$ and zero

for firm A and B respectively, and Π^B for the retailer. Since A is dominant, it can

always outbid firm B. The minimum payment that B will accept just covers its costs,

leaving the retailer with surplus from signing an exclusive with B of Π^B. This is the

minimum that A has to insure the retailer earns when it signs an exclusive with it. The

bid that insures this is $P_A^e = \Pi^A - \Pi^B + c(x_A^*)$. The dominant firm is able to outbid the

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[116] Bernheim and Whinston assume that the payment cannot be based on the quantity of the other
manufacturer. This precludes cooperative contracting between the two manufacturers.

other because it is more profitable, but the competition for exclusivity means that the retailer is able to capture profits equal to its next best alternative, dealing with *B* exclusively at a bid equal to cost. Hence the dominant firm bears the full cost incurred by the retailer of forgoing product *B*.

On the other hand, the outcome involving common representation entails payments of $P_j^c = \widehat{\Pi}^c - \Pi^i + c(x_j^{**})$ where x_j^{**} is the output of *j* that maximizes aggregate profits under common representation. Under this payment each manufacturer *j* receives its contribution to aggregate profits $(\widehat{\Pi}^c - \Pi^i)$ and the retailer earns $\widehat{\Pi}^c - \Pi^A - \Pi^B$.

The equilibrium involves exclusivity when it leads to aggregate profits greater than common representation $(\Pi^A > \widehat{\Pi}^c)$, otherwise there is common representation. The payoff to manufacturer *A* is greater under common representation when $\widehat{\Pi}^c > \Pi^A$.

When efficient contracting is possible between the manufacturers and the retailer, there is not an explicit role for contractual exclusivity.[117] Under common representation the firms, even without explicit cooperation between the two manufacturers, are able to contract to maximize aggregate profits. For instance the contracts could be of the form $P_j^c(x_j) = F_j + c_j(x_j)$ where $F_j = \widehat{\Pi}^c - \Pi^i$ is a fixed payment from the retailer to manufacturer *j*. Under these contracts, the full marginal benefit and costs for the sale of each product is transferred to the retailer. Because they internalize the benefits and costs of production across both products, they will choose x_A and x_B to maximize aggregate profits (these are the x_j^{**}). Hence under common representation, it will be the case that $\widehat{\Pi}^c \geq \Pi^A$, since $\widehat{\Pi}^c$ will equal optimal aggregate profits. The inequality is strict provided it is optimal for both products to be carried by the retailer under common representation.

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[117] O'Brien and Shaffer (1997) reach a similar conclusion in a model with nonlinear pricing. They show that if nonlinear pricing is possible, then equilibria involving exclusive dealing are Pareto-dominated from the perspective of the manufacturers.

When $\widehat{\Pi}^c = \Pi^A$, then the outcome is effective exclusion under common representation since at the optimum $x_B = 0$.

In Mathewson and Winter's model where the terms of trade between manufacturers and retailers is restricted to linear pricing, there is a contractual externality between a manufacturer and a retailer: double marginalization. The retailer does not recognize under common representation that when it increases its sales of product B it harms A. Lowering the price of B affects the demand for A negatively, and the reduction in demand harms A: it suffers a loss of $w_A - c_A$ (its margin) on each unit no longer purchased. As a result it is possible for $\Pi^A > \widehat{\Pi}^c$ and there is scope for exclusive contracting. This externality does not exist when there is an efficient incentive contract, e.g., where the price of the product to the retailer equals marginal cost.

This result is consistent with two general principles which underlie the analysis of Bernheim and Whinston (pp. 71-72): (i) "the form of representation (i.e., exclusivity or common representation) is chosen to maximize the joint surplus of the manufacturers and the retailer, subject to whatever inefficiencies may (or may not) characterize incentive contracting between the retailer and the represented parties"; and (ii) "explicit exclusive dealing (as distinguished from a retailer's unilateral decision to carry only one product) will not arise unless common representation involves externalities among the manufacturers that result in contracting inefficiencies." The second principle implies that in general we would expect $\widehat{\Pi}^c > \Pi^A$ unless there are inefficiencies associated with common representation whose effect is sufficiently large that $\Pi^A > \widehat{\Pi}^c$.

Bernheim and Whinston II: A Role for Exclusive Dealing Based on Market Power
The significant contribution of Bernheim and Whinston is the observation that if there are not any contracting externalities under common representation, then if contracting is sufficiently flexible, there is not a reason for exclusive dealing (or vertical integration for that matter). In order for exclusive dealing to arise in equilibrium there has to be a

contracting externality under common representation which prevents the maximization of the total profits of the three firms without exclusive dealing.

In this context, Bernheim and Whinston demonstrate that exclusive dealing might arise because it creates market power for one of the manufacturers in a second downstream market. The emphasis in Bernheim and Whinston is on noncoincident market effects, i.e., market power creation in a different market. Entering into an exclusive deal with the retailer in market one, forecloses the second manufacturer not only from the first market, but also a second retail market. The foreclosure in the first market, excludes the second manufacturer in the second retail market due to a scale effect. Without making sales in the first market, its average costs are too high to compete with the first manufacturer in the second retail market. Foreclosure of the second manufacturer in the first retail market results in the monopolization of the second retail market. Monopoly profits from this market can be used by the first manufacturer to compensate the first retailer. However, because of contracting externalities attributable to noncoincident market effects, explicit exclusion is required in equilibrium to maximize the joint profits of the two manufacturers and the retailer in market one. A key requirement is that the second retailer is not part of the contracting game between the first retailer and the two manufacturers. This means that the profits of the second retailer are not considered when representation is determined in the first market. This assumption is appropriate when the two retail markets develop sequentially, i.e., the second retail market does not exist when the two manufacturers and the first retailer contract. A second reason might be antitrust laws that prohibit coordination between the retailers and the manufacturers to maximize aggregate profits across both markets.

The timing of the model with noncoincident market effects is as follows: in phase 1, the two manufacturers contract with the retailer in market 1; in phase 2, the second manufacturer (B) must pay a fixed cost (f) to enter and produce; in phase 3, the two manufacturers contract with the second retailer in market 2 and production occurs. Firm

B cannot produce if it does not incur the fixed costs in phase 2. Two assumptions are made on the parameters of the model:

(i) $f > \hat{\Pi}_2^c - \Pi_2^A$, i.e., it is not profitable for manufacturer B to enter if it does not have positive sales in market one and the outcome in the second market is common representation.

(ii) $\hat{\Pi}_1^c + \hat{\Pi}_2^c - \Pi_1^A - \Pi_2^A - f > 0$, i.e., it is profitable for firm B to enter if there is common representation in both retail markets.

Assumption (i) implies that if firm A is able to enter into an exclusive contract with the first retailer, manufacturer B will be excluded.

If manufacturer B has invested *f*, then the equilibrium in phase 3 will be identical to that when there are no noncoincidental market effects, and the payoffs for the two manufacturers are $\hat{\Pi}_2^c - \Pi_2^B$ and $\hat{\Pi}_2^c - \Pi_2^A$. If on the other hand B has not invested in *f*, then firm A is a monopolist in the second retail market and its payoff is Π_2^A.

In phase 2, if retailer 1 has chosen common representation, then anticipating correctly that retailer 2 will also represent both manufacturers if B enters, B invests *f*. If retailer 1 has entered into an exclusive arrangement with manufacturer A, then B does not enter by investing *f*.

In phase 1, if the retailer enters an exclusive contract with firm A, then aggregate profits for manufacturer A and the retailer in market 1 are[118]

$$\Pi_1^A + \Pi_2^A. \tag{15}$$

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[118] Under exclusivity the profits of B in this market are zero.

If instead there is common representation, then aggregate profits for the two manufactures and the retailer in market 1 are

$$\hat{\Pi}_1^c + \hat{\Pi}_2^c - \Pi_2^A + \hat{\Pi}_2^c - \Pi_2^B - f \tag{16}$$

since there will be common representation in the second retail market, with payoffs to the two manufacturers of $\hat{\Pi}_2^c - \Pi_2^A$ and $\hat{\Pi}_2^c - \Pi_2^B$ (the second retailer will get a payoff of $\hat{\Pi}_2^c - \left(\hat{\Pi}_2^c - \Pi_2^A\right) - \left(\hat{\Pi}_2^c - \Pi_2^B\right)$). Exclusion is *jointly* profitable if (15) exceeds (16) or

$$\Pi_2^A - \left[\left(\hat{\Pi}_2^c - \Pi_2^A\right) - \left(\hat{\Pi}_2^c - \Pi_2^B\right)\right] > \hat{\Pi}_1^c - \Pi_1^A \tag{17}$$

The left-hand side of (17) is the loss in market 2 to the first market coalition (retailer 1 and the two manufacturers) if there is entry. It is the difference between the profits (to the coalition) in the second market if A is a monopolist, less duopoly profits for the manufacturers. The right-hand side of (17) is the loss in first market profits from exclusivity. It is the loss in profits to the coalition of only supplying the product of manufacturer A instead of having supply of both products in the first market. Both sides of (17) depend on the extent to which the two products A and B are substitutes. The more substitutable the two products, the larger the benefit from exclusion and the smaller the cost.

Moreover, it can be the case when there are noncoincident market effects that exclusion cannot be obtained under common representation, i.e., it requires explicit exclusion. The reason for this is that there is a negative externality: when firm B enters it reduces the payoff to firm A in the second market. Hence non-cooperative contracting under common representation between the two manufacturers and the retailer will not necessarily result in efficient contracting that maximizes joint profits of all three firms. It could easily be the case that this negative externality means that retailer 1 and firm B under common representation would find it profitable to deviate when the profit-maximizing outcome under common representation involves $x_B = 0$. The issue here is the credibility of the "promise" by the retailer not to source and sell any product from

manufacturer B. If the profits of the retailer and manufacturer B would increase, then the promise is not credible and A cannot count on B being excluded without contractual exclusivity: contractual exclusivity is required to prevent retailer 1 from participating in this deviation.

To see the potential for a profitable deviation by the retailer and manufacturer B under common representation, note that under it with effective exclusion, the quantities are $x_A = x_A^*$ and $x_B = 0$ where x_A^* is the quantity that maximizes the joint profits of manufacturer A and retailer 1. The equilibrium payment schedules are $P_{A1}^C(x_{A1}) = R_1(x_{A1}^*, 0)$ when $x_A = x_A^*$ and prohibitively expensive for any other quantity (a forcing contract), where $R_1(x_{A1}^*, 0)$ are the retailers revenues when $x_A = x_A^*$ and $x_B = 0$; and $P_{B1}^C(x_{B1}) = c_B x_{B1} - (\hat{\Pi}_2^C - \Pi_2^A - f)$. Under these payment schedules, manufacturer A is able to extract all of the revenues from the retailer since B is not going to invest f if $x_B = 0$. Manufacturer B is not willing to accept a smaller payment, since it is just recovering its costs ($c_B x_{B1} + f$), less a subsidy equal to its profits in retail market 2 ($\hat{\Pi}_2^C - \Pi_2^A$). The payoffs to the three firms are Π_1^A for manufacturer A and 0 for the retailer and the second manufacturer.

Firm B and the retailer's optimal deviation is for the retailer to sell $\tilde{x}_{B1}$ where $\tilde{x}_{B1}$ maximizes $R_1(x_{A1}^*, x_{B1}) - c_B(x_{B1})$, i.e., the retailers revenues given that it is already committed to sell $x_A = x_A^*$. The profits of manufacturer B remain 0, but the profits of the retailer from not excluding B's product are

$$R_1\left(x_{A1}^*, \tilde{x}_{B1}\right) - c_B\left(\tilde{x}_{B1}\right) - (\hat{\Pi}_2^C - \Pi_2^A - f) - R_1(x_{A1}^*, 0) \qquad (18)$$

If (18) is greater than zero, or

$$R_1\left(x_{A1}^*, \tilde{x}_{B1}\right) - c_B\left(\tilde{x}_{B1}\right) - (\hat{\Pi}_2^C - \Pi_2^A - f) > R_1(x_{A1}^*, 0) \qquad (19)$$

then the profits to retailer 1 from common representation will be positive, even though aggregate profits for the three firms will fall. The aggregate profits fall, since the retailer

does not take into account that firm A's profits in market 2 will be reduced if it sells $\tilde{x}_{B1}$ and firm B enters. In order to eliminate this possibility, firm A and the retailer will enter into an exclusive agreement. Under the exclusive agreement, firm A and the retailer will share the aggregate profits from excluding firm B, i.e., $\Pi_1^A + \Pi_2^A$. A vertical merger would also insure that the retailer internalizes the negative effect on A's profits from deviating by sourcing and selling the product of manufacturer B. Hence in this model it is credible for the merged firm to foreclose firm B because it is profitable.

The welfare effects of exclusive dealing in the Bernheim and Whinston model are ambiguous. Consumer surplus is reduced: consumers in both markets are made worse off from higher prices and reduced variety. On the other hand, total surplus might increase if the savings in fixed costs from excluding firm B are large enough.

Antitrust Implications: Competition for Exclusivity

Both the Salinger and Bernheim and Whinston model with noncoincident market effects identify circumstances when vertical merger would lead to customer foreclosure. A key requirement for customer foreclosure is market power downstream. Indeed in both models the downstream firm is a monopolist. The sets of circumstances differ in one key respect: the nature of contracting between up and downstream firms pre-merger. If contracting is efficient and double marginalization is not an issue, then anticompetitive effects upstream (from customer foreclosure) will not arise unless there are noncoincident market effects. If on the other hand, there is double marginalization, then the Salinger model suggests the potential for a vertical merger to have foreclosure effects that harm consumers.

In general the price effects associated with a downstream monopolist integrating backwards in the Salinger model depend on conditions of demand, marginal cost differences, and the extent of double marginalization pre-merger. Since these all interact to determine the incentives for the downstream monopolist to price the two goods ex ante

and ex post, untangling analytically the impact of each is impossible. However, if a demand system can be estimated, then a vertical merger simulation, similar to a horizontal merger simulation could be performed and the effect on prices downstream post-merger predicted.[119]

One of the key results of our discussion of the Mathewson and Winter and Salinger models is that backwards integration by a monopolist is not likely to result in complete foreclosure: the monopolist downstream will have incentives to carry both products unless there are large product specific fixed costs or the marginal cost of one of the goods exceeds the willingness to pay of consumers. Instead there is partial foreclosure, the vertical merger will provide the integrated firm with an incentive to raise the price of its unintegrated rival's product. Whether this incentive will overcome the price reducing effects of eliminating double marginalization of the integrated product depends on the circumstances. However, if the products are relatively close substitutes then it is more likely that the price of one or both downstream products will rise. Confirmation could then be sought through merger simulation.

The Bernheim and Whinston model is consistent with the following fact circumstances:

(a)   Efficient contracting between up and downstream firms.

(b)   Monopoly downstream, sustained by barriers to entry that preclude two-stage entry.

(c)   Differentiated products upstream.

(d)   Noncoincident markets.

(e)   Exclusion must be profitable: the gain in profits from monopolizing the noncoincident market must exceed the loss in the market in which there is a vertical merger. The less differentiated the products, the more likely vertical merger and exclusion is profitable.

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[119] For an introduction to demand system estimation and horizontal merger simulation, see Abere et al

(f)   Exclusion is effective: vertical merger will result in an increase in market power in the noncoincident market, either because it results in the exit of upstream competitors or because a reduction in volume raises the marginal cost of upstream competitors in those markets.

Because there is competition for exclusivity in the Bernheim and Whinston model, implicitly a counter strategy is available to the foreclosed firm: it can outbid its rival to either replace it as the foreclosing firm or make it more profitable for the downstream firm to elect common representation instead of exclusivity. The Bernheim and Whinston model foreclosure result suggests that there are circumstances under which the implied counter strategy is not effective. The more obvious counter-strategy by vertical merger is precluded because there is only one downstream firm. Implicit in the model is the assumption of significant barriers to entry downstream that preclude vertical merger or integration by the foreclosed upstream firm.

3.3.4 *First-Mover Advantage and Exclusivity*

The literature in which an incumbent has a first mover advantage divides also into two branches. In the first, initiated by Aghion and Bolton (1987), there is a single buyer and the externality affects a potential rival of the incumbent seller. In the second, which starts with Rasmussen, Ramseyer, and Wiley (1991)—hereafter RRW—there are many buyers and the externality affects buyers who do not sign exclusive contracts with the monopolizing seller.

Aghion and Bolton show how an incumbent seller and buyer can contractually create switching costs using exclusive agreements. For successful entry, an entrant will have to be more efficient and will have to induce the buyer to switch by paying the switching costs. Payment of the switching cost allows the incumbent and buyer to extract rents

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(2002) and/or Capps et al (2003).

from the more efficient entrant. However, if the switching costs are too high, then some entrants, even though they are more efficient, will be deterred.

The work that considers buyer externalities begins with Rasmussen, Ramseyer, and Wiley (1991). They investigate how an incumbent monopolist can exclude an entrant when there are economies of scale by locking up downstream buyers through exclusive contracts. If enough buyers can be locked up, the entrant will be denied volume sufficient to realize economies of scale and its costs will be sufficiently high that entry becomes unprofitable.

Finally, we consider, in the last subsection here, models in which buyers compete with each other.   Entering into an exclusive agreement may, given economies of scale, render competing upstream firms non-viable. However, here a lower price upstream provides a firm downstream with a competitive advantage, inducing shifts in market share. This effect differentiates circumstances where buyers compete with each other from situations where they do not.

Seller Externalities

The first example of a situation where a contracting externality provides the source of surplus to compensate buyers for agreeing to an exclusive agreement that preserves an incumbent's monopoly power is attributable to Aghion and Bolton (1987).   They consider the use of exclusive supply contracts that have liquidated damages provisions. Under these provisions, the buyer can be released from its exclusive contract and buy from an entrant, provided it pays the damages required to liquidate the contract. In order to convince the buyer to switch, the entrant will have to compensate the buyer (through a lower price) and hence the liquidated damages are "funded" by the profits of the entrant (which are positive if the entrant has lower costs). The liquidated damages are similar to an entry fee, payable to the buyer. Thus by setting the liquidated damages clause appropriately, the buyer and the seller are able to collude and extract rents from the entrant. The terms of the exclusive contract determine how the surplus extracted from

the entrant is shared between the incumbent and the buyer. The buyer receives at least as much expected surplus as they would if they did not sign the exclusive contract. In the set-up of Aghion and Bolton the buyer and seller enter the contract without knowing exactly the costs of the entrant. As a result efficient entry can be deterred if the liquidated damages are too high relative to the realized costs of the entrant. This will be the case when the entrant is only slightly more efficient than the incumbent.

Innes and Sexton (1994) expand the framework of Aghion and Bolton by considering the possibility that the buyer can contract with the entrant instead of the incumbent. In effect, the buyer is able to sponsor entry and create competition with the incumbent. They find that exclusionary contracts between the buyer and the incumbent no longer deter efficient entry and that these contracts deter inefficient entry. [120]

Buyer Externalities

Rasmussen, Ramseyer, and Wiley (1991) and Segal and Whinston (2000) have investigated the potential for coordination difficulties among buyers, or the ability of an incumbent monopolist to make discriminatory offers, to deter entry of an equally efficient rival through exclusive contracts when there are economies of scale.

Suppose that there is an incumbent and an entrant. Economies of scale mean that the entrant will have the same (or lower) unit cost as the incumbent only if it is able to supply some minimum number of buyers. Suppose that post-entry competition is such that if the number of free buyers is equal to or greater than that required for the entrant to realize minimum efficient scale, entry will be profitable.

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[120] An implicit assumption in the Aghion and Bolton framework is that the contract between the buyer and incumbent seller cannot be renegotiated if an efficient entrant is deterred. If it can be renegotiated then entry by a lower cost firm would never be precluded: the buyer and seller could both be made better off if they agreed to lower the amount of the liquidated damages to insure entry. However, if the incumbent can make investments in cost-reduction, it has an incentive to overinvest to force the entrant to offer lower prices. The effect of this is to preclude entry that otherwise would have occurred. See Spier and Whinston (1995).

The simplest case to see that the incumbent may be able to deter entry and maintain its monopoly power is when she is able to make discriminatory offers across buyers. Returning to Figure 5, suppose that P^D is the post-entry price, area $A + B$ (buyer surplus) equals 12, and area A (monopoly profit if entry is deterred) equals 10. Suppose further that minimum efficient scale is achieved by sales to 4 buyers and there are 10 buyers in total.

An incumbent who can make simultaneous and discriminatory offers can profitably deter entry and become a monopolist. She can do this by offering to pay 7 of the buyers their lost surplus from monopolization (per buyer this is 12, in total it equals 84). As a result entry is deterred and the price faced by all buyers is the monopoly price. The profit per buyer is 10, which given that there are 10 buyers gives total monopoly profits of 100 gross of the payment for exclusivity and net profits of 16 after deducting the payment of 12 each to the 7 buyers for exclusivity.

The externality between buyers arises because while the 7 buyers who sign the exclusive contract are compensated for the cost of monopoly they incur, they do not take into account the cost their actions (deterring entry) impose on the 3 free buyers: paying monopoly instead of competitive prices. It is also possible in this case that because all buyers know that the incumbent will find it profitable to sign up 7 buyers (and therefore exclude the entrant) that they are willing to sign up for less than their loss surplus: the alternative to not signing will be exclusion, hence buyers compete among themselves to sign, driving the price of their agreement to essentially zero. In this case the net and gross profits of the incumbent are 100! It is clear in this case that buyers would be better off if they all agreed not to sign, but because they think others will sign they would rather sign than be monopolized without any compensation. Buyers are harmed by their inability to coordinate expectations.

Suppose instead that the lost consumer surplus from monopoly pricing is 15 per buyer instead of 12. In this case it is not profitable for the incumbent to fully compensate 7

buyers: the cost to purchase exclusion is 105, the benefit 100. However, once again if consumers are unable to coordinate, the equilibrium may involve profitable exclusion with little or no compensation for signing buyers. This is not an equilibrium, however, if buyers are able to coordinate. If consumers are able to coordinate, then an exclusion equilibrium when there are discriminatory offers is only possible if the profits from exclusion exceed the payments required for full compensation.

Finally, if the seller can make offers sequentially rather than simultaneously, then by playing buyers off against each other, i.e., getting them to compete to be the signer, the seller may be able to profitably exclude the entrant even if the cost to purchase exclusion (105) is greater than the profits of exclusion (100). In all cases exclusion is more likely if monopolization is relatively less inefficient, i.e., the difference between lost buyer surplus and monopoly profits smaller.

Buyer Externalities in Input Markets

The insight that contracting externalities may make exclusion profitable for a coalition of buyers and a seller applies as well when the buyers are firms that compete against each other in downstream markets and the seller is supplying them with an input. Contractual foreclosure in this case can reduce or eliminate competition upstream in the input market. In these circumstances the externality comes from the competition between downstream firms. Stefanadis (1998) and Simpson and Wickelgren (2001) have considered situations where buyers are competing firms, while Fumagalli and Motta (2002) extend RRW to incorporate buyers who compete against each other. After introducing the three papers, we discuss only Stefanadis in detail.

Stefanadis' setup is very similar to OSS (1990), except that rather then two upstream firms, there is initially only an upstream monopolist and the anticompetitive effect is due to customer foreclosure not input foreclosure This upstream monopolist is threatened by a potential entry with lower per unit costs, but entry is only profitable—because of economies of scale—if the market for the entrant is sufficient, which it will not be if the

incumbent is able to enter into an exclusive agreement with one of the buyers. Stefanadis demonstrates that in these circumstances an exclusive agreement between one downstream firm and the incumbent firm upstream is profit-maximizing because of the effect it has on the second downstream firm. Because entry is precluded the incumbent is able to raise the price it sells the upstream input to the second downstream firm above marginal cost. Moreover, this introduces cost asymmetry downstream—since the downstream partner of the upstream monopolist is able to source the upstream good at a lower price. The cost asymmetry downstream raises the profits of the downstream firm party to the exclusive deal. If instead of exclusive dealing the incumbent vertically integrated, the upstream good would be available at marginal cost, furthering the cost asymmetry and profitability of exclusive dealing.

Simpson and Wickelgren's finding that exclusive dealing can have an anticompetitive effect depends on intertemporal economies of scope. An incumbent faces an entry challenge in the second of two periods. If the incumbent can enter into exclusive agreements with *both* downstream firms in the first period, entry is precluded. The incumbent by offering a discounted wholesale price in the first period is able to induce both downstream firms to sign exclusives even though they are made worse off. The reason is that offering both downstream firms exclusives creates a Prisoner's Dilemma for the downstream firms since access to the upstream input at a low price in the first period gives it a competitive advantage over its rival.

Notice that in the absence of any other effect (in particular Simpson and Wickelgren assume that there is no discounting, i.e. the value of a euro today is the same as the value of a euro tomorrow) that the two downstream firms would be indifferent between the pattern of prices under entry (monopoly today, duopoly tomorrow) and the duopoly price in the first period and the monopoly price in the second period.   The monopolist can thus offer a discount in the first period equal to the difference between the monopoly and duopoly price for signing the exclusive supply agreement.

However, there is another effect: if only one downstream firm accepts the exclusive contract with the discounted first period price it will have a cost advantage in the first period. This cost advantage will typically translate into higher profits downstream. Because the offers are accepted or rejected simultaneously in this model, offering both exclusive supply contracts is what creates the Prisoners' Dilemma for the two downstream firms. Both would be better off if they did not accept, but signing an exclusive is a dominant strategy. If the other does not, then it is profitable to sign and have a lower input cost. If the other signs, then it is profitable to sign as well. If the firm does not, then it gets very low profits in the first period (since its costs are higher than its rival), however there will then be entry in the second period and prices will fall. If it signs its cost asymmetry in the first period is eliminated, but then it pays monopoly prices in the second period as entry is precluded. The incumbent can always choose his discount in the first period to make sure that the gain in the first period exceeds the loss in the second period, so a downstream firm will sign if its rival has already signed.

The larger the effect of asymmetries of cost on profits in the downstream market (either because the input accounts for a large share of marginal cost or products downstream are not very differentiated) the less the incumbent has to discount in the first period: if downstream competition is over prices and products are not differentiated, then the discount from the monopoly price in the first period will be very small and the inefficiency of the exclusion more significant.

The last paper is a recent contribution by Fumagalli and Motta (2002), in which they introduce buyers who compete against each other into the RRW framework and the entrant has a lower marginal cost, but must pay a fixed cost to enter. Introduction of competition among buyers means that downstream firms will have a cost advantage downstream if they source supply from the entrant. This will result in higher market shares for them and lower market shares and profits for downstream firms that sign exclusives. Anticipating this, downstream firms that sign exclusives will demand higher

compensation. Depending on the strength of competition downstream, this may make exclusion unprofitable for the incumbent.

The strength of competition refers to the market share differential that occurs when firms have asymmetric marginal costs. It depends on product differentiation and the nature of the competitive interaction. For instance if firms compete over prices and there are two downstream firms who produce a homogenous good then the low cost firm captures all of the downstream market. A single downstream firm in this case would be sufficient to sustain entry. On the other hard if the two downstream products are sufficiently differentiated that they are virtually independent, then competition between the buyers would be almost negligible, as would the implications of differing marginal costs for market shares. The stronger competition and the less differentiated products, the larger the demand for the input for downstream firms that have not entered into exclusives and hence the easier it is for the entrant to reach minimum efficient scale. Fumagalli and Motta conclude that exclusionary equilibria are more difficult, but not impossible, to achieve, when downstream buyers compete with each other.

Stefanadis

In Stefanadis (1998) there are two upstream firms, an incumbent with constant unit costs c_I and a potential entrant, whose unit cost is $c_E < c_I$. The upstream good is homogeneous. Post-entry the price competition in the input market will drive prices down to c_I, with the entrant just undercutting the incumbent and making all sales. To enter, the entrant must incur a fixed entry cost of *f:* this cost means that there are economies of scale and that entry will be unprofitable for the entrant unless it anticipates a minimum market share. If there are no exclusive contracts, then entry is assumed to be profitable. There are two downstream firms that produce (symmetric) differentiated products.

Prior to the entry decision, the incumbent can offer one or both downstream firms an exclusive dealing contract. The contract provides that the downstream firm will buy only

from the incumbent, not from the entrant, and it specifies the price. Unlike the models of Rasmussen, Ramseyer, and Wiley and Segal and Whinston the exclusive contract specifies the price and compensation is "paid" not through a transfer, but through lower wholesale prices, similar to Mathewson and Winter. The existence of economies of scale implies that if the incumbent can lock up at least one of the downstream firms, the entrant will not find it profitable to enter. In the absence of exclusive contracts, the entrant will find it profitable to enter, and the wholesale price will be c_I.

Stefanadis assumes that the two downstream firms are able to respond to contract offers. In particular if both firms are offered exclusive dealing contracts and only one accepts, the other gets the opportunity to reconsider once it learns of the acceptance by the first. This precludes take it or leave it offers by the incumbent (implicit in sequential offers) and failure of buyers to coordinate. However, the incumbent has the option to make discriminatory contract offers, offering an exclusive supply contract to only one of the downstream firms.

Suppose the incumbent offers an exclusive supply contract to one of the downstream firms, say D_1, with a contact price of c_I. This is the same price that D_1 would pay with entry so it is not harmed by accepting. In fact, however, it will be made strictly better off if it accepts the contract. The reason is that if it signs, the entrant will be precluded from entering the market and the incumbent will be a monopoly supplier of D_2, charging it a monopoly price strictly greater than its marginal cost c_I. Relative to an input price of c_I, D_2 with a higher input cost will be a much less aggressive competitor and will want to raise its price. Since the goods are imperfect substitutes this reduces the elasticity of demand for D_1, allowing it to raise its price and profits. D_1 by accepting the contract imposes an externality on D_2 (entry deterrence and higher wholesale prices) that it benefits from. The incumbent finds it profitable since it earns monopoly profits selling to D_2. Moreover, the fact that D_1 benefits from the asymmetry of marginal costs means that in equilibrium the incumbent can raise the price in the exclusive supply contract until

the profits of D_1 under the contract equal what its profits would have been if there was entry.

If the incumbent offers the same exclusive contracts to both downstream firms with a contract price greater than c_1 they will not accept. If one was to agree, it would have an advantage over the second, but realizing this the second would also sign upon reconsidering. This makes both of them worse off, since their input prices will be higher than what it would have been with entry and their costs are symmetric. If their costs are symmetric, they prefer that they be as low as possible. Hence exclusive contracts offered to both would only be accepted if the contract prices were less than c_1, which the incumbent will not find profitable to offer.

Relative to entry and competition between the two upstream suppliers, exclusive dealing raises the input prices for both downstream firms. As a result the prices of both products downstream increase, decreasing the welfare of consumers. The effect on total surplus is not discussed, but is likely ambiguous—involving a trade off between the savings in fixed costs from precluding entry against higher production costs and lost consumer surplus.

The Stefanadis model can be adapted to consider the effects of a vertical merger between U_1 and D_1. Two differences arise with implications for the equilibrium: (i) under exclusive dealing, a legal contract provides commitment on behalf of D_1 not to buy from the entrant, a legal commitment that will be absent in the case of vertical merger;[121] and (ii) with a vertical merger double marginalization between U_1 and D_1 will be eliminated.

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[121] A Stefanadis observes, the foreclosure equilibrium depends on the commitment of D_1 not to buy from U_2. If the contract can be renegotiated, then U_2 will pay f and enter the market, knowing that D_1 will have an incentive to renegotiate with U_1. Once U_2 has entered there are joint gains from U_1 and D_1 renegotiating which will make entry by U_2 profitable. For instance, D_1 could agree to pay a tax equal to the difference between U_1's price without entry and its marginal cost for every unit that it buys to U_1.

Foreclosure after vertical merger will only be credible if it is profitable or there is a technological reason which precludes the merged firm from buying the input from U_2 post-merger. Leaving aside the possibility that issues of design will create incompatibility, it still may be possible for the integrated firm to find it profitable not to source from the entrant. If it buys from the entrant—at a lower price than its marginal cost—then the entrant will be able to enter and supply the merged firm's downstream competitor. If on the other hand the merged entity sources the input internally, i.e., forecloses, then the entrant does not enter and the merged firm is a monopoly supplier of its rival downstream. The merged firm will recognize that increasing the upstream price will raise the costs of its rival downstream, leading to greater downstream prices and profits for D_1. If it sources from the entrant, it will gain lower production costs, but lose for certain the profits upstream from supplying its rival downstream and, depending on the price the entrant charges its rival, its advantage downstream.

An initial exploration of the profitability of vertical merger and foreclosure is contained in Table 1. The calculations in Table 1 are derived using the following linear demand specification in the downstream market:[122]

$$Q_i = \frac{2(1 - 2P_i + P_j)}{3}$$

Further, we assume the constant marginal cost for the incumbent upstream is 0.50, while downstream marginal costs equal the price of the upstream input. The row labeled "Entry" shows the equilibrium price upstream for the entrant (w_2), the downstream

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This would make both it and U_1 whole, given entry, but U_2 would then earn profits on each unit sold equal to the difference in marginal costs. Renegotiation might be problematic because of the legal costs involved or because exclusivity involves technological commitment, i.e., after an exclusive contract is signed, D_1's product is no longer compatible with U_2's input.

[122] The aggregate utility function from which these demand functions are derived is a simple parameterization of the quadratic functional form in which the substitution between the two goods is set at its median value:

$$U(Q_1, Q_2) = (Q_1 + Q_2) - .5(Q_1 Q_2) - .5(Q_1^2 + Q_2^2) + I$$

equilibrium prices (P_i) and quantities (Q_i), and the profits of D_1 (π_1) when there is entry. In this case, the entrant is able to monopolize the upstream market by "limit pricing" at the marginal cost of the incumbent. The profits of the incumbent firm upstream equal zero. The row labeled "Foreclosure" shows the equilibrium price upstream for the vertically integrated firm (w_1), the downstream equilibrium prices (P_i) and quantities (Q_i), and the profits of the integrated firm (π_1) when there is a vertical merger and foreclosure. In this case, the entrant does not enter and the vertically integrated firm acts as a monopoly supplier to its downstream rival, recognizing the opportunity to raise its rival's costs.

Comparing these two rows, in this example merger and foreclosure is profitable (0.07>0.04), the upstream price charged the unintegrated downstream firm exceeds marginal cost (0.74>0.50), leading to a much higher price for the unintegrated downstream firm (0.79>0.69). Indeed the upstream price for the input exceeds the price of the integrated firm's downstream product.

The two rows labeled "Renegotiation" test the credibility of foreclosure by the integrated firm. Renegotiation is an issue if U_2 enters and the integrated firm can use the input produced by the entrant. At issue is whether the entrant can offer the incumbent a price for its input which makes the incumbent better off even though it knows that when it agrees it will lose its upstream monopoly and profits. The incumbent has no incentive to use the input of the entrant if its price is the same as the incumbent's marginal cost: sourcing from the entrant would make entry profitable, eliminate the integrated firm's monopoly sales to its downstream rival, and eliminate cost asymmetry downstream. However, the integrated firm might be tempted by the entrant to purchase from the entrant at a price less than its marginal cost. Doing so, however, makes the entrant viable and allows it to sell to the integrated firm's downstream rival. The two renegotiation rows correspond to marginal costs for the entrant equal to 0.20 and 0.40. These rows calculate the downstream equilibrium and profits for the integrated firm assuming that the

entrant charges marginal cost to both downstream firms. This is not profitable for the entrant, since it will not cover its fixed costs, and while it minimizes the price at which the merged firm can acquire the input, it eliminates the cost asymmetry downstream. With these assumptions, the threat not to buy from the entrant is credible when its marginal cost is 0.40 (0.07>0.05) , but not when it is 0.20 (0.07 is not greater than 0.10).

The last two rows show the equilibrium if the entrant enters and is able to price discriminate, charging the limit price to the unintegrated downstream firm, but marginal cost to the integrated firm. This is the very best possible equilibrium for the integrated firm when there is entry. Again, when the entrant's marginal cost is close to the incumbent's, the threat to foreclose is credible (0.07>0.06), but not when the entrant's marginal cost is 0.20 (0.07 is not greater than 0.12).

Relative to entry, foreclosure has negative welfare results for consumers: the price of both products increase. The effect on total surplus will be ambiguous: production costs are higher, consumer surplus less, but the fixed costs of entry are saved. However, foreclosure with renegotiation or renegotiation that results in price discrimination can be beneficial for consumers: elimination of double marginalization and lower marginal costs can lead to lower prices for both products. As indicated above, renegotiation is profitable if the costs of the entrant are low relative to the incumbent's.

The analysis in Table 1 is based on partial foreclosure—raising the price of the input to the unintegrated downstream firm—not complete foreclosure. It is easy to check that in this example complete foreclosure, resulting in monopolization downstream, is not as profitable as partial foreclosure. The profits from complete foreclosure are 0.62, less than the 0.70 the integrated firm earns from partial foreclosure.

Antitrust Implications: First-Mover Advantage, Customer Foreclosure, and Exclusivity
The antitrust implications of this literature for understanding the competitive implications of a vertical merger are as follows:

(i) The anticompetitive effect of exclusive dealing in Aghion and Bolton depends on enforceable liquidated damage clauses between the incumbent and the buyer. In Simpson and Wickelgren, the upstream monopolist would have to merge with both downstream firms. The effect would be monopolization of the downstream market through horizontal merger.[123]

(ii) The literature on buyer externalities is applicable when economies of scale are sufficient upstream that a vertical merger between the upstream incumbent and, at the margin, one more downstream "buyer" would result in deterrence of a competitor upstream. Unlike the Salinger and Mathewson and Winter models, the upstream product here is homogenous, so the threat not to source from an entrant is not so obviously non-credible. If the entrant's costs are identical or greater than the integrated firm, then the threat not to source from the entrant is credible. If the entrant's costs are lower however, then the credibility of customer foreclosure will depend on whether the profits of the vertically integrated firm post merger from not sourcing from the entrant at a price less than its costs, but acting as a monopoly supplier to all other buyers are greater than the profits from sourcing from the entrant at a lower cost and earning duopoly profits in the competition with the entrant for supplying the other downstream buyers.

(iii) The analysis of Stefanadis is complementary to Salinger (1991), except there is differentiated duopoly downstream and the upstream good is homogenous, used as an input by the downstream firms. This means that downstream firms do not, as in Salinger, have a love for variety. Our extension of Stefanadis suggests that a dominant firm upstream can integrate downstream to foreclose entry when:

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[123] Recall that in Simpson and Wickelgren the incumbent enters into exclusive dealing arrangements with both downstream buyers.

(a) Economies of scale preclude entry if an entrant is not able to capture sufficient market share downstream.

(b) Vertical merger by the incumbent and foreclosure precludes the entrant from realizing economies of scale necessary for profitable entry. As the analysis of Fumagalli and Motta suggests, this will depend on the nature of the competitive interaction downstream. The easier it is for the entrant and the unintegrated downstream firm to attract consumers through price competition, the less effective vertical merger will be at deterring entry.

(c) Foreclosure must be credible. Credibility can arise because integration creates the possibility that the integrated firm can design its downstream products to be incompatible with the upstream input of the entrant. Alternatively, foreclosure must be profitable: the gains from monopolization upstream and raising rivals' costs downstream are greater than the lost profits downstream from lower marginal cost.

(d) The entry deterring effects of vertical merger are reduced if the entrant expects that it can use its cost advantage post-entry to make the threat of foreclosure non-credible through negotiations. This is facilitated if the entrant can price discriminate between the integrated and unintegrated downstream firms.

4.0   Unilateral Effects and Conglomerate Mergers

A conglomerate merger may involve the acquisition of complements, products in neighboring markets, or unrelated (independent) goods. The acquisition of these products provides the acquiring conglomerate with the opportunity to engage in (i) tying, (ii) bundling, or (iii) foreclosure.

Tying occurs when purchase of good *A* (the tying good) requires that consumers also purchase good *B* (the tied good). Requirements tying occurs when consumers have to purchase all of their *B* requirements in order to buy *A*. Pure bundling occurs when consumers cannot buy products individually, but instead are required to purchase a group of products collectively. In the case of mixed bundling, consumers can buy the individual products separately, or pay in total a lower price if the goods are bought as a bundle.   Often in the literature it is assumed that there are two goods where consumers demand a single unit *each* of *A* and *B* making a tie indistinguishable from a bundle. More generally a tie differs from bundling because a tie is more likely to involve divisibility. For instance a tie requiring two units of *B* be purchased for every unit of *A* is not the same as offering to sell a package consisting of four units of *B* and two units of *A*.

The section then considers the equilibrium merger and foreclosure models of Ma (1997) and Church and Gandal (2000).   In these models the conglomerate firm ends up with a portfolio or range advantage: if it forecloses it is able to offer a broader range of products than its unintegrated rivals post-merger.   Foreclosure here means not supplying a rival with access to the complements controlled by the conglomerate: if consumers value variety, then the variety advantage can provide the conglomerate with market power or lead to monopolization.

Both of these models are equilibrium foreclosure models: the decision to integrate is endogenous and counter mergers are explicitly considered. The insights of these two models on the value of a variety advantage likely apply to other settings where there is a fixed cost associated with providing (or obtaining) service and consumers value variety.

In particular, they point out the importance of counter strategies: explicit consideration of whether the foreclosed firm can also merge and foreclose with a complement supplier and/or whether barriers to entry into the complementary products are sufficient that a rival cannot introduce its own set of complements.

Before considering these literatures, however, we start with an examination of the two models that have formed the basis for a skeptical view regarding any anticompetitive effects of mergers between suppliers of complements.

4.1   The Traditional/Chicago View

The skeptical view of the potential for a merger between suppliers of complements is based on two models: Cournot's model of monopoly supply of complements and the single monopoly profit critique, applied to complements.[124]

4.1.1   Cournot Effect

Cournot's model of the pricing of complements identifies a horizontal pricing externality when both goods are supplied by separate monopolists. If the same firm supplies both complements, prices will be lower since the pricing externality will be internalized. The integrated firm will recognize that lowering the price of one will increase sales and profits of the other and vice-versa. The Cournot effect means that the price of both complements will go down if there is a merger between the two monopoly suppliers.[125]

To see this more formally, suppose that consumers assemble systems composed of two components, *A* and *B* and that each does not provide any stand- alone consumption benefits. The demand for systems depends on the price of a system, the sum of the prices of its components: $p^S = p^A + p^B$. Denote the demand for systems as $D(p^S)$. Let the marginal cost of production for each component be the same and equal to zero.

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[124] The Cournot model of monopoly supply of complements is distinct from the Cournot model of oligopoly in which firms compete simultaneously by choosing quantity.

[125] See Cournot (1838). Our presentation follows Economides and Salop (1992).

If the two components are supplied by separate firms, then the profits of the supplier of component *i* is:

$$\pi^i = p^i D(p^i + p^j). \tag{20}$$

The optimal price for component supplier *i* will depend on its expectations about the price of component supplier *j*. The relationship between the profit-maximizing price for *i* and the price of *j* is found by maximizing (20) with respect to p^i:

$$\frac{\partial \pi^i}{\partial p^i} = D(p^i + p^j) + p^i \frac{\partial D(p^i + p^j)}{\partial p^i} = 0 \tag{21}$$

Increasing the price of component *i* increases profits on inframarginal units, the first term in (21), but leads to a reduction in profits from a reduction in revenue from marginal units no longer sold, the second term in (21). The smaller p^j —holding p^i constant—the greater the demand for systems, and (typically) the greater the incentive for *i* to charge a higher price since inframarginal sales are greater. The equilibrium prices p^i and p^i are found when (21) holds for both firms. Adding (21) for both firms together and substituting in $p^S = p^A + p^B$ yields:

$$2D(p^s) + p^S \frac{\partial D(p^S)}{\partial p^S} = 0. \tag{22}$$

If the two complements were instead supplied by a single firm and sold as a bundle for price p^S, then the profits under joint supply are:[126]

$$\pi^S = p^S D(p^S). \tag{23}$$

The profit-maximizing price for the bundle satisfies:

$$D(p^s) + p^S \frac{\partial D(p^S)}{\partial p^S} = 0. \tag{24}$$

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[126] Alternatively, the two complements could instead be sold separately as long as the sum of their prices added up to the optimal p^S under common ownership.

Comparing (22) to (24), the sum of the prices under independent supply will be greater since $2D(p^s) > D(p^s)$. The intuition comes from comparing (21) to (24). When the supplier of a single component considers the effect of raising (lowering) its price, it only considers the loss (gain) it receives on the marginal units and does not internalize the loss (gain) of the other supplier that result because its price increase results in a decrease (increase) in the number of systems sold.

The result that internalization of the horizontal pricing externality when the two complements are subject to coordinated pricing leads to a decrease in the price of the system is known as the *Cournot Effect*. The Cournot effect means that coordinated pricing of the two complements enhances consumer welfare and increases aggregate profits. The advantages of integration and providing the two complements as a bundle are very similar to vertical integration that eliminates double marginalization. In both cases in the absence of integration, a firm with market power sets a price without taking into account that it affects the demand for another firm who also has a positive margin. The difference is that in the Cournot model of complements prices are chosen simultaneously when they are supplied separately, whereas in the double marginalization model considered in Section 3.1.1, the upstream firm sets its price first, providing it with a first-mover advantage.

Price Discrimination: A Caveat

The Cournot effect does not arise if the two monopoly suppliers are able to engage in price discrimination, or alternatively, set prices with buyers through individual negotiations. In the case of perfect price discrimination the two firms are perfectly informed regarding the willingness to pay schedule for a consumer. Assuming no dispute between the two firms over the division of profits, the equilibrium price for unit l sold to consumer k will be $p^i + p^j = v_l^k$ where v_l^k is the maximum willingness to pay of consumer k for unit l. If the two firms were to merge they would set $p^s = p^i + p^j = v_l^k$.

A merger enabling the two firms to coordinate their price would have no effect on prices if the two firms are able to practice perfect price discrimination.[127]

This result extends to the case in which the firms bargain with consumers over the division of surplus. The surplus created on unit l consumed by customer k is v_l^k (under the assumption that marginal costs are zero). If the share captured by the firms in bargaining with consumer k is s then we would expect $p^i + p^j = sv_l^k$. Assuming that the bargaining power of the firm does not change, then the coordinated price post-merger would be $p^s = p^i + p^j = sv_l^k$. This is the same price as when the two firms are independent and again there is not a Cournot effect.

The absence of a Cournot effect depends on the assumption that the firms are well informed and that they are able to agree on the division of surplus.[128] If the two firms disagree over the division of the profits, the combined price will be too high and the consumer will not purchase the unit. In this case, a merger would lead to a lower price and an expansion in output.

4.1.2   *The Single Profit Critique*

The single monopoly critique of the foreclosure effects of vertical mergers also applies to the tying/bundling of complements. The intuition is similar to the case of monopoly leverage discussed in Section 3.1.2. Under certain conditions—explored below—a monopoly supplier of one complement can extract all of the monopoly profit through the price of its product, it need not monopolize the other components by tying or bundling. If anything tying or bundling its monopoly supplied component with a complement which is competitively supplied will decrease its profits if the competing suppliers offer a differentiated product or are lower cost producers. Similarly, if the two goods are

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[127] This point is made by Nalebuff and Lu (2001).

[128] Any sum of the two component prices equal to the willingness to pay of a consumer is a Nash equilibrium in prices. Agreement between the two firms over the division of surplus requires them to coordinate on the same Nash equilibrium.

independent, tying a monopoly supplied good to a second good in an attempt to monopolize it will typically reduce the profits of the monopolist: some consumers who would have purchased the monopoly good but have a low willingness to pay for the tied good will forgo buying either under tying/bundling.

Tying Complements: Homogenous Case

As in the previous section, assume that consumers assemble systems composed of two components, *A* and *B*, and that each does not provide any stand-alone consumption benefits. Component *A* is produced only by firm 1 and its marginal cost is c_A. There is free entry into the production of component *B* and its marginal cost is c_B. A key assumption is that all consumers have the same willingness to pay for a system denoted by *v*. The maximum profit per consumer is $v - c_B - c_A$. The monopolist can extract this by setting her price equal to $v - c_B$ This leaves consumers just willing to purchase and suppliers just willing to supply component *B* at price c_B. There is no market power rationale for the monopolist of component *A* to enter production of component *B* and tie sales of *B* to sales of *A*. If the monopolist charged p_A for component *A*, then the maximum it could charge for component *B* if it was tied is $v - p_A$ and its profits per consumer would still be $v - c_B - c_A$.

In general the monopolist of *A* would like component *B* to be provided at the lowest possible cost, since this maximizes the surplus to consumers from the system. If its cost of producing component *B* was $\bar{c}_B > c_B$, then if it tied the sale of *A* to *B* (or sold them as a bundle), its profits would be $v - c_A - \bar{c}_B$. If instead it allowed consumers to buy the *B* component at its competitive price, then its profit-maximizing price for *A* is $v - c_A$ and its profits rise to $v - c_B - c_A$.

Tying Complements: Differentiated Complements

If the *B* components are differentiated but a system still consists only of one *A* and one *B* component, a monopolist supplier of *A* would reduce her profits if she tied consumption

of A to her B component. Suppose that B is supplied by firm 1 and a rival (firm 2). Then some consumers will prefer the system AB_2 and if B is tied to A then these consumers may opt not to purchase a system and as a result do not purchase A. On the other hand, not tying A to B_1 allows the monopolist to raise the price of A and sell to all consumers, thereby increasing its profits. It can raise its price for A since it need not convince consumers who prefer AB_2 to purchase AB_1. Alternatively, not tying A to B allows the monopolist to extract surplus created by both B_1 and B_2 by raising the price of A, just as it did when B was homogenous.

Tying Independent Products

The conclusion that tying is not profitable applies as well when the two goods are independent.[129]   Again denote the two goods as A and B. Suppose that A is produced by firm 1 and both firms 1 and 2 produce good B.   Product B is differentiated, the two products imperfect substitutes, and every consumer will buy either zero or one unit of each product. Competition between the two firms in market B is Bertrand. Demand for product i in market B is given by

$$q_i^B = D_i(p_i^B, p_j^B).$$

Suppose further that demand for A is homogenous, with each consumer having unit demands and a maximum willingness to pay of v. Costs for firm 1 are c_1^A and c_1^B. Normalize the number of consumers to one.

Firm 1 can either offer its two products independently at prices p_1^A and p_1^B or tie the two products by requiring purchasers of its monopoly product, A, to also purchase its B product. If it ties (which in this simple setup is equivalent to offering consumers the option of only buying its A and B as a bundle), it sells both products for price P.

The profits of firm 1 when it supplies a bundle are

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[129] The result is due to Whinston (1990). We follow the presentation of Tirole (1988).

$$\bar{\pi}_1 = (P - c_1^A - c_1^B) D_1(P - v, p_2^B)$$

since only those willing to buy its product B at the implicit price $P - v$ will buy its bundle.[130] Let its profit-maximizing price for its bundle (given p_2^B) be $\bar{P}$. Then the implicit price it is charging for B is $\bar{p}_1^B = \bar{P} - v$ and its maximized profits are

$$(\bar{P} - c_1^A - c_1^B) D_1(\bar{P} - v, p_2^B). \tag{25}$$

If it sold A and B separately at prices $\bar{p}_1^B = \bar{P} - v$ and v its profits would be

$$v - c_1^A + (\bar{P} - v - c_1^B) D_1(\bar{P} - v, p_2^B). \tag{26}$$

Rewrite (25) as

$$(\bar{P} - v - c_1^B + v - c_1^A) D_1(\bar{P} - v, p_2^B) = (v - c_1^A) D_1(\bar{P} - v, p_2^B) + (\bar{P} - v - c_1^B) D_1(\bar{P} - v, p_2^B) \tag{27}$$

This will be less than (25) if $D_1(\bar{P} - v, p_2^B) < 1$ which will be true if some consumers who strongly prefer firm 2's B offering opt to forgo A, do not buy the bundle, and instead buy B from firm 2. If true, this means for any p_2^B, firm 1 will find it profit maximizing not to bundle, but instead to offer the two products independently. Bundling has the effect of reducing sales (and profits) of (from) its monopoly product.

4.1.3 *Tying, Bundling, and Price Discrimination*

A considerable complicating factor in the analysis of the implications of tying and bundling is that—when consumers have heterogeneous demands—the rationale for their adoption by a firm with market power in A maybe not to create or maintain its market power, but instead to enhance its effectiveness through price discrimination. Tying and bundling can be effective means for a firm with market power to implement price discrimination and extract more surplus from consumers than it can when it must use a uniform price (same price charged to all consumers for each unit sold).

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[130] The willingness to pay for the A product for a consumer is v. Hence if the price for the bundle is $\bar{P}$, the price the consumer is paying for the unit of the B product is $\bar{P} - v$.

In this subsection we provide an overview of the use of tying and bundling to effect price discrimination. We consider how tying can be used as a means to meter consumption. In this case, there are high and low intensity users of a system: high intensity users use more of the product complementary to the monopolist's product. Tying allows the monopolist to become the sole supplier of the complementary product and it will find it profitable to charge a markup over the competitive price, in order to extract more surplus from the high intensity users who use more of the complementary product.

The classic analysis of tying assumed that consumers of A—the monopoly product—consumed at most a single unit and the two goods are complements. Requirements tying can be used to extract more surplus from the monopoly product than can be extracted under monopoly pricing when the two goods are independent and demand for the monopoly product varies with its price. Under requirements contracting consumers are willing to forgo surplus from consuming the competitively supplied good in order to continue to enjoy surplus from the monopolist's product. Hence the monopolist can raise the price of the product in which it faces competition if it implements a tie. Consumers will only substitute away from the requirements tie when their surplus under it is less than just purchasing the tied good at competitive prices and forgoing consumption of the monopoly tying good, i.e. the lost surplus from the increase in price of the competitive good becomes greater than the surplus from the monopoly product.

The model of Mathewson and Winter (1997) explains the role of demand correlation among independent products in explaining the profitability of requirements tying. Demand correlation between two goods means that those with a higher willingness to pay for A on average, have a high willingness to pay for B. A monopolist in A who engages in requirements tying for B can extract more surplus from the high intensity users by charging a higher markup on both products rather than just product B as in the metering

case. Note that requirements tying in this case is used in conjunction with an access fee on the monopoly good.

The final literature considered shows the role of bundling in reducing demand heterogeneity across goods.   In the absence of bundling the profit-maximizing prices for two goods often reflects those with lower willingness to pay. If the monopolist can bundle, then demand will reflect average willingness to pay across the two goods, allowing the monopolist to charge a bundle price that implies higher individual prices for the goods in the bundle. By doing so the monopolist is able to extract surplus from consumption of the good from those with a higher willingness to pay without forgoing sales to those with a lower willingness to pay for that good.

Tying and Metering

To see how tying can implement price discrimination, continue to consider the situation where consumers demand a "system" comprised of an *A* component which uses a complementary product, *B* to provide services.[131] However, now suppose that while consumers demand a single unit of *A*, they have variable demands for *B*—the quantity they consume of *B* will depend on the price of *B*. Moreover, suppose that there are two different types of consumers: intensive and casual users.   The intensive types demand more of component *B* than the casual users for any price of *B* (p_B). Ex ante the monopolist cannot identify whether an individual is a casual or intensive user of *B*. Identify a casual user as a low benefit type *(l)* and intensive users as a high benefit type *(h)*. Suppose that the number of low type individuals is n_l and the number of high type individuals is n_h.

If the consumption of *A* alone provides no benefit, then the monopolist of *A* essentially sells access to the benefits provided by consuming the complementary product *B*. If

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[131] The exploration here of tying as a mechanism to implement price discrimination by metering consumption of a complementary product follows Tirole (1988).

component B is competitively supplied at marginal cost c_B, then the monopolist has two choices when it does not engage in tying. She can sell component A for the benefit it creates to light users when they use it optimally to produce benefits along with component B when component B is priced at marginal cost. Denote this benefit—consumer surplus—when $p_B = c_B$ as $CS_l(c_B)$. At this price the low types are just indifferent between purchasing A or not. The high types strictly prefer to purchase since they enjoy a positive benefit of $CS_h(c_B) - CS_l(c_B)$. The monopolist's profits when it does not tie would then be $\pi_l^{NT} = (n_l + n_h)CS_l(c_B)$. On the other hand, she could raise the price of A to $CS_h(c_B)$ and earn profits of $\pi_h^{NT} = n_h CS_h(c_B)$. Raising the price of A to $CS_h(c_B)$ means that only the high types will purchase a system and thus component A.

The monopolist can do better if she ties. Tying allows the monopolist to price discriminate between the high and low types based on their intensity of use for component B. Tying is a mechanism to meter consumption: sales of the complementary product B indicate the intensity of use and if intensity of use reflects benefits, it can be used to price discriminate, i.e., extract more surplus from those who realize substantial benefit. By tying consumption of A to B, the monopolist in A is able to monopolize B. Maximization of the monopolist profits involves charging a price for B above marginal cost but below the monopoly price in B (denote it p_B^T) and setting $p_A^T = CS_l(p_B^T)$.

Raising the price of B above its marginal cost requires the monopolist to lower her price for A or demand by the low types will go to zero. At the margin, the profits from the sale of B to the low types equals the decrease in profits from the reduction in the price of A to the low types. Since the profits from the sale of B is greater to the high types, as they, by definition, demand more, and the decrease in the price of access for the high types is the same as for the low types, profits must increase. Of course, in order to keep the price of B above c_B the monopolist must prevent consumers from purchasing B from alternative suppliers. This is done by tying B to A.

This simple model has interesting welfare implications in the context of a merger between one of the suppliers of *B* and the *A* monopolist. Prior to the merger competition in the production of *B* resulted in its price equaling its marginal cost. Post-merger, the monopolist has an incentive to tie and raise the price of the *B* component above its marginal cost. This increases its profits and can lead to a reduction in total surplus and consumer welfare. If, in the absence of the tie, the monopolist set $p_A^{NT} = CS_l(c_B)$,[132] then tying results in a reduction in welfare since it results in an increase in the price of *B*, leading to the creation of deadweight loss in the market for *B* without any change in the consumption of *A* (both types continue to buy *A*). The monopolist serves both groups in the absence of a tie when $\pi_l^{NT} = (n_l + n_h)CS_l(c_B) > \pi_h^{NT} = n_h CS_h(c_B)$. This is more likely the larger the relative size of the low types and the less the difference between the willingness to pay of the high and low types.

If on the other hand, $\pi_h^{NT} = n_h CS_h(c_B) > \pi_l^{NT} = (n_l + n_h)CS_l(c_B)$ then in the absence of the tie, the monopolist raises the price of *A* such that only the high types purchase. The introduction of tying in this case could result in an increase in total surplus. On the one hand, the monopolist will lower the price of *A* so that both types of consumers will purchase. On the other hand, the price of good *B* will increase, inducing the high types to consume less of good *B*. The surplus of the high types increases: the decrease in the price of *A* means that they are able to keep some of the surplus they realize from consuming *B*.

Requirements Tying

The Chicago school critique is based on the assumption that demand for the monopolized component is homogenous and indivisible. An alternative perspective considers the impact if demand is homogenous, but demand for the monopolized good is not one or nothing, but varies continuously with price, i.e. is downward sloping. In this context, Burstein (1960), Katz (1989), and Mathewson and Winter (1997) have established that

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[132] Here *NT* reflects "No Tie".

tying can be profitable because it creates a situation where consumers are required to make an all or nothing choice.

The logic for the profitability of requirements tying—requiring consumers to purchase all of their *B* requirements in order to purchase *A*—follows from the fact that if the monopolist in *A* is restricted to charge a uniform price for *A*, it will not be able to extract all consumer surplus when their demands are downward sloping. Tying is a means for it to increase surplus extraction from consumers. The tying requirement means that consumers which decline to accept the tie—and purchase *B* from other suppliers—will forgo their surplus (if any) from consuming *A*. Rather than forgo all of their surplus in *A* they will be willing to pay a higher price—under the tie—for *B*, forgoing some surplus in *B* in order to maintain their surplus from *A*. Hence it is profit maximizing for the monopolist in *A* to impose a requirements tie and extract additional profit in the *B* market by raising its price above competitive levels. The analysis makes no assumptions regarding the relationship between *A* and *B*: they could be independent, substitutes, or complements. Burstein does argue, however, that the ability of the firm to enforce the tie will be an issue, particularly if the goods are not complements.

Mathewson and Winter (1997) have shown that the optimal prices under tying involve Ramsey pricing when the goods are independent: the price of each good in the tie is set such that its margin relative to its price is inversely related to its elasticity of demand. Goods with elastic demand are marked-up relatively less than those with inelastic demand. In this way the monopolist maximizes its surplus subject to the constraint that consumers receive the same surplus when purchasing subject to the tie as they would get from buying only *B* at the competitive price.

Mathewson and Winter further show that only if the demand for *B* is characterized by strong complementarity will it be optimal for the monopolist, when tying, to set $p_B = c_B$. Of course this means that it has no incentive to engage in tying (the original Chicago School result), since its profits on *B* are zero and this is the competitive price. Strong

complementarity exists when the demand for *B*, conditional on the demand for *A*, depends only on p_B: $q_B(p_B) = r(p_B)q_A(p_A, p_B)$. An example would be when the demand for toner for photocopying depends only on the number of photocopiers and the price of toner. Of course the demand for photocopiers will depend on the price of photocopiers and the price of toner.

Mathewson and Winter (1997) argue, however, that when demand is known and consumers identical, that the monopolist could do even better by charging a two-part tariff for *A* and leaving competition in the market for *B*. Profit-maximization would involve setting $p_A = c_A$ and setting the fixed fee for access equal to $CS(c_A)$. Setting the price of *A* equal to its marginal cost expands consumption to its efficient level and the fixed fee is set to extract all of the (maximized) surplus from consumers.

Mathewson and Winter demonstrate that tying can be a complement to a two-part tariff if there are heterogeneous consumers whose demand is private information. In this case tying can be profitable when the two goods are independent in demand, provided their demand is correlated. In these circumstances, in the absence of a tie, the monopolist would charge both an access fee and a usage price for good *A*. If it ties, it can set a usage price for both *A* and *B* above their marginal cost. If the demand for the two goods is correlated, then having two prices under its control provides the monopolist with the ability to institute a more efficient mix of mark-ups (when demand for the two goods is perfectly correlated the prices will be Ramsey). It can extract more surplus from the intensive demanders when it has two margins to work with than when it has just one. Since it can extract more surplus from consumers when it ties, it has an incentive to expand the size of the market. It does this by lowering the access fee for *A*.

Mathewson and Winter show that requirements tying in these circumstances can be Pareto improving: beneficial to the firm and every consumer. It is possible, however, that some consumers are made worse off—those with a high willingness to pay who are

harmed by the increased markups on the two goods—and others made better off—low intensity users who benefit from the reduction in the access fee.

Bundling

The essence of bundling is offering to consumers a group of products for a single price: consumers are offered a package at a set price. They are restricted from putting together their own package and paying only for the products where their marginal willingness to pay is greater (or equal) to the price. A substantial literature in economics, that is initiated by Stigler (1968), analyzes bundling as a price discrimination tool used by a multiproduct monopolist.[133]

Consider a two product monopolist: denote the two products as *A* and *B*. Suppose that the marginal costs of production are c_A and c_B respectively. Suppose further that there are only two consumers. The willingness to pay for consumer one is v_A^1 and v_B^1; that for consumer two v_A^2 and v_B^2 where $v_A^1 = v_B^2$, $v_A^2 = v_B^1$, and $v_A^1 > v_B^1 > c_i$. Under this specification of preferences the first consumer prefers product *A,* the second product *B,* and both are willing to buy a unit of each good if it is priced at marginal cost.

If the monopolist is restricted to charging the same price for each good for all units to both consumers, she faces a trade-off. In order to sell to both consumers, the maximum prices she can charge are $p_A = v_A^2$ and $p_B = v_B^1$, i.e., her maximum price is equal to the lowest willingness to pay for that product. This leaves surplus for the consumer with the highest willingness to pay. On the other hand, she could set her prices equal to $p_A = v_A^1$ and $p_B = v_B^2$. If she does, then she only sells one unit of each product to the consumer with the greater willingness to pay, and while this extracts all of their surplus, the monopolist is not able to extract any surplus from the consumer with the lower

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[133] See Adams and Yellen (1976), Schmalensee (1982), McAfee, McMillan, and Whinston (1989), and Salinger (1995).

willingness to pay for both goods. If the marginal revenue from pricing to induce both consumers to buy exceeds (is less than) the marginal cost of the second unit, then it will be profitable for the monopolist to charge the lower (higher) prices. For good i, $i = A, B$, marginal revenue will exceed marginal cost if $2v_i^2 - v_i^1 > c_i$. Lowering price such that both consumers are induced to purchase gives revenues of $2v_i^2$, while the revenues from selling to just the consumer with the high willingness to pay are v_i^1. The difference between the two is marginal revenue and marginal cost is simply c_i.

The surplus extraction "problem" arises because of the heterogeneous valuation of the two goods by the different consumers. Bundling is a means for the monopolist to reduce the heterogeneity of consumer valuations: the distribution of willingness to pay for the bundle is often less widely distributed than the individual components. For instance, in our example when the monopolist bundles she is able to eliminate all heterogeneity: the willingness to pay for a bundle is the same for both consumers since $v_A^1 + v_B^1 = v_A^2 + v_B^2$. By setting the price of a bundle *(P)* equal to $P = v_A^1 + v_B^1 = v_A^2 + v_B^2$ the monopolist is able to extract all surplus from both consumers. In our example, bundling is particularly effective since willingness to pay, or reservation values, are perfectly negatively correlated: consumers with a high reservation value for product *A* have a the low reservation value for product *B* (and vice-versa).

Salinger (1995) provides a general analysis of bundling when products are substitutes. He shows that an appreciation for the effects and incentives to bundle can be found from comparing the demand for bundles to the aggregate demand for components. The aggregate demand for components is the sum of the willingness to pay for each of the components. He demonstrates that for higher bundle prices (lower levels of output) the willingness to pay for aggregated components exceeds bundle demand, while for lower bundle prices (higher levels of output), the willingness to pay in total for separate components (aggregate demand) is less than willingness to pay for the bundle. Intuitively, this follows because the total willingness to pay (the total area under the

aggregated inverse demand curve) for components purchased separately must equal the total willingness to pay for the bundle. At low levels of output consumers with the highest willingness to pay for the bundle are those whose sum of willingness to pay for the two goods is greatest, while at low levels of output the greatest willingness to pay (in aggregate) for the components separately is the sum of those with the highest willingness to pay for A plus the willingness to pay for those who have the highest willingness to pay for B.

In our simple two consumer example with perfectly negatively correlated willingness to pay the demand for bundles is simply 2 bundles for a price less than or equal to $v_A^1 + v_B^1 = v_A^2 + v_B^2$. The aggregate demand for components is 1 unit of A (to the first consumer) and 1 unit of B (to the second consumer) will be sold at a price of $v_A^1 + v_B^2$, 2 units of A and 2 units of B will be sold at a price of $v_A^2 + v_B^1$ or less. Salinger's observation is that $v_A^1 + v_B^2 > v_A^1 + v_B^1 = v_A^2 + v_B^2 > v_A^2 + v_B^1$.

The relationship between the two demand curves does not depend on whether there is negative or positive correlation. The effect of positive correlation is to make the aggregate demand for components equal the demand for the bundle at intermediate price values.   When there is perfect positive correlation, the two demand curves are perfectly coincident.

A necessary condition for bundling to be profitable—when it does not affect costs—is that the profit-maximizing bundle price must be in the range where (inverse) demand for the bundle exceeds (inverse) demand for the separate components in aggregate. If this was not true, the firm could increase its profits by selling the components separately. Moreover, if costs increase with bundling, there is always an increase in costs which makes bundling unprofitable.

In general we would expect that the bundled price would be less than the sum of the monopoly prices of *A* and *B*.   Bundling and offering a small discount will increase profits. To see why, note that at the monopoly prices, the gain from a lower price (the product of expansion of sales and the price-marginal cost difference) equals the loss from a lower price (lost profits on inframarginal units). Suppose that the small decrease in the price of the bundle is decomposed into a decrease in the price of *A,* with the price of *B* unchanged. Then, the small decrease in price for *A* does not change the profits from *A*—because the benefit and costs are approximately the same—but it increases the sales and profits from *B*.

For consumer surplus to increase with bundling, the price of the bundle must be sufficiently lower than the price of the products offered separately.   At unchanged prices—when the bundle price equals the sum of the prices when the products are offered separately—consumer surplus will decrease. The reason is that the two goods will be distributed inefficiently: when offered separately the distribution across consumers will be efficient, at the margin all consumers who purchase will have the same value for a product. Under bundling, this will not be true, some individuals with a high willingness to pay for *B*, but a low willingness to pay for *A* might not buy the bundle. Other individuals whose willingness to pay for the bundle exceeds the price of the bundle will buy, even though their willingness to pay for *B* could be less than the willingness to pay of some who forgo purchasing the bundle. In order to make up for this pure bundling effect, the bundle price decrease must be large enough to create greater consumer surplus through expansion of consumption.

The profitability of bundling depends on both the correlation of reservation values, the level of costs, and the effect of bundling on costs. Provided costs are low, bundling is likely to be profitable, since low costs imply that the bundled price will be low and in the region where the bundled demand curve lies above the aggregate component demand curve. Salinger also notes, however, that if bundling lowers costs it could still be

profitable even if bundled demand is less than the aggregated demand for the separate components. This will be case if the cost effect makes up for the reduction in demand.

Salinger also highlights the importance of the changes in costs from bundling and the nature of the correlation. Consider a situation where the initial level of costs are fairly high (relative to average reservation values) and the cost reduction from bundling insufficient to make bundling profitable under negative correlation. In these circumstances under *positive correlation* any reduction in costs makes bundling profitable if the optimal price pre-bundling is in the range where the demand curves are coincident: bundling has very little effect on demand, but decrease costs. The counter-intuitive observation is that the range for which the two demand curves are coincident is greater the greater the extent of correlation. As Salinger (p. 98) points out, this implies that "When bundling lowers costs, it tends to be more profitable when demands for the components are highly positively correlated and component costs high. This finding is in distinct contrast to the purely demand-based analysis of bundling, in which the practice tends to be most profitable when component costs are low and demands are negatively correlated."

4.2   Tying

In this section, models in which tying is used to enhance market power are considered. The models discussed are Whinston (1990) and Carlton and Waldman (2002). In addition, we consider models that evaluate the effects of tying on their effect on the incentives for rival firms to engage in R&D. Discussed are Katz and Farrell (2000), Choi and Stefanadis (2001), and Choi (2004).

Examination of these models provides insights into the incentive of a firm to tie products after a non-horizontal merger (the goods are either independent or complements). Unlike the equilibrium models of foreclosure (discussed in Section 4.4), however, these models typically do not provide for counter-strategies by a disadvantaged rival. They are applicable to a setting where there is a dominant firm, protected by entry barriers. These

entry barriers not only preclude a counter merger—since there is not a second firm with which to merge— they also implicitly preclude a disadvantaged rival from entering the dominant firm's market. In any event, these barriers to entry preclude a disadvantaged rival from replicating the structure of the merging firm.

Whinston (1990) demonstrated that the Chicago School critique based on a single monopoly profit was not robust if there is imperfect competition in the tied product and tying affects the market structure in the tied good.[134] In the case of independent products, Whinston shows that by tying the monopolist commits to price its independent product aggressively. In order to earn its profit on its monopoly good, it has to convince consumers to buy its tied product. It acts as if every sale of the tied good is cross-subsidized by the margin on its monopoly product. This may be profit maximizing if the price reducing effect of tying in the event of competition is sufficient to either induce its rival in the tied product to exit or not to enter and the extent of differentiation between the tied goods is limited.   The first condition—inducing the exit or preventing the entry of a rival in the tied product—gives the monopolist market power in the tied good market. The second condition insures that consumers do not make tying unprofitable even if it results in monopolization by substituting away from the monopolist's tied good by forgoing the monopoly tying good.

In the context of complements, Whinston also shows that the monopolist may have an incentive to tie its monopoly good to a complement in two circumstances. In the first, there is an inferior substitute for its "monopoly" good. The presence of this substitute puts a limit on the surplus it can extract by raising the price of its "monopoly" product. Hence the monopolist may have an incentive to tie its monopoly product and complement: doing so provides it with an incentive to lower the price of its complement since the only way to earn its monopoly margin is to convince consumers to buy its system, not the rival system. If there are fixed costs associated with the production of the

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[134] An assumption of the Chicago school analysis is that market structure was taken as given.

complement, then the increase in price competition for it and loss of market share to the monopolist might induce the rival producer of the complement to exit the market. As a result, of course, the inferior system ceases to exist and the inferior substitute for the monopoly good is also excluded. The profitability of tying complements in these circumstances depends on whether the rival system is in fact excluded and whether the gain from removing the limit on the price of the monopoly good makes up for its lost sales as some consumers who dislike the monopolist's complementary product leave the market for the monopoly product.

Similarly, Whinston points out that if there is demand for the complement based on a use that does not require the monopoly product, the monopolist cannot extract all of the surplus created by competing complements through its price of the monopoly product. If the market for the use of the complement independent of the monopoly product is large and tying by the monopolist is sufficient to make the competing complement supplier unprofitable, then tying can be profitable because it results in monopolization of the independent use market. Tying forecloses the competing complement supplier from selling into the systems market and if economies of scale are such that the sales into the independent market are too small to sustain the competing complement supplier, it will either exit or not enter.

Carlton and Waldman (2002) consider how a dominant firm might use tying of complementary products to deter future entry into its monopoly or primary market. The analysis of Carlton and Waldman is similar to Whinston (1990), but instead of eliminating an inferior rival in the primary market (the market in which the firm is a monopolist), the focus is on preserving that power by deterring entry into the complementary good market. Carlton and Waldman consider systems composed of two goods, that are consumed in fixed proportions. In one variant there are fixed costs associated with the introduction of the complementary products. In the second variant, the fixed costs of introducing the complementary product are zero, but it is characterized

by direct network effects.[135] The key assumption is that a rival system producer can enter into the complementary product today (with a product superior to that of the incumbent), but its entry into the primary good is delayed into the future.

Carlton and Waldman demonstrate that when faced with the threat of entry into its primary market, the monopolist has an incentive to sell its two products as a bundle or system. This tie precludes sales of the complementary product offered by its rival today, and because that reduces its profits, may preclude the entrant from entering. For tying to be effective, it must be the case that the entrant is not able to recover the fixed costs of entry associated with simultaneously entering both markets in the future. Tying is necessary to deter entry if in its absence the rival would have found it profitable to enter today with the complement and introduce the primary good in the future.   Tying is profitable for the incumbent when it deters entry and the loss in profits today from not sharing in the surplus created by the entrant's superior complement—whose presence would allow the incumbent to charge a higher price for the primary good—is less than the monopoly profits it preserves in the future by deterring the entrant and not being replaced.

Carlton and Waldman also consider an extension in which there is no longer fixed costs associated with the complementary product, but it is instead characterized by a direct network effect: the more consumers who buy the same complementary product the greater their benefit.   Then by tying in the first period, the monopolist is able to create an installed base of users for its complementary product in the second period. This serves to deter entry of the competing system, since without sales in the first period, the introduction of a competing system by the entrant may not be profitable.

More recently, the focus has been on the effect of tying on the incentives for innovation. Farrell and Katz (2000) and Choi and Stefanadis (2001) have looked at the effect of

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[135] A direct network effect exists if the benefit from a product is increasing in the number of consumers who

tying components in a system has on innovation. Farrell and Katz show that a monopolist in one component has an incentive to integrate into the supply of the second component even when it is competitively supplied.   This incentive arises when suppliers of the complement can invest in quality enhancing research and development. Integration into production of the complement enhances the incentive for the monopolist to invest in innovation. Like all other complement suppliers, it will earn profits on sales of the complement if it is the high quality supplier: its additional incentive arises because it will also benefit if it is the second highest quality supplier.   A higher second quality in the market reduces the price that the highest quality firm can charge, allowing room for the monopolist to raise the price of its monopoly component. This is a private benefit, not a social benefit, and integration results in excessive expenditure on innovation by the monopolist and a reduction in innovation by its rivals (though total expenditure rises).[136]

Choi and Stefanadis (2001) consider as well systems comprised of two complements, but there is an incumbent monopolist in both. For each component there is a potential entrant, but entry is stochastic. The potential entrants can increase the probability of entry by investing more in R&D. If successful, their product is identical to that of the incumbent, but their costs are lower.   Prior to the entrants making their investment decision, the incumbent can commit to tying her two components. To make sure it is credible, the assumption made is that if the incumbent ties, the tie is created through the design of the two products.   When the incumbent ties, the entrant only receives profits when the other firm is also successful, unlike the case when the incumbent does not tie. Because tying makes the payoff from investment by the entrants contingent on success by the other entrant, it lowers their payoff, and hence equilibrium investment levels. This makes entry into both components less likely, preserving the incumbent's monopoly position.   Whether tying is profitable for the incumbent depends on whether the cost, a reduction in the probability of extracting surplus from a single entrant through a price

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purchase compatible or the same product. The classic example is a telephone exchange.

squeeze is less than the benefit, decreasing the probability that it will be completely displaced if both entrants are successful.

Choi (2004) introduces a research and development stage into Whinston's model of tying with independent goods. In the first stage the monopolist can tie her two products, in the second stage the monopolist and the independent supplier of the second good can invest in cost-reducing research and development. Choi shows, that tying might be profitable even if it does not induce the exit or prevent the entry of the competing supplier of the independent product. The effect of tying is to reduce the incentive for the rival to engage in innovation and increase the incentive for the monopolist to invest in innovation. The reason is that the marginal benefit from investment in cost reduction is proportional to output. The monopolist uses the fact that tying provides it with an incentive to increase its market share in the tied good and reduces the market share of its rival to alter the firms incentives for R&D: tying enhances its incentives and reduces the incentive of its rival. Tying therefore provides the monopolist in A with a dynamic advantage in B: it will have lower costs of production than its rival. This advantage may be sufficient that tying is profitable—the cost advantage makes up for the increase in price competition and lost sales of the monopoly product—even if it does not prevent the entry or induce the exit of its rival.

4.2.1   *Whinston and Independent Products*

The first rigorous game theory model showing the possibility of profitable leveraging of market power is Whinston (1990). Consider the framework used earlier to show that tying was not profitable. Recall that there were two goods, A and B, which are independent in demand. A is produced by firm 1 and both firms 1 and 2 produce good B. Product B is differentiated, the two products imperfect substitutes, and every consumer

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[136] Farrell and Katz avoid the single profit result by assuming that the prices of the complement are set first and then the price of the monopoly good. Otherwise there would also be a perfect price squeeze and the independent suppliers of the complement would not have an incentive to incur any R&D costs.

will buy either zero or one unit of each product. Normalize the number of consumers to one.

Competition between the two firms in market B is Bertrand. Demand for product i in market B is given by

$$q_i^B = D_i^B(p_i^B, p_j^B).$$

Suppose further that demand for A is homogenous, with each consumer having unit demand and a maximum willingness to pay of v. Costs for firm 1 are c_1^A and c_1^B. Unit costs for firm 2 are c_2^B.

Firm 1 can either offer its two products independently at prices p_1^A and p_1^B or tie the two products by requiring purchasers of its monopoly product, A, to also purchase its B product. If it ties (which in this simple setup is equivalent to offering consumers the option of only buying its A and B as a bundle), it sells both products for price P. In Section 4.1.2 we demonstrated that bundling/tying would be unprofitable for firm 1, since some consumers who dislike B_1 will forgo the bundle, reducing sales and profits of the monopoly product A. However, firm 1 may have an incentive to tie/bundle if it changes the market structure for good B by either inducing the exit or preventing the entry of firm 2. This will be the case if tying reduces the profits of firm 2. Firm 2's profits will be reduced if tying lowers the equilibrium prices in the market for B and reduces B's sales.

Lower prices in the market for B will result if the bundle changes the pricing incentives for firm 1 in that market. In the absence of a bundle, firm 1 will choose its price for B_1 to maximize its profits. Its profits from sale of B_1 are

$$\pi_1^B = \left(p_1^B - c_1^B\right) D_1^B(p_1^B, p_2^B) \tag{28}$$

If it bundles, its profits are

$$\bar{\pi}_1^B = \left(P - c_1^B - c_1^A\right) D_1^B(P - v, p_2^B) \tag{29}$$

since only those willing to buy its product B at the implicit price $p_1^B = P - v$ will buy its bundle. Substituting into (29) $p_1^B = P - v$ and $p_1^B + v = P$,

$$\bar{\pi}_1^B = \left(p_1^B + v - c_1^B - c_1^A\right)D_1^B(p_1^B, p_2^B) \tag{30}$$

or

$$\bar{\pi}_1^B = \left(p_1^B - [c_1^B - \left(v - c_1^A\right)]\right)D_1^B(p_1^B, p_2^B) \tag{31}$$

Comparing (28) and (31) we can see that firm 1's pricing incentives for B_1 have been changed by its decision to bundle. The effect of bundling is that in order to earn its margin on the monopoly good, $(v - c_1^A)$, firm 1 has to expand its sales of B_1.

Alternatively, if it can sell one more unit of B_1, it will also sell a unit of its monopoly good and earn a margin of $(v - c_1^A)$. Hence bundling reduces its effective marginal cost—its opportunity cost—for B_1 by its margin on sales of A: $(v - c_1^A)$. This "subsidy" provides it with an incentive to charge a lower "implicit" price for B_1 when it bundles for every p_2^B. Because of price competition, firm 2 will have an incentive to lower its price for B_2.[137] If the reduction in price and profits for firm 2 is sufficiently large, it may not be able to recover its fixed costs, resulting in it not entering, or (in the long-run) inducing its exit. Indeed since tying lowers the profits of firm 1 in the absence of a change in market structure, the decision to tie is only profitable for firm 1 if it is successful in foreclosing the market for B_2 and eliminating firm 2. However, even in this case tying for foreclosure may not be profitable for firm 1. If there are a sufficient number of consumers who strongly dislike B_1 they may substitute not from B_2 to B_1, but out of the market, reducing demand for A in the process.

If tying does not change market structure it is not profitable and the monopolist's profits are greater if it does not tie. Hence if it implements a tying strategy to foreclose firm 2, it must not be able to undo the tie, i.e., it must be unable to provide the two goods

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[137] Technically, this change in incentives shifts its implicit B_1 price best-response function when it bundles upwards since it finds it optimal to charge a lower price for every price of its rival, which in equilibrium

individually. A mere threat to tie to induce exit or prevent entry would not be credible, since given entry or failure to exit by firm 2, firm 1 would have greater profits if it did not tie.

The consequences for total surplus when tying leads to foreclosure are ambiguous. Consumers are made worse off by the monopolization of good B. Monopolization results in a reduction in product variety and—likely—higher prices.[138] Moreover, to the extent that sales of A are reduced, consumer welfare will fall. However, the resource cost savings associated with eliminating the second firm—either fixed or production cost reductions may mean that total surplus increases.

Whinston considers the implications of relaxing the assumption that the preferences for good A are homogenous, i.e. that consumers have identical valuations for A. Assuming commitment, bundling is an effective exclusionary strategy because at the bundle price firm 1 had an incentive to expand its output of B_1, reducing market share and price for firm 2. The reason this is true when preferences are homogenous is that the willingness to pay of all consumers for A is greater than its marginal cost and the change in demand for the bundle from a change in the price of the bundle is the same as the change in demand for B_1 from the change in the price of B_1. The effect of bundling does not change demand for good A.

With heterogeneous preferences neither one of these will necessarily be true. For instance, if there is a large number of consumers with a willingness to pay for A less than its marginal cost, then the margin on the bundle might become less than the margin on B_1 alone. Rather than have the margin on A subsidize sales of B—which gives the tying

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induces firm 2 to lower its price for B_2 (since its inframarginal units are reduced by the decrease in the price of B_1).

[138] It is possible that to maintain sales of A, firm 1 could reduce the (implicit) price of B_1, in which case consumers that favor B_1 would gain under monopolization. This is likely inconsistent with foreclosure being profitable.

firm an incentive to price *B* aggressively—it now effectively losses money on *A* for each bundle sold. Consequently, bundling/tying makes it less aggressive in the market for *B*. As Whinston observes (p. 847) "In such a case, firm 1's monopoly of good *A* is too weak for bundling to be an effective exclusionary threat in market *B;* bundling would help rather than hurt firm 2. This effect, of course, is exactly what one should expect a priori."

The second reason is that the responsiveness of bundle demand to a change in price may be very different than the change in demand for B_1 from a change in price under bundling. In this case, explored below in Section 4.3.1, bundling can be a facilitating practice that increases the price and profits of firm 2.

Tying may also be exclusionary even if the monopolist cannot commit to tie *if* consumers valuations are heterogeneous. In these circumstances Whinston (1990) has shown that the monopolist may find it profitable to bundle the two goods and also offer the monopoly good separately regardless of whether it is exclusionary. Instead the monopoly good is priced separately such that those with a high willingness to pay—but who prefer the tied good offered by the rival—will still buy the monopoly good. However, for those with a low willingness to pay for the monopoly good, the effect of tying is exclusionary, reducing the rival's sales and profits for the same reasons discussed above that apply to the case when the monopolist can commit to the tie, i.e., only offer its monopoly good as part of the tie.

4.2.2 Whinston and Complements

Whinston (1990) considers two models in which tying involving complements is profitable. The first involves systems where the monopolist in *A* is not able to extract all of the value from the system because of competition from an inferior substitute. In the second the complement, *B*, has an alternative use that does not depend on simultaneous acquisition of *A*, such that the value associated with this use cannot be extracted through the pricing of *A*.

Complements and Systems

Assume that consumers assemble systems composed of two components in fixed proportions, one A and one B component, and that each component does not provide any stand-alone consumption benefits. Component A is produced only by firm 1, but there are two differentiated versions of component B available, B_1 supplied by firm 1 and B_2 supplied by a competitor. Costs of production are constant and given by c^A, c_1^B, and c_2^B.

Suppose, unlike the previous discussion in Section 4.1.2, where it was shown that under these assumptions tying would reduce the profits of firm 1, that the ability of firm 1 to raise the price of its A component is constrained by the existence of an inferior substitute. The presence of this inferior substitute will constrain the pricing behaviour of firm 1 for its A component if consumers substitute to the inferior component at a price less than the profit-maximizing price in the absence of the availability of the substitute. Although consumers would prefer to assemble systems AB_1 or AB_2, if the price firm 1 charges for A is too high, they will switch to a competitive supplier for component A. Suppose, however, that firm 1 ties sales of its A component to its proprietary component, B_1. Then in the pricing game between B_1 and B_2, firm 1 has, relative to not tying, an additional incentive to price B_1 aggressively: acquiring more market share for B_1 increases sales of its A component. If there are fixed costs associated with the production of component B, then the increase in price competition for component B and loss of market share to firm 1 might induce the rival producer of component B to exit the market. As a result, of course, the alternative producer of the A component is also forced to exit and firm 1 can raise the price of both its products.

To see the incentive that A has to price more aggressively when it ties, consider first the profit-maximizing condition for A when it sets the price of B_1 in the absence of a tie. It is:

$$\frac{\partial \Pi_1}{\partial p_1^B} = (p_A - c_A) \frac{\partial x_1^B \left(p_A + p_1^B, p_A + p_2^B\right)}{\partial p_1^B} + (p_A - c_A) \frac{\partial x_2^B \left(p_A + p_1^B, p_A + p_2^B\right)}{\partial p_1^B}$$

$$+ x_1^B \left(p_A + p_1^B, p_A + p_2^B\right) + (p_1^B - c_B) \frac{\partial x_1^B \left(p_A + p_1^B, p_A + p_2^B\right)}{\partial p_1^B} = 0 \qquad (32)$$

where $x_i^B \left(p_A + p_i^B, p_A + p_j^B\right)$ is the demand for system AB_i when its price is $p_A + p_i^B$ and

the price of the rival system AB_j is $p_A + p_j^B$. The unit costs of production are c_A and c_B.

The marginal profitability from a change in the price of B_1 consists of four terms. The

first two terms in (32) reflect the effect that changes in the price of B_1 have on firm 1's

sales of its monopoly *A* component. The first is the loss in profit from the reduction in

AB_1 system sales. The second is the gain in profits from the increase in AB_2 system sales

as the increase in the price of B_1 encourages consumers to substitute away from system

AB_1 to its alternative. The last two terms in (32) are the usual terms that determine a

profit-maximizing price: the first on the second line is the gain on the inframarginal

units, the second the lost profits on marginal units from an increase in the price of B_1.

For there to be an incentive to tie, the inferior substitute for *A* must limit the price that

can be charged by the monopolist, restricting its ability to extract rents created by

competition in *B*. Suppose that the inferior substitute for *A* results in an upper limit on

the price of *A* equal to γ. Then in the absence of a tie, (32) becomes:

$$\frac{\partial \Pi_1}{\partial p_1^B} = (\gamma - c_A) \frac{\partial x_1^B \left(\gamma + p_1^B, \gamma + p_2^B\right)}{\partial p_1^B} + (\gamma - c_A) \frac{\partial x_2^B \left(\gamma + p_1^B, \gamma + p_2^B\right)}{\partial p_1^B}$$

$$+ x_1^B \left(\gamma + p_1^B, \gamma + p_2^B\right) + (p_1^B - c_B) \frac{\partial x_1^B \left(\gamma + p_1^B, \gamma + p_2^B\right)}{\partial p_1^B} = 0 \qquad (33)$$

where it is recognized that $p_A = \gamma$.

If firm 1 ties/bundles component *A* with B_1 and charges price *P* for the system AB_1 the

profit-maximizing bundle price is determined by

$$\frac{\partial \Pi_1}{\partial P} = x_1^B\left(P, \gamma + p_2^B\right) + (P - c_B - c_A)\frac{\partial x_1^B\left(P, \gamma + p_2^B\right)}{\partial P} = 0 \tag{34}$$

where the first term is the gain on inframarginal sales, the second the loss from lost marginal units as the price of the bundle increases. At bundle price P the de facto price for component B_1 is $p_1^B = P - \gamma$ since $P = \gamma + p_1^B$. Substituting, (34) becomes

$$\frac{\partial \Pi_1}{\partial P} = x_1^B\left(P, \gamma + p_2^B\right) + \left[(\gamma - c_A) + \left(p_1^B - c_B\right)\right]\frac{\partial x_1^B\left(P, \gamma + p_2^B\right)}{\partial P} = 0 \tag{35}$$

Comparing (33) to (35) reveals that for any p_2^B firm 1 has an incentive to charge a lower price for B_1 by lowering P.[139]   Present in (33) but missing from (35) is the term

$$(\gamma - c_A)\frac{\partial x_2^B\left(\gamma + p_1^B, \gamma + p_2^B\right)}{\partial p_1^B}$$

which reflects an advantage in the absence of a tie of raising the price of B_1 — increased sales of system AB_2 on which the monopolist earns a margin of $(\gamma - c_A)$.   When it bundles, it forgoes sales of system AB_2 and the only means to increase sales of component A is to, de facto, lower the price of B_1 by charging a lower price for its bundle. The lower price for its bundle reduces the price and sales of the competing system and component B_2. If the effect is sufficiently negative on the profits of firm 2, it will be excluded and firm 1 will be a monopolist.

The incentives for firm 1 to engage in this exclusionary tying depends on its effectiveness. If it does not result in the exclusion of the supplier of component B_2 it will not be profitable. Its exclusionary effect depends on the extent of economies of scale in the production of B_2 and the effect that tying has on prices in the market for the B component.   The effect tying has on the equilibrium prices in market B depends on the

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[139] Note that in (34) and (35) $\dfrac{\partial x_1^B(P, \gamma + p_2^B)}{\partial P} = \dfrac{\partial x_1^B(\gamma + p_1^B, \gamma + p_2^B)}{\partial p_1^B}$ since $P = \gamma + p_1^B$.

extent to which tying affects firm 1's incentives to reduce its price of B_1 and the sensitivity of firm 2's optimal price to p_1^B.

The sensitivity of firm 1's pricing of B_1 to depends on the magnitude of

$$(\gamma - c_A) \frac{\partial x_2^B \left(\gamma + p_1^B, \gamma + p_2^B \right)}{\partial p_1^B}.$$ The larger the pre-bundling mark-up and the sensitivity of

B_2 to p_1^B, the larger the incentive firm 1 has to lower the implicit price of B_1 by reducing the price of its bundle. The larger the sensitivity of B_2 to p_1^B, the greater the effect tying by firm 1 has on the price of firm 2.

The profitability of tying that effectively excludes the competing system will depend on the following trade-off. While firm 1 is now a monopolist (and will be able to raise the price of its A component), it will forgo sales of its A component to some who prefer system AB_2 and will not substitute to AB_1. This was what makes tying in the absence of a change in market structure unprofitable for firm 1. If the constraint imposed by the inferior A alternative is significant and the extent of differentiation between the two systems AB_1 and AB_2 relatively small, tying will be profitable for firm 1. If on the other hand, the competitive constraint on the price of the A component of the inferior substitute is not very effective and the two systems, AB_1 and AB_2, very differentiated, tying even if it is exclusionary may not be profitable.

The implications for total welfare of exclusionary tying are ambiguous. On the one hand total surplus increases because of the fixed costs savings associated with the exit of firm 2. On the other hand, total surplus is reduced since some consumers are now "forced" to purchase B_1 instead of B_2, and some consumers at the higher "implicit" price for A may forgo consumption altogether. Both of these mean that in aggregate consumers are harmed.

Alternative Use for the Complement

If there is an alternative use for the complement, i.e., one that does not depend on the simultaneous purchase of *A*, then the monopolist may tie *B* to *A* in order to monopolize *B*. As Whinston notes, because *A* is not essential for the use of *B* in this alternative market, firm 1 does not benefit from the presence of a competing component in the market for *B*. Hence it may find it profitable to monopolize the market for *B*. The means for it to do this is to tie *A* to *B*. This will be successful if tying *A* to *B* reduces, i.e., forecloses, enough of the market to firm 2 that it cannot cover its fixed costs and exits. This will be profitable if the market for the independent use of *B* is large. Consumers are made worse off, though the effect on total surplus is—again—ambiguous.

4.2.3 Tying to Preserve and Create Market Power in Evolving Markets

Carlton and Waldman (2002) consider how a dominant firm might use tying of complementary products to deter future entry into its primary market. The analysis of Carlton and Waldman is similar to Whinston (1990), but instead of eliminating an inferior rival in the primary market (the market in which the firm is a monopolist), the focus is on preserving that power by deterring entry.[140] Carlton and Waldman instead consider systems composed of two goods, i.e., they are consumed in fixed proportions. In one variant there are fixed costs associated with the introduction of both products. In the second variant, the fixed costs of introducing the complementary product are zero, but it is characterized by direct network effects.

Carlton and Waldman consider a two period model. The incumbent is a monopolist in the primary market (*A*) and is also active in the complementary goods market (*B*). In the second period there is a potential entrant into *A*. However, the potential entry can enter the complementary goods market in either period 1 or 2. The primary products of the two firms are homogenous, but the complementary product of firm 2, the entrant, is

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[140] Their analysis is also similar to Church and Gandal (2000), except that Church and Gandal consider the effect of tying/bundling—foreclosure—when systems are characterized by indirect network effects. See Section 4.4.1 *infra*.

superior to that of the incumbent (firm 1). As in Whinston (1990), the monopolist in *A* has no incentive to tie if there is no threat of entry into its primary market.

When faced with the threat of entry, however, into its primary market, the monopolist has an incentive to sell its two products as a bundle or system. This tie precludes sales of the complementary product offered by its rival in the first period, and because that reduces its profits, may preclude the entrant from entering market *B*. Of course if it is precluded from entering *B* in the first period, it will not enter *A* in the second period. This argument requires that the entrant not be able to recover the fixed costs of entry associated with simultaneously entering both markets in the second period.

More formally, the Carlton and Waldman model makes the following assumptions. There are two cohorts of identical consumers, corresponding to the two periods: N_1 is the size of the first cohort and N_2 the size of the second cohort. All consumers value for the incumbent's system is V, but it is $V + \Delta$ if instead of the incumbent's complementary product, the system is comprised of the *B* component supplied by the entrant. The *A* components are not differentiated. First period consumers cannot purchase in the second period. The timing is as follows: (i) in the first period the incumbent firm makes a commitment to tie or provide its products separately; (ii) the entrant can incur the fixed costs of entering the complementary product market (f_B), and if it enters there is Bertrand price competition;[141] (iii) in the second period the entrant can enter the primary market at cost f_A if it has previously entered the complementary product market or it can

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[141] If the entrant enters the complementary product market, there are multiple price equilibria, each corresponding to a different division of the surplus created by the superior quality of the entrant's complementary product. The implicit assumption is that it does not all accrue to the incumbent, through a higher price for its primary product, or to the entrant. Instead Carlton and Waldman assume it is shared equally. If the incumbent was able to exercise a price squeeze it would extract all of the incremental surplus created by entry by raising the price of the primary product to $p_A = V + \Delta - c_B$. The optimal price for the entrant is then $p_B = c_B$ and the incumbent is able to extract all of the surplus created by the entrant's superior product through the price of its monopoly supplied complement. In general with two duopoly suppliers of perfect complements, any p_A, p_B such that $p_A + p_B = V + \Delta$ is a Nash equilibrium in prices.

enter both markets by incurring cost $f_A + f_B$. If it enters, prices are once again determined by Bertrand competition. Costs for both firms are the same: the constant marginal cost to produce the primary good is c_A, that for the complementary product c_B.

In the second stage, when the entrant produces both products and regardless of whether the incumbent ties, the equilibrium price for the incumbent's system is $c_A + c_B$ and that for the entrant $c_A + c_B + \Delta$. All consumers buy the entrant's complementary good, and are indifferent with regard to which primary component purchased: the *A* components are homogenous and the effective price is c_A independent of which firm is the supplier. If the entrant only supplies its superior complementary good in the second period, then its price is $c_B + \Delta / 2$ and the price the incumbent charges for the primary component is $V - c_B + \Delta / 2$, since for consumers to buy $p_A + p_B = V + \Delta$. Consumers purchase the primary good from the incumbent and the complementary good from the entrant. Similar prices would prevail in the first period if the entrant supplies the complementary good. The effect in the second period if the entrant is able to supply the primary good is that it realizes all of the surplus created by its superior product. If it only supplies the complementary product, then some of the incremental surplus created is captured by the incumbent. If the incumbent is the only provider of a system it charges, in aggregate, *V*, regardless of whether it ties or not.

The equilibrium depends on the size of the entry costs incurred by the entrant into the production of both good *A* (primary) and good *B* (complementary). For the incumbent to exclude the entrant by tying, four conditions must be satisfied:

> (i) The entrant would find it profitable to enter the primary market in the second period if it entered the complementary market in period 1. This requires that its profits in the second period increase when it incrementally supplies the primary good: $N_2(c_A + c_B + \Delta) - N_2(c_A + c_B) - f_A > N_2(c_B + \Delta / 2) - N_2 c_B$ or $N_2 \Delta / 2 > f_A$. This condition requires that the increase in profits from supplying

both products (which arises because it can capture all of the surplus of its superior complementary good rather than only half of it) exceed the fixed cost of introducing its primary good. Define f_A^* as $f_A^* = N_2 \Delta / 2$.

(ii) The entrant must not find it profitable to introduce both products simultaneously in the second period. The condition for this is

$N_2(c_A + c_B + \Delta) - N_2(c_A + c_B) - (f_A + f_B) < 0$ or $N_2 \Delta - (f_A + f_B) < 0$. The incremental surplus created, and captured, by introducing its superior product is insufficient to cover the fixed costs of introducing the entire system if the surplus is only captured in the second period. Define f_B^* as $f_B^* = N_2 \Delta - f_A$.

(iii) Condition (ii) implies that the entrant will only find it profitable to enter with a system if it can capture some surplus in the first period. The third condition required for the incumbent to tie in the first period is that the entrant find it profitable, in the absence of a tie, to enter in the first period with its complementary product and introduce its primary good in the second period:

$N_1(c_B + \Delta / 2) - N_1 c_B - f_B + \sigma[N_2(c_A + c_B + \Delta) - N_2(c_A + c_B) - f_A] > 0$

where σ is the discount factor. This can be rewritten as

$$N_1 \Delta / 2 - f_B + \sigma[N_2 \Delta - f_A] > 0.$$

Define f_B^{**} as $f_B^{**} = N_1 \Delta / 2 + \sigma(N_2 \Delta - f_A)$.

(iv) Finally, it must be profitable for the incumbent to tie when it would deter entry. Tying deters entry if the condition in (iii) is satisfied, since when the incumbent ties the sales and profits of the entrant in the first period are zero, which given (ii) means that the entrant will not enter in the second period. Recall that the tie must be a commitment, hence even though the incumbent would like to abandon the tie in the second period—allowing the entrant to enter with its superior complementary product—by assumption it cannot. The profits to the

incumbent when it ties are $N_1(V - c_A - c_B) + \sigma N_2(V - c_A - c_B)$. Its profits if it does not tie and the entrant enters sequentially (complementary product in the first period and primary product in the second period) are $N_1(V + \Delta/2 - c_A - c_B)$ since if the entrant's superior product is available, the incumbent can extract half the surplus created by raising the price of the primary product, and its profits in the second period are zero. It is profitable for the incumbent to tie if

$$\sigma N_2(V - c_A - c_B) > N_1 \Delta/2 . \tag{36}$$

The first term is the (discounted) monopoly profits in period two preserved by deterring entry. The second term is the decrease in first period profits because tying precludes entry of the entrant's superior product whose presence allows the incumbent to raise its price and hence profits in the first period.

Conditions (ii) and (iii) imply that the fixed costs of entering the complementary products cannot be too high or too low. For tying to arise in equilibrium $f_B^* < f_B < f_B^{**}$. If f_B is less than f_B^* then the entrant will find it profitable to enter with a system in the second period regardless of the tie. If f_B is greater than f_B^{**} then the entrant will not find it profitable to enter sequentially. Carlton and Waldman show that the restrictions on the parameters implied by conditions (i), (ii), and (iii) mean that

$$f_B^{**} - f_B^* = N_1 \Delta/2 + (\sigma - 1)(N_2\Delta - f_A) > 0 \tag{37}$$

for tying to be required and effective for exclusion.

Restriction (36) implies that tying is more likely to be profitable for the incumbent when the second cohort is large relative to the first, the superiority of the complementary product of the entrant relatively small, the system margin large $(V - c_A - c_B)$, and the discount factor close to one. Restriction (37) implies that tying will be effective and is required to exclude entry of a competing system when the first period cohort is relatively large and/or the discount factor close to one. When the first period cohort is large, tying eliminates substantial profits for the entrant from entering the complementary product in

the first period. When the discount factor is close to one, the profits from introducing the primary good in the second period are valuable, hence providing the entrant with an incentive to enter with its complementary good in the first period. If the first period cohort is relatively large and/or the discount factor close to one, then the effectiveness of tying will also be increasing in the quality advantage of the entrant. Tying is also more likely the smaller the fixed costs of entering the primary product.

Carlton and Waldman offer an interesting interpretation of (37). They consider how the size of the two cohorts likely depend on the lifespan of the primary product and the imitation lag—the length the lifespan of the primary product when entry is not possible. The greater the imitation lag, the larger the size of the first cohort relative to the second cohort and the more likely (37) is satisfied. On the other hand—given a fixed imitation lag—the longer the life of the primary product, the more important the second cohort relative to the first, and the less likely (37) is satisfied. Carlton and Waldman conclude that tying to preserve a monopoly is more likely the longer imitation lags and the shorter product lifespan.

The welfare effects of tying in this model are as follows. From an efficiency perspective, tying is inefficient since in the absence of tying the entrant would have found entry profitable. Because the entrant only captures a share of the total surplus its entry creates (this is condition (iii)) , the incentive for entry in the absence of a tie is insufficient. Tying makes things worse. Moreover, consumers are made strictly worse off when there is a tie. When there is a tie and entry deterrence, consumers receive zero net surplus. Without tying this is also true in the first period, but entry in the second period results in system competition and strictly positive surplus as prices fall from $V - c_A - c_B$ —under monopoly and the tie—to $c_A + c_B + \Delta$ under system competition.

Network Externality Variation

It is easy to see that the substitution of direct network externalities for the fixed costs of the complementary good results in tying again deterring entry. By tying in the first

period, the monopolist is able to create an installed base of users for its complementary product in the second period. This serves to deter entry of the competing system, since without sales in the first period, the introduction of a competing system by the entrant may not be profitable.

Tying will be effective in this case if the fixed costs incurred by the entrant when it introduces its primary product are large enough that it is not profitable to introduce both products in the second period, but small enough that it is profitable to introduce the primary product in the second period if it has already introduced its superior complementary product in the first period. By tying in the first period, the monopolist can counter act the quality advantage of the entrant in the complementary product in the second period with a network advantage. As a result the entrant is not able to extract the surplus that it creates solely by being able to offer a complete system. This is easiest to see when the advantage to consumers of having a standard—both cohorts adopt the same complementary product—exceed the quality advantage of the entrant. In this case even if the entrant enters, it will not have any sales in the second period despite its quality advantage, and thus, entry will not be profitable. For smaller network advantages, the entrant will be able to induce second period consumers to adopt its system. However, provided the network advantage is large enough—at least half the size of the quality advantage—then tying will still exclude entry since the entrant must reduce its prices to insure that consumers in the second period receive the same benefit from buying its complementary good and system as they would if they received the network benefits from following first period consumers.

The welfare impacts of tying in this extension are ambiguous. On the one hand entry is welfare improving since surplus is created by the entrant's superior product. On the other hand there is a fixed cost associated with entry. Unlike the previous model, the social and private incentives for entry are not the same. Here in the absence of tying there is an excessive incentive to enter since the entrant is able to extract some of the consumer surplus associate with standardization when it enters in the first period. The surplus

associated with standardization would have been created even without entry. Hence it is possible that welfare could be increased by entry deterrence and tying.   While consumer welfare in the first period does not depend on the tie, consumer welfare in the second period is reduced by the deterrence of the entrant.

4.2.4   Tying and Incentives for Innovation

A number of recent contributions have extended the analysis of leveraging models to consider the effect not only on price competition, but also the effects of tying on competition in research and development.   The work of Farrell and Katz (2000) and Choi and Stefanadis (2001) considers the effect of tying complements when a system consists of two components. More recently Choi (2004) has extended the analysis of Whinston's tying model of independent products to include innovation in cost reduction.

Farrell and Katz

The focus of Farrell and Katz is on the effects of integration on the incentives for innovation in the "competitive" complementary product.[142] In their model the two components A and B (as usual) are consumed in fixed proportions, i.e., as a system. The A component is supplied by a monopolist, but there is oligopolistic supply in component B.   Demand for a system is completely inelastic: the value of a system to consumers is $v + q_i$, where q_i is the quality of the B component supplied by firm i. Consumers, in the absence of a tie, buy the system that provides the greatest net surplus: $v + q_i - p_A - p_{Bi}$ where p_A is the price of component A and p_{Bi} the price of component B supplied by firm i. Production costs are normalized to zero for both components.

Farrell and Katz assume that prices for the B component are determined via Bertrand competition prior to the price of A. The Nash equilibrium in prices involves each supplier charging marginal cost except for the highest quality supplier. If the highest quality

supplier is firm i, then its equilibrium price, the price that just induces all consumers to buy its component equals $\Delta = q_i - q_j$ where q_j is the quality of the next highest component/supplier. Given this price for the B component, the monopolist extracts all the remaining surplus from consumers by setting $p_A = v + q_i - \Delta = v + q_j$. The "single monopoly theorem" applies in this model: the profits of the monopolist in A are increasing in the quality of the B component and the A monopolist does not have an incentive to exclude efficient B competitors or reduce innovation in component B. In particular it has an incentive neither to vertically integrate into the B component and foreclose other suppliers of component B—at least in the absence of the possibility that B suppliers can invest in quality enhancing innovation.

Suppose instead, that the B component suppliers can invest in quality enhancing innovation. Because of completely inelastic demand, an independent supplier of component B in this model has the socially correct incentives to engage in innovation. If their quality is the highest, they capture all of its incremental benefit in their price. However, when one of the B component suppliers is acquired by the monopolist in A, the integrated firm has an additional incentive to invest in innovation, besides the probability that it will have the highest quality. The integrated firm also benefits if it has the second highest quality, since this reduces the price that the highest quality firm can charge, allowing room for the monopolist to raise the price of the A component. This is a private benefit, not a social benefit, and integration results in excessive expenditure on innovation. As innovation is a strategic substitute, the increase in innovative activity by the integrated firm leads to a reduction in innovation by its rivals, though total expenditure rises. The excessive incentive to innovation provides the monopolist in A with socially excessive incentives to integrate.

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[142] Choi, Lee, and Stefanadis (2003) consider a similar model where initially there is asymmetries of cost in component B and the A monopolist integrates with the high cost B supplier. They also show that integration into the B component reduces total surplus.

The effect of integration on the relative incentives of an integrated supplier and an independent supplier of component B is robust to the introduction of elastic demand. However, in general with elastic demand, incentives for innovation (in this model where innovation success is independent of other firms patent races, and the implied rent dissipation are precluded, ruling out excessive incentives for innovation) for the independent suppliers are insufficient since they do not capture all of the benefits when innovation results in an increase in output. The same feature also means that even with integration the vertically integrated firm's incentives for innovation are insufficient from a social perspective. Hence integration could be efficient in these circumstances even if it leads to a reduction in innovation by the independent suppliers.

The main focus of Farrell and Katz's analysis is on the incentive for the integrated monopolist to overinvest in innovation in order to increase the quality of its B component, leading to lower prices for it which allow it to set the price of its monopoly component higher. However, they also point out that an integrated monopolist may be able to strategically price its B component to execute a price squeeze which transfers the independent supplier's rents from having the highest quality to the monopolist. Instead of having the prices of the components set sequentially, suppose that they are set simultaneously. Assume that the independent supplier with the highest quality component B is firm j. Then in the Nash equilibrium, the integrated firm sets the price of its component B equal to $c_B - \Delta$, firm j sets is price to cost, c_B, and the price of component A is set to extract all of the surplus, i.e., $p_A = V + q_j - c_B$. This ability to extract all of the profits from being the successful innovator ex post destroys the incentive for any independent supplier to incur the costs of innovation.

Choi and Stefanadis

Choi and Stefanadis (2001) has a similar framework to Carlton and Waldman (2002). The focus is again on how tying can raise barriers to entry by requiring two-stage entry into both complements. Like Carlton and Waldman, tying arises because the presence of

a competing complement makes it possible for a competing system, i.e., entry into the monopolized *A* component.

Consumers once again consume two components (*A* and *B*) in fixed proportions, demand is completely inelastic, with homogenous valuation of a system equal to *V*. Each component is produced by an incumbent with constant marginal cost $\overline{c}$. There are two entrants, one associated with each of the two components. Each entrant must incur fixed cost of research to enter, but entry is not certain. By increasing its development costs the entrant increases the probability that it will successfully innovate. If it is successful, the entrant's cost of production is $\underline{c} < \overline{c}$: if it is not successful then the entrant cannot enter. The component of an entrant and the incumbent are perfect substitutes. Observe that the value created by successful innovation in a component is $\Delta = \overline{c} - \underline{c}$.

Prior to the entrants making their investment decision, the incumbent can commit to tying her two components. To make sure it is credible, the assumption made is that if the incumbent ties, the tie is created through the design of the two products. Having observed whether the incumbent tied her two components, the entrants simultaneously make their investment decisions. Price competition and consumer adoption occurs in the last stage, contingent on the success of entry.

The incentive for an entrant to invest in research and development depends on its payoff if it is successful. This, in turn, depends on the anticipated price equilibrium, post-entry. Prices post entry will be a function of whether the incumbent has tied her two components and if there is entry into one or both components.

> (i) No tying and entry into only one of the components. Suppose there is entry into component *A* but not *B*. Then, as usual, there are multiple price equilibria, corresponding to different distributions of the surplus created by the entrant between it and the incumbent. If the incumbent is able to execute a perfect price

squeeze, then $p_{AE} = \underline{c}$ and $p_{BI} = V - \underline{c}$. On the other hand, if the entrant captures all of the incremental value it creates, then $p_{AE} = \overline{c}$ and $p_{BI} = V - \overline{c}$. In general, Choi and Stefanadis assume that the surplus created by the entrant is shared between the incumbent and the entrant. Denote the share that accrues to the entrant as λ. Consumers are induced by the equilibrium prices to buy system $A_E B_I$.

(ii) No tying and entry into both components. Price competition means that the incumbent is willing to drop the price for its components to marginal cost. The entrants will price their components so as to just undercut the incumbent. The equilibrium prices are $p_{AE} = \overline{c}$ and $p_{BE} = \overline{c}$. The entrants are able to capture all the surplus from their entry and consumers adopt system $A_E B_E$.

(iii) Tying and entry into a single component. In this case, the successful entrant is not able to sell its component, since it is of no value on its own and consumers cannot create a system using components supplied by the entrant and the incumbent. Instead the incumbent is able to extract all of the surplus of consumers by charging a price for its system/bundle of *V*.

(iv) Tying and entry into both components. In this case the incumbent is willing to lower its price for its system to cost : $2\overline{c}$. Any set of prices for the entrants such that $p_{AE} + p_{BE} = 2\overline{c}$ are an equilibrium, each corresponding to a different division of the surplus created by successful entry by both entrants (2Δ). Choi and Stefanadis assume that each receives its incremental surplus, so that the equilibrium prices are $p_{AE} = \overline{c}$ and $p_{BE} = \overline{c}$.

In the second stage, the entrants invest in research. Their willingness to invest in research depends on the expected payoff. In the absence of a tie, their payoff is the incremental surplus (Δ) if the other entrant is successful and, because of a price squeeze

only $\lambda\Delta$ if the other entrant is not successful. When the incumbent ties, the entrant only receives a payoff of its incremental surplus when the other firm is also successful. Consequently, because tying makes the payoff from investment by the entrants contingent on success by the other entrant, it lowers their payoff, and hence equilibrium investment levels. This makes entry into both components less likely, preserving the incumbent's monopoly position. This does not mean, however, that the incumbent will always tie.

Tying by the incumbent has two effects. The benefit to tying is that by reducing the investment by each entrant, the incumbent decreases the probability that it will be completely displaced (the displacement effect). The cost to tying is that the incumbent does not receive any benefit from the innovation of the entrant when only one is able to enter successfully. In the absent of a tie, when only one entrant successfully innovates and enters, the incumbent is able to extract some of the additional value created through a price squeeze provided that $\lambda < 1$. There is a critical value λ^* such that when $\lambda > \lambda^*$ the displacement effect dominates and the incumbent finds it profitable to tie. When $\lambda < \lambda^*$, the benefits of the chance of a price squeeze dominate and the incumbent does not tie.

The effect of tying is to reduce both total and consumer surplus. Total surplus is reduced since even without tying the entrant's have socially insufficient incentives to invest in innovation when $\lambda < 1$, as they base their investment only on their private benefit and do not internalize that successful innovation also benefits the incumbent (through the price squeeze).   The effect of tying is to further reduce their incentives to invest. Consumers are made worse off, since they only realize surplus when both entrants are successful and tying reduces the probability of this outcome.

Choi and Stefanadis extend their model to consider the situation when the entrant is integrated across both components. In this case the effect and incentives for tying by the incumbent depend on the cost of investment and the extent of uncertainty. When

investment is costly and very uncertain, then tying will reduce the integrated entrant's incentives to invest in either component. If in the absence of a tie, however, the integrated entrant was likely to be successful—because investment is not very costly or uncertain—then the effect of tying is to enhance its investment. In the first case, tying discourages investment for the same reason as before, the investment only payoffs off if both of the entrant's research programmes are successful. In the second case, tying leads to an increase in investment for the same reason, but now because innovation is relatively easy, rather than be discouraged, the entrant invests additional resources to try and make sure that its innovation is successful for both components. Tying is profitable only in the first case, not the second, and then only if the displacement effect dominates the price squeeze effect—which will be true for λ close enough to 1.

Choi

Choi (2004) considers how the introduction of research and development affects the profitability and welfare effects of tying in Whinston (1990). Choi adds a middle stage to Whinston's analysis of tying when the two goods are independent.[143] In the first stage the monopolist in *A* can tie her two products, in the second stage the monopolist and the independent supplier of *B* can invest in cost-reducing research and development for product *B*. The technology of innovation is very simple. Costs can be reduced through investment, where the greater the extent of cost reduction desired, the larger the cost required and the marginal expenditure required for a reduction in cost is increasing. Prices are determined in the third and last stage.

Whinston established that when the two products are independent, the monopolist does not have an incentive to tie unless by doing so its rival in *B* will exit or not enter. Choi shows, however, that this result is not robust to the introduction of cost-reducing innovation. The effect of tying is to reduce the incentive for the rival to engage in innovation and increase the incentive for the monopolist to invest in innovation. The

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[143] This model was discussed above in Section 4.2.1.

reason is that the marginal benefit from investment in cost reduction is proportional to output. Tying, by requiring the monopolist to sell a unit of *B* in order to sell a unit of *A*, provides it with an incentive to expand its output of *B*.   At the same time, tying reduces the output of the independent supplier.   As a result the payoff from innovation is increased for the monopolist and decreased for the independent firm.

Tying therefore provides the monopolist in *A* with a dynamic advantage in *B:* it will have lower costs of production than its rival. This advantage may be sufficient that tying is profitable—the cost advantage makes up for the increase in price competition and lost sales of the monopoly product—even if it does not prevent the entry or induce the exit of the rival *B* supplier.

In Choi's model, the differentiation in market *B* follows Hotelling, with the two products at the end of the unit interval and linear transportation costs.[144]   Moreover, as indicated above research and development is deterministic and subject to decreasing returns. Consequently, Choi is able to demonstrate that tying is inefficient.   There are three effects which reduce total surplus from bundling: (i) efficiency requires equal expenditures on innovation, whereas tying induces asymmetries; (ii) efficiency also requires that transportation costs be minimized, which requires equal market shares, but the asymmetries in production costs mean that market shares will be asymmetric; and (iii) some consumers will forgo consumption of *A* under bundling rather than consume the *B* brand by the monopolist, thereby forgoing the benefits of *A*.

As Choi points out, the negative welfare effects of tying in his model arise because of the specification of the R&D process and horizontal product differentiation. If there were large fixed costs or economies of scale associated with R&D, then minimizing the R&D expenditures of one of the *B* suppliers may be efficiency enhancing. Moreover, if there is uncertainty regarding R&D and the *B* brands are relatively undifferentiated, then there is

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[144] Similar to hardware differentiation in Church and Gandal (2000) discussed in Section 4.4.1

a trade off between the advantages of diversity of R&D—a greater probability of success—versus the costs of duplication. As Choi observes, it is then not possible to rule out that tying could be welfare enhancing because it eliminates duplicative R&D.

4.3   Bundling

In this section the literature that considers when and how bundling can enhance or maintain market power is considered. Two separate set of circumstances when bundling can have an effect on market power are identified. In one set of circumstances, the effect of bundling is to reduce demand and revenues for rivals and increase the market power of the bundling firm by changing the willingness of consumers to substitute. Models that explore the exclusionary effect of bundling include Martin (1999), Nalebuff (2000), Denicolo (2000), and Choi (2003).

The second set of models focuses on how bundling can relax price competition between firms by introducing or increasing product differentiation. Contributions that consider the potential for bundling to mitigate the extent of competition between firms, leading to higher prices, include Carbajo, de Meza, and Seidmann (1990), Seidmann (1991), and Chen (1997). Examination of these models provides insights into the incentives and competitive effects of a firm to bundle products after a non-horizontal merger (the goods are either independent or complements). These models typically assume a multiproduct firm and explore its incentives to bundle.

4.3.1   Bundling as a Mechanism to Relax Price Competition

There are three papers that explore the use of bundling as a mechanism to reduce price competition. These are Carbajo, de Meza, and Seidmann (1990), Seidmann (1991), and Chen (1997). In Carbajo et al a monopolist in one market is a duopolist in a second where the output of the two firms is homogenous. In the absence of a bundle by the monopolist, it charges its monopoly price and Bertrand competition drives the price in the duopoly market to (the common) marginal cost. If the monopolist is able to commit to pure bundling, then the effect of the bundle is to relax price competition by introducing

product differentiation and segmenting the market for the duopoly product. Bundling allocates the high valuation consumers to the monopolist and those with intermediate valuations are served by its competitor, i.e., those who are willing to pay more for the duopoly good than the competitor's price, but whose willingness to pay for the monopoly good is not greater than the price difference between the bundle and the price of the duopolist. Since the bundle commits the bundling firm not to participate in the market for these consumers, its competitor can raise its price above marginal cost. This in turn gives the monopolist room to raise the price of its bundle above the sum of its monopoly price and the marginal cost of the duopoly good—the implicit price of the bundle when the goods are sold separately.

The models of Seidmann (1991) and Chen (1997), though slightly different, have a similar result for similar reasons. In Seidmann (1991) there are three products, two of which are produced by separate monopolists, both of which can produce the third product. In the absence of bundling, each monopolist charges the monopoly price for its monopoly good while price competition between the two of them drives price in the common market down to their (common) marginal cost.

If one of the monopolist bundles its monopoly good with the common good, the effect is to partition the market for the common commodity by type. Each firm would like to be able to credibly commit to act less aggressively in the market for the common commodity. This occurs when there is bundling since for the bundling firm it effectively raises their costs of competing for the third good: the cost of providing the bundle is greater than the cost of the third commodity by the marginal cost of the monopoly product it provides. Moreover, the strategic response by the other firm is to raise its prices for the third commodity to monopoly levels for consumers who prefer its monopoly good and not to compete for sales of the third good to consumers of the opposite type. Bundling partitions the market, leading to an increase in market power, and reducing consumer and total surplus. It will be profitable for the bundling firm if the extra surplus extracted from the higher bundle price exceeds the lost profits from some of

its monopoly consumers who forgo its product because their surplus on the common commodity is low.

Chen (1997) assumes that there are two firms each capable of producing *A* and *B*. The two firms are duopolists in the market for *A*, but the market for *B* is perfectly competitive. Suppose that one of the firms bundles *A* with *B*, while the other sells *A* separately. The effect of the bundle is to allocate those in the market for *A* who also like *B* to the firm that bundles, and the consumers who do not like *B* are allocated to the firm that does not bundle. The introduction of bundling differentiates the products available in the *A* market, enhancing the market power of the two duopolists.

In the remaining two subsections we provide a more extensive discussion of Carbajo et al and Seidmann.

Carbajo, de Meza, and Seidmann

The model of Carbajo et al assumes two goods, *A* and *B*, produced at constant, but potentially different, marginal cost. Product *A* is produced by a monopolist, but there are two producers of product *B*, the *A* monopolist and a competitor. The two products are independent of each other, consumers demand at most one unit of each, and the reservation prices (v_j) for the two goods have identical (uniform) distributions on the interval [0,1]. Moreover, to eliminate the possibility that the incentive for bundling arises because it institutes price discrimination, it is assumed that consumers have perfect positive correlation between their reservation prices/willingness to pay for the two goods. This means that a consumer's willingness to pay for the two goods is identical. Given these assumptions the set of consumers that purchase product *i* when its price is p^i and the two products are sold separately is all those with a willingness to pay greater than p^i, i.e., $\{j : p^i \leq v_j \leq 1\}$. When firm *A* offers a bundle of *AB* for price *P* when firm *B* sells product *B* for price p^B, then consumer *j* will choose between the two options on the basis of which provides the largest net benefit. Consumer *j* will buy the bundle if

$$2v_j - P \geq v_j - p^B$$

or

$$v_j \geq P - p^B.$$

This last inequality is easily understood. The left-hand side is the incremental benefit of the bundle versus buying only product B: it is the consumption benefit of A. The right-hand side is the implicit price that the consumer will pay for A if it buys the bundle rather than just product B from the independent supplier. It equals the increase in expenditure required to obtain product A.

The set of consumers therefore that buy the bundle is $\{j : P - p^B \leq v_j \leq 1\}$, the set which buy only product B—those not willing to pay the difference between the price of the bundle and the price of B, but whose willingness to pay for B exceeds its price—is $\{j : p^B \leq v_j \leq P - p^B\}$. If $P - p^B < p^B$ or $P < 2p^B$ then the set of consumers who buy B alone disappears. The benefit of the bundle is twice as much, yet its price is less than twice that of purchasing B alone. Those with a willingness to pay less than p^B buy neither B nor the bundle. To summarize, those with high reservation prices for both goods buy the bundle, those with intermediate reservation prices buy only product B (assuming the price of the bundle is not too low), and those with low reservation prices are excluded from the market.

In the absence of a bundle by the monopolist, it charges the monopoly price for A and, given Bertrand competition in the market for B, the price for the B component equals marginal cost. If the monopolist in A is able to commit to pure bundling, then its profit-maximizing bundle price is greater than the sum of the marginal cost of B and the monopoly price of A.[145] The price and profits of firm B are also higher under bundling. The effect of the bundle is to relax price competition by introducing product

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[145] For a pure strategy equilibrium to exist when firm A bundles it must be true that marginal costs are such that the monopoly price of A is greater than the marginal cost of product B. This condition also insures that firm A prefers to bundle.

differentiation and segmenting the market for product *B*. Bundling insures that *A* only serves high valuation consumers, providing room for *B* to raise its price above marginal cost. This in turn gives *A* room to raise the price of its bundle.

Bundling increases the profits of both firms, but decreases consumer surplus. The effect on total surplus (efficiency) is ambiguous. It is possible that total surplus could increase. For instance if the marginal cost of *A* is less than *B,* and both are relatively low, then it is possible that under bundling the output of product *A* when there is bundling increases, and the incremental surplus created by the increase in output of *A* exceeds the surplus destroyed by the increase in the price of *B*.

Carbajo et al also briefly consider a setting where *A* and *B* are complements in production, but there is an imperfect substitute for *B*. Moreover, *B* also has an independent use, for which good *C* is an imperfect substitute. In this case the monopoly supplier of *A* would like to supply *B* to the first market at marginal cost—to avoid inefficient substitution—and extract monopoly profits in the downstream market for that product through the price of *A*. It sells *B* into the second market at a higher price that reflects competition from the supplier of *C*.   If arbitrage makes price discrimination impossible and it does not bundle, it sells *B* at a common price, in between the high and low price under price discrimination.

If it can bundle, however, it can do better than under price discrimination. It can bundle the efficient quantity of *B* with sales of *A* and sell the bundle as the sum of the marginal cost of *B* plus the price of *A* when it can discriminate.   This gives it an incentive to raise the price of *B* in the second use since it no longer has to price *B* low to reduce the incentive for inefficient substitution to the other input. If *B* and its imperfect substitute are strategic complements, this leads to an increase in the price of *C* and, indirectly, a further increase in the price of *B*.   Hence in this example, mixed bundling (*B* is still available independently at a higher price) increases the profits of the monopolist supplier of *A* and *B*, as well as its competitor *C*.

Seidmann

In Seidmann (1991) there are three products, two products, i and j, are produced by separate monopolists. Consumers are divided into two types. Type i demand a single unit of i with a common willingness to pay (or reservation price) of u. Type j demand a single unit of j with a common willingness to pay (or reservation price) of u. Both firms can also produce a third good. Willingness to pay for a type i or j consumer for the third product, r, is distributed uniformly on [0,1]. Seidmann investigates a two-stage game the bundling choice and resulting pricing equilibrium. Denote the (common) marginal cost of the monopoly goods as c, where $c > 1/2$, and normalize the marginal cost of the common good to zero.

In the absence of bundling, each monopolist charges the monopoly price for its monopoly good, u. The two firms compete in the third market over prices, and since the product is homogenous, the equilibrium price equals their (common) marginal cost.

Suppose that firm i bundles its monopoly product with the third good and offers its bundle at price P_i. Denote the price that firm j charges for the third good as p_j. A type i consumer buys the bundle only if $u + r \geq P_i$ (insuring non-negative surplus from the bundle) and $u \geq P_i - p_j$ (insuring that the surplus from buying the bundle exceeds the surplus from buying only the third commodity from firm j).[146] Firm i sells its bundle to all i consumers with a willingness to pay for the bundle greater than P_i or a willingness to pay for the third commodity greater than $P_i - u$. This proportion is the demand curve for the bundle and it equals $D(P_i) = 1 + u - P_i$. The profits of firm i will be the product of its margin (price of the bundle less its marginal cost c) and demand:

$$\pi_i(P_i) = (P_i - c)(1 + u - P_i). \tag{38}$$

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[146] This will be the case if $u + r - P_i \geq r - p_j$ or $u \geq P_i - p_j$.

The profit-maximizing price for the bundle based on (38) is

$$P_i = (1+u+c)/2. \tag{39}$$

If

$$1 > u - c \tag{40}$$

then the bundled price exceeds the sum of the prices when the two products are offered separately (by both firms). When this condition holds, not only is the price of the bundle greater, but so to are the profits of firm i. This condition requires that the difference between the willingness to pay and the cost of good i not be greater than the maximum willingness to pay for the third commodity. It also reveals the trade-off for firm i. If it bundles it is effectively able to raise the price at which it sells the third commodity, but this benefit is not without a cost. The cost is that when its products are unbundled it is able to sell its monopoly good i to all type i consumers for the monopoly price. When it bundles good i with the third commodity, some consumers with a very low willingness to pay for the third commodity forgo the bundle, reducing the profits of firm i on its monopoly product.[147] [148]

Firm j, the firm that sells the two products separately, sells product j for its monopoly price, u. It has two choices regarding the price of the third product. It can try and sell it to both type i and j consumers or it can sell it only to type j consumers. If it sells it only to type j consumers, then its demand is

$$D(p_j) = 1 - p_j$$

and its monopoly price and profits are simply

$$p_j^m = 1/2$$

and

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[147] The economic intuition here is identical for why it is not profit maximizing for a monopolist to tie independent goods in the model of Whinston (1990) discussed previously *unless* the tie induces exit or prevents entry in the tying good market.

[148] It is not profit maximizing for firm i to price its bundle so that it is attractive to type j consumers. For a type j consumer to prefer the bundle that includes product i, firm i will have to price it less than the price j

$$\pi_j^m = 1/4 \tag{41}$$

(under the maintained assumption that the marginal cost of the third commodity is zero).

Alternatively, firm j can induce type i consumers to forgo the bundle that includes product i and the third commodity offered by firm i and buy only the third product from firm j. Given the price of the bundle given by (39), the price necessary to induce demand from type i consumers such that they are just indifferent between buying the third commodity from j or the bundle from i is defined by:

$$r - p_j = u + r - P_i$$

or

$$p_j^c = P_i - u$$

which given (39) is

$$p_j^c = \frac{1 + c - u}{2}. \tag{42}$$

At this price, firm j sells the third commodity to all type i and type j consumers with a willingness to pay greater than p_j^c, or

$$q_j^c = 2\left(\frac{1 - c + u}{2}\right)$$

and, since marginal cost of the third commodity is normalized to zero, an upper bound on its profits from selling the third commodity to type i consumers is

$$\pi_j^c = p_j^c q_j^c = \left(\frac{1 + c - u}{2}\right)(1 - c + u). \tag{43}$$

Comparing (41) to (43), firm j will find it profit maximizing not to price its third commodity to compete with the bundle if the following condition holds:

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charges for the third commodity. Given the assumptions Seidman makes regarding marginal cost of goods i and j, this requires firm i to price the bundle below the marginal cost of good i. See infra.

$$u - c \geq \frac{1}{\sqrt{2}}. \qquad (44)$$

This requires that the margin available on the monopolized good be above some minimum level. The larger the surplus available on the monopoly goods—as implied by (44)—the lower the price firm j must charge to induce type i consumers to forgo the bundle—see (42).

Moreover, given the price j charges for the third commodity (1/2) , it will not pay for the bundling firm to try and lower the price of the bundle to compete with firm j to sell j type consumers access to the common commodity by buying the bundle. In order to induce them to buy the bundle—given that they have no value for the i good—the bundle price would have to fall to 1/2, but this is less than the marginal cost of the bundle. Hence firm i will not compete to sell the common commodity to type j consumers.

The two conditions required for bundling to arise in equilibrium are (40) and (44). If (40) holds, bundling is profitable for the bundling firm. If (44) holds then when firm i bundles and firm j offers the product separately, it is profit maximizing for them not to compete over prices to sell the bundle (in the case of firm i) or the third commodity (in the case of firm j) to consumers of the other type. The profits of both firms increase, but the profits of the non-bundling firm increase by even more, than when neither firm bundles. The non-bundling firm enjoys the benefit of reduced competition from the bundling firm and does not have to forgo sales of its monopoly good to those with a low willingness to pay for the third commodity. Hence if one firm bundles in the first stage, the optimal response by the other is offer its products independently. The full two-stage game has the structure of the "battle of the sexes" game. Both firms prefer that one bundles, but they also prefer that it be the other firm. Profits of both increase, and consumer welfare is clearly reduced.

The intuition for the increase in profits from one firm bundling is as follows. Each firm would like to be able to credibly commit to act less aggressively in the market for the

third commodity. This occurs when there is bundling since for the bundling firm it effectively raises their costs of competing for the third good: the cost of providing the bundle is greater than the cost of the third commodity by the marginal cost of the monopoly product it provides. Moreover, the strategic response by the other firm is to raise its prices for the third commodity to monopoly levels for consumers who prefer its monopoly good and not to compete for sales of the third good to consumers of the opposite type. Bundling can partition the market, leading to an increase in market power, and reducing consumer and total surplus.

As we have seen before, the bundling firm must be able to commit to only providing the two goods bundled. If the bundle can be unraveled in the pricing stage, then bundling has no effect on the equilibrium. The bundling firm will find it profitable to compete for the other types demand for the third good, leading to the same equilibrium as when none of the firms bundle.

4.3.2   Exclusionary Bundling: Strategic Substitutes

In this section and the next we consider the incentive and effectiveness of bundling to create market power when it reduces the revenues of rivals. Two situations have been considered in the literature. The first is formally similar to Whinston's analysis of tying except that competition in the duopoly market is over quantities, not prices. The models that consider bundling when there are strategic substitutes include Martin (1999) and Carbajo et al (1990).[149] The second stream of the literature considers the potential for bundling in systems markets: the goods ultimately consumed are systems of complements. The literature here consists of Denicolo (2000), Nalebuff (2000), and Choi (2004).

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[149] Notice that the effect of bundling on competitors, but not consumer welfare, depends on the nature of competition in the duopoly market. It is exclusionary when competition in the duopoly market—as in this section—is Cournot, i.e., over quantities. It benefits the bonding firm's rival in the duopoly market when competition is Bertrand, i.e., over prices. See the discussion of Carbajo et al (1990) in the previous section.

In Martin (1999) and Carbajo et al (1990) there are two differentiated products. A monopolist produces one good, while it faces a competitor in the market for the second good. The decision to bundle in Martin (1999) and Carbajo et al (1990) links the two markets by creating or enhancing substitution between the two firms. If the two goods are substitutes, the effect of bundling is to reduce the extent of product differentiation and the bundles are closer substitutes than the two products themselves. Even if the two products were complements or independent, the bundle of the monopolist and the product of its competitor will be substitutes.

By creating or enhancing substitution the decision to bundle has two effects. The demand effect arises as bundling reduces demand of the monopolists' competitor in the duopoly market and increases its demand in the same market. Moreover, there is a price effect, similar to that of Whinston, with the monopolist in A having once again an additional incentive to produce more in B since the effect of bundling is to effectively reduce the costs of producing a unit of B by the margin earned on A. This provides the bundling firm with a competitive advantage in B, implying that it has an incentive to increase its output, which results, in equilibrium, in a reduction in production by its competitor.

Relative to the case when the two products are supplied separately, the effect of bundling is to reduce the output of the monopoly product, raise total output and the output in market B of the bundling firm, and reduce the output of the firm that only produces in market B. The profits of the bundling firm increase, while the profits of its rival in market B are reduced. The monopolist forgoes output in market A in order to increase its output and profits in market B. The exclusionary effect—the reduction in the rival's profits—is more pronounced the greater the extent to which the two products are complements.

These two models, like the tying models, assume a dominant firm in one of the products, implicitly protected by barriers to entry. This precludes the possibility of a counter-

merger by definition. It also implicitly excludes the disadvantaged competitor from entering into the dominant firm's protected market.

Martin

Martin assumes homogeneous consumers with quadratic preferences. If the two goods are *A* and *B*, then the utility function of a consumer is:

$$U(Q_A, Q_B) = m + a(Q_A, Q_B) - 0.5(Q_A^2 + 2\theta Q_A Q_B + Q_B^2) \tag{45}$$

The demand curves associated with (45) are linear:

$$p_i = a - (Q_i + \theta Q_j) \tag{46}$$

where i and $j = A, B$ and $i \neq j$. The parameter θ lies between -1 and 1. If it is negative, the two goods are complements. If it is positive they are substitutes, and if it is equal to zero, the goods are independent. When it equals 1 the two goods are perfect substitutes.

If the monopolist producer of good *A,* firm 1, decides to bundle then it offers consumers access to good *A* only if they consume *A* and *B* in fixed proportions. A bundle offered by firm 1 requires in general that for every k_1 units of good *A* a consumer must also purchase a unit of good *B*. Firm 2 also sells bundles, but without the ability to produce good *A* its bundles are simply 0 units of good *A* for every unit of good *B*. Denote the number of bundles produced by firm *i* as b_i. The underlying relationship between the two products consumed and the bundles purchased are

$$Q_A = k_1 b_1 \tag{47}$$

and

$$Q_B = b_1 + b_2 \tag{48}$$

Substituting these into (45), the demand curves for the bundles (b_1 and b_2) are

$$P_1 = (k_1 + 1)a - [(1 + 2\theta k_1 + k_1^2)b_1 + (1 + \theta k_1)b_2] \tag{49}$$

and

$$P_2 = a - [(1 + \theta k_1)b_1 + b_2] \tag{50}$$

The effect of the bundle is to enhance substitutability between the offerings of the two firms. In the absence of bundling the effect of an increase in good *A* is to reduce the willingness to pay for good *B* by θ — see (46). When firm 1 bundles, the effect of a marginal increase in its bundle output is to reduce the willingness to pay of consumers for firm 2's bundle, i.e., good *B*, by $1 + k_1\theta$ — see (50). If we let $k_1 = 1$, then the effect is clear. In the case of substitutes the willingness to pay for the product of firm 2 is reduced by –1 (compared to the no bundling case) when firm 1 sells another unit of its bundle. The reason is that the bundle contains a unit of good *B*, as well as a unit of good *A*. The effect on demand (willingness to pay) for firm 2's product reflects the increase in supply of good *A* $(-\theta)$ and the increase in supply of good *B* (-1) when firm 1 increases its bundle output by one. In the case of substitutes, the bundles are closer substitutes than the two products themselves.

When the two goods are complements, the benefit to firm 2 (increased willingness to pay for its good) from an increase in production of good *A* by firm 1 is reduced from θ to $\theta - 1$. The effect on demand for firm 2's product reflects the increase in supply of good *A* (θ) and the increase in supply of good *B* (-1) when firm 1 increases its bundle output by one. Even though the two goods are complements, the bundles of the two firms are substitutes.

The effect is similar when $\theta = 0$ and the two products are independent. In the absence of a bundle the fact that firm 1 participates in both markets does not change its pricing incentives for either good when it does not bundle. With bundling by firm 1, however, the offerings of the firms become substitutes, linking the two markets and affecting demand and the pricing incentives of firm 1. In the absence of a bundle, an increase in output of good *A* by firm 1 has no effect on the willingness to pay for the product of firm 2, good *B*. With bundling, however, an increase in bundle output by firm 1 reduces willingness to pay for the product of firm 2 — its bundle — by 1, reflecting the increase in

output of good *B* by firm 1. Again, the bundles are substitutes even though the two products are independent.[150]

To see the demand effect assume that $\theta = 0$ and $k_1 = 1$. Then the demand functions in the absence of bundling are (from inverting (46)):

$$q_i = a - p_i \tag{51}$$

with *i = A, B.*

Under bundling, however, the demand functions (from inverting (49) and (50)) are:

$$b_1 = a + P_2 - P_1 \tag{52}$$

and

$$b_2 = P_1 - 2P_2 \tag{53}$$

To see the effect on the demand of the two firms, substitute in the prices without bundling into (52) and (53), i.e., the equivalent prices under bundling are $P_1 = p_A + p_B$ and $P_2 = p_B$. Then (52) and (53) become

$$b_1 = a - p_A \tag{54}$$

and

$$b_2 = p_A - p_B \tag{55}$$

Since the number of bundles for firm 2 equals its output, we can compare (55) to its residual demand in the absence of bundling. Residual demand from (51) is

$$q_{B2} = a - q_{B1} - p_B \tag{56}$$

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[150] A key effect of this is that even if the two goods are complements, so that in the absence of bundling, competition involves strategic complements, with bundling competition between bundles involves strategic substitutes. The marginal profit for firm 2 in the absence of bundling would be increasing in the output of good *A* when the two goods are complements, but with bundling the marginal profit is decreasing in bundled output.

where q_{Bi} is the output of firm i in market B in the absence of bundling. Comparing (55) to (56), the effect of bundling is to lower firm 2's residual demand if

$$a - p_B - q_{B1} > p_A - p_B$$

or

$$a - p_A = q_{A1} > q_{B1},$$

which is true given symmetric demand, duopoly competition in the market for good B, and monopoly in market A.

On the other hand (51) and (54) are identical for firm 1, indicating that bundling does not change the demand for firm 1's monopoly product. It does, however, increase its demand for product B. In the absence of bundling, firm 1's residual demand in the market for B is less than the demand for its bundle if

$$a - p_A > a - q_{B2} - p_B$$

or

$$q_{B2} > p_A - p_B = b_2$$

which is true since bundling reduces the output of firm 2 in market B.

The effect on demand results in a reduction in the revenues of rivals since at the unbundled equilibrium prices, with bundling, demand for firm 2 in market B is reduced. Intuitively, the effect of the bundle is to reduce the willingness to pay of consumers for B separately since when they buy a bundle to get a unit of A they also get a unit of B.

Of course it will not be an equilibrium for $b_1 = q_A$, since this implies too large of an increase in q_{B1} (firm 1 will be selling the monopoly level of B which, given the presence of firm 2, will not be optimal). Similarly, firm 1 will not find it profit maximizing to set $b_1 = q_{B1}$ as this will lead to a large reduction in the output of the monopoly good (A). Instead it will have an incentive to expand its output in B, because that is the only way

that in can sell its monopoly good, and in response, firm 2 will contract its output. The effect of bundling has similar implications for pricing for firm 1 as tying by a monopolist does in the model of Whinston (1990).[151] The equilibrium level of output under bundling will involve $q_{B1} < b_1 < q_A$.

Martin's formal analysis and welfare results are derived only for the case of $\theta = 0$. He shows that bundling of independent goods is always inefficient and exclusionary, raising the profits of the bundling firm and lowering the profits of its rival. It is not surprising that total surplus falls since the effect of bundling is to increase the quantity distortion in the monopoly market and reduce it in the duopoly market. For the same reason consumer welfare is harmed even though the price of good *B* falls, the benefit to consumers of this is less than the welfare loss associated with the increase in the price of good *A*.

Table 2 presents simulation results that explore the effect of bundling when the two goods are substitutes and complements.[152] The exclusionary effect of bundling holds for all values of the product differentiation parameter (θ): the effect of bundling is to reduce the output of the monopoly good, increase the output of the good in the market where the monopolist has a competitor, and reduce the output and profits of its rival. Total surplus also falls. However, if the two goods are relatively close substitutes, bundling might increase the profits of the bundling firm and at the same time increase consumer surplus.[153] The results in Table 2 suggest that while bundling might have a fairly exclusionary effect on the profits of rival firms, the effect on the profits of the bundling firm, consumer welfare, and total surplus is minor. Another interesting implication of the

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[151] See Section 4.2.1 *supra*.

[152] The simulation results in Table 2 assume $a = 21$ and $c = 0$.

[153] Carbajo et al (1990) find that bundling is not always profitable. Their analysis shows that differences in marginal costs between the two products can reduce the profitability of bundling. For their specification of preferences (indivisible unit demands and perfect correlation) bundling will not be profitable if the marginal cost of the monopoly good is sufficiently less than the duopoly good. In this case bundling is unprofitable because the expansion in the output of the duopoly good is too large, given its high marginal cost and the reduction in the monopoly good very costly, given its relatively low marginal cost.

results in Table 2 is that the greater the degree of complementary, the more exclusionary bundling, i.e., the greater the reduction in the profits of firm 2.

4.3.3 *Bundling as an Exclusionary Practice: Bundling and Systems*

The models of Nalebuff (2000), Denicolo (2000), and Choi (2004) investigate the effects of bundling when consumers' demand is for systems of complements. The models of Nalebuff (2000) and Denicolo (2000) are based on the so-called "mix and match" specification of preferences associated with Matutes and Regibeau (1988). Consumers derive utility from consumption of a system. A system is composed of compatible components. The demand for a component is completely inelastic (indivisible): consumers demand one unit of each component. The components are differentiated and the systems that consumers can assemble depend on whether the components of different firms are compatible. In the extreme case the components of different firms are incompatible and firms compete over systems. In this case a system corresponds to pure bundling on the part of the firm. Matutes and Regibeau (1988) demonstrated that in a duopoly when firms produce both components, the firms prefer compatibility because price competition component by component is much less severe than price competition between incompatible systems.[154] When components are incompatible, the Cournot effect provides firms with incentives that lead to very low equilibrium prices relative to compatibility.

Nalebuff (2000) and Denicolo (2000) consider situations where the extent of the firms' product ranges is asymmetric. In Denicolo, there are two types of firms. The "generalist" firm (firm 1) produces both components that comprise the two-component system. It faces competition for each component from one of two specialist firms (firms 2 and 3). In Nalebuff (2000), systems can comprise more than two components. One firm is capable of providing all of the components that comprise a system, while the components of the other system are supplied individually by separate firms. The analysis

in both cases focuses on the incentives for the multiproduct firm to bundle, i.e., make its components incompatible with competing components.

In Denicolo, the issue is whether the generalist firm will bundle its two components as a system, making them incompatible with the components of its two rivals. Instead of component by component competition, the decision to bundle creates system versus system competition. In this the generalist firm has an advantage due to the Cournot effect: it can set the price for its system to maximize system profits, unlike the rival system where the specialists firms are interested in maximizing component profits, not system profits. The Cournot effect provides it with an incentive to price its components more aggressively. On the other hand because the decision by the generalist firm to bundle expands the extent of product differentiation, the price of the competing system increases. Whether the generalist firm finds it profitable to bundle depends on the extent of differentiation between its components and its rivals. If the components are sufficiently differentiated it will not engage in pure bundling since the Cournot effect dominates. On the other hand, if the components are relatively close substitutes, the generalist firm will bundle in order to increase the extent of differentiation.

Bundling reduces the profits of the independent component producer whose component is more differentiated. If its fixed costs are sufficiently large and avoidable, this will either deter its entry or induce its exit. In either of these cases, the other component producer will also be induced to exit or not enter, since its component is useless except as part of a system. Moreover, because of the Cournot effect the two nonintegrated firms will not find it profitable to engage in a counter merger and bundle/coordinate pricing. The profits of the two specialist firms are always greater when they are provided separately and compete against the system of the generalist firm than if they coordinate pricing and there is system competition. The reason is clear: when provided separately, a lower price

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[154] Farrell, Monroe, and Katz (1998) show that this result does not generalize when there are more than two firms producing each component, systems are not differentiated, and firms have different costs.

benefits the other component provider of the system and hence when they are supplied separately the incentive to reduce prices is reduced.

Bundling by firm 1 is inefficient. Since the market is covered—all consumers always purchase a system—allocative efficiency is not an issue. What is at issue is whether the costs of provision, in particular mismatch costs are minimized. These costs are the reduction in utility when consumers are not able to consume their most preferred system. In this model they are minimized under compatibility (no bundling). When firm 1 bundles, it induces some consumers to purchase from it who prefer (under no bundling) the competing system.

The model of Nalebuff (2000) is very similar to Denicolo. Consumers assemble systems comprised of n components. Each component is horizontally differentiated and a duopoly. Unlike Denicolo's focus on the extent of differentiation between the components, Nalebuff's focus is on the size of the system, i.e., how the effects and incentives to bundle vary with n. Unlike Denicolo the extent of product differentiation is fixed and the same for all components.

When the n components are supplied separately, then the components are not linked. Instead price competition between the two suppliers of each component results in a symmetric equilibrium where each of the two differentiated brands for each component share the market equally.

Suppose, however, that firm 1 acquires one of each components and offers them as a bundle. Its components can only be acquired by purchasing all of its components together as a system. The Cournot effect means that firm 1 internalizes the pricing externality between its components, providing it with an incentive to implicitly price each more aggressively, leading to a lower system price.

The pricing behaviour of the independent component suppliers of the competing system is also affected by the decision by firm 1 to bundle. The decrease in the price of the bundled system in the first instance reduces the sales of the unbundled components, providing them with an incentive to lower their prices in response. This is mitigated, however, by the fact that bundling by firm 1 also decreases the elasticity of demand of the unbundled components. Bundling, by eliminating the off-diagonal systems, reduces the increase in sales of an individual component supplier from a reduction in its price. Moreover, the effect of bundling on the elasticity of the individual component suppliers is increasing in the number of components bundled. That is, the more components in a system, the more inelastic the demand for the individually supplied components becomes when firm 1 bundles. This is because the number of off-diagonal systems that are eliminated by bundling by firm 1 increases as the number of components in a system rises. As a result the price reduction of the individual component suppliers in equilibrium will be less the greater the number of components. As long as the system and the independent components are strategic complements the internalization of the Cournot effect will result in lower prices for both the bundle, each component, and the price of the rival system. It is possible, however, that if the effect on the demand elasticity of the individual components is large enough, that the price of the system and the price of an individual component become strategic substitutes. In this case it is possible for the price of the individual components to rise in the bundling equilibrium.

For all values of *n* the effect of bundling is to reduce the profits and market share of the independent component suppliers. The exclusionary effect—the decrease in the market share and profits of the unbundled components—from bundling is increasing as the number of components increase. The advantage of the Cournot effect increases with the number of components, widening the difference in price between the bundled system and the rival system as *n* increases.

The profitability of bundling for firm 1 depends on the number of components. When there are only 2 or 3 components, the Cournot effect and the price response of the

individual component suppliers is sufficiently severe that bundling is unprofitable unless it results in a change in market structure.[155] Such a change would occur and firm 1 would become a monopolist if the (gross) profits of the individual component suppliers are reduced below their fixed costs. However, when the number of components is greater than 3, bundling is profitable even without inducing a change in market structure.

A counter merger by the unbundled suppliers is not profitable. This creates competition between two rival systems, with each internalizing the Cournot effect. Though a counter merger is effective in restoring market share for the unbundled system, the resulting increase in price competition makes it less profitable than being foreclosed.

Bundling in the Nalebuff model results in a reduction in total surplus and consumer welfare. The optimal industry structure is competition between components, since then consumers have the most choice between systems. System competition between a bundled system and a system with independently supplied components reduces choice of systems and because of price asymmetries induces some consumers to adopt a less preferred system.

In a recent working paper Choi (2003) considers the incentive for bundling post-merger between suppliers of complements. Choi considers a setting very similar to the model used previously to explore the Cournot effect in Section 4.1.1. The only difference is that instead of the two components being supplied by a monopolist, there is duopoly supply of both. Systems consumed consist of two components and there are two suppliers of a differentiated brand for each component. In the absence of bundling, there are four potential systems. Choi investigates the profitability of the merged firm to engage in either mixed or pure bundling post-merger.

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[155] This is why in the model of Denicolo for low values of $a < 1/8$ the equilibrium does not involve bundling.

In contrast to the demand systems used by Denicolo and Nalebuff where consumers had indivisible unit demands for a component of a system, Choi assumes (like Martin), that demand is not completely inelastic, i.e., fixed at one, but price sensitive. This means that pure bundling will have both price and demand effects, not just price effects. The demand effect means that bundling will reduce demand for the rival system and hence in general be much more exclusionary than when its effect is to only reduce the prices of the bundling firm.

When the merged firm engages in mixed bundling it has an incentive to lower the price of the bundle due to the Cournot effect. Moreover, it has an incentive to raise the price of the individual components, since some of the consumers of the mix and match systems—which incorporate one of its components and a component from another firm—in the face of a higher price, will substitute to its bundled system. On the other hand, because of the increase in the price of the components provided by the merged firm and the decrease in price of the system provided as a bundle by the merged firm, the independent suppliers of components reduce their prices.

In equilibrium, the demand for the bundle and the demand for the outside system increase, while demand for the mix and match systems decreases (relative to the premerger equilibrium). The total demand for a component of the merged firm increases, while the demand for a component supplied independently falls, again relative to the premerger equilibrium. The profits of the merged firm increase, the profits of the independent suppliers falls. The increase in profits for the merged firm provides it with an incentive to merge and bundle. The welfare effects depend on the extent to which systems are substitutes. Choi presents simulation results that suggest that when the systems are very close substitutes it is possible for total surplus to fall. On the other hand, if the systems are not very close substitutes, then the effect of the merger and mixed bundling is to increase total surplus as the Cournot effect dominates. The ambiguity extends to the effects of bundling on the welfare of consumers. The price effects mean that some consumers will benefit—those who consume the pure systems

including the bundled system of the merging firm—while others will lose. In particular, consumers of the mix and match systems in the absence of bundling will be made worse off from the increase in the price of the merged firm's individual components.

Choi also considers pure bundling, whereby the merged firm is able to commit not to provide its two components independently. In this case, only two systems are available. Unlike the mixed bundling case, in the pure bundling case, bundling has both demand and price effects. When the merged firm is able to commit to only offer its two components as a bundle, the effect is to significantly reduce demand for all four components since two of the systems are no longer available.

Under pure bundling the merged firm has an incentive to lower the price of its system because the demand effect means fewer inframarginal units and the Cournot effect. The effect of bundling is to make the demand for independent suppliers more inelastic, giving them an incentive to raise their prices.

A complementary products merger—leading to foreclosure through bundling—will be an equilibrium outcome if (i) it is profitable and (ii) it is not meet with retaliation.[156] This is the case when the two systems are relatively undifferentiated. Foreclosure—in this case through pure bundling—arises in equilibrium when it introduces asymmetries in demand post-merger that result in price increases for the merged firm.   The price of the merged firm rises because of the change in the incentives of its rivals: when systems are undifferentiated there demand becomes very inelastic when there is pure bundling. Moreover, the internalization of the Cournot effect on the part of both firms when the systems are relatively undifferentiated leads to prices that make retaliation unprofitable. A counter-merger does not restore the initial situation.

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[156] Choi does not explicitly consider the possibilities of a counter-merger in either the mixed or pure bundling cases.

When the systems are relatively differentiated, mixed bundling is significantly more profitable than pure bundling for the merging firms. This is because the demand effect is very large when the systems are differentiated. Pure bundling that precludes the mix and match systems results in significant sales losses because the mix and match consumers do not substitute to the pure systems. When the systems become less differentiated, then the pure bundling strategy is more profitable than mixed bundling. The reason is that under mixed bundling the independent firms lower their prices, but under pure bundling they raise their prices, while at the same time the demand effect is mitigated since consumers will substitute the pure systems for the mix and match systems no longer available.

The profits of the independent firms are significantly less (when the systems are differentiated) when the merged firm engages in pure bundling. Again this is due to the demand effect of the removal of the mix and match systems. When the systems are less differentiated the demand effect is reduced, since consumers will substitute from the mix and match systems to the pure systems. Moreover, because pure bundling results in higher prices for less differentiated systems, the profits of the independent firms are greater under pure bundling when the systems are relatively undifferentiated.

Even when mixed bundling is more profitable than pure bundling, the merged firm might engage in pure bundling because it is much more effective at reducing the profits of the independent firms. Thus pure bundling might be preferred to mixed bundling if it results in a change in market structure—the exit or deterrence of the independent suppliers.

In all three of these papers, the models assume one firm that can provide a complete system when it bundles is in competition with a group of firms that, collectively, but independently, provide consumers with a competing system. This makes it possible to extend these models to consider explicitly the profitability of a counter-merger. The irony is that internalization of the Cournot effect by the independent firms typically reduces their profits, making a counter-merger unprofitable.

Denicolo

Denote the two components that comprise a system X and Y: each component is horizontally differentiated. Firm 1 produces both components and its components are located at $X_1 = a$ and $Y_1 = 0$. Firm 2 produces the X component at location 1-a. Firm 3 produces the Y component at $Y = 1$. The parameter a reflects the degree of product differentiation and lies between 0 and 1/2. When $a = 0$ there is maximum product differentiation, while when $a = 1/2$ the X component is homogenous. Figure 6 shows the unit square over which consumers' ideal systems are located: the distribution of these preferences is assumed to be uniform. The locations of the four components are also shown.

Consumers' willingness to pay for a component is decreasing in the distance between the location of their ideal system and the location of the components they actually purchase. The cost to a consumer is the price of each component plus the "transportation" costs associated with the reduced benefit of not being ideal.[157] Consumers are assumed to buy the system with the lowest cost.

If the components are compatible, then consumers can "mix and match" across firms and components. As a result there are effectively four systems available:
$$(X_1, Y_1), \ (X_1, Y_2), \ (X_2, Y_1), \text{ and } (X_2, Y_2)$$
and the markets for the two components are not linked. The two X components compete against each other, as do the two Y components. The location (θ^X) of the consumer indifferent between the two X components is defined by:
$$\left(\theta^X - a\right)^2 + p_1^X = \left(1 - a - \theta^X\right)^2 + p_2^X$$

or

$$\theta^X = \frac{1}{2} + \frac{p_2^X - p_1^X}{2(1-2a)} \tag{57}$$

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[157] To insure a price equilibrium exists for all values of a it is assumed that transportation costs are quadratic in distance.

Because consumers are assumed to be distributed uniformly, (57) is also the demand

function for component X supplied by firm 1: $1 - \theta^X$ is the demand for firm 2. The more

differentiated the two X components (the smaller a) the smaller the cross-price elasticity

between the components of firms 1 and 2. Setting a equal to zero in (57), the demand for

firm 1's Y component is

$$\theta^Y = \frac{1}{2} + \frac{p_3^Y - p_1^Y}{2} \tag{58}$$

Using (57) the best-response functions for the X components are

$$p_j^X = \frac{\left(1 - 2a + p_i^X\right)}{2} \tag{59}$$

for i and $j = 1,2$, and $i \neq j$. Similarly, the best-response functions for the Y components

are

$$p_j^Y = \frac{\left(1 + p_i^Y\right)}{2} \tag{60}$$

The equilibrium in prices is symmetric (all components have market shares of one half)

with $p_1^X = p_2^X = 1 - 2a$ and $p_1^Y = p_3^Y = 1$.

If firm 1 instead bundles its two components (which can be achieved by making them

incompatible with the components of the other two firms), consumers must now choose

between competing systems: (X_1, Y_1) and (X_2, Y_2) located at $(a, 0)$ and $(1 - a, 1)$. A

consumer whose ideal system is (θ^X, θ^Y) will be indifferent between the two systems

when

$$p_1 + \left(\theta^X - a\right)^2 + \left(\theta^Y\right)^2 = p_2^X + p_3^Y + \left(1 - a - \theta^X\right)^2 + \left(1 - \theta^Y\right)^2 \tag{61}$$

where p_1 is the price of the system provided by firm 1. The line that divides the unit

square between the two competing systems is found by solving (61) for θ^Y:

$$\theta^Y = \frac{p_2^x + p_3^y - p_1 + 2(1-a)}{2} - \theta^X(1-2a) \tag{62}$$

In general it would be expected that bundling—here a decision by firm 1 to make its components incompatible—would have both a price and a demand effect. The demand effect—as usual—exists if the demand for the products of the rival firms is reduced at the equilibrium unbundled prices. Of interest here is that with this specification of preferences the demand effect is zero. This can be seen by noting that at the unbundled prices $p_1 = p_1^X + p_1^Y = p_2^X + p_3^Y$. Substituting these prices into (62), the line of indifference becomes

$$\theta^Y = (1-a) - \theta^X(1-2a) \tag{63}$$

When $a=0$, so that the two components are equally differentiated, then this line is the diagonal in the unit square shown in Figure 6. Those above it purchase the system consisting of the unbundled components (X_2,Y_2), while those below purchase the bundled system from firm $1(X_1,Y_1)$. Clearly both systems have a market share of 1/2 and sales of the components are unchanged. For each of the off diagonal (or mix and match systems), half of the consumers switch to the bundled system (X_1,Y_1) and half of the consumers switch to the unbundled system (X_2,Y_2). If a=1/2, then (63) becomes a horizontal line at $y=1/2$. The X component is homogenous, and consumers split in half on the basis of those that prefer Y_1 (below the line) and those that prefer Y_2 (above the line). In this case all of the (X_2,Y_1) consumers switch to (X_1,Y_1) and all of the (X_1,Y_2) consumers switch to (X_2,Y_2). Again each system has a market share of 1/2 and total sales of each component remain unchanged. For $0 < a < 1/2$, (63) rotates around the diagonal symmetrically (i.e. through the point (1/2, 1/2)). More of the (X_2,Y_1) consumers will switch to (X_1,Y_1) than (X_2,Y_2): likewise more of the (X_1,Y_2) consumers will switch to (X_2,Y_2) than (X_1,Y_1). However, both systems end up with market shares of 1/2 and for every component, its total sales are unchanged.

The lack of a demand effect (at the symmetric unbundled pricing equilibrium) arises in this model, but not in that of Martin (or Choi considered below), because of the assumption of unit (or indivisible) demands. If demand was in fact price sensitive, then there would be a demand effect. However, there are still price effects associated with bundling. These price effects depend on the extent to which the X components are differentiated. In equilibrium, if the two X components are not too differentiated ($a \geq 1/8$) the demand for the system supplied by firm 1 is

$$D(X_1 Y_1) = q_1 = \frac{1 + p_2^X + p_3^Y - p_1}{2} \tag{64}$$

When firm 1 bundles, the best-response functions for the three firms (based on (64)) and $q_2^x = q_3^y = 1 - q_1$ are:[158]

$$p_1 = \frac{1 + p_2^X + p_3^Y}{2}$$

$$p_2^X = \frac{1 + p_1 - p_3^Y}{2}$$

$$p_3^Y = \frac{1 + p_1 - p_2^X}{2} \tag{65}$$

The effect on pricing incentives for firm 1 can be found by comparing "system best-response functions". Under compatibility the system best-response function for firm 1 is the sum of (59) and (60):

$$p_1^X + p_1^Y = \frac{2(1-a) + p_2^X + p_3^Y}{2} \tag{66}$$

Comparing (65) to (66) reveals, as expected, that for any price for the competing system ($p_2^X + p_3^Y$) firm 1 wants to charge a lower price (it is tougher). When it bundles, it internalizes the entire benefit from lowering the price of one of its components, the

benefit is not shared with the supplier of a competing complement. This is the Cournot effect. As the extent of product differentiation decreases, (66) approaches (65), indicating that the Cournot effect disappears as the two X components become homogenous. The reason is that the "effective" margin on the X component disappears as it becomes homogenous, eliminating the incentive to increase sales of X by reducing the price of the Y component.

On the other hand comparing the sum of firm 2 and firm 3's best response functions under bundling and unbundling shows that bundling results in a softening of competition from the competing system: for any price of firm 1's system, the competing system charges a higher price. The increase in price for the competing system arises from the pricing behaviour of firm 2, since firm 3's incentives are unchanged. To see this, substitute into the best response for firm 2 in (65) $p_1 = p_1^x + p_3^Y$ and $p_1 = p_2^X + p_1^Y$ into the best-response function for firm 3. The result Denicolo terms the component-wise best-response function. It is the response of firm 2 (firm 3) to firm 1's pricing of the X (Y) component assuming that firm 1's price of the other component is the same as its competitor. Firm 3's component-wise best-response function is identical to its price best-response function in the absence of bundling. Firm 2 on the other hand, finds it profit-maximizing to charge a higher price—an incentive that is greater the less differentiated the X components.

Firm 3's pricing incentives do not change because the effect of a change in its price on its demand is unchanged. On the other hand, firm 2 finds that the demand response from reducing its prices is reduced, hence it has an incentive to charge a higher price. The reason is that with bundling, the extent of differentiation for firm 2 is effectively increased, since the extent of differentiation between the two systems is determined by the component that is the most differentiated, which is the Y component of firm 3. For the same reason, the price sensitivity of firm 3's demand to its price is unchanged.

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[158] These are for $a \geq 1/8$.

The effect of bundling on the profits of the three firms depends on these price effects. The profits of all firms are reduced by the Cournot effect. Firms 1 and 2 gain from 2's softer pricing, but this also reduces the profits of firm 3. Consequently, firm 3 is made worse off by bundling. Firms 1 and 2 lose when the *X* component is sufficiently differentiated ($1/8 = 4/32 \le a \le 7/32$), but both gain when the extent of differentiation is less ($a > 7/32$). For levels of differentiation less than 1/8, bundling reduces the profits of all firms.[159]

Thus if the *X* components are sufficiently differentiated firm 1 would not engage in pure bundling. On the other hand, if the *X* components are not sufficiently differentiated, firm 1 will bundle. This will reduce the profits of firm 3 and if fixed costs are sufficiently large either deter entry or induce exit. In either of these cases, firm 2 will be induced to exit or not enter, since its component is useless except as part of a system with firm 3. Moreover, because of the Cournot effect, firm 2 and firm 3 will not find it profitable to engage in a counter merger and bundle/coordinate pricing. Matutes and Regibeau (1988) have demonstrated that competition between systems in this model dissipates profits through intense price competition. The profits of the two specialist firms is always greater when they are provided separately and compete against the system of firm 1 than if they coordinate pricing and there is system competition. The reason is clear: when provided separately, a lower price benefits the other component provider of the system and hence when they are supplied separately the incentive to reduce prices is reduced.

The non-profitability of a counter merger depends on the reversibility of the bundling decision by firm 1. To avoid the price competition between two systems, it would have an incentive to restore compatibility if firms 2 and 3 were to bundle. What is interesting is that because firm 2 gains from firm 1's bundling, the stand-alone profits of firms 2 and

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[159] When a <1/8 demand is not given by (64) and the analysis of price effects based on (65) and (66) no longer holds. This case is considered below in the discussion of Nalebuff (2000).

3 are greater than profits under compatibility when the *X* components are relatively undifferentiated ($a \geq 7/16$) and thus there is not an incentive to counter merge.

Bundling by firm 1 is inefficient. Since the market is covered—all consumers always purchase a system—allocative efficiency is not an issue. What is at issue is whether the costs of provision, in particular mismatch costs are minimized. These costs are the reduction in utility when consumers are not able to consume their most preferred system. In this model they are minimized under compatibility (no bundling). When firm 1 bundles, it induces some consumers to purchase from it who prefer (under no bundling) the competing system.

Nalebuff (2000)

The model of Nalebuff (2000) is very similar to Denicolo. Consumers assemble systems comprised of *n* components. Each component is horizontally differentiated and a duopoly. For each component, the location of one firm's version is at 0, the other at 1 on the unit interval. If there are two components ($n = 2$), then the model is identical to that of Denicolo when a=0. Consumers choose either the combination of components (unbundling) or systems (when components are bundled) that minimizes their total cost (disutility or transportation costs plus price).[160]

When the *n* components are supplied separately, then the components are not linked. Instead, as in Denicolo, there is only price competition between the two suppliers of the component. The symmetric equilibrium involves each component having a market share of 1/2 and price of 1.

Suppose, however, that firm 1 acquires all of the components located at 0 and offers a bundle. Its components can only be acquired by purchasing all of its components

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[160] Because Denicolo allows the extent of differentiation to vary with one component, to insure a price equilibrium for large *a* he assumes quadratic transportation/disutility costs. Nalebuff assumes that these

together as a system. Alternatively, its components are incompatible with those supplied by the *n* independent firms located at 1 on the unit line.

For the case of *n=2* (say *X* and *Y*), a consumer located at θ^X and θ^Y would prefer the bundle of firm 1 to the competing system consisting of the two independently supplied components $(X_2 Y_2)$ if

$$p_1 + \theta^X + \theta^Y \le p_2^X + p_2^Y + 1 - \theta^X + 1 - \theta^Y \tag{67}$$

Solving (67) for θ^Y, the locus of consumers indifferent between the two systems is,

$$\theta^Y = \frac{2 + p_2^x + p_2^y - p_1}{2} - \theta^X \tag{68}$$

which is the same as (62) when *a=0*.

Since consumers are distributed uniformly the demand for the system supplied by firm 1 is the area beneath (68) in the unit square. This is

$$D^1(\Delta, n = 2) = \frac{1}{2}[1 + \frac{\Delta}{2}]^2 - 2\max[0, \frac{\Delta}{2}]^2 \tag{69}$$

where $\Delta = p_2^X + p_2^Y - p_1$ is the difference between the prices of the two systems. If $\Delta = 0$, then (68) is the diagonal of the unit square and the demand for system 1 is 1/2. If system 1 is priced less than system 2, then $\Delta > 0$, and the line of indifference cuts both the *X* and *Y* access outside of the unit square. Demand is the area under the line, less the area outside of the unit square (which is the second term in (69)).

As in Denicolo, bundling does not provide firm 1 with an advantage through a demand effect, but bundling does change the pricing incentives of both firm 1 and the component suppliers of the competing system.   For firm 1, the Cournot effect means that it internalizes the pricing externality between its two components, providing it with an incentive to price more aggressively.

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costs are linear in distance. When the versions of a component are located at the ends of the unit interval,

In component versus component competition, the profit-maximizing price for firm 1's supply of component X is

$$q_1^X + p_1^X \frac{\partial q_1^X}{\partial p_1^X} = 0 \qquad (70)$$

where from (57) $\frac{\partial q_1^X}{\partial p_1^X} = -\frac{1}{2}$. On the other hand, when firm 1 is supplying a bundle, its profit-maximizing price is defined by

$$q_1 + p_1 \frac{\partial D^1(\Delta, n = 2)}{\partial p_1} = 0 \qquad (71)$$

where from (69) $\frac{\partial D^1(\Delta, n = 2)}{\partial p_1} = \left(-\frac{1}{2} + \frac{\Delta}{4}\right)$. At the equilibrium unbundled prices $\Delta = 0$

and $p_1 = p_1^X + p_1^Y = 2$. Substituting these, (69) and $\frac{\partial D^1(\Delta, n = 2)}{\partial p_1} = \left(-\frac{1}{2} + \frac{\Delta}{4}\right)$ into (71)

gives

$$\frac{\partial \Pi_1}{\partial p_1} = (\frac{1}{2} - 0) - 2(-\frac{1}{2} - 0) = -\frac{1}{2} < 0 \qquad (72)$$

This indicates that when firm 1 internalizes the loss on its bundle and not just on a single component, it has an incentive to lower the price of its bundle. Notice that (71) is satisfied when $p_1 = 1$.

The pricing behaviour of the independent component suppliers of the competing system is also affected by the decision by firm 1 to bundle. In the absence of bundling, their profit-maximizing prices are determined by their equivalent of (70):

$$q_2^i + p_2^i \frac{\partial q_2^i}{\partial p_2^i} = 0 \qquad (73)$$

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demand is the same whether these costs are linear or quadratic.

where i $= X$ or Y and, using (56) $\dfrac{\partial q_2^i}{\partial p_2^i} = -\dfrac{1}{2}$. On the other hand when firm 1 bundles, the

profit-maximizing price for the independent supplier of either component X or Y is

$$\overline{q}_2^i + p_2^i \, \frac{\partial(1 - D^1(\Delta, n = 2))}{\partial p_2^i} = 0 \tag{74}$$

where $\overline{q}_2^i = 1 - D^1(\Delta, n = 2)$ is the demand for component i for the second system under

bundling. At the unbundled equilibrium prices, $\Delta = 0$, and both (73) and (74) are

satisfied.

However, the change in firm 1's prices (from the Cournot effect) elicits a response from

the independent suppliers. In the first instance, the lower price for firm 1's system

reduces the sales an inframarginal units of the independent suppliers, inducing them to

lower their prices in response. This effect is mitigated however, by the fact that an effect

of bundling is to also decrease the elasticity of demand for the individual components.

The reason is that bundling, by eliminating the off-diagonal systems, reduces the increase

in sales of an individual component supplier from a reduction in its price.[161] Instead of

increasing sales of both $X_1 Y_2$ and $X_2 Y_2$ when the firm that supplies Y_2 cuts its price, the

price cut only increases sales of $X_2 Y_2$ under bundling. Moreover, the effect of bundling

on the elasticity of the individual component suppliers is increasing in the number of

components bundled. That is, the more components in a system, the more inelastic the

demand for the individually supplied components becomes when firm 1 bundles. This is

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[161] In the absence of bundling the slope of the demand functions for a component is $-1/2$ (using (56)). The

slope of the demand curve for an independently supplied component when firm 1 bundles is

$\dfrac{\partial(1 - D^1(\Delta, n = 2))}{\partial p_1} = \left(-\dfrac{1}{2} + \dfrac{\Delta}{4}\right)$ which has an absolute value less than $1/2$ when the bundle price is

less than the sum of the individual components (i.e., $\Delta > 0$). Consequently, the best-response function of

an independent supplier becomes steeper through the unbundled equilibrium prices (holding the price of the

other component supplier constant), and it has an incentive to charge a higher price as the extent of its loss

from raising its price is reduced because it has fewer marginal units. The effect of bundling is to rotate the

best-response function of the independent suppliers around the unbundled equilibrium prices.

because the number of off-diagonal systems that are eliminated by bundling by firm 1 increases as the number of components in a system rises. As a result the price reduction of the individual component suppliers in equilibrium will be less the greater the number of components. As long as the system and the independent components are strategic complements (best-response functions slope upwards) the internalization of the Cournot effect will result in lower prices for both the bundle, each component, and the price of the rival system.

It is possible, however, that if the effect on the demand elasticity of the individual components is large enough, the rotation in the best-response function of the individual component suppliers will be sufficiently significant that the price of the system and the price of an individual component become strategic substitutes. In this case it is possible for the price of the individual components to rise in the bundling equilibrium.

Table 3—replicated from Nalebuff (2000, p. 9)—shows the sensitivity of the bundled equilibrium prices, market shares, and profits to the number of components in a system. Recall that in the absence of bundling, the price for each component is 1 and profits are 1/2 per component. Hence if firm 1 does not bundle, its profits when there are n components will be $n/2$ and its system price equivalent will be n.

For all values of n the effect of bundling is to reduce the profits and market share of the independent component suppliers. The exclusionary effect of bundling is increasing as the number of components increases because the difference in price between the bundled system and the rival system increases: the advantage of the Cournot effect increases with the number of components. Notice that with 8 components, the price of an individual components rises above the unbundled equilibrium price of 1.

The profitability of bundling for firm 1 depends on the number of components. When there are only 2 or 3 components, the Cournot effect and the price response of the individual component suppliers is sufficiently severe that bundling is unprofitable unless

it results in a change in market structure.[162] Such a change would occur, and firm 1 would become a monopolist, if the (gross) profits of the individual component suppliers are reduced below their fixed costs. However, when the number of components is greater than 3, bundling is profitable even without inducing a change in market structure.

An equilibrium analysis of a merger between all of the components supplied by firm 1 requires an investigation regarding the profitability of a counter-merger by the independent suppliers. In this case, there are two rival systems and each internalizes the Cournot effect. As expected the resulting competition results in retaliation profits less than stand alone profits (see Table 3), even though it is effective in restoring market shares of each system to 1/2. Hence a counter-merger does not restore the ex ante situation and is not profitable.

Bundling in the Nalebuff model results in a reduction in total surplus and consumer welfare. The optimal industry structure is competition between components, since then consumers have the most choice between systems. System competition between a bundled system and a system with independently supplied components reduces choice of systems and because of price asymmetries induces some consumers to adopt a less preferred system.

Nalebuff (2003) has expressed concerns regarding the robustness of this model with respect to (i) uniform distribution of consumer preferences and (ii) the assumption that all products in the bundle are of equal importance.   Nalebuff argues that the model in any particular application should be customized to reflect these considerations.

Choi

Consumers assemble systems consisting of one *A* component and one *B* component. There are two suppliers of each component and their components are differentiated.

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[162] This is why in the model of Denicolo for low values of $a < 1/8$ the equilibrium does not involve

Consumers can assemble four systems: A_1B_1, A_1B_2, A_2B_1, and A_2B_2. The price of a system equals the sum of the price of its components: $s_{ij} = p_i + q_j$ where p_i is the price of brand A_i and q_j is the price of brand B_j. The four systems are substitutes and demand is symmetric. Denote the demand for system A_iB_j as $D^{ij}(s_{11}, s_{21}, s_{23}, s_{22})$.[163] In contrast to the demand systems used by Denicolo and Nalebuff where consumers had indivisible unit demands for a component of a system, Choi assumes (like Martin), that demand is not completely inelastic, i.e., fixed at one, but price sensitive. Unit costs of production are assumed to be zero.

The benchmark case is when separate firms supply all four components. Given symmetry, each firm charges the same price, each of the four systems has a market share of 1/4, and each component has a market share of 1/2. This benchmark case is used as a basis to consider the effects of a merger between two of the suppliers of complements (e.g., the producers of A_1 and B_1). Choi investigates the profitability of the merged firm to engage in bundling post-merger. There are two possibilities. The first is that it engages in mixed bundling: it sells three products, the system D^{11} and the two components A_1 and B_1, where the system is sold at a discount relative to the sum of the prices of the individual components. The second possibility is that the merged firm engages in pure bundling and only offers the system D^{11}: the individual components are not offered separately.

When the merged firm engages in mixed bundling it has an incentive to lower the price of the bundle due to the Cournot effect. Moreover, it has an incentive to raise the price of the individual components, since some of the consumers of the mix and match systems—which incorporate one of its components and a component from another

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bundling.

[163] Choi in fact assumes that the demand system is linear:

$$D^{ij}(s_{11}, s_{12}, s_{21}, s_{22}) = a - bs_{ij} + c(s_{ii} + s_{ji} + s_{jj})$$

where b> 3c to insure that the systems are gross substitutes.

firm—in the face of a higher price, will substitute to its bundled system. On the other hand, because of the increase in the price of the components provided by the merged firm and the decrease in price of the system provided as a bundle by the merged firm, the independent suppliers of components *A* and *B* reduce their prices.

In equilibrium, the demand for the bundle and the demand for the outside system increase, while demand for the mix and match systems decreases (relative to the premerger equilibrium). The increase in demand for the bundled system exceeds that for the other system. The total demand for a component of the merged firm increases, while the demand for a component supplied independently falls, again relative to the premerger equilibrium. The profits of the merged firm increase, the profits of the independent suppliers falls. The increase in profits for the merged firm provides it with an incentive to merge and bundle. The welfare effects depend on the extent to which systems are substitutes. Choi presents simulation results that suggest that when the systems are very close substitutes it is possible for total surplus to fall. On the other hand, if the systems are not very close substitutes, then the effect of the merger and mixed bundling is to increase total surplus as the Cournot effect dominates.

The ambiguity extends to the effects of bundling on the welfare of consumers. The price effects mean that some consumers will benefit—those who consume the pure systems including the bundled system of the merging firm—while others will lose. In particular, consumers of the mix and match systems in the absence of bundling will be made worse off from the increase in the price of the merged firm's individual components.

Choi also considers pure bundling, whereby the merged firm is able to commit not to provide its two components independently. In this case, the only two systems available are the pure systems, D^{11} and D^{22}. Unlike the mixed bundling case, in the pure bundling case, bundling has both demand and price effects.[164] When the merged firm is able to

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[164] In the linear case with bundling the demand function for the system provided by the merged firm is:

commit to only offer its two components as a bundle, the effect is to significantly reduce demand for all four components since the two off-diagonal systems D^{12} and D^{21} are not available.

To understand the effect on the pricing behaviour of the merged firm, recall that two off-setting effects associated with raising a price determine the profit-maximizing price. These are the gain on inframarginal units and the loss on marginal units. When component A_i is supplied independently its profit-maximizing price is defined implicitly by:

$$D^{ii} + D^{ij} + p_{Ai}\left(\frac{\partial D^{ii}}{\partial p_{Ai}} + \frac{\partial D^{ij}}{\partial p_{Ai}}\right) = 0. \tag{75}$$

Similarly, for component B_i:

$$D^{ii} + D^{ji} + p_{Bi}\left(\frac{\partial D^{ii}}{\partial p_{Bi}} + \frac{\partial D^{ji}}{\partial p_{Bi}}\right) = 0 \tag{76}$$

The first two terms are the gain on the inframarginal units, the last term the loss on marginal units.

If there is a merger between component suppliers A_1 and B_1 and the merged firm only offers a bundle then the profit-maximizing bundle price (s) is defined by

$$\overline{D}^{11} + s\left(\frac{\partial \overline{D}^{11}}{\partial s}\right) = 0 \tag{77}$$

where $\overline{D}^{11}$ is the demand for the system of the merged firm under pure bundling.

$$D^{11} = \left(\frac{(b+c)}{b-c}\right)(a - (b - 2c)s + c(p_2 + q_2))$$

where s is the price of the system $A_1 B_1$ and p_2 and q_2 are the prices of the independently supplied components that comprise system $A_2 B_2$. The demand for system $A_2 B_2$ is symmetric.

The sum of (75) and (76) would yield the (implicit) system best-response function for D^{11} when the two components A_1 and B_1 are supplied independently. Comparing the system best-response function to (77) indicates that under pure bundling the merged firm has an incentive to lower the price of its system because (i) the demand effect means fewer inframarginal units; and (ii) the loss on marginal units includes the margin on both components, hence it is greater, indicating an incentive to lower the price of the system (this is the Cournot effect). On the other hand, the effect of bundling is to (i) increase the extent of differentiation, indicating that the reduction in demand for system D^{11} from an increase in its price will be less under bundling and (ii) the merged firm no longer internalizes losses on components associated with the off-diagonal systems. These later two effects provide it with an incentive to raise the price of its system post-merger.[165]

The effect of bundling on the best-response function of the independent suppliers is subject to three effects. On the one hand, the demand effect reduces the extent of its inframarginal units, providing it with an incentive to price more aggressively. On the other hand, the elimination of the mix and match systems and competition only between the two systems enhances the extent of product differentiation, thereby reducing the sensitivity of demand to price: rather than expand consumption of both the mix and match system and D^{22}, the effect now of a decrease in price of a component is only to expand the sales of D^{22}. Essentially, the effect of bundling is to reduce the demand for independent components and make it more inelastic. Moreover, a further incentive to price higher arises because the component supplier will no longer internalize the reduction in profits from a price increase due to loss sales of the mix and match system.[166]

Table 4 presents illustrative simulation results for Choi's model for a linear, symmetric, demand system. The table shows the sensitivity of the equilibrium outcome when there

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[165] At the unbundled equilibrium prices it can be demonstrated in the linear specification of preferences that the merged firm has an incentive to decrease the price of its system.

[166] At the unbundled equilibrium prices it can be demonstrated in the linear specification of preferences that the independent firms have an incentive to increase the price of their components.

is bundling and when the four components are supplied independently to the extent of product differentiation. Low values of the parameter c reflect relatively extensive product differentiation and low cross-price elasticities. Higher values correspond to a greater willingness to substitute between components and systems.[167]

Included in Table 4 are the profits and equilibrium bundle prices associated with retaliation through counter-merger and bundling by the two independent component suppliers. The simulation results shown in Table 4 indicate the following:

(i)   Pure bundling is not profitable—relative to supplying the components separately—when the systems are relatively differentiated. Only when the systems are relatively undifferentiated ($c>0.250$) are merger and pure bundling profitable. Compare columns (2) and (3).

(ii)   Retaliation is profitable for the two independent component suppliers when the two systems are relatively differentiated, but not when they are undifferentiated. Compare columns (4) and (5).

(iii)   If there is retaliation, the initial merger and bundling decision is unprofitable. Compare columns (1) and (5).

(iv)   The bundle price is greater than the sum of the unbundled prices when the two systems are relatively undifferentiated ($c>0.250$). Compare columns (6) and (7).

(v)   The price of the independently supplied components in the bundling equilibria always exceeds their price in the absence of bundling. Compare columns (6) and (8).

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[167] We assume $a=b=1$. To insure that the four systems are gross substitutes in demand requires that $b>3c$.

(vi)   The price if there is retaliation with a counter merger is less than the bundle price, and less than—on a per component basis—the component prices in the unbundling equilibria. Compare columns (6), (7), and (9).

A complementary products merger—leading to foreclosure through bundling—will be an equilibrium outcome if (i) it is profitable and (ii) it is not meet with retaliation.[168] This is the case when the two systems are relatively undifferentiated. Foreclosure—in this case through pure bundling—arises in equilibrium when it introduces asymmetries in demand post-merger that result in price increases for the merged firm.   The price of the merged firm rises because of the change in the incentives of its rivals: when systems are undifferentiated their demand becomes very inelastic when there is pure bundling. Moreover, the internalization of the Cournot effect on the part of both firms when the systems are relatively undifferentiated leads to prices that make retaliation unprofitable. A counter-merger does not restore the initial situation.

Table 5 presents a comparison of the profits in the no merger/unbundled equilibria with monopoly profits, the profits from pure bundling, and the profits from mixed bundling for the merging firm. It also shows the stand-alone profits of the two independent suppliers when there is pure bundling and when there is mixed bundling. When the systems are relatively differentiated, mixed bundling is significantly more profitable than pure bundling for the merging firms. This is because the demand effect is very large when the systems are differentiated. Pure bundling that precludes the mix and match systems results in significant sales losses because the mix and match consumers do not substitute to the pure systems (D^{11} and D^{22}). When the systems become less differentiated, then the pure bundling strategy is more profitable than mixed bundling (i.e., for c>0.250). The reason is that under mixed bundling the independent firms lower their prices, but under pure bundling they raise their prices, while at the same time the demand effect is

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[168] Choi does not explicitly consider the possibilities of a counter-merger in either the mixed or pure bundling cases.

mitigated since consumers will substitute the pure systems for the mix and match systems no longer available.

The profits of the independent firms are significantly less (when the systems are differentiated) when the merged firm engages in pure bundling. Again this is due to the demand effect of the removal of the mix and match systems. When the systems are less differentiated the demand effect is reduced, since consumers will substitute from the mix and match systems to the pure systems. Moreover, because pure bundling results in higher prices for less differentiated systems, the profits of the independent firms are greater under pure bundling when the systems are relatively undifferentiated. Indeed if the systems are very good substitutes, the independent firms prefer a merger and foreclosure—their profits rise when c=0.330 relative to the initial unbundled equilibrium.

Even when mixed bundling is more profitable than pure bundling, the merged firm might engage in pure bundling because it is much more effective at reducing the profits of the independent firms. Thus pure bundling might be preferred to mixed bundling if it results in a change in market structure—the exit or deterrence of the independent suppliers. For instance, in Table 5, when c=0.250, mixed bundling is more profitable for the merged firm than pure bundling. However, it is also more profitable for the independent firms. On the other hand monopoly profits for the merged firm are greater than the mixed bundling profits. Hence if there are fixed costs less than an independent firm's profits when there is mixed bundling, but greater than the independent firm's profits under pure bundling, pure bundling would lead to monopoly and would be profitable.

4.4 Equilibrium Foreclosure Models

In this section we consider equilibrium foreclosure models involving mergers where there are portfolio or range effects. They are Ma (1997) and Church and Gandal (2000). These two models explore situations where a firm has a competitive advantage when it has a larger range, or portfolio, of products than its rivals. The advantage is achieved post-merger, by foreclosure. In both cases this means not supplying a rival with a compatible

complement. This "variety advantage" manifests itself in two different ways. In the first model (Church and Gandal) consumption is of systems of complements. These systems consist of two components which are combined to provide consumption benefits: on their own the components provide zero or very little value. In the systems of interest, one component ("hardware") can be combined with many different varieties of the second component ("software") to produce benefits. Church and Gandal (2004) observe that though the abundance of examples from consumer electronics provides the justification for the convention of referring to these as hardware-software systems, the framework is much broader. They note:

> Examples abound in consumer electronics: televisions and programming, compact disc players and compact discs, video game systems and video games, FM radios and FM radio stations, video- cassette recorders and prerecorded programming, digital music formats and digital music players, satellite radio and satellite radio channels. Examples abound in consumer electronics: televisions and programming, compact disc players and compact discs, video game systems and video games, FM radios and FM radio stations, video- cassette recorders and prerecorded programming, digital music formats and digital music players, satellite radio and satellite radio channels. This "hardware- software" paradigm is not restricted to consumer electronics and the hardware need not literally be hardware. Other examples are operating systems (hardware) and application programs (software); credit cards (hardware) and the stores that accept them (software); natural gas powered vehicles (hardware) and natural gas filling stations (software); browsers (hardware) and websites (software); yellow pages (hardware) and yellow page listings (software); ATM cards (hardware) and ATM teller machines (software). In the last example, for instance, the value of an ATM card depends on the number of ATM machines at which it can be used.

A key attribute of hardware-software systems its that the willingness of consumers to pay for a hardware technology is increasing in the variety of compatible software. In such a

market foreclosure could arise, if after a merger between a hardware firm and a software firm, the integrated firm ceased to supply compatible software for rival hardware technologies or systems, giving it a variety advantage. This advantage creates market power for the integrating and foreclosing firm in the market for hardware. If the variety advantage is of sufficient magnitude it can result in monopolization of the hardware component.

In Ma consumers sign up with service providers before their preferences are known over a group of substitutes. After selecting a service provider, the uncertainty is resolved. This gives a firm with a broader range of products an advantage ex ante, since it is more likely they will have a consumer's most preferred product, and if consumers recognize this, their demand for service from a firm with a broader range of products will be greater. The service provider with the widest variety of products will have a variety advantage in these circumstances since it is more likely that they will have a better match between available products and preferences once they are known. This raises the possibility that an integrated firm may decide not to make its products available to other service providers.

Both the Ma and Church and Gandal models are equilibrium foreclosure models. That means that in both the merger and foreclosure decision are endogenous and foreclosed rivals have the opportunity to counter merge, thereby potentially undoing the disadvantage associated with being foreclosed. Even so, in both, foreclosure can arise in equilibrium. In Church and Gandal it is inefficient and harms consumer welfare. In Ma the effect on consumer welfare depends on how the upstream prices of nonintegrated firms change in response to a merger.

The work of Church and Gandal shows that foreclosure can arise when it creates market power in the hardware market and there is not retaliation. Foreclosure involves a trade-off between lost software profits—from lost sales to the other system—in exchange for increased hardware sales and profits. A counter merger by the foreclosed system and

foreclosure by it would restore software parity, however, that creates an environment where the Cournot effect provides both firms with an incentive to aggressively price hardware and adversely affects profits. This precludes retaliation by foreclosure. Instead integration, but not foreclosing, is a more profitable form of retaliation. This partially harnesses the Cournot effect allowing credible lower hardware prices to offset a software disadvantage. Church and Gandal find that foreclosure arises when either hardware or software is relatively undifferentiated. When hardware and software are differentiated, foreclosure results in retaliation or is unprofitable.

This subsection also briefly considers two related contributions by Church and Gandal (1992 and 1996). The key differences are that the variety of software is endogenous and software variety is not compatible across hardware technologies. The two papers differ in their timing. In the first, two hardware firms simultaneously make integration decisions and the result is a Prisoners' Dilemma in which both integrate into software production (when the fixed costs of software are relatively low) even though they would both be better off if neither integrated: firms find it profitable to retaliate through a counter-merger. In this paper integration is beneficial for consumers.

In the second both firms are integrated, but there is a first-mover. The first-mover has an opportunity to invest in software varieties prior to entry by its integrated rival. This provides it with the ability to overinvest in its software installed base: the result is either entry deterrence of its rival or a larger installed base that minimizes the competitive impact of entry. Integration with a first-mover advantage results in inefficient adoption by consumers. In this paper, the second-mover does not find it profitable to match the installed base of the incumbent, even though it could. In essence the first-mover can effectively raise the costs of entry—the fixed costs associated with matching its installed base—to a level that is unprofitable for the entrant in a duopoly, but is profitable for it when it is a monopolist or has a greater market share.

Ma considers the competitive effect of vertical integration when downstream firms compete by bundling upstream products and enter into contracts with consumers under which consumers have the right to buy one of the products from the bundle.   In Ma's terminology consumers select option contracts from the downstream firms. Consumers are willing to select option contracts because they are uncertain, at the time they enter into the contracts, which of the goods in the bundle they will prefer.

The justification for consumers entering into contracts prior to knowing their valuation of the goods in a bundle is due to the fixed costs of providing consumers with any products. These fixed costs of providing consumers' access—or a connection—imply that there will not be a spot market in products that operates once valuations are revealed, since that would require consumers to have a connection with all service providers. For instance in cable television, consumers typically have access to only one cable distributor and cannot switch between multiple cable distributors who compete to provide television services at any instance. Instead, because of the fixed costs of connection, different providers of video programming compete by offering a range of programming and consumers make their selection on the basis of the range of potential programming and the cost of the connection.

Competition between service providers downstream is based on the expected value of their bundles. The value of a bundle depends on the prices and the variety of products offered. Assuming homogenous consumers, the downstream firm selected to provide service (by all consumers) is the firm that can offer the greatest expected surplus when it earns non-negative profits. This provides an integrated firm with an incentive to foreclose its rival, since that reduces the expected surplus of its rival's bundle and allows the integrated firm to charge a higher price and still monopolize the downstream market.

The foreclosed downstream firm could counter merge, putting it in a position to foreclose in retaliation and potentially restoring parity in the product offerings. However, Ma assumes that the expected value of one of the two products is greater. It follows that in a

bilateral foreclosure equilibrium, the integrated firm with the inferior product would not be able to price sufficiently low to assure adoption without incurring loses. Consequently, the integrated firm with the inferior product will find it profitable to sell to its rival, rather than be shut out at retail. Retaliation does not restore the ex ante situation, just as it does not in Church and Gandal.

Whether foreclosure occurs depends on its profitability. Ma shows that foreclosure is profitable if at the pre-merger prices it is more profitable for the superior upstream product provider to foreclose and integrate, rather than supply both downstream firms. This is more likely to be true, the more competitive the upstream market and the lower pre-merger markups upstream. If it is true that at premerger prices integration and foreclosure is profitable, then integration and foreclosure will likely be profitable, since integration lowers the costs of the integrated firm—by eliminating double marginalization—and the price response by its upstream rival is unlikely to make integration unprofitable.

4.4.1 Portfolio Effects: Complementary Products and Indirect Network Effects

In the Church and Gandal model a system consists of a hardware component and complementary software. The willingness of a consumer to pay for a system depends on her preferences about hardware, software and the number of compatible software varieties available. Hardware and software are complements and provide no benefit when consumed without the other. The software benefit function is increasing at a decreasing rate in the variety of software. There are two hardware firms who produce differentiated products.[169] Software is provided by two multiproduct software firms. Each software firm, in the absence of foreclosure, can supply software in formats compatible with both hardware technologies.

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[169] Church and Gandal assume that hardware preferences can be represented with the Hotelling model. Consumers preferences for hardware are uniformly distributed on the unit interval. The hardware firms are located at the end of the interval: one at one end, one at the other.

In the initial stage of the game, a hardware firm has the opportunity to merge with one of the two independent software firms. If a merger occurs, then the integrated, or merged firm, must determine the formats in which it will offer software. The integrated firm can elect either to make the software available only in a format compatible with its own hardware or it can make its software available in formats compatible with both hardware technologies. Foreclosure occurs when an integrated firm makes its software incompatible. Having observed both the integration and compatibility decisions of the first hardware firm, the remaining hardware firm then has the opportunity in the second stage to merge with the other independent software firm and if it does so, it also makes a compatibility decision. Hardware pricing and adoption occurs in the third stage, while in the fourth stage consumers purchase software.

Since consumers purchase one unit of a software variety, the software price falls until consumers are induced to buy all varieties, which means that the equilibrium software price equals the marginal benefit of software. For example, if the marginal benefit of the second software variety is large, so to will be the price of software.

The equilibrium depends on an analysis of how the different industry structures affect pricing and demand for hardware in stage three. There are four relevant industry structures: (i) unintegrated (UU); (ii) both hardware firms have integrated and foreclosed (FF); (iii) both hardware firms have integrated, but only one has foreclosed (FI); and (iv) one has integrated and foreclosed, but the other has not (FU). The four structures differ in terms of the compatibility of software and the extent to which complements are supplied by a common owner.

An integrated system that forecloses software access on its rival (who does not) will be more attractive to consumers than its rival, ceteris paribus. Its demand will expand and the demand for its rival's system will decrease because it has twice as much software variety available. This differential in demand from unilateral foreclosure is termed the demand effect. The demand effect has a direct effect on market share, but it also has an

indirect through its effect on hardware pricing. The demand effect increases the number of inframarginal consumers for the foreclosing firm and reduces it for the foreclosed firm. As a result the foreclosing firm has an incentive to increase its price, the foreclosed firm an incentive to reduce its prices.

Differences in the pattern of ownership on the other hand imply different incentives to internalize pricing externalities. In particular, an integrated firm may have an incentive to price its hardware lower to promote hardware adoption and software sales. This incentive exists most notably when a hardware firm has integrated and foreclosed—the only way it can sell software is if it first sells a consumer its compatible hardware. However, it also exists when an integrated firm that has not foreclosed faces an integrated firm that has foreclosed. In this case the integrated non-foreclosing firm is a monopolist in software on its system, but a duopolist on the foreclosing system. The differential in software prices and profits provides it with an incentive to lower its hardware price to extend the software market in which it is a monopolist. This pricing effect is an example of the Cournot effect discussed earlier.[170]

The equilibrium in hardware prices and system market share by industry structure can be ordered. Suppose that the two systems are denoted *A* and *B*, then the ordering of hardware prices is

$$p_B^{UU} > p_B^{FU} > p_B^{FI} > p_B^{FF}$$

and

$$p_A^{UU}, p_A^{FU} > p_A^{FI} > p_A^{FF}$$

where the superscripts refer to the industry structure, with the strategy of hardware firm A listed first, B second. If we denote A's market share as *t* then the ordering of market shares is

$$1 \geq t^{FU} \geq t^{FI} > t^{FF} = t^{UU} = 1/2 .$$

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[170] Because hardware and software prices are not set simultaneously, the Cournot effect here is one-way, not two-way.

When the extent of hardware product differentiation is small, then the demand effect from foreclosure can result in monopolization ($t = 1$). In the face of foreclosure by firm A, firm B has two counter-strategies: (i) integration but no foreclosure; and (ii) foreclosure. Foreclosure, since it restores software parity between the two systems completely restores system B's market share. Integration alone without foreclosure, because it provides firm B with an incentive to price its hardware more aggressively can partially restore B's market share when hardware is sufficiently differentiated.

The price ordering and market share ordering follow from the demand and price effects associated with the different structures. To see this compare the pricing equilibrium associated with *UU* to *FU*. The *UU* pricing equilibrium is point *V* in Figure 7. The change in industry structure to *FU* has three effects on the hardware pricing equilibrium: (i) the demand effect on system B makes it tougher, and in Figure 7 its best-response function shifts down and out (for every price of its competitor it now finds it profitable to charge a lower price, since its loss on inframarginal consumers from doing so is less as there are fewer of them) to $R_B^{FU}(p_A)$; (ii) the pricing effect makes firm A tougher and its best-response function shifts in and left (for every price of its competitor it now finds it profitable to charge a lower price for hardware since an additional advantage of increasing hardware sales is sales of software); and (iii) the demand effect makes A softer and its best-response function shifts out and right (for every price of its competitor it now finds it profitable to charge a higher price, since its gain on inframarginal consumers from doing so is greater as there are more of them). Whether A is made tougher or softer in the hardware market depends on which of the two opposing effects ((ii) and (iii)) dominate. If the pricing effect dominates, A's best-response function shifts to $\bar{R}_A^{FU}(p_B)$ and if the demand effect dominates A's best-response shifts to $\hat{R}_A^{FU}(p_B)$ in Figure 7. The equilibrium will be at either *X* or *W* in Figure 7. In either case B's price is reduced.

The pricing effect dominates if the marginal value of software is large, since then software prices are high, and while extending hardware market share is then profitable, the demand effect is also reduced, reducing the demand effect influence on hardware pricing.   In fact the pricing effect dominates if software expenditures rise when the number of varieties consumed increases. It is possible when the demand effect dominates, so that A finds it profitable to charge a higher price, that in equilibrium its price rises even though B's equilibrium price falls. This happens when the marginal benefit of another unit of software is relatively small, so that there is a big drop in software prices when there are two versus one software varieties available.

If B retaliates by integrating, but not foreclosing, the effect is to make B tougher. For every price A charges, B finds it profit-maximizing to charge a lower price and its best-response function shifts to $R_B^{FI}(p_A)$. The reason is the price effect: B earns monopoly profits in software for sales on its system, but only duopoly profits for sales on the A system. This drops its price and A's price relative to the UU or FU industry structure. The new equilibrium is at *Y* in Figure 7.

If B further retaliates by foreclosing, then A finds it profit maximizing to charge lower prices: the demand effect for A has been eliminated. The change in B's incentives in the hardware market depends on the net effect of two things. It has an incentive to price higher because the demand effect is gone, it now has greater inframarginal units. On the other hand, the pricing effect is even more important since now it only makes software sales to consumers who purchase its software.   What is true is that regardless of the direction of the shift from $R_B^{FI}(p_A)$ to $R_B^{FF}(p_A)$, the equilibrium price for both A and B hardware decreases. Foreclosure restores symmetry in software varieties and the new equilibrium corresponding to the best-response functions $R_B^{FF}(p_A)$ and $R_B^{FF}(p_A)$ is at *Z* in Figure 7. The Cournot effect in a model of competing systems leads to supracompetitive pricing between the two systems. It is the internalization of the pricing

externality between hardware and software for both systems that makes retaliation unprofitable.

Unlike OSS, retaliation by the foreclosed firm does not restore the ex ante situation. It leads to lower hardware prices for the retaliating firm and in the case of foreclosure, both lower hardware profits and lost software profits. In fact, Church and Gandal show that the most profitable counter strategy is not to foreclose, but instead to simply integrate and use the pricing effect to restore hardware market share, without forgoing software profits on the other system. Retaliation by B—in any form—makes foreclosure by A unprofitable.

For unilateral foreclosure to arise in equilibrium, three conditions must be satisfied:

(i) The profitability of foreclosure depends on the trade off between increased hardware profits and lost software profits. Foreclosure will only emerge in equilibrium if the increase in hardware profits exceeds lost software profits from not supplying the rival system. Whether this will be the case depends on the response of the foreclosed firm.

(ii) Foreclosure will not occur in equilibrium if the foreclosed firm retaliates, either by integrating or foreclosing itself. Hence the stand-alone profits of the unintegrated software firm and the unintegrated hardware firm must be greater than their combined profits if they retaliate by counter merging or foreclosing.

(iii) The profits of the foreclosing firm must exceed the stand-alone profits of the unintegrated firms to insure that there is not a hold out problem. If the aggregate profits of the foreclosing system exceed the aggregate profits of the foreclosed system, then a software firm can be induced to merge with a hardware firm and be part of the foreclosing coalition. This is not immediately obvious, since the

> profits of an unintegrated software firm in a foreclosure equilibrium will be at
> least as large as in the UU industry structure.

Church and Gandal find that there are two sets of circumstances when the equilibrium to the game is characterized by unilateral foreclosure. In an interior foreclosure equilibrium, foreclosure does not result in monopolization, both systems have positive market shares. It happens when hardware is very differentiated and the marginal value of software is small. In these circumstances, both the price of the foreclosing firm's hardware and its market share increase, leading to greater hardware market power and profits. The low marginal value of software implies low duopoly software prices and hence the cost associated from foreclosure is minimized. Moreover, retaliation by only integrating and recapturing hardware market share by taking advantage of the Cournot effect is not profitable for the foreclosed system, since hardware is sufficiently differentiated, that recovering hardware sales through lower prices is not very effective and it limits the size of the demand effect, reducing the impact on B of foreclosure.

Foreclosure leading to monopolization occurs in very different circumstances, when hardware is not very differentiated and B cannot restore market share simply by integrating. The demand effect is too large from having twice as much software variety. Since foreclosure leads to monopolization in the absence of retaliation, A does not forgo any software profits. The incentive to foreclose depends on what happens to hardware profits. For sufficiently low levels of product differentiation, not only does hardware market share double, so to does the price of hardware, and foreclosure is clearly profitable. As the marginal value of software increases, the profits of retaliation decrease, since in the FF industry structure, both firms are willing to compete very aggressively to sell software, allowing for the extent of hardware differentiation to increase and still maintain foreclosure as an equilibrium. However as the marginal value of software continues to increase, eventually the profitability of foreclosing declines, since it leads to lower hardware prices as the demand effect falls. In order for foreclosure

to remain profitable, the extent of hardware differentiation must fall, allowing for a greater hardware quantity response from the demand effect.

Relative to the UU structure, which is the equilibrium in all other cases, the FU structure is inefficient. The sources of the inefficiency are two fold: (i) in the monopoly case some consumers adopt a less preferred system and (ii) in the duopoly case, not only do some consumers adopt a less preferred system, but those that remain with the foreclosed system consume less software. Interestingly enough, it is possible that consumers (in aggregate) are made better off in the monopoly case if the extent of hardware differentiation is sufficient that the hardware price of the foreclosed system is reduced by enough to compensate for consumption of the less preferred system.

A limitation on the welfare analysis of Church and Gandal is that the efficiency advantages associated with the Cournot effect are absent. Whether the equilibrium is FU or UU the model assumes that there is full coverage, i.e., all consumers purchase one system. One might expect that the Cournot effect should lead to an expansion of the market, but there is no opportunity in the model for the integrated firm to expand the market and attract new consumers, rather than convince its rival's consumers to switch systems, by lowering the price of hardware. Instead in the foreclosure equilibrium, the price of hardware typically rises, rather than falls, as predicted by a simple application of the Cournot effect. It is likely that if there was the possibility to attract marginal consumers into the market, then there would be a trade off between the incentive to lower hardware prices to expand the market and the incentive to extract surplus from inframarginal consumers through higher hardware prices.

The foreclosure equilibria do not arise when both software and hardware are relatively differentiated, since it is either not profitable or would invite retaliation. It is only when one of them is relatively differentiated and the other not that foreclosure is a concern. When hardware is differentiated and software not (i.e., the marginal value of additional

software is low) then the outcome is an interior foreclosure equilibrium. When software is differentiated, but not hardware, then the outcome is foreclosure and monopolization.

Variety of Software is Endogenous

Church and Gandal (1992 and 1996) have used a similar model to Church and Gandal (2000) to explore the effects and incentives for hardware firms to integrate into software when software variety is endogenous. The key difference between these two papers and Church and Gandal (2000) is that software is incompatible: a variety of software can be developed by incurring a fixed cost but software varieties are incompatible between hardware—a variety written for hardware *A* will not work on hardware *B*. The two papers differ in their timing. In Church and Gandal (1992), the incentive for two competing hardware firms to integrate into software is modeled as a multi-stage game. In the first stage the two hardware firms simultaneously determined whether to integrate or not. In Church and Gandal (1996) one of the hardware firms has a first-mover advantage. Both are integrated, but one can incur the cost and commit to its installed base of software prior to the other.

In the simultaneous move game, Church and Gandal find that when the fixed costs of software are low, the stage in which integration decisions are made has the structure of a Prisoners' Dilemma. Both firms would be better off if neither integrated, but integrating is a dominant strategy.   In the absence of integration, software is provided by an independent software industry and the number of varieties available for a hardware is determined by a zero-profit free entry condition. An integrated firm has an incentive to strategically increase its installed base of software: this increases its market share. An indirect result is to foreclose the extent of the software market for its rival, leading to a reduction in the number of software varieties provided for it, further shrinking its market share and increasing the market share of the integrated firm. In this model, however, integration is a profitable counter strategy, though its credibility does not deter integration by the other firm. Consumers benefit from integration and the system competition it creates, while the profits of the firms are reduced relative to the

unintegrated market structure. Vertical separation is the market structure when the fixed costs of software are sufficiently high.

Church and Gandal (1996) show that an integrated firm that can make its investment in its installed base of software before its rival will have an incentive to overinvest in software. When fixed costs are small, the overinvestment results in deterrence of its rival, even when hardware has constant returns to scale. While it is true that the rival, which is also integrated, can match the installed base of the first-mover, such an investment is not profitable. In essence the first-mover can effectively raise the costs of entry—the fixed costs associated with matching its installed base—to a level that is unprofitable for the entrant in a duopoly, but is profitable for it when it is a monopolist. For higher levels of the fixed cost of software development, the first-mover will strategically accommodate entry by overinvesting. It will provide more software than the entry and by doing so increase its profits and market share. Church and Gandal show that the strategic behaviour by the first-mover can be inefficient, resulting in de facto standardization on the wrong technology or preventing standardization on the efficient technology of the entrant. In this model, vertical integration into software is a potent weapon that distorts competition.

4.4.2   Portfolio Effects: Complements Ex Ante, Substitutes Ex Post

Ma assumes that there are two upstream and two downstream firms. Consumers are homogenous and risk neutral. The upstream firms produce differentiated products at constant, but not necessarily equal, marginal costs. Downstream production is fixed proportions, involving the combination of a unit of an upstream product with a unit of the homogenous downstream product (assumed to have marginal cost of zero). Hence both downstream firms can produce the two available downstream products—if they are supplied by the relevant upstream producer—and are differentiated on the basis of which upstream input is used. Ma assumes that the utility of consuming the first downstream product is certain and equal to u. The utility from consuming the second downstream product is uncertain ex ante. Ex post, after the valuation is revealed, consumers will

purchase the downstream product that provides the highest net benefit (valuation less price). Ma assumes that the expected utility from only having access to downstream good 1 at marginal cost yields greater expected utility than having similar access to downstream good 2 (input 1 is therefore superior to input 2).

If a downstream firm has sourced inputs from both upstream suppliers, it can offer an option contract *(A, B)* under which the consumer pays *A* if it selects the first downstream product and *B* if it selects the second, where the consumer makes her choice after her uncertainty regarding the valuation of the second good is revealed. If a downstream firm only sources from one of the upstream suppliers, it can offer only a simple contract, specifying the payment for that good if it is selected by the consumer. Consumers select the contract from the downstream firm that offers the greatest expected net benefit.

The Ma model is a five-stage game. In the first stage U_1 and D_1 can merge, and if they do then U_2 and D_2 can also merge. In the second stage U_1 and U_2 compete over prices to supply the unintegrated downstream firms. If U_1 or U_2 are part of an integrated firm, the upstream good is transferred internally at marginal cost. In the third stage D_1 and D_2 enter into agreements under which U_1 and U_2 will supply the upstream good at the second stage prices given realized demand. In the fourth stage, the downstream firms offer consumers their contracts. In the fifth stage, consumers in the ex ante stage select the contract and supplier that offers the highest expected utility. After contract selection, a consumer's valuation for the second good is revealed and they determine, given the contract selected, which downstream product to purchase.

Consider first what happens in stage two and the continuation game if there is no integration in the first stage. Both downstream firms can source both upstream inputs at the prices established in the second stage. Option policies can then be written in terms of markups over the costs of delivery, which are simply the price paid to the upstream firms. Hence the option policies take the form $(\alpha + p_1, \beta + p_2)$ where α and β are the markups

on good 1 and good 2 respectively. Because competition between the two downstream firms is based on which can offer the greatest expected utility, the option policies will be structured such that they induce an efficient choice between the two goods ex post. This requires the choice of markups to be nondistorting, or $\alpha = \beta$. Thus under non-integration, the option policies offered will take the form of a two-part tariff where consumers pay a fixed fee for the option to consume, and then once they make their product selection they pay an additional fee equal to the marginal cost of procurement (p_1 or p_2).

Competition between the two downstream firms will insure not only that the policies offered are efficient, but also minimize the access fee such that the firms' profits are non-negative. Competition will drive the common markup to zero. The equilibrium policies will be (p_1, p_2) and consumers realize all surplus downstream, $S(p_1, p_2)$.

The equilibrium upstream prices are determined in the first stage based on price competition between the two upstream firms. Since the products are differentiated, they will be able to exercise market power. The benefit from increasing price is the extra profit from inframarginal consumers. The cost is the decrease in demand because it is less likely that some consumers will find that it continues to offer the greatest net benefit. In equilibrium, the upstream Lerner indexes will be equal to the inverse of their elasticity of demand, where the elasticity of demand is going to depend on the probability of losing customers when price increases.

When the downstream firms face different prices for the upstream inputs—which they will when there is vertical integration—their costs downstream will be asymmetric. The firm that will "win" the downstream market will be the one that is able to offer the greatest expected surplus. Its equilibrium markup will be the same on each good and it will be such that the expected surplus of the winning firm equals the surplus of the losing firm when its markup is zero. A downstream firm is able to charge a higher markup and

earn greater profits the greater the input prices its rival must pay, since the higher the prices it pays for the upstream products, the greater its costs and the less surplus it can offer consumers and maintain zero profits.

Suppose now that U_1 and D_1 have integrated. Then U_1 supplies D_1 at a price equal to its marginal cost. U_2 supplies both D_1 and D_2 at price p_2. The integrated firm finds it profit-maximizing to foreclose, i.e., not supply D_2 with U_1. Suppose it provides U_1 to D_2 at a price greater than marginal cost. Then for any p_2, the integrated firm can offer consumers greater expected surplus since it pays only marginal cost for U_1. The smaller the surplus D_2 can offer, the greater the markup and profits of the integrated firm. By increasing its price to D_2 to infinity, i.e., foreclosing D_2, the integrated firm maximizes its profits. Complete foreclosure is profit-maximizing for the vertically integrated firm because of the winner take all nature of downstream competition.

Since D_2 can only offer a simple contract for good 2, the integrated firm can offer an option contract pricing good 1 at marginal cost that yields greater surplus. As a result the integrated firm can monopolize the market by setting its (common) markup such that its option policy gives consumers the same expected utility as the simple policy of firm 2. U_2 will then price the second upstream product optimally, given that the integrated firm transfers good one at marginal cost and that the integrated firm will markup both by the same amount.

Integration is clearly profitable, but what if it provokes a counter merger? Ma shows that if there is full integration, then the pure strategy equilibria are for one or the other integrated firm to monopolize the downstream market: consumers will buy option contracts from only one of the firms, with one of the integrated firms supplying its upstream good to the other's downstream affiliate. Consequently, retaliation does not restore the pre-merger situation. Given that one of the vertically integrated firms forecloses, the best-response of its rival is to sell its upstream good to the vertically

integrated firms downstream affiliate. Though there are multiple equilibria here, in what follows Ma focuses on the one in which the integrated firm with the superior product forecloses its rival.

Whether foreclosure occurs depends on its profitability. Ma explores sufficient conditions for foreclosure to be profitable. Ma shows that the profitability of a vertical merger and foreclosure under these conditions depends on two things:

(i) Assuming prices at the Bertrand equilibrium level pre-merger, it must be true that profits under integration and foreclosure are greater than U_1's profits from supplying both downstream firms. This will be true if the extent of market power in the absence of a merger is relatively small, i.e., pre-merger markups are low.

(ii) The exercise of market power upstream implies the usual efficiency advantage to integration: elimination of the markup. Integration means that U_1 lowers the effective price of product 1 upstream to marginal cost. This implies that profits for the integrated firm should increase in the absence of a price response from the other upstream firm. However, integration will provoke a price response from the other upstream: the profitability of integration and foreclosure depends on the price response of the unintegrated upstream rival (U_2). If the upstream products are strategic substitutes, U_2 responds to foreclosure and integration by raising its price, which increases the integrated firm's profits, since a price increase by U_2 makes D_2 much less competitive. If the upstream goods are strategic complements, then U_2 will respond to the price decrease of U_1 by lowering its price. Provided this price decrease does not match the price decrease of U_1—which seems reasonable and will be true if there is stability—then the profits

of the integrated firm will increase over the level implied by the Bertrand prices pre-merger. [171]

When the non-merging upstream firm's price increases consumers are made worse off by integration and foreclosure.   The case when the price of the non-merging upstream firm decreases is ambiguous. If the price fall is sufficient, consumers will be made better off.

If consumers know their valuations or can delay their purchase decisions until after valuations become known, option contracts have no value or purpose.   In these cases vertical integration and foreclosure are irrelevant: the situation essentially involves the two upstream firms competing with each other over price, i.e., there is competition over spot prices. Implicit in Ma's analysis is the assumption that competition over spot prices after consumers learn their valuations is not possible. Ma argues that this assumption is reasonable in markets where fixed costs per customer make it inefficient for them to have access to all downstream firms. If they could costlessly access the "portfolios" or packages of all service providers ex post, then they would have spot market access to all products and competition over portfolios would be irrelevant.

4.5   Summary: Unilateral Effects and Conglomerate Mergers

This section provides a summary of the circumstances identified in the previous three sections in which a conglomerate merger could give rise to a unilateral effect. The theories of anticompetitive harm are classified into two groups depending on whether the anticompetitive effect is or is not contingent on preventing the entry or inducing the exit of rivals.

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[171] The characteristics of the distribution function for consumers' valuation of good 2 determine whether upstream prices are strategic complements or substitutes.

4.5.1   *Anticompetitive Effect not Contingent on Preventing the Entry or Inducing the Exit of Rivals*

Bundling and foreclosure strategies made possible by a conglomerate merger can give rise to an anticompetitive effect—harm to consumers—which does not depend on inducing the exit or preventing the entry of rival firms. Instead they create market power by increasing the extent of differentiation between the products of the conglomerate and its rival: the strategies reduce the attractiveness of rivals' product for consumers, making them less willing to substitute, reducing the elasticity of demand for the conglomerate, and increasing its market power.

The anticompetitive theories in which this occurs are:

- Bundling Relaxes Price Competition
  (Carbajo et al, Seidmann, and Chen)

- Exclusionary Bundling
  (Martin and Carbajo et al; Choi; Denicolo when the components are relatively undifferentiated; and Nalebuff when relatively many components comprise a system)

- Portfolio Effects
  (Church and Gandal when hardware is relatively differentiated hardware and software relatively homogeneous; Ma)

4.5.2   *Anticompetitive Effect Contingent on Preventing the Entry or Inducing the Exit of Rivals*

In other circumstances, tying, bundling and foreclosure strategies made possible by a conglomerate merger can only give rise to an anticompetitive effect—harm to consumers—if they induce the exit or prevent the entry of rival firms.

The anticompetitive theories in which this occurs are:

- Tying

  (Whinston and Carlton and Waldman)

- Exclusionary Bundling

  (Denicolo when components are relatively undifferentiated and Nalebuff when a system consists of relatively few components

- Portfolio Effects

  (Church and Gandal when software is relatively differentiated and hardware relatively homogeneous)

5.0   Coordinated Effects

The collective exercise of market power occurs when a group of firms coordinate their price increases to reduce the extent of substitution by their customers to each other. The ability of firm *i* to increase its price depends on the ability of the other suppliers to make up for the reduction in supply and the other substitution possibilities available to the customers of firm *i*. The ability and incentive for *i* to increase its output at prevailing prices imposes a similar constraint on the ability of other suppliers of the same good to exercise market power. However, if all of the suppliers in the market were to simultaneously raise their prices or reduce their output, they would relax the constraints exerted on the ability of each to profitably raise prices. Acting collectively, they would be able to exercise more market power than if they each act alone. In the context of a non-horizontal merger the issue is whether such a transaction makes it easier, post-merger, for firms to coordinate their behaviour and enhance the exercise market power.

In the discussion of the economics of non-horizontal mergers above, the focus has been on the effect of the merger on the unilateral exercise of market power. Without the cooperation of its competitors, would the non-horizontal merger result in an increase in the ability of a firm to exercise market power? In all cases the approach has been to consider how the non-horizontal merger (or equivalent behaviour) changed either the Cournot (firms compete over quantities) or Bertrand (firms compete over prices) equilibrium.

In this section we consider how non-horizontal mergers could affect the ability of firms to collectively exercise market power. We begin with a review of the economics of coordination and its implications for antitrust enforcement. We then follow with a discussion of the circumstances under which a vertical merger could enhance coordination. The hypotheses found in the economics literature on coordinated effects and vertical merger discussed are: (i) the vertical merger eliminates a disruptive buyer and enhances incentives to coordinate, facilitating the coordination upstream; (ii) increased vertical integration contributes to the ability of upstream firms to monitor each

other's pricing and identify deviations from coordinated outcomes; and (iii) a vertical merger could enhance transparency by creating a conduit (the downstream subsidiary) for the exchange of information between upstream firms. On the other hand a vertical merger might well create a maverick firm that disrupts coordinated upstream. This will be the case if the vertical merger creates asymmetries among the upstream firms.

This section concludes with a discussion of the effect of conglomerate mergers on the effectiveness of coordination. Two hypothesis are explored. The first is how the change in bundling and tying opportunities from the acquisition of complements affect the sustainability of coordination. The second hypothesis explored is that a conglomerate merger that gives rise to multimarket contact between firms will enhance the ability of firms to coordinate.

5.1 The Economics of Coordination

The ability of firms to coordinate their behaviour and enhance their ability to collectively exercise market power depends on two factors. The first is that there must be repeated interaction between the firms—they must compete over prices or quantities more than once. The second is that the firms must value future profits. In the absence of these two factors, when a firm's rivals restrict output (or charge higher prices) a firm finds it profitable to increase its output (or charge lower prices) and since this incentive is applicable to all firms, the result is a non-cooperative outcome that does not maximize industry profits. Competition among oligopolists when firms do not need to worry, or do not care, about reprisals in the future results only in the unilateral exercise of market power.

The introduction of repeated interaction and the ability to react tomorrow to a rival's choice today provides an opportunity for firms to adopt history-contingent strategies in dynamic settings that may permit greater coordination and facilitate the exercise of (collective) market power. Concern over reprisals in the future for cheating today and repeated interaction makes it possible for firms to retaliate in the future for increases in

output, or decreases in price, today—creating an avenue for firms to reduce or eliminate incentives to cheat.

In a context where the interaction is repeated the collective exercise of market power requires that the firms be able to (i) identify a collusive outcome that they are all willing to implement and (ii) be able to enforce that outcome by punishing firms which deviate. Identifying the collusive outcome involves the firms negotiating—either explicitly or tacitly—price and market shares, or total supply and a quota, for each firm. Firms will have an interest in not only maximizing industry profits, but their share of industry profits. Enhanced coordination may founder on disagreements over the appropriate division of coordinated profits.

The selected coordinated outcome will only be sustained if the incentive to cheat, or deviate, can be eliminated through the threat of credible reprisal. The problem of policing the coordinated outcome involves detecting and punishing deviations. The more certain detection, the swifter punishment, and the harsher (credible) punishment the less incentive a firm has to deviate and the easier it is for firms to enforce a coordinated outcome—or alternatively the greater the exercise of collective market power possible. An important point is that the alternative is not bimodal—either perfect coordination (maximizing industry profits) or no multilateral exercise of market power (the outcome corresponding to the noncooperative Cournot or Bertrand equilibrium involving only unilateral market power). Instead as Stigler (1964, p. 46) conjectured "If the enforcement is weak, however—if price cutting is detected slowly and incompletely—the conspiracy must recognize its weakness: it must set prices not much above the competitive level so the inducements to price cutting are small, or it must restrict the conspiracy to areas in which enforcement can be made efficient." Depending on the harshness, swiftness, and certainty of punishment, the exercise of market power falls on a continuum from its unilateral exercise to joint profit maximization.

The selection of a coordinated outcome depends very much on antitrust laws since those laws have an influence on how firms can reach an agreement. Antitrust laws typically focus on the process of coordination and make attempts to reach an agreement to restrain trade, or unduly lessen competition, illegal. As a result explicit negotiation over the details of the coordinated outcome are illegal and typically subject to criminal sanctions. In response firms might utilize alternative means to "negotiate" or identify the coordinated outcome. They may use less direct means to indirectly signal preferences, possibilities, and intentions to reach an implicit understanding. Or they may be able to coordinate their activities simply by observing and anticipating their rival's pricing behaviour: in this case the process of coordinating firm behaviour is known as tacit collusion. In the context of merger policy the concern is over the effect of mergers on the effectiveness of tacit collusion since it is either typically outside of the reach of conspiracy laws or very difficult to prosecute successfully.

The economics literature has identified market characteristics that make both reaching agreement on the coordinated outcome and enforcing an agreement difficult. Even with explicit communication the following characteristics negatively impact on the ability of firms to determine the coordinated outcome: cost asymmetries; product differentiation and non-price competition; innovation; incomplete information regarding other firms; market uncertainty; asymmetries in preferences; large number of firms and the greater the asymmetries among firms; and industry social structure.[172]

The sustainability of a coordinated outcome depends on the speed, strength, and certainty of punishment. The effectiveness of enforcement depends on industry characteristics. Industry characteristics thought to be conducive to enhanced coordination include transparency—especially public information about prices, sales, and customers of firms; small, numerous buyers; relatively homogenous products and the absence of non-price

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[172] See Church and Ware (2000, pp. 318-325) for a detailed analysis of these factors.

competition; excess capacity; cost asymmetries, inelastic firm demand; a small number of symmetric firms; and multimarket contact.[173]

The complexity of determining the coordinated outcome, especially when explicit communication is illegal, likely means that the coordinated outcome will be second best, though still entailing higher profits and a greater exercise of market power than if the firms did not coordinate. A lessening of competition as a result of a merger due to enhanced coordination results if the transaction enables firms to "more likely, more successfully or more completely" engage in coordinated interaction.[174] A convincing theory of why a non-horizontal merger should be enjoined based on concerns over interdependency must explain why the merger makes it easier for the firms, post-merger, to coordinate their behaviour, either by making it easier to reach an agreement or making enforcement more effective.

In the context of a horizontal merger, the inherent difficulty with constructing a convincing argument is that the economics of coordination is not sufficiently precise. Posner's observation (1976, p. 96) that the linkage between concentration and collusion is complicated and poorly understood stands today. The advances associated with the development of game theory models have mostly been to formalize Stigler's intuition: verifying the importance of strength, speed, and certainty of punishment in sustaining a coordinated outcome in the context of repeated game theory. Hay and Werden (1993, p. 173) observe that "Collusion models support structural merger policy, but do not make predictions sufficiently clear to be useful in identifying which mergers should be prevented." Baker (2002, pp. 139-140) observes that the link between concentration and price in an industry is a "rough empirical regularity" and not "an economic model". Instead it is a statement about averages or a "probabilistic statement" that is "widely accepted", but which is not supported by evidence that establishes how concentration

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[173] For an analysis of these factors see Church and Ware (2000, pp. 340-348).
[174] U.S. Horizontal Merger Guidelines, 1992, Section 2.1.

affects prices. If anything Baker's summary of the evidence supports the position that firm and industry specific factors other than concentration play an important role in determining when changes in concentration will lead to higher prices.

One approach to horizontal mergers is to presume that in markets characterized by low levels of concentration tacit coordination is not likely to be an issue and that in markets characterized by high levels of concentration enhanced coordination is a real concern. This latter concern can be rebutted by demonstrating that the characteristics of the market are not conducive to the collective exercise of market power through interdependence and hence increases in concentration are unlikely to result in enhanced interdependence. Its power is reduced however by two factors: (i) the factors that hinder coordination are not necessarily easily—if at all—measurable and (ii) resolving conflicting indications will be problematic.

A second approach is possible when the fact situation clearly indicates why the merger makes enhanced coordination easier. How precisely will the merger make reaching an agreement easier; make the agreement more complete; make the agreement more effective; make detection easier; or punishment more effective?[175] This involves identifying factors pre-merger that limited coordinated interaction and whose constraining effect will be reduced or eliminated post-merger. What are the binding constraints on sustainability and how are the incentives to deviate from the coordinated outcome affected by the merger?   What are the binding constraints on the credibility of punishment and how are the incentives for firms to engage in punishment affected by the merger? What are the constraints that prevent reaching an efficient agreement? How are these constraints affected by the merger?

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[175]   See Denis (1993, p. 513), Baker (1993, pp. 202-207), or Baker (2002) for examples of how such a "story" might be told in the context of horizontal mergers.

In the context of non-horizontal mergers, a number of hypotheses regarding the potential for a coordinated effect have been advanced in the antitrust literature. With regard to vertical mergers, they include elimination of a disruptive buyer and enhanced incentives to coordinate, enhanced transparency of wholesale pricing, and information exchange.[176] With respect to a conglomerate merger, the concern is that introducing multimarket contact will enhance coordination or enhance the scope for punishment. It is important to observe, however, that these theories all assume that, depending on the case theory, at least one of the upstream and downstream markets are conducive to coordination. If the relevant market is not, then the coordinated effects of a non-horizontal merger are not likely to be significant.

5.2   Coordination and Vertical Mergers

In this section the hypotheses found in the antitrust literature which identify the relationship between vertical mergers and a coordinated effect in the upstream market are discussed. The formal economics literature that considers the potential for a coordinated effect from a vertical merger is very small and very recent. It consists, as far as can be ascertained, of the contribution by Nocke and White (2004). After considering the hypotheses found in the antitrust literature, the work of Nocke and White is discussed.

5.2.1 Elimination of a Disruptive Buyer and Enhanced Incentives to Coordinate

Integration forward by an upstream firm which involves the acquisition of a disruptive buyer may enhance coordination in the upstream market. This will be the case if there is

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[176] Krattenmaker and Salop (1986) consider how exclusionary rights can raise the costs of rivals' by inducing collusion. The two theories discussed are known as the "Cartel Ringmaster" and the "Frankenstein Monster". In the first the downstream firm plays the role of cartel ringmaster, facilitating coordination through the terms of its vertical agreements with upstream suppliers. Granitz and Klein (1996) explain how Standard Oil by playing the ringmaster for petroleum transportation was able to monopolize petroleum refining. It was able to enforce the collusive agreement for the railroads through its ability to shift its petroleum shipments among the members of the railroad cartel. In the second, the vertical agreements induce suppliers upstream to foreclose supply to downstream competitors. As a result firms not party to the vertical agreements may be able to engage in more successful coordination. The ringmaster story does not readily apply to vertical mergers: the ringmaster theory requires the downstream firm to enter into agreements or source supply from all firms upstream. The Frankenstein Monster hypothesis

a buyer which is able to obtain lower prices premerger from its supplier. This may put pressure on other suppliers to match, since their buyers will be disadvantaged in the downstream market because of the higher cost they pay for the input. As a result their demand falls and they will find it unprofitable to maintain the higher upstream price. Alternatively, one buyer might be significantly larger than other buyers. Competition to supply this buyer may limit the extent to which upstream firms can coordinate.

In both cases, vertical integration between an upstream firm and the disruptive buyer is likely to make coordination easier. Riordan and Salop (1995 p. 538) suggest that the vertically integrated firm is unlikely to have the same interest in reducing the extent of coordination upstream as the disruptive buyer. Rather than push for lower prices in the input market to provide it with a competitive advantage downstream (the behaviour of the disruptive buyer), it will likely have an incentive to instead cooperate with the other upstream firms to raise input prices upstream.[177]

The possibility that a vertical merger may eliminate a disruptive buyer and facilitate an increase in coordination upstream is recognized in the U.S. Non-Horizontal Merger Guidelines. The factual circumstances under which this theory is relevant are (i) that the upstream market is sufficiently concentrated and has characteristics conducive to coordination; (ii) sales to the buyer are particularly important to upstream suppliers, perhaps due to its volume; and (iii) there is evidence that the buyer has been able to disrupt coordination by fostering price competition.

The reason for the enhanced incentive to cooperate created by vertical merger follows more generally from the fact that post-merger the integrated firm has more of an interest

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depends on the credibility of the integrated firm's threat not to supply downstream competitors. See Section 5.2.1 *infra*.

[177] Riordan and Salop (1995 p. 542) observe that a vertical merger involving a maverick competitor in the downstream market will also facilitate coordination in the downstream market for similar reasons. Post-merger the downstream division will have more of an incentive to coordinate higher downstream prices in order to "facilitate coordinated input pricing that benefits its upstream partner" than the unintegrated maverick.

in raising the price upstream: higher input prices raise the costs of its rivals downstream, relaxing their competitive constraint on its downstream division, leading to enhanced market power and profits downstream.[178] Vertical integration provides it with less incentive to deviate since it benefits more from upstream coordination. A vertically integrated firm is more likely to incur the costs of coordinating—lost profits from deviating today—because its benefit from doing so in the long run is greater—higher profits both up and downstream. While an unintegrated firm might not be willing to incur the costs of commitment (reduced output in the short-run), an integrated firm might be willing to do so. Dynamic considerations might make commitment profitable for an integrated firm, even though it is not profitable for an unintegrated firm.[179] The greater the benefit of the downstream division from raising the costs of its rivals, the greater the effect a vertical merger will enhance incentives for an integrated firm to cooperate with coordinated pricing upstream.

5.2.2 Enhanced Monitoring

Coordination at the upstream level may be difficult because prices are not transparent. If transaction prices at the wholesale level (upstream market) are secret, then detection and punishment of deviations from the coordinated outcome will be difficult. Retail prices (prices in the downstream market), however, may be more visible. The U.S. *Non-Horizontal Merger Guidelines* argue that in these circumstances vertical integration becomes an important factor in enhancing monitoring of rivals' pricing.[180] If true, then a vertical merger which increases the extent of vertical integration in the market may contribute to a substantial lessening of competition because of an increase in the effectiveness of monitoring. The U.S. guidelines note that "Adverse competitive consequences are unlikely unless the upstream market is generally conducive to collusion

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[178] See the discussion in Section 3.2.4 *supra*.
[179] Alternatively, an integrated firm might be willing to build a reputation for not supplying its downstream rivals, i.e., foreclosure, even though an unintegrated firm would choose not to because its benefit from doing so is less.
[180] Section 4.221

and a large percentage of the products produced there are sold through vertically integrated retail outlets."

Retail prices could be used to detect cheating at the wholesale level *if* variations in the retail price are attributable to fluctuations in wholesale prices. However, retail price fluctuations could also be attributable to changes in the costs of retailing. Vertical integration presumably provides the firm with information on the costs of retailing, allowing it to extract more information regarding wholesale prices from retail prices. Implicit in this argument are one of two assumptions: either the retail costs of different products/manufacturers differ or the costs of retailers differ and retailers are exclusive.

This is in fact a variant of a more general argument that originates with Comanor (1967). Comanor observed that if in general the conditions in the upstream market are not as conducive to coordination as those downstream, then a vertically integrated structure will be favored by upstream firms. By establishing a vertically integrated structure for the industry and eliminating wholesale market transactions (which are subject to cheating), the firms are more likely able to coordinate pricing and collectively exercise market power at retail. On these grounds a vertical merger which results in the elimination of a large buyer downstream, thereby insuring that post-merger market share of unintegrated downstream firms is small raises concerns.

5.2.3   *Information Exchange*

A vertical merger could also enhance transparency by creating a conduit for the exchange of information regarding prices and other information regarding the activities of rival upstream firms. Provided the downstream subsidiary post-merger continues to purchase from the upstream rivals of the vertically integrated firm, the potential exists for the downstream division to transfer information regarding the prices and offers of those

rivals to its upstream division.[181] Riordan and Salop (1995 pp. 558-560) observe that there are three necessary conditions for information exchange under these circumstances to facilitate coordination. These are that the information has to be projectable, it must be unique, and the input market must be conducive to coordination:

(i)   The price information is projectable if the information learned by the downstream subsidiary is indicative of the prices that the rivals of the vertically integrated firm charge other buyers.   As Riordan and Salop observe there are valid reasons to doubt that the terms of trade quoted to a vertically integrated firm are indicative of quotes to other downstream firms. They may be lower, since the upstream division can supply at marginal cost or because of this they may be higher, because of the very fact that the downstream subsidiary is looking for outside supply.

A key consideration will be whether it is possible for the firms to develop and maintain an expectation that the information will be used to coordinated pricing in the upstream market. This is not automatic, since information on the part of the supplier to try and convince the downstream firm that the information is projectionable is risky since it provides the vertically integrated firm with an opportunity to undercut. Similarly, the rival firm may deliberately provide high bids to create an opportunity for it to undercut the vertically integrated firm.

(ii)   For the vertical merger to facilitate coordination, the information from the information exchange that the vertical merger creates must be relatively unique. That is, it must not be readily and verifiably available from other sources.   If

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[181] The focus here is on one way communication—from the rival upstream firm, through the downstream subsidiary to the upstream subsidiary of the vertically integrated firm. The possibility exists that the downstream subsidiary acts as a two way conduit that facilitates explicit collusion. We do not consider this further, based on the recognition that this type of behaviour is reachable under the antitrust laws. The concern here is with the vertical merger creating conditions which facilitates coordination which is not reachable—typically—under laws prohibiting conspiracy to lessen competition.

upstream transaction prices are public, then the information exchange is completely redundant.

On the other hand, the fact that the information from the downstream firm is more likely to be accurately reported than that received from other customers regarding the pricing of rivals is an advantage for the upstream firm which may facilitate monitoring.

(iii)   The input market must be conducive to coordination except for the absence of public information regarding prices.

Moreover, even if these three conditions are satisfied, it is not clear how useful the information will be for coordinating upstream input suppliers if the conduit is one way and only the information set of the vertically integrated firm is enhanced.

5.2.4   Creation of a Maverick

On the other hand, it has been suggested that in a relatively unintegrated vertical structure, a vertical merger can be destabilizing and reduce the extent of coordination upstream. The reason is that a vertical merger, by creating asymmetries between upstream firms creates a maverick. In particular if integration is associated with a reduction in transparency, because the vertically integrated firm has an incentive and the ability to secretly expands its sales through its downstream subsidiary, a vertical merger can be pro-competitive. The incentive to increase sales arises if the merger eliminates double marginalization.[182]

5.2.5   Efficient Contracts, Vertical Mergers and Upstream Coordination

In a recent contribution Nocke and White (2004) make a formal assessment of the potential for vertical mergers to facilitate coordination in upstream markets. They

consider the following situation: (i) upstream firms produce a homogenous input which is used in fixed proportions by downstream firms to produce a homogenous final product; (ii) competition downstream is Cournot in each period; (iii) competition upstream is over two-part tariffs and an upstream firm's terms are public information; (iv) in each period offers are made and accepted upstream prior to competition downstream; (v) there are an infinite number of periods.[183]

Nocke and White establish the effect of vertical integration by comparing the critical discount factor when there is vertical separation and when there is one vertically integrated firm. The critical discount factor is a measure of how susceptible a market is to coordination. It is the value of the discount factor at which the monopoly outcome is just supported as the coordinated outcome—firms are just indifferent between coordinating and deviating.[184]

Nocke and White identify two reasons why coordination is more likely under integration. The first they term the outlet effect: an unintegrated rival finds deviation from the coordinated two-part tariff less profitable when there is a vertically integrated rival. The reason is that it cannot replicate the monopoly profit when it deviates because it is not able to sell to, and through, the integrated firm's downstream division, though it can do so in the absence of integration. Foreclosure from the integrated firm's downstream division makes deviation less profitable. The outlet effect will exist whenever the deviating upstream rival needs the cooperation of the integrated firm's downstream division to maximize the profits from deviation.

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[182] This is recognized in the U.S. Merger Guidelines in Section 2.12. See also Baker (2002, pp. 176-177) for further discussion.

[183] They also consider Bertrand competition downstream. Their result concerning the facilitating effect of a vertical merger is robust to the nature of the competition downstream.

[184] The discount factor is how much a euro a year from now is worth today. It shows how willing firms are to trade profits today for future profits. Low discount factors mean that future profits are not valued as highly. The lower the critical discount factor, the more likely the coordinated outcome replicates the monopoly solution.

The second they term the reaction effect: the integrated firm is able to react to the deviation by the unintegrated rival in the same period in which it cheats. Deviating firms can be punished by the integrated firm—by expanding output—in the period in which they defect, thereby reducing the incentives for defection. On the other hand they also show that the integrated firm's punishment profits are greater than an unintegrated upstream rivals (Cournot profits downstream). However, they are able to show that the outlet and reaction effect always exceed the punishment effect and integration by a single firm makes coordination more likely: it lowers the critical discount factor.

Nocke and White are also able to use their analysis to identify characteristics of the acquired downstream firm which would facilitate coordination upstream the most. They find that the acquisition in a vertical merger of the most efficient firm downstream (Bertrand competition downstream) or the one with the largest capacity (Cournot competition downstream) has the largest effect on the critical discount factor.

Unfortunately, as Nocke and White note, it is not clear that their results generalize to the case where there is more than one vertically integrated firm. The reason is that a vertically integrated firm can deviate in a period without detection—and punishment—until the next period. Thus if more than one firm is vertically integrated, the flexibility which is responsible for the reaction effect—the ability to increase output in response to a posted offer that deviates from the coordinated outcome—becomes a factor that hinders coordination.

5.3   Conglomerate Mergers and Coordination

5.3.1   *Enhanced Prospects for Disciplining*

A conglomerate merger that involves the acquisition of complements or independent goods creates the opportunity for the conglomerate to bundle or tie post-acquisition. In Section 4 the analysis indicated that the conglomerate firm in many circumstances would only have exclusionary incentives to bundle or tie if it resulted in the exit or prevented the

entry of a competitor. If it did not have this exclusionary effect, then while it disadvantaged its rival, it also reduced the profits of the conglomerate.

In a dynamic context, however, the fact that the Nash equilibrium profits for both firms is reduced provides for the possibility that coordination becomes easier to sustain. The reason for this conclusion is that the likely punishment when firms attempt to collectively exercise market power and a firm deviates is reversion to the static equilibrium outcome. The harsher—less profitable—this outcome the more sustainable coordination. Moreover, the less profitable the static outcome, the greater the gains to coordination.

5.3.2   *Multimarket Contact*

Multimarket contact arises when firms compete against each other in multiple markets. This can occur if the firms are multiproduct firms and compete with each other in different product markets or they are single product firms, but compete against each other in a number of different geographic markets.   The coordinated exercise of market power requires repeated interaction between firms: the interaction through time allows for (credible) threats which change the incentives for firms to defect from the coordinated outcome today. Similarly, it has been conjectured that multiplicity of contact across products or space might also make collusion easier (Edwards 1955).   The empirical evidence confirms the importance of multimarket contact for "higher prices, lower production volumes, higher profits, and lower failure rates for incumbent firms."[185]

Multimarket contact makes coordination easier by making reaching an agreement easier, or making enforcement more effective. Scott (1993, 2001) has argued for the effect that multimarket contact has on reducing the difficulties associated with identifying the coordinated outcome.   Bernheim and Whinston (1990) have systematically considered the effect of multimarket contact on the scope for punishment and hence sustainability.

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[185] See Greve and Baum (2001, p. 6) for evidence and cites to the literature.

Matsushima (2001) demonstrates how multimarket competition facilitates the detection of deviations when monitoring is imperfect (prices are not observable).

Scott argues that multimarket contact facilitates reaching a tacit agreement or identifying the coordinated outcome in market. For instance, when the extent of multimarket contact increases, the firms become more symmetric and the extent of their interaction increases. On both counts it is likely easier for the firms to develop coordinating strategies and identify the outcome on which to coordinate. Scott (2001) in particular stresses the importance of the increase in familiarity that multimarket contact creates.

Bernheim and Whinston focus on the effect that multimarket contact has on the ability to enhance the sustainability of coordination, i.e., insuring that firms do not have an incentive to defect from the coordinated outcome. Multimarket contact allows firms to pool the criterion for sustainability across markets.[186] Pooling the sustainability criterion means that a firm can "transfer" slack in the sustainability condition for one market to help support coordination in other markets. If firms were able to coordinate their activities to maximize profits in each market, then multimarket contact could not enhance coordination. On the other hand, if the incentive to deviate is too strong in one market, then following Stigler, the firms will have to reduce the extent of their coordination in order to prevent the break down of coordination.

Suppose there are two markets. In one the firms are able to coordinate perfectly since the losses from deviation exceed the gains. In this market (*A*) the punishment is more than sufficient to insure compliance with the agreement: there is slack enforcement power. In the other the extent of coordination is less than perfect and at least one firm is essentially indifferent between cooperating and defecting: any increase in coordination is prevented

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[186] For a coordinated outcome to be sustainable it must not be in the interests of any firm to profitably deviate. The condition requires the net present value of profits from cooperating to be at least as large as the net present value of deviating and being punished. There will be slack in the sustainability criterion if a firm strictly prefers to cooperate. A maverick might be identified by the firm whose sustainability condition is binding.

because then the gains from deviating would exceed the punishment.   In this market (*B*) there is insufficient enforcement power.

The effect of multimarket contact is that the firms will not consider the two markets in isolation. When there is multimarket contact, the firms will be able to increase the extent of coordination in market *B* by punishing a deviating firm in both markets.   If a firm cheats in either market *A* or market *B* its rivals will punish it in both markets.   In this way the excess enforcement power in market *A* is transferred to *B* where it is used to increase the extent of coordination. With multimarket contact, the condition for sustainability is that the sum of the gains in both markets be less than the sum of the punishment payoffs. For multimarket conduct to make a difference, the two markets will have to differ. If they do not then the gains from deviating and the punishment in each market will be the same—there is no excess enforcement power to transfer.

If the two markets differ with respect to any factor that influences the collusive payoffs, the punishment payoffs, or the detection of deviations, there is the potential for multimarket contact to enhance coordination *provided perfect coordination is not possible in it is absence in each market alone*. Bernheim and Whinston identify a number of differences that allow for multimarket contact to promote coordination, including differences in the number of firms; differences in market growth rates; differences in detection lags; random demand fluctuations; and cost asymmetries.

Matsushima has demonstrated how multimarket contact increases the profitability of collusion when the actions of rivals are not observable. Non-public prices or outputs makes coordination difficult as firms have a signal extraction problem: are smaller than expected sales due to low demand or cheating by a rival? Suppose firms compete over quantities but the quantities of their rivals are unobservable. The price is observable, but the price is determined not only by supply but also by a demand and demand is subject to a shock which is also not observable. In these circumstances a firm will not know if a low price is attributable to low demand or cheating by a rival.

Green and Porter (1984) have shown in these circumstances that firms can still coordinate through the use of trigger price strategies. These strategies involve a cooperative output for each firm, a trigger price, and a punishment phase in which the firms play their Cournot output every period. The trigger price strategies involve cooperating if the price last period exceeds the trigger price, launching a punishment phase if the observed price is less than the trigger price, and reverting to their coordinated outputs when the punishment phase is over.

For the coordinated outcome to be sustainable by a trigger price strategy, it must be true (as always) that no firm would have an incentive to deviate and increase its output in a cooperative period. When a firm produces more than its coordinated output, this increases the probability that the price in the current period will drop below the trigger price and trigger the punishment phase.   In a trigger price equilibrium there is, by definition, no cheating on the collusive agreement. Because of the randomness of demand, eventually price will fall below the trigger price. When this happens firms know that it is not due to cheating, but weak demand conditions. However, they still must participate in the punishment phase in order to forestall cheating. In equilibrium, the industry will alternate between episodes of cooperative behavior of random length and price wars of a fixed length brought on by weak demand conditions.

An optimal trigger price equilibrium would maximize industry profits. There is a tradeoff, however, in implementing the optimal trigger price scheme. Lowering the trigger price reduces the probability of a price war, but requires either longer periods of punishment or lower coordinated profits, the effect of either is to reduce the profits from defection, for sustainability. In fact the optimal trigger price does not typically support the joint-profit maximizing output. Producing slightly more than the level which maximizes industry profits has very little effect on the profits from coordination, but it does reduce the incentive to cheat, thereby allowing the firms to reduce the trigger price and reduce the probability of the profit reducing punishment phase.

Matsushima's contribution is to demonstrate that multimarket contact allows the firms to enhance the extent of their coordination when monitoring is imperfect. As the number of markets in which the firms interacts increases, the closer the optimal trigger price equilibrium comes to maximizing industry profits. The reason is that firms' base their current output decision in market i not just on the history of prices in i—in particular the price last period—but the history of realized prices in all markets.

Matsushima demonstrates that at the coordinated equilibrium, a firm would not deviate in all of the markets at one time, since such an all market deviation will almost certainly be detected by rivals based on the ratio of the number of markets where the price falls below the trigger price and the total number of markets. On the other hand, deviation in a single market is not profitable since, while it is unlikely to be detected, if it is punishment occurs in all markets. As the number of markets increase, the amount of information available increases, which facilitates the detection of cheating, and thereby contributes to the extent of coordination, i.e., the collective exercise of market power.

6.0   Conglomerate Mergers: Finance and Competition

In this section, the financial implications of a non-horizontal merger on competition are considered.   In particular, the assumption is that the non-horizontal merger results in a change in access to capital by the acquired firm.   Pre-merger, the assumption is that the acquired entity is capital constrained, and that this constraint is relaxed or eliminated post-merger when it becomes part of a conglomerate.   The acquired firm post-merger has access to internally generated funds and no longer needs to access capital markets or can do so on substantially better terms than its rivals. The literature on the interaction between product and financial markets is extensive.[187] In this section we focus on three hypotheses that link financial structure (financial leverage) of a firm and capital constraints to product market competition.

The first two hypotheses relate to the effect of financial leverage. Leverage occurs when a firm finances its activities not just through shareholder equity, but also by issuing debt. Consideration of the firm's financial structure has implications for the objective of the firm.   Rather than maximize the profits of the firm, the argument is that the firm will instead be interested in maximizing the return to equity.   Exploring when this is true and what its implications are for firm behaviour is an active research agenda. The two literatures that consider the implications of leverage for competition are relevant to considering the competitive effects of a conglomerate merger if it results in a change in leverage. The two literatures consider the unilateral and coordinated effects of changes in leverage.

The seminal contribution on the unilateral implications of leverage is by Brander and Lewis (1986). Their focus is on the effect leverage has on the incentives of a firm to compete in product markets. Their work suggests a strategic incentive for firms to use debt and increase leverage when products are strategic substitutes: leverage is a means

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[187] For two relatively recent surveys see Maksimovic (1995) and Cestone (1999). An early influential survey is Harris and Ravi (1991).

for firms to profitably commit to more aggressive (greater output, lower prices) behaviour in product markets. This view has been challenged more recently by Faure-Grimaud (2000) and Povel and Raith (2003) whose work suggests that leverage makes a firm less aggressive in product markets.

The focus of Maksimovic (1988) and Damania (1997), on the other hand, is on identifying the effect that limited liability and leverage have on the sustainability of coordination. Together, their work suggests the circumstances under which debt makes coordination easier to sustain because of its effect on incentives to defect (Maksimovic) or its effect on punishment (Damania).

The third hypothesis explored is that capital market imperfections that result in limits to firms access to finance makes them vulnerable to predation. In order to continue to access capital markets their financial performance must be satisfactory. Suppose that pre-merger all firms in the market are capital constrained, but post-merger the merged firm has increased access to internal finance or the terms at which it can access external sources of finance become significantly more favorable than its rivals. In these circumstance a non-horizontal merger that eliminates the constraint on access to one firm in the market—because the merger enhances its access to internal sources of finance or allows it to access external markets on favorable terms—may provide it with incentives to engage in predation.

6.1   Leverage and Product Market Competition

In this section the relationship between financial structure and product market competition is explored.   In this section the model of Brander and Lewis (1986) is introduced, extensions discussed, and the recent reexamination of the basic result that leverage makes a firm more aggressive by Povel and Raith (2003) presented.

6.1.1   Leverage as a Strategic Commitment

Brander and Lewis show that leverage commits a firm to act more aggressively, producing a greater output. Since they assume Cournot competition (strategic substitutes), this increases the profits of a firm since its rivals respond by reducing their output, given their expectation of an increase in the output of the leveraged firm. This expectation is rational if the increase in output is profit-maximizing. Brander and Lewis show that the introduction of debt financing provides the owner-managers of the firm with an incentive to expand their output.

The reason this occurs is due to limited liability. Under debt financing, the firm commits to a fixed payment to debt holders: any profits in excess of this fixed amount accrue to the owners. If the firm is unable to pay the required amount, the firm is in default, title to any profits pass to the debt holders, and the payoff to shareholders is zero, regardless of the extent to which the firm is unable to meet its debt obligations. Consequently, only states of the world in which the firm will be able to make its debt service obligations are relevant when the firm acts to maximize the payoffs to shareholders. Since these "good states" are associated with high demand or low costs, and it is these states in which shareholders profit, the firm will have an incentive to produce more than would be profitable than if it also considered states in which it is bankrupt.   The extent to which the firm is leveraged determines which states are good and which are bad. The greater leverage, the more aggressive the firm, since the relevant states from the perspective of the firm involve greater demand or lower costs.   Brander and Lewis' analysis suggests a purely strategic role for debt: its only role is to provide a credible incentive for the owners of the firm to act more aggressively, which is profitable since it induces its rivals to reduce their output.

More formally, Brander and Lewis consider a duopoly that produces a homogenous good. Competition is over output, but firms commit to their level of output prior to the realization of the state of the world: there is uncertainty over some variable which affects

profitability. This uncertainty could, for instance, be over the actual realization of marginal cost or the strength of demand. Denote the realization of the state of the world as θ. The gross profits of firm i are $\pi_i(q_i, q_j, \theta)$ when the state of the world is θ, firm i produces q_i, and firm j produces q_j.

The Brander and Lewis game is a three-stage game. In the first stage the two firms simultaneously select their debt levels. In the second stage, having observed the debt levels of each other, they simultaneously commit to their output. In the third stage, the state of the world is realized, profits determined and production costs paid. If a firm is not able to cover its debt repayment, title to its gross profits is transferred to its creditors.

To see the effect of debt on the incentives of the firm to supply, suppose that there are only two states of the world and each are equally likely. Denote the two states as θ^H and θ^L where $\theta^H > \theta^L$. Moreover, as expected, let both the profits of a firm and its marginal profit be increasing in θ: in the high state for any output levels both the profit and marginal profit (the difference between marginal revenue and marginal cost) are greater than in the low state.

The expected profit of firm i is

$$E\pi = 0.5\pi^i(q_i, q_j, \theta^H) + 0.5\pi^i(q_i, q_j, \theta^L). \tag{78}$$

A profit-maximizing firm would recognize that half of the time an increase in output would result in the marginal profit in the bad, or low, state, and half of the time an increase in output would increase profits by the marginal profit in the good, or high, state. Hence its profit-maximizing output is found by setting the sum of these equal to zero: the optimal output is found when on average an increase in output does not increase profits:

$$0.5\frac{\partial\pi^i(q_i, q_j, \theta^L)}{\partial q_i} + 0.5\frac{\partial\pi^i(q_i, q_j, \theta^H)}{\partial q_i} = 0. \tag{79}$$

In equilibrium (79) has to hold for both firms. Denote the symmetric Nash equilibrium output where (79) is satisfied as $q_i^c = q_j^c = q^c$.

Suppose that firm i has taken on debt of D_i where $\pi^i(q_i^c, q_j^c, \theta^H) > D_i > \pi^i(q_i^c, q_j^c, \theta^L)$: if the low state is realized, then the firm would be unable to repay its debt and all earnings would be paid out to its debt holders, but it is profitable and able to repay its debt if the high state is realized. A firm operating in the interests of its shareholders would maximize their expected return:

$$E\pi^e = 0.5\pi^i(q_i, q_j, \theta^H) \tag{80}$$

This requires it to set its marginal profit in the high state equal to zero:

$$0.5\frac{\partial \pi^i(q_i, q_j, \theta^H)}{\partial q_i} = 0 \tag{81}$$

and since marginal profit is increasing in the state of the world (θ), for any expected output level of its rival, i will find it profitable to produce more when its optimal output is determined by (81) than when it is determined by (79). A leveraged firm run for the benefit of its equity owners will only take into account the marginal return of increasing output in the good state, not the low state. As a result the leveraged firm has an incentive to produce a greater level of output than an all equity firm.

A leveraged firm competing against an all equity firm would have greater output and greater profits, the all equity firm a smaller output and profits. Relative to the equilibrium when neither firm is leveraged, total output is greater and price lower, enhancing the welfare of consumers. In the Brander and Lewis model, both firms in the first stage can acquire strategic debt. This stage is a Prisoner's Dilemma: each would be better off if neither acquired strategic debt, but both have a unilateral incentive to acquire strategic debt. This results in both committing to act aggressively, increasing their output and lowering prices to the benefit of consumers.

The model of Brander and Lewis has been subject to a number of critiques. These include the following:[188]

(i) *Debt is exogenously imposed*. The use of debt in the Brander and Lewis model is not because it is an optimal financing contract, adopted in response to capital market imperfections based on asymmetries of information. Asymmetries of information, whether they be that managers are better informed (adverse selection), can take actions which are unobserved (moral hazard), or that "true" profits are unobservable/unverifiable create a conflict of interest between external finance and the managers of the firm. Asymmetric information provides managers of the firm with the opportunity to act in their own interest at the expense of the interests of their investors. The potential for managers to act in their own interest and not that of investors is an example of an agency problem.

For instance when true profits are unobservable/unverifiable, investors have to worry about strategic default. In these circumstances the firm always has an incentive to default—it claims and pays low profits to its creditors instead of paying off its debt.   The inability to contract on realized profits is one of the standard explanations for debt financing. In order for the firm to continue to access finance, it must repay its debt. It is the unwillingness of creditors to provide further finance in the event of default which insures that the firm repays.[189]

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[188] For details see Maksimovic (1995), Cestone (1999), Faure-Grimaud (2000), and Povel and Raith (2003).
[189] See Diamond (1984) and Bolton and Scharfstein (1990).

If profits are verifiable and hence contractible, there is no rationale for a debt contract except for its commitment value.[190] However, the difficulty then is that the commitment value is based on the debt contract being public and not renegotiable. If a firm could secretly buy back its debt prior to committing to its output its profits would be greater: it would have induced its rival to produce less and it would also select its output optimally, based on its rival's output.

In Brander and Lewis bankruptcy is costless. This means that the ex ante incentive to reduce leverage to avoid bankruptcy is dominated by the ex post incentives debt provides to overproduce. If a firm incurred costs because of bankruptcy, in particular forgone profits in the future, then the firm might be more concerned about its survival, leading to an offsetting effect to produce less.

(ii)   *Treatment of production costs*.   Variable production costs are ignored or implicitly set equal to zero.   The timing of Brander and Lewis assumes that firms commit to their level of output prior to the resolution of uncertainty, but pay variable production costs out of ex post revenues. Debt is purely strategic, it does not enable the firm to produce more. It is difficult to see how the firm could commit its debt holders to pay the production costs of its previously committed level of output (Maksimovic 1995, p. 906).   Alternatively, as Povel and Raith (2003, p. 15) observe, implicitly the assumption is that the firm has financed its production costs: the issue is then why the creditors should trust the firm to repay the debt.

With positive production costs incurred at the time the commitment to its output level is made, financial constraints will limit what a firm can

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[190] Instead the firm and its creditors would be able to write an enforceable profit-contingent contract instead

produce. As Povel and Raith observe, positive variable costs paid when output is produced create a close link between borrowing and product market behaviour (2003, p. 3).   By limiting its debt, a financially constrained firm commits itself to produce less.

(iii)   *Nature of Product Market Competition.* The Brander and Lewis results depends on the nature of uncertainty and the nature of competition. Showalter (1995) assumes price competition in the product market, i.e., strategic complements. If the uncertainty is over demand, then marginal profits are higher in the good state and a leveraged firm will choose a higher price than an all equity firm, so that leverage makes a firm less aggressive.[191] This induces a favorable response from its rival, so a firm has a strategic incentive to use debt financing as in Brander and Lewis, only here it leads to higher prices.

However, the results of Brander and Lewis are not completely robust if the uncertainty is over marginal cost. When the uncertainty is over marginal cost, the firm will have an incentive to charge a lower price in the good state when marginal costs are low, an incentive which induces lower prices from its rival, which is not profitable. Hence it will not have a strategic incentive to acquire debt if it is sure there will be competition. On the other hand, since debt commits it to low prices, it may have a strategic incentive to become financially leveraged if the commitment it provides to low prices results in entry deterrence or induces the exit of its rivals.

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of a debt contract that specifies a fixed repayment and default if it is not made.

[191] As Riordan (2003) observes, this is the case only if positive demand shifts decrease the elasticity of demand holding the price of rivals constant.

(iv) *Empirical Verification.* In their summaries of the empirical literature on the effect of leverage, Faure-Grimaud (2000) and Povel and Roth (2003) conclude that the evidence is substantially more consistent with the proposition that leverage makes a firm less aggressive.[192]

6.1.2 Leverage and Agency Costs

Povel and Raith (2003) extend the model of Brander and Lewis in two directions. First they provide an agency rationale for debt-like contracts by assuming that profits are not contractible.[193] They assume that true profits are not observable, so that a firm can easily divert or conceal its actual profits. Investors' (debtors') only recourse when a firm fails to repay its debt is to force the firm into bankruptcy, thereby depriving the firm of future profits. Given the informational constraint, debt is optimal since it minimizes the probability of bankruptcy, induces repayment when possible, and enables outside investment as on average the investor is repaid.[194] They also assume that the output of the firm is not observable. This introduces an element of moral hazard since the output level is a choice made by the firm. The output level chosen will affect the distribution of earnings and hence the probability of repayment. This means that the firm's creditors

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[192] Both Povel and Raith and Faure-Grimaud cite a number of empirical studies whose main result is that highly leveraged firms appear to be at a competitive disadvantage. In most cases the empirical evidence suggests that increases in leverage are associated with decreases in market share. In two classic studies Chevalier (1995a, 1995b) studies the effect of leveraged buyouts (LBOs, which increase leverage) on the supermarket industry. Riordan (2003, pp. 188-190) summarizes:

> Her results for the most part show that supermarket LBOs softened product
> market competition. The stock value of firms went up when a rival firm
> undertook an LBO. New entry was more likely in local markets where
> competitors were highly leveraged due to recent LBOs. Firms that underwent a
> recent LBO were more likely to close stores. And prices rose after an LBO in
> markets were rival firms were highly leveraged (footnote omitted).

[193] Bolton and Scharfstein (1990) argue that profits are not likely to be contractible because they are either unobservable or unverifiable in court (or by another third party). They point to the difficulty of assessing whether a particular expense is necessary and difficulties determining the appropriate allocation of joint costs and revenues when companies are affiliated.

[194] Faure-Grimaud (2000) also endogenizes the debt contract and finds that leveraged firms have incentives to compete less aggressively when there is interim renegotiation. Interim renegotiation means that the firm and its creditors can renegotiate after output is chosen, but before the state of the world is revealed. As Faure-Grimaud observes, renegotiation forces the firm "to internalize the consequences of its output choices on the optimal debt contract. In these circumstances, the firm maximizes the total surplus and then shares the returns with the creditor." (p. 1834)

will seek to implement a contract that recognizes the link between the firm's output and repayment. The second extension is that they assume that production costs are paid when the firm commits to its output level. This provides a link between the firm's financial resources and its ability to compete.

Povel and Raith show that the optimal contract involves a threat of liquidation that is based on the extent to which the firm falls short in making its debt payments. The threat of liquidation is harmful, since it denies the firm the ability to earn profits in the future. Povel and Raith show that the optimal debt contract has the feature that the probability of liquidation is based on the amount of the repayment. If the firm distorts its output making it more likely that it will default and reducing its profits in poor states, the firm is punished by an increased probability of liquidation. The repayment schedule is constructed to minimize the net costs (lost profits in the future) from liquidation. This schedule is constructed such that the firm is indifferent between paying its debt and paying less but suffering a loss of future profits which, in total, has the same expected value as the debt. Regardless of its choice, its expected payment is the same. This makes it a residual claimant with incentives to maximize profits ex post, eliminating the distortion identified by Brander and Lewis. Since the firm has undistorted incentives, it produces the Cournot output provided it has sufficient finance.

In the model of Povel and Raith, there are two firms, one of which is financially constrained and one which is not. The financially constrained firm does not have sufficient finance to fund its fixed costs and the variable costs of producing the Cournot output, unlike its rival which has sufficient retained earnings to do both. In the production stage, the unconstrained firm will produce the Cournot output, whereas the leveraged firm can only produce the Cournot output if it has sufficient financing. Because Povel and Raith assume that the contract between the leveraged firm and its creditors is unobservable, the product market equilibrium arises when both firms are profit-maximizing and, given the implied level of finance and the nature of the debt contract, creditors expect to break even. As a result the financially constrained firm

makes its borrowing and production decision simultaneously. When it does so it has an incentive to underproduce relative to the financially unconstrained firm, i.e., it puts more weight on the poor states to reduce the probability of liquidation and forgoing profits in the future. Hence with positive variable production costs the financially constrained firm strategically limits its behaviour in the product market by borrowing less and reducing its output.[195] Recognizing this, its unconstrained rival finds it profitable to produce more than its Cournot output. Because liquidation is harmful, the leveraged firm has an incentive to act less aggressively, not more aggressively.

As Povel and Raith observe, the effect of introducing the financial constraint results in asymmetric production costs—it is as if the financially constrained firm has higher costs—with predictable implications for the equilibrium in the product market. Relative to the symmetric outcome in which neither firm is leveraged, the equilibrium with a leveraged firm has lower output for the leveraged firm, higher output for its rival, lower aggregate output, and higher prices for consumers.

Povel and Raith demonstrate that the output of the leveraged firm is a "U-shaped" function of its level of internal finance (retained earnings). The effect of a change in internal finance on output depends on the marginal cost of debt finance, which in turn depends on the interplay of a cost and revenue effect. When the leveraged firm increases its output, it requires additional finance–the cost effect. On the other hand, its gross profits also increase as it moves closer to the Cournot output—the revenue effect. The cost effect implies a larger loan, but the revenue effect a higher expected repayment. The cost effect raises the marginal cost of debt finance, leading to a lower output level, the revenue effect reduces the marginal cost of debt finance, leading to a higher output level. At positive and moderately negative levels of internal finance the cost effect dominates, while for sufficiently negative levels of internal funds the revenue effect dominates, until a level is reached beyond which finance is not available.

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[195] If variable production costs were zero, breaking the link between its borrowing and output decisions, the

The conglomerate merger scenario of interest involves pre-merger two leveraged firms, with the effect of the merger being to eliminate the requirement for one of them to seek external financing. This situation is not explicitly considered by Povel and Raith. However, their results suggest that while the elimination of the constraint on internal finance would harm its leveraged rival, consumers would benefit. The reduction in output of the leveraged firm would typically be less than the increase in output of the merging firm, leading to an increase in output and a decrease in prices, thereby benefiting consumers. Unless the leveraged firm had lower costs or there was some other asymmetry which would make the transfer in output inefficient, the elimination of leverage is also efficiency enhancing.

6.2   Leverage and Coordination

The extent to which leverage affects the ability of firms to coordinate the exercise of market power has been explored by Maksimovic (1988) and Damania (1997). Both explore the effect of leverage on the sustainability of coordination in a repeated Cournot game. The two papers differ only in their assumptions regarding demand. Maksimovic assumes known and constant demand from period to period. Damania instead assumes that firms commit to their output each period and then demand is realized. While demand is stochastic, it is also stationary, i.e., it varies around a stable mean.

Maksimovic, with constant and known demand, establishes that leverage makes coordination more difficult to sustain, because it enhances the profitability of cheating. The reason is that limited liability protects shareholders from bearing the full cost of punishment from a deviation. Consequently, a leveraged firm has more of an incentive to deviate than a non-leveraged firm. Increases in its debt do not affect its punishment profits, but reduce the return to equity from the coordinated equilibrium. Hence increases in debt levels make coordination more difficult. This suggests that a non-horizontal

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leveraged firm would produce the Cournot output.

merger that eliminates leverage for the maverick firm, the firm that is just indifferent between cooperating and deviating and who limits the extent of coordination, will have a coordinated effect. The difficulty, as with all coordinated effect theories of competitive harm from a merger, is demonstrating that the sustainability condition for the merged firm is the binding constraint on coordination and that elimination of leverage will change its willingness to coordinate.[196] A caveat is that in Maksimovic's model debt is exogenous. It is not immediately clear how robust the result that leverage is destabilizing is to allowing the firm and its creditors to enter into optimal contracts, given repeated interaction in the product market, in an environment where there is a role for debt, i.e., asymmetric information.

Damania, in the Brander and Lewis framework, shows that leverage makes coordination more sustainable because leverage makes firms more aggressive when they punish defections by reverting to the Cournot-Nash equilibrium—which as we have seen in the Brander and Lewis model involves more aggressive behavior, the more leveraged the firms. Hence leveraged firms can promise a more severe punishment if there is a defection. Because Damania's model is based on Brander and Lewis, it is subject to the same criticisms, discussed above.

6.3   Financial Predation

The modern theory of finance focuses on the role of asymmetric information as an explanation for capital market imperfections. This literature highlights the role moral hazard, adverse selection, and difficulties determining profits play in determining the terms of finance and creating constraints on the access to capital for firms. The terms under which firms are financed often designed to mitigate the costs associated with these asymmetries of information, i.e., they are designed to try and minimize costs of agency.

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[196] See the discussion in Section 5.1 above.

Incentive problems arise because of information asymmetries. Informational asymmetries create agency problems because they provide managers with the opportunity to pursue their own objectives, which are not necessarily in the best interests of those providing external finance. In particular, managers can exert suboptimal effort or divert resources of the firm towards uses that are in their interests, but which reduces the return of those who provide finance. As Bolton, Brodley, and Riordan observe (2000, p. 2286) "In supplying capital investors face agency or moral hazard problems: the managers of the firm may take excessive risks, shield assets from creditors, dilute outside equity, fail to exert sufficient effort, or otherwise fail to protect investors' interests." The costs associated with (i) providing incentives; (ii) monitoring managers; and (iii) the inability of (i) and (ii) to perfectly align the interests of managers with the interests of those providing finance are called agency costs.

An interesting question is whether solutions to the firm's agency problems leave it vulnerable to predation by its financially unconstrained rivals. The theory of financial predation illustrates that a financially constrained firm is at risk of predation if its external sources adopt the following incentive scheme to insure repayment of capital to investors: finance is advanced in stages with the condition that further finance will not be available if the firm reports poor profits (which as above are unobservable or unverifiable) in early stages. The threat that the managers will not have access to future streams of profits if they reports low profits—because the firm is then liquidated—is the means to insure that a high profit firm does not pretend to be a low profit firm, diverting the difference to the benefit of the managers. As a result there is an opportunity for rival firms to induce the exit of the constrained firm by reducing its profitability, thereby decreasing the probability that it will receive further finance and increasing the probability that it will exit the market.[197]

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[197] Cestone (1999) and Phillips (1993) develop similar models where the availability of finance in the second period depends on financial performance in the first period. They make different assumptions regarding the nature of the asymmetric information. Cestone develops a model of moral hazard, while Phillips explores a model of adverse selection. In Cestone the threat of termination insures effort by managers, while in Phillips it insures truthful revelation of profit opportunities. The Phillips model is

Bolton and Scharfstein (1990) model the agency problem that arises because profits are unobservable to outside investors and investigate how this (i) makes the firm vulnerable to a well financed rival and (ii) how the constrained firm and its investors might alter the terms of their contract to minimize the threat of predation. They uncover a relevant trade off: contracts that minimizes agency costs maximize the threat of predation, while the contract that minimizes the threat of predation, maximizes agency costs. The optimal contract therefore trades off agency costs and the threat of predation, but does not eliminate the threat of predation.

Bolton and Scharfstein assume two firms and two periods. Output is homogenous and the costs of the firm identical. Each period firms incur a fixed cost of f to stay in the market. The firms differ in how they can finance this cost. One firm has "deep pockets" enabling it to finance it internally (firm *A*). The other firm (firm *B*) must finance its fixed costs by raising funds externally. Gross profits are uncertain and can either be high (π_h) or low (π_l). The probability they are low is known to all and equal to p_h. Bolton and Scharfstein assume that production is unprofitable if realized profits are low: $f > \pi_l$. On the other hand, in every period expected profits ($\bar{\pi}$) are positive:

$$\bar{\pi} = (1 - p_h)\pi_l + p_h\pi_h > f .$$

Agency problems arise because realized gross profits are not observable by investors, only the firm. Outside investors know that profits will either be π_h or π_l. The unobservability/unverifiability of gross profits means that a first-best contract contingent on realized profits is not optimal. The firs-best contingent contract would specify that the firm pay π_l if low profits are realized, implying a loss to investors of $f - \pi_l$, and, depending on the distribution of bargaining power, some amount between

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discussed in Maksimovic (1995). See also Poitevin (1989) for a model where an entrant is vulnerable to predation because its lack of a track record means that to signal to financial markets that it is high quality it must be more leveraged than its incumbent rival. This differential in leverage makes it vulnerable to predation.

$R_{\min} = \dfrac{f - (1 - p_h)\pi_l}{p_h}$ and $R_{\max} = \pi_h$ if high profits are realized. If the payment is $R_{\max}$ then investors have all of the bargaining power and receive all of the profits. If the firm has all of the bargaining power the minimum payment required for investors to break even (on average) is $R_{\min}$.

If profits are not observable, this contract is not incentive compatible since the firm has an incentive to always report low profits and investors will not break even. And since they will not at least break even, they will not finance the firm. A contract insuring that investors will break even cannot be implemented if there is only one period of production. In order to provide the firm with an incentive to report and pay more than low profits, investors have to have a mechanism to punish low profits. The way this is done in Bolton and Scharfstein is to refuse to finance the firm in the future, i.e., in the second period, unless it makes its debt repayment in the first period. It is assumed that $f > \pi_h - \pi_l$ so that the firm requires external finance to produce in the second period regardless of the profits in the first period.

6.3.1 *Agency without Predation*

In this subsection we discuss the optimal contract between investors and the firms when they do not respond to the threat of predation. This contract is optimal because it minimizes, but does not eliminate, agency costs. Assume first that the investors fund first period production. Then the contract requires a payment of r_i at the end of the first period if the firm reports π_i. Based on its reported profits, the investor decides to finance second period production with probability β_i. If the firm is funded in the second period, then the payment to investors at the end of the second period can only be contingent on the reported profits in the first period. Because there is not a third period, the firm has an incentive to report the profit requiring the smallest repayment at the end of the second period. Denote the payment at the end of the second period contingent on first period reported profits as R_i.

Assuming, following Bolton and Scharfstein, that investors have all of the bargaining power, the optimal contract maximizes the return of the lender. This means that r_i, β_i, and R_i are chosen to maximize the return of the investor

$$(1 - p_l)[r_l + \beta_l(R_l - f)] + p_h[r_h + \beta_h(R_h - f)] - f \tag{82}$$

where $(1 - p_l)[r_l + \beta_l(R_l - f)$ is the expected return if low profits are reported in the first period, $p_h[r_h + \beta_h(R_h - f)]$ is the expected return if high profits are reported in the first period, and the last f is the cost of funds advanced in the first period. The expected returns assume the firm truthfully reports its profits, which the firm will be induced to do by the terms of the contract.

The parameters that define the contract— r_i, β_i, and R_i —are chosen subject to three (binding) constraints. The first constraint insures that the firm finds it profitable to truthfully report first period profits when they are high. The incentive compatibility constraint for the firm is

$$\pi_h - R_h + \beta_h(\bar{\pi} - R_h) \geq \pi_h - R_l + \beta_l(\bar{\pi} - R_l) \tag{83}$$

The left-hand side of (83) are the firm's profits if it truthfully reports high profits, the right-hand side its profits if it reports low profits when high profits are realized.[198] The advantage of misreporting, the increase in first period profits equal to $R_h - R_l$ must be less than the disadvantage, the reduction in expected profits in the second period. In addition the contract must respect limited liability constraints. In the first period these are $\pi_i \geq r_i$, which simply requires that the payment in the first period cannot exceed first period profits. In the second period the required payment cannot exceed the sum of low profits and retained earnings from the first period, i.e., $\pi_i - r_i + \pi_l \geq R_i$.

Bolton and Scharfstein show that the firm will be funded if

$$\pi_l - f + p_h(\bar{\pi} - f) > 0, \tag{84}$$

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[198] Recall that $\bar{\pi}$ are the expected profits in a period.

where the left-hand side of (84) is the expected return of the investor under the optimal contract. The optimal contract specifies: $r_l^* = \pi_l$, $\beta_l^* = 0$, $r_h^* = \bar{\pi}$, $\beta_h^* = 1$, and $R_h^* = \pi_l$. The optimal contract does not eliminate the agency problem. Funding in each period is profitable, but (84) indicates that for some values funding will not be provided in the first period even if $\bar{\pi} > f$. Moreover, if first period profits are low, the firm is not financed in the second period, $\beta_l^* = 0$. Reducing the probability of refinance if low profits are reported has two benefits: (i) it saves the investor from loses in the second period (recall that $f > \pi_l$) and it allows the investor to extract more from the firm when it reports high profits. Similarly, increasing the probability that the firm will be refinanced also relaxes (83), allowing the investor to extract more from the firm when there are high profits.

The implications for product market competition of this optimal contract are interesting. They provide the unconstrained firm with an opportunity to prey on the constrained firm. Suppose that firm A's profits if it is a monopolist in the second period are π^m and its profits if it shares the market with firm B are π^d. To easily introduce the possibility of predation, suppose that at cost c firm A can reduce the probability of high profits from p_h to p_p. Given a contract between firm B and its creditors with refinancing parameters (β_h, β_l) the gain to predation is $(\beta_h - \beta_l)(p_h - p_p)(\pi^m - \pi^d)$. If this is greater than c the unconstrained rival has an incentive to prey. The gain from predation is increasing in $(\beta_h - \beta_l)$, which is maximized when $\beta_l^* = 0$ and $\beta_h^* = 1$, the values associated with the optimal debt contract! Firm A will prey if the gain is greater than the cost or

$$(\beta_h - \beta_l) > \frac{c}{(p_h - p_p)(\pi^m - \pi^d)} = \Delta \tag{85}$$

Predation is more likely to be profitable the lower its costs (c), the more effective it is at reducing the probability of high profits (the larger p_p), the greater the gain in profits

from monopolization (the larger $\pi^m - \pi^d$), and the more sensitive the financing contract to poor performance (the larger $\beta_h - \beta_l$).

6.3.2 Agency and Predation

It might be argued that if (85) is true, then firm B and its creditors should adapt the terms of their contract to minimize the profitability of preying. They can do this by decreasing $\beta_h - \beta_l$, which involves either increasing the probability of refinancing the firm even if low profits are realized, i.e., increasing β_l, or adopting a "shallow pocket" strategy, i.e., decreasing β_h. The problem with increasing β_l is that it rewards the firm for under reporting its profits.

The optimal contract which deters predation involves adding another constraint to the maximization problem. The constraint which makes predation unprofitable is

$$(\beta_h - \beta_l) = \frac{c}{(p_h - p_p)(\pi^m - \pi^d)} = \Delta \tag{86}$$

Bolton and Scharfstein show that the optimal contract that deters predation entails $r_l^* = \pi_l$, $\beta_l^* = 0$, $r_h^* = \Delta\bar{\pi} + (1-\Delta)\pi_l$, $\beta_h^* = \Delta$, and $R_h^* = \pi_l$. The predation-deterring contract has a lower expected return for the investors and a lower probability of refinancing. The payoff to the investor from adopting this contract is:

$$\pi_l - f + \Delta p_h(\bar{\pi} - f) \tag{87}$$

Whether predation is deterred depends on whether the left-hand side of (84) is greater (predation not deterred) or less (predation is deterred) than (87). Deterrence is preferred if and only if[199]

$$\Delta p_h > p_p. \tag{88}$$

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[199] Snyder (1996) shows that predation can still be deterred even if firm B and investors can renegotiate their contract after the incumbent decides to prey or not but before first period profits are revealed. Anticipating this firm *A* might ignore the ex ante terms of the contract when deciding whether to prey or not. Snyder shows that renegotiation does not completely destroy the commitment value of the initial contract to deter predation. It does, however, result in fewer cases of initial funding for firm *B* and there are fewer cases in which the optimal contract deters predation.

6.3.3   Antitrust Implications of Financial Predation Models for a Conglomerate Merger

The Bolton and Scharfstein model indicates the conditions under which a financially unconstrained firm has an incentive to monopolize by inducing the exit of a rival by exclusionary or predatory tactics. The model does not specify the tactic used, only that it involves costs of c for the monopolizing firm. The tactic could be reducing prices, tying,[200] or any other tactic, or combination of tactics, that reduce the profits of its rival.

Bolton, Brodley and Riordan (2000, pp. 2290-2292) have suggested the following elements are required to show proof of a financial predation strategy:

(i)   The prey depends on external financing.

(ii)   The financing of the prey depends on its initial performance.

(iii)   Predation reduces the prey's initial performance sufficiently to threaten continued financing of the prey and therefore its viability.

(iv)   The predator is aware and understands the reliance of the prey's external financing on its initial performance.

(v)   The predator can finance its predatory activities internally or does not have the similar constraints as the prey.

In addition, Bolton, Brodley and Riordan (p. 2264) would require establishment of a facilitating market structure, probable recoupment, establishing that price is below cost (for a predatory pricing case), and the absence of an efficiency justification.[201]   Where the exclusionary action is not based on predatory pricing, the onus on the plaintiff is to show that the firm engaged in behaviour that is only profitable because it induces the exit

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[200] Whinston (1989, pp. 248-249) explores in this context how a dominant firm could engage in mixed bundling of independent goods to induce exit of a rival when consumers have heterogeneous preferences for the monopoly good.

[201] A facilitating market structure means a finding that the market structure is consistent with the exercise of sustainable market power, typically high market shares and barriers to entry.

of its rival. Bolton, Brodley, and Riordan (p. 2287) observe that agency problems and the scope for financial predation "are particularly acute in the financing of new enterprises." The reason is that the cash flow of a new enterprise is particularly uncertain, and as a result initial losses are typically greater than expected, giving rise to the possibility and concerns over moral hazard problems.   In these instances the use of contracts where financing is provided in stages subject to adequate performance is common.

The difficulty in bringing suit to enjoin a conglomerate merger case based on a theory of financial predation is that the action is prospective. This means that the enforcement agency has to demonstrate not that the merged firm has engaged in a "scheme of predation and supporting evidence" ((i) to (v) above) the requirement for a predation case. Rather it will have to demonstrate that post-merger the firm will have the ability and the incentive to engage in predation: (i) to (v) must be established ex ante, not ex post, and the profitability of predation demonstrated, i.e., recoupment.   Finally, the initial condition for considering such a case theory is that the conglomerate merger creates an asymmetry in access to internal funds which creates the precondition for financial predation.

7.0   Efficiency Rationales for Non-Horizontal Mergers

The focus of the preceding sections has been on identifying theories of anticompetitive harm associated with non-horizontal mergers. In this section we briefly discuss some of the efficiency advantages associated with vertical integration, exclusive dealing, and tying.[202] The proposed framework introduced in Section 2.3 for dealing with non-horizontal mergers requires that after an anticompetitive effect is indicated, the parties to the transaction have an opportunity to demonstrate that the efficiency benefits from the transaction are greater than, and will offset, the harm associated with the increase in market power—according to either a consumer welfare standard or a total welfare standard. Much of the controversy associated with non-horizontal merger enforcement arises from the widely held view that anticompetitive harm from such a transaction is unlikely (and if present is difficult to identify) and therefore that the motivation for non-horizontal mergers is not to enhance or preserve market power, but to realize efficiencies.[203]

Since there is considerable overlap, and the objective is not to be exhaustive, but representative, the approach here is to indicate in general the types of efficiencies associated with non-horizontal mergers, rather than provide a discussion by type of behaviour (vertical merger, tying, bundling, exclusive dealing etc.) In general efficiencies can arise because enhanced coordination made possible by the non-horizontal merger allows for (i) production efficiencies and savings; (ii) internalization of vertical externalities and alignment of incentives; and (iii) transaction cost savings, including mitigating opportunistic behaviour.[204]

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[202] For more extended discussion and references see, for vertical mergers Fisher and Sciacca (1984) and Riordan and Salop (1995); on tying Ahlborn, Evans, and Padilla (2003), Rey, Seabright, and Tirole (2001), and Evans, Padilla, and Salinger (2003), and for exclusive dealing Ornstein (1989) and Jacobson (2002).

[203] See, for example, Sunshine (1995) and Riordan and Salop (1995), both of whom observe that the anticompetitive implications from horizontal mergers are much easier to understand/identify than a vertical merger, while for efficiencies the opposite is true.

[204] Some might argue that all of these efficiencies arise because the enhanced coordination alleged to follow from the merger reduces transaction costs. In a world of zero transaction costs contracts would be complete and coordination to realize efficiencies achieved independent of patterns of ownership.

Two other types of efficiencies are not discussed in this section: pricing externalities and inefficient market structure. The pricing externalities, double marginalization and the Cournot effect, have been discussed at length *supra*. Neither of these efficiency gains should automatically be presumed.   Double marginalization might not be an issue pre-merger because of efficient contracting practices: the importance of the Cournot effect is reduced if there is price discrimination pre-merger. In the discussion of the efficiency effects of non-horizontal mergers that result in entry deterrence or the exit of a rival, the issue of duplication of fixed costs and an inefficient versus efficient number of firms has been implicitly addressed. In many instances, we found that behaviour that resulted in a reduction in the number of competitors could not be presumed to harm total welfare, even if consumers were harmed, since there was also fixed cost savings.

Production Efficiencies and Cost Savings

A number of different production efficiencies and cost savings can arise because of the enhanced coordination possible from a non-horizontal merger.[205] In a vertical merger, one efficiency already considered is the elimination of inefficient input substitution which results in lower costs.[206] Riordan and Salop (1995, pp. 523-524) point to other potential efficiencies from coordination in both design and production made possible by a vertical merger, including lower costs, higher quality, shorter lead times, improved quality control, reduced costs of inventory, optimized production runs etc.

Transaction costs are the costs incurred to negotiate, reach, and enforce agreements. Efficiencies are realized from a merger, from this perspective, because in a world of positive transaction costs, different patterns of organization will have different transaction costs. A merger which reduces transaction costs will allow efficiencies to be realized, since the reduction in transaction costs will make the activities required to realize these benefits profitable. In the text we focus on the activities which the assumed decrease in transaction costs allow to be realized post-merger.

[205] The coordination possibility discussed here is between the units that were separate ex ante, but post-merger are under common ownership. This is to be distinguished from the enhanced coordination between independent entities post merger that gives rise to a coordinated effect.

[206] See the discussion in Section 3.1.2.

In the context of bundling of complements into systems, rather than allow consumers the choice of assembling compatible components, there are a number of reasons for why it might be more efficient for firms to assemble systems. Lower cost assembly by a firm can arise due to expertise, knowledge and skill advantages that the firm has relative to most consumers, as well as economies of scale. In many, if not most, instances firms have the requisite expertise to assemble the system, the knowledge of which components should be combined, and can do so at lower cost. Moreover, there may be economies of scale, scope and learning in production and distribution which make it efficient for a firm to produce a range of products or to bundle a number of products together. Indeed the fixed costs of introducing an unbundled option for consumers so that they can design their own product from the ground up may not be justified by the benefits. Evans, Padilla, and Salinger (2003) emphasize how the role of fixed costs associated with a product offering results in bundling/tying that limits the ability of consumers to assemble their own systems. The existence of such fixed costs means that even in competitive markets there will be restrictions on product offerings. The two examples they use to illustrate the argument are the inclusion of bread with most meals at a restaurant and the inability to custom design a newspaper, so that subscribers only receive and pay for the sections they want.[207]

Vertical Externalities and Exclusivity

Externalities arise when the actions of one entity directly affect the welfare of another entity. The entities might be an upstream and downstream firm, two downstream firms that both retail the products of the same manufacturers, or two manufacturers. Advantages from enhanced coordination from exclusivity can arise from (i) alignment of incentives within the vertical structure; (ii) prevention of free-riding; and (iii) quality certification, creation, and maintenance.

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[207] The fact that the internet may make it possible for custom design of an electronic version, because it lowers the cost of doing so, underlies their point.

The potential for incentive effects to arise is most clearly seen in the case of a merger between a retailer and a manufacturer, leading to customer foreclosure. Incentive effects arise when retailers can invest in product quality and sales effort. The incentives by the retailer to invest in sales effort and incentives will not be "fragmented" across the products of different manufacturers when there is customer foreclosure. Furthermore, integration means that manufacturers can share information regarding market conditions and their promotional plans/activities with their retailer and be less concerned that it will be leaked intentionally, or inadvertently, to a competing manufacturer. Exclusivity also eliminates any incentive the retailer might have to lower its costs and increase its profits by substituting lower quality products. This will be more difficult if the retailer is not able to carry lower quality brands from rival manufacturers.

Similarly, a vertical merger more closely aligns the welfare of a downstream firm with that of the upstream firm. Investments by either that increase demand or quality will not take into account the benefit that the other derives when they are separate, but will be internalized post-merger. In the context of systems of complements, integration might solve the chicken and egg problem: successful introduction of a system requires the availability of all components.

In the absence of an exclusive dealing arrangement or merger between a manufacturer and its retailer, the incentive for the manufacturer to invest in the retailer and its product are reduced because of potential free-riding (benefiting from an activity without bearing any of the costs) by other manufacturers. Instances of free-riding that can be eliminated through exclusivity through merger include:

(a)   free-riding by rivals on demand created through investments in product quality and promotion. In this case the investments by the manufacturer creates demand for the product category, which its rivals attempt to capitalize on by providing financial inducements (such as higher margins) to retailers to switch customers.

(b)   free-riding by rivals on product innovation and design. This case is possible when design and innovation are not completely protected by intellectual property rights. If rivals can easily copy and sell imitations, there will again be an incentive for them to induce retailers to switch customers to their (lower) priced imitations.

(c)   free-riding by rivals on investments in retailers. A manufacturer will have less of an incentive to make investments in its retailer network if the benefits to those investments are not specific to it. For instance, investments by the manufacturer in the sales force of the retailer (through technical education and training) or store fixtures likely benefit its rivals.

The last vertical externality highlighted in the literature is quality assurance. Joint provision of the components that make up a system avoids disputes and disagreements over which component is to blame when the system does not function, at all, or below its capabilities. Joint provision insures that firms are able to develop and maintain reputations for quality. Moreover, joint provision may be a mechanism that allows a firm to signal that its system is high quality. It can offer one component (typically the one that is more durable) at a low price to signal high quality, since the only way it will be able to recoup its initial losses on the durable component is through its sales and margins on other components, sales which will only be realized if quality is high.

Transaction Costs and the Holdup Problem

A non-horizontal merger can reduce transaction costs and promote investment in specific assets by mitigating more effectively the hold-up problem. An asset is specific to a trading relationship (i.e. between a given buyer and a given seller) if it has no value either to alternative buyers or sellers.[208] More generally, there is some degree of asset specificity if the asset is less valuable when redeployed to another use (i.e. an alternative trading partner). The degree of asset specificity is related to the extent to which the cost

of the asset is sunk, i.e. non-recoverable if the trading relationship is terminated. The incentive difficulty associated with investments in relationship-specific assets is known as the hold-up problem. The hold-up problem involves opportunistic behaviour by a buyer (lower price) or seller (higher price) who attempt to renegotiate the terms of trade after investment in the asset. For instance a buyer may have agreed to pay average total cost pre-investment, but post-investment, the seller will also be just willing to supply even if it receives only its average variable costs if its capital costs are sunk. Anticipating that the buyer may take advantage of the change in the seller's incentives post-investment, the seller will be reluctant to make the required investment. If the transaction costs associated with eliminating the risk of hold up through private contracts are too large, then one alternative is merger.

Inefficiency of Non-Horizontal Mergers

It should also be recognized that a non-horizontal merger involves an increase in the scope/breadth of a firm. Increases in the scope of a firm's activities can often lead to changes in the nature of remuneration and incentives that result in a loss in cost efficiency.[209]

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[208] See Church and Ware (2000) Chapter 3 for a detailed analysis of the role of exclusivity clauses in promoting investment in relationship-specific assets.
[209] See the discussion in Church and Ware (2000) Chapter 3 for a summary of the incentive effects that limit the size of firms.

8.0   References

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9.0   Appendix I: Glossary

bundling	Bundling occurs when consumers cannot buy products individually, but instead are required to purchase a group of products collectively in fixed proportions.
complementary product merger	Occurs between producers of complements that are consumed together by final consumers.
conglomerate merger	Neither an horizontal or vertical merger.
consumer welfare	A consumer welfare standard can be used to trade off efficiencies and market power. With a consumer welfare standard, the trade off between efficiencies and market power depends on the net effect on consumer surplus, which in the absence of changes to quality or product variety, involves an assessment of the effect on the price paid by consumers. Consumer surplus is a measure of the gains from trade that accrue to consumers. It is the sum over all units of the difference between what a consumer was willing to pay for a unit less what they actually had to pay for that unit.
coordinated effect	Merger makes it easier for firms to collectively exercise market power.
Cournot effect	Merger between suppliers of complements leads to lower prices for each.
customer foreclosure	Firm stops buying inputs from upstream competitors.
double marginalization	Downstream firm marks up over its marginal cost, which because of market power upstream exceeds social marginal cost.

downstream	The downstream firm can be identified on the basis of three alternatives: (i) timing of production, (ii) variable proportions; and (iii) direction of trade. If (i) is used it is the firm whose production occurs second. If (ii) is used the downstream firm is the one that chooses input proportions. If (iii) is used the downstream firm is the buyer.
efficient	An efficient outcome maximizes total surplus. Total surplus is the sum of producer and consumer surplus. Producer surplus is the difference between revenues and avoidable costs: it is a measure of the gains from trade that accrue to firms. Consumer surplus is a measure of the gains from trade that accrue to consumers. It is the sum over all units of the difference between what a consumer was willing to pay for a unit less what they actually had to pay for that unit.
exclusionary conduct	Conduct that reduces the profitability of a rival firm.
financial leverage	A financially leveraged firm finances its operations through a combination of debt and equity. The greater its relative reliance on debt, the greater its financial leverage.
horizontal merger	Occurs between firms that produce substitutes in the same antitrust market.
inefficient	When economists observe that a conduct is inefficient, they mean that it results in a decrease in total surplus. Because consumer and producer surplus are dollar measures of changes in welfare, when total surplus decreases from a change, for

instance a vertical merger, then those made better off by the change—the winners—could not compensate those harmed by the change—the losers—and still be better off, i.e., winners. An efficiency enhancing change increases total surplus, implying that winners could compensate losers and still be better off. It does not imply that compensation will be paid, only that the change creates enough wealth that it could be.

foreclosure, complete (vertical merger)	Firm withdraws from the upstream market, either not selling to downstream firms or not buying from upstream firms.
foreclosure, partial (vertical merger)	Firm sells to downstream firms at a higher price post- merger.
foreclosure (complementary products)	Making complementary products unavailable to consumers who purchase from rivals.
input foreclosure	Firm stops supplying downstream competitors with inputs, leading to an increase in the price of the input.
leveraging	A firm with market power in market *A* extends its market power into market *B*.
mixed bundling	Mixed bundling occurs when consumers can buy the individual products separately, or pay in total a lower price if the goods are bought as a bundle.
neighboring products	Products may be substitutes or independent in consumption, but demand at the level of the firm depends on the extent of its product range, so that from the perspective of the firm the products will be complements. Alternatively, the products are independent of each other, but are generally sold to

the same set of consumers, i.e., they share the same distribution channel.

portfolio effects	Variety advantage gives a firm a demand advantage and reduces the revenues of its rival.
pure bundling	Pure bundling occurs when consumers cannot buy products individually, but instead are required to purchase a group of products collectively in fixed proportions.
raising rivals' cost	Conduct that raises either the marginal or average cost of a rival.
range effects	Same as portfolio effect.
reducing rivals' revenues	Conduct that diverts demand away from a rival firm.
requirements tying	Occurs when consumers have to purchase all of their *B* requirements in order to buy *A*.
total welfare	A total welfare standard can be used to trade off efficiencies and market power. With a total welfare standard, the trade off between efficiencies and market power depends on the net effect on total surplus. Total surplus is the sum of producer and consumer surplus. Producer surplus is the difference between revenues and avoidable costs: it is a measure of the gains from trade that accrue to firms. Consumer surplus is a measure of the gains from trade that accrue to consumers. It is the sum over all units of the difference between what a consumer was willing to pay for a unit less what they actually had to pay for that unit.

tying	Tying occurs when purchase of good *A* (the tying good) requires that consumers also purchase good *B*.
unilateral effect	Merger creates market power for a firm.
upstream	The upstream firm can be identified on the basis of three alternatives: (i) timing of production, (ii) variable proportions; and (iii) direction of trade. If (i) is used it is the firm whose production must occur first. If (ii) is used the upstream firm does not choose input proportions. If (iii) is used the upstream firm is the seller.
vertical merger	Occurs between firms located at different stages of production or distribution, with one producing an input used by the other.

10.0   Appendix II: Questions in the Terms of Reference

a) *To what extent are foreclosure scenarios in vertical and conglomerate settings*
    comparable?

> Foreclosure scenarios involving vertical mergers—input and customer
> foreclosure— are discussed in Sections 3.2 and 3.3. Foreclosure in a
> conglomerate setting, involving complements and independent goods is discussed
> in Section 4.0. Customer foreclosure and foreclosure in the conglomerate setting
> are similar in that they both involve reducing the revenue of rivals. However, in
> the case of customer foreclosure it is a scale effect that leads to an increase in
> market power for the foreclosing firm upstream, while in the case of
> conglomerate mergers it involves changes in pricing incentives and, especially,
> demand effects that shift demand away from rivals.

b) *Within the context of conglomerate mergers, does the likelihood of foreclosure*
    depend on whether or not the companies involved supply complementary products,
    substitutable products, or products being sold to the same pool of customers?

> Logically consistent stories involving foreclosure in the context of conglomerate
> mergers exist for mergers involving complementary products (Sections 4.2.2,
> 4.2.3, 4.2.4, 4.3.3, and 4.4.1) and independent products (4.2.1 and 4.3.2). While
> the model of Ma in Section 4.4.2 involves substitute products ex post, they are
> complements ex ante.   Both the Ma and Church and Gandal model of Section
> 4.4.1 are based on variety effects. Consumers select a service provider (in Ma,
> which really amounts to a fixed cost of service being incurred) or a hardware
> technology (in Church and Gandal, the price of hardware is equivalent to the fixed
> cost of service in Ma) in part based on the variety of products available. The
> preference for variety arises in Church and Gandal from a love of variety, in Ma,
> from uncertain preferences. These models suggest an analysis appropriate to

circumstances where fixed costs preclude consumers from frequenting multiple suppliers when they value variety. The variety effect makes the products complements from the perspective of firms that sell to consumers and it is the variety effect that drives foreclosure in these models.

c) *Should one, in the review of mergers, be equally concerned with scenarios which involve "raising rivals' cost" as with scenarios where primarily the revenue prospects of rivals are reduced, leading to rivals' exit or marginalization (e.g. through bundling or exclusionary pricing) ?*

In either case there are circumstances where the concern is legitimate.

d) *Within the context of "raising rivals' cost" theories, what is the relevant cost measure? (Marginal costs, fixed costs, incremental costs). In other words, what is the relevant time frame in this regard?*

The relevant cost measure depends on the nature of the behaviour that leads to the increase in the cost of rivals. In some cases it involves marginal costs, as in input foreclosure, where the ability of the rival to expand output is reduced. In other cases it is demand effects that can be interpreted as either raising average cost or reducing rivals' revenues such that they are induced to exit or are deterred from entry.

e) *Within the context of exclusionary ("predatory") pricing scenarios, what would be the appropriate way to measure "financial strength"? What are the relevant factors?*

The literature on financial predation highlights the financial strength of both the prey and the predator. For the models to apply it must be the case that the prey is financially constrained. This means that its continued access to external finance (which without it is forced to exit) requires that it meet financial targets. A

predator is not financially constrained and can finance its predation either because
it has sufficient internal resources or can access external finance without having
the agency problems of the prey. The agency problems of the prey mean that
financing is only provided in stages. The theory of financial predation is
discussed in detail in Section 6.3.

f) *What does the economic literature say about the relation between financial leverage
and the willingness to compete on the part of the financially leveraged firm?*

An extended discussion of this issue is found in Section 6.1. The weight of the
empirical and theoretical evidence suggests that leverage makes a firm less
aggressive in product markets. However, the older literature in which debt was
exogenous suggested that leverage made a firm more aggressive.

g) *How do foreclosure scenarios interact with co-ordinated effects theories ? For
example, can the threat of foreclosure be considered as an effective "retaliation
mechanism" (disciplining mechanism) in the context of sustaining tacit co-
ordination?*

This is addressed in Section 5.3.1. Though not formally addressed in the
economics literature, the logic is compelling that foreclosure from a conglomerate
merger, that reduces both the profits of the conglomerate and its competitors and
hence would not be profitable in a static context, could be an important factor in
sustaining tacit coordination. Its impact on sustaining coordination arises if it is
the natural "punishment" equilibrium firms would resort to in the event of
deviations from the coordinated outcome when coordination is tacit.

h) *How do efficiencies being brought about by mergers interact with foreclosure
scenarios? Can efficiencies lead to foreclosure?*

In both vertical mergers and complementary product mergers the elimination of pricing inefficiencies contribute to enhanced consumer welfare and foreclosure. The elimination of double marginalization lowers the marginal cost downstream of an integrating firm, creating cost asymmetries that favor the integrated firm. In Avenel and Barlet (2000) this downstream asymmetry deters the upstream entrant, enhancing the upstream market power of the incumbent. The Cournot effect leads to foreclosure in complementary product mergers, either directly as in, e.g., Nalebuff (2000) and precludes retaliation, as in, e.g., Nalebuff (2000), Church and Gandal (2000), and Choi (2004). Moreover, in vertical mergers there may be efficiency advantages from adopting a specific technology, but adoption of the specific technology may provide the basis for committing not to participate in the input market.

i)   *Within the context of complementary products, should the elimination of pricing externalities through a merger (the "Cournot effect") be regarded as merger efficiencies?*

It is a merger efficiency, but as the discussion in Section 4.3 and 4.4.1 demonstrate the Cournot effect can lead to foreclosure which harms consumers. Analysis of the effect of eliminating pricing externalities in both vertical mergers and complementary product mergers should be based on an equilibrium analysis that considers the response of the firm's rivals and their incentives to engage in counter strategies.

j)   *When do vertical or conglomerate mergers critically affect barriers to entry?*

They do not directly. When foreclosure leads to exit or deterrence of a rival that otherwise would have been in the market, the vertical or conglomerate merger reduce the revenues of a rival sufficiently to imperil its viability, thereby magnifying the importance of existing barriers to entry.

k) *What role do network effects play in the possible impact that vertical and conglomerate mergers may have? Can "leveraging" entail the development of exclusive relationships or network effects?*

Models involving complementary product mergers and network effects were considered in Sections 4.2.3 and 4.4.1. Both in the case direct network effects (Carlton and Waldman in Section 4.2.3) and indirect network effects (Church and Gandal in Section 4.4.1) it was shown that a merger between suppliers of complements could result in foreclosure.

l) *When can the long term effects be considered equally "certain" or predictable as those expected to arise in the short term ?*

The long term effects typically involve exit of a rival firm. Assuming that quasi-rents are less than fixed costs (which is what exit depends upon) means that in the absence of any other change, a rival will eventually exit when its fixed costs become avoidable. To the extent that it is less likely that the assumption of ceteris paribus holds, then long term effects based on exit could be considered less certain. However, the same exogenous changes would also likely affect the short run equilibrium as well.

The exception are the theories in Section 4.2.4 which consider the effects of tying on the incentives for R&D. R&D by its very nature is a long-run activity whose outcome is uncertain. Even if an anticompetitive effect is found ex ante, i.e. tying reduces the incentives for rivals to reduce R&D expenditures and this leads to a reduction in expected consumer welfare, it might not be realized ex post. Even with the reduction in R&D from tying the rival might still successfully innovate.

m) *The number of "stages" in the game, does it matter a lot in order to assess the likelihood of the potential anticompetitive effects ? To what extent can the number of stages in the game be associated with the length of the time horizon in which competitive harm will occur ?*

The role played by the number of stages is not related to calendar time or the length of the time horizon in which competitive harm will occur. Rather what the stages do is typically provide firms that move in initial stages with the opportunity to act strategically and commit to actions that firms which move in later stages have to respond to.

n) *"Upstream" and "downstream": does it matter at what level the bottleneck is situated?*

Rey and Tirole (2003) make the argument that where the bottleneck (i.e. monopolist) is located matters. The location matters because in their theoretical framework, there is not a commitment problem if the monopolist is downstream, only if the monopolist is upstream. They argue that a regulator may be able to structure an industry to make the monopolist upstream, implicitly identifying up and downstream in the case of perfect complements by who firms sell to. The firm which sells the system of perfect complements to final consumers is considered the downstream firm.

Input foreclosure in the literature corresponds with concern over market power upstream that is extended downstream. Customer foreclosure in the literature corresponds to concerns with market power downstream being extended upstream.

o) *Input foreclosure vs. Customer foreclosure: how comparable are the two?*

Input and customer foreclosure are exact opposites in terms of the behaviour of the vertically integrated firm. Under the "customer foreclosure" hypothesis, the integrated firm no longer sources supply from upstream competitors, but continues to supply other downstream firms. The concern with input foreclosure is that the integrated firm will no longer supply downstream firms, creating market power for its rivals upstream, which increases its market power downstream. Under customer foreclosure the objective is to create market power upstream for the integrated firm. However, to the extent that raises input prices for other downstream firms, the effect could be input foreclosure as well, reflected in higher downstream prices.

p) *How do the theories on "creating market power" through raising rivals' cost relate to "restoring market power" through solving a commitment problem ?*

An interpretation of the Hart and Tirole model is that vertical integration raises the costs to unintegrated downstream firms to infinity as they are completely foreclosed. However, like the Chicago school analysis, the Hart and Tirole analysis assumes monopoly upstream pre-merger and monopoly both up and downstream post merger. The theories which focus on creating or preserving market power typically start, and (less often) end, with imperfect competition both up and downstream.

q) *Please systematically indicate, where relevant, whether the models being discussed are typically associated with a short term effect on consumer welfare or a longer term effect (contingent on competitor exit or marginalization).*

The effect of a non-horizontal merger can be anticompetitive because post-merger the products of other producers are not as attractive substitutes as they were pre-merger, either because the merger results in an increase in their price or reduces

their quality.   This effect might arise because of a change in the marginal costs of rivals' or because a reduction in quality results in a decrease in willingness to pay for the products of rivals. These effects would be true in both the short and long run. Alternatively, the market power created by a non-horizontal merger might arise only in the long run because the merger prevents the entry or induces the exit of rivals, thereby reducing competitive constraints on the merging firm.

Models with an anticompetitive effect not contingent on preventing the entry or inducing the exit of rivals:

> Vertical Merger (Input Foreclosure)
> > Salinger and extensions (GLH)
> > Ordover, Saloner, and Salop
> > Choi and Yi
> > Chen
> > Riordan

> Vertical Merger (Customer Foreclosure)
> > Salinger
> > Bernheim and Whinston (informally)

> Conglomerate Merger (Bundling Relaxes Price Competition)
> > Carbajo et al
> > Seidmann
> > Chen

> Conglomerate Merger (Exclusionary Bundling)
> > Martin and Carbajo et al
> > Choi
> > Denicolo (relatively undifferentiated components)

Nalebuff (relatively many components comprise a system)

Conglomerate Merger (Portfolio Effects)

 Church and Gandal (Relatively differentiated hardware and

    homogenous software)

 Ma

Coordinated Effects

 Both vertical and conglomerate merger

Models with an anticompetitive effect contingent on preventing the entry or inducing the exit of rivals:

 Vertical Merger (Input Foreclosure)

  Avenel and Barlet

  Gilbert and Newbery

 Vertical Merger (Customer Foreclosure)

  Bernheim and Whinston (formally)

  Rasmussen, Ramseyer, and Wiley; Segal and Whinston

  Stefanadis

 Conglomerate Merger (Tying)

  Whinston Secondary Market

  Whinston Primary Market

  Carlton and Waldman

 Conglomerate Merger (Exclusionary Bundling)

  Denicolo   (relatively undifferentiated components)

Nalebuff (relatively few components comprise a system)

Conglomerate Merger (Portfolio Effects)
Church and Gandal (Relatively differentiated software and
homogenous hardware)

Conglomerate Merger (Financial Predation)
Bolton and Scharfstein

r) *What are the similarities and differences between vertical and conglomerate*
mergers?

Unilateral effects from a non-horizontal merger arise because it reduces a
constraint on the merging firm. This relaxation occurs either because it raises the
costs of a rival or makes their products less attractive. The increase in costs leads
either to their exit or an increase in the price of their products: in either case the
ability of consumers to substitute away from the merged firm will be reduced.
Similarly, to the extent the merger makes the products of the merged firm's rivals
less attractive, their constraint on its market power will be reduced as consumers'
willingness to substitute diminishes.

A vertical merger leading to input foreclosure and an increase in the marginal
costs of downstream competitors does not have a conglomerate merger analogue.
All of the unilateral effects stories involving conglomerate mergers are based on
reducing the revenues of rivals, just as in the case of vertical mergers that result in
customer foreclosure. With the exception of Salinger (1991), all of the customer
foreclosure theories involve scale effects. In these situations, a vertical merger
that results in a credible commitment by the integrated firm not to source supply
from competitors upstream, induces its exit or prevents its entry if the denial of

access to customers precludes its rivals from realizing economies of scale necessary for profitable entry.

Conglomerate mergers giving rise to a unilateral effect because they result in the e exit of rivals or deter their entry are based on a similar scale effect. The theories which suggest harm from tying—Whinston and Carlton and Waldman—all find tying to be profitable and exclusionary when tying reduces demand for the rival/entrant and because of scale effects makes its profits non-positive. The input foreclosure model of Avenel and Barlet (2000) has input foreclosure inducing customer foreclosure based on scale effects. The effect of a vertical merger on demand for the input upstream is two-fold. There is a direct effect on demand—sales to the downstream subsidiary of the vertically integrated firm are no longer on the market—and also an indirect effect—the market share of the unintegrated rivals is reduced because of the cost advantage of the vertically integrated firm. While it shares the direct effect with Carlton and Waldman, the indirect effect is unique.

The theories that identify the unilateral effect from a conglomerate merger due to exclusionary bundling or portfolio based foreclosure are not based on scale effects. Rather bundling or foreclosure makes the products of rivals' less attractive to consumers (at heart a quality effect) which leads to an increase in market power for the conglomerate.

In the case of exclusionary bundling, there are typically demand and price effects. The demand effect means that at pre-bundling prices rival's demand is less under bundling. The price effects are two fold: (i) the Cournot effect provides the conglomerate with incentives to reduces it prices, but (ii) this can be offset if the effect of bundling/foreclosure is to make rivals' demand significantly more inelastic.

11. Appendix 3: GLH with Asymmetric Costs

GLH assume that all firms up and downstream have the same marginal costs. In a Cournot equilibrium this means that they will all have the same output and market share. It is of some interest to consider the sensitivity of their results to asymmetric firm sizes ex ante. In this Appendix we briefly consider the effect of a vertical merger when firms upstream have different marginal costs, in which case firms with lower marginal costs will have an advantage that translates into a larger market share and profits.

Consider the simplest case in which ex ante there are two upstream and two downstream firms. Assume that the two downstream firms can transform the upstream good into the downstream good at constant marginal cost (which we normalize to zero). Suppose that the costs of production upstream are constant for each firm and that $c_2 > c_1$, i.e., firm 1 has a cost advantage. Assume linear inverse demand downstream: $P = 1 - Y$, where $Y = y_1 + y_2$ is aggregate output and y_i the output of firm i. Let x_i be the upstream output of firm i. Let w be the price of the upstream input.

Vertical Separation

In this case the two upstream firms are independent of the two downstream firms. The following are the expressions for the equilibrium values:

$$x_i = \frac{2}{9}(1 + c_j - 2c_i) \tag{A1}$$

$$w = \frac{1 + c_1 + c_2}{3} \tag{A2}$$

$$y_i = \frac{1}{9}(2 - c_1 - c_2) \tag{A3}$$

$$P = \frac{5 + 2c_1 + 2c_2}{9} \tag{A4}$$

Vertical Integration (A Single Vertical Merger)

Suppose that upstream and downstream firm 1 merge. Then the following are the expressions for the equilibrium values:

$$y_2 = \frac{1 + c_1 - 2c_2}{8} \tag{A5}$$

$$y_1 = \frac{7 + 2c_2 - 9c_1}{16} \tag{A6}$$

$$P = \frac{7 + 2c_2 + 7c_1}{16} \tag{A7}$$

$$s = \frac{2c_2 - c_1 - 1}{12} \tag{A8}$$

$$x_2 = \frac{5(1 + c_1 - 2c_2)}{24} \tag{A9}$$

$$w = \frac{5c_1 + 6c_2 + 5}{16} \tag{A10}$$

Comparing (A7) to (A4) the downstream price falls when there is a vertical merger if

$$\frac{5 + 2c_1 + 2c_2}{9} - \frac{7 + 2c_2 + 7c_1}{16} > 0 \tag{A11}$$

This is true if

$$17 > 31c_1 - 14c_2 \tag{A12}$$

which holds for all $c_2 > c_1$. This indicates that if the low cost dominant firm merges with one of the downstream firms, price downstream will fall. Three forces are at work which determine what happens to the downstream price. The elimination of double marginalization for the integrated firm lowers its marginal cost to that of the low cost upstream firm, which provides the integrated firm with an incentive to increase output downstream. The integrated firm also has an incentive to act strategically in the input market, either by reducing its supply or engaging in overbuying (which it does depends on the sign of (A8)). This raises the costs of its rivals, reducing their output and pushes

prices downstream upwards. The third effect was previously identified in our discussion of the results of Reiffen and Vita (1995) in Section 3.2.4. The unintegrated rival downstream reduces its output in response to the expansion in output by the vertically integrated firm, and as a result its demand for the upstream good falls. If the low cost firm upstream integrates, the demand effect and elimination of double marginalization dominate the raising rivals' cost effect and the price downstream falls. As in the symmetric case of GLH a vertical merger is beneficial for consumers.

For the premerger equilibrium quantities upstream to be positive the following two restrictions are required on c_1 and c_2:

$$c_1 > 2c_2 - 1 \tag{A13}$$

and

$$c_2 > 2c_1 - 1 \tag{A14}$$

This insures that the cost difference is not so large that one of the firms finds it optimal to shut down. In addition, both c_1 and c_2 must be less than 1, which is the maximum willingness to pay. It is possible to show that it is not possible for (A13) and (A14) to hold and (A8) not to hold. This means that even if the high cost firm upstream acquires a downstream firm, the downstream price will still fall.

Complete Vertical Integration

If both pairs of firms vertically merge, the equilibrium downstream price is:

$$P = \frac{1 + c_1 + c_2}{3}. \tag{A15}$$

(A15) is less than (A7) for all permissible value of c_1 and c_2, confirming that consumers will prefer the fully integrated structure.

	c_2	w_2	w_1	P_1	P_2	Q_1	Q_2	π_1
Entry	0.50	0.50	0.50	0.67	0.67	0.222	0.222	0.04
Foreclosure	0.50		0.74	0.69	0.79	0.264	0.076	0.07
Renegotiation	0.20	0.20	0.50	0.47	0.47	0.356	0.356	0.10
Renegotiation	0.40	0.40	0.50	0.60	0.60	0.277	0.277	0.05
Renegotiation (Price Discrimination)	0.20	$w_{21} = 0.20$ $w_{22} = 0.50$	0.50	0.51	0.63	0.41	0.17	0.12
Renegotiation (Price Discrimination)	0.40	$w_{21} = 0.40$ $w_{22} = 0.50$	0.50	0.61	0.65	0.28	0.20	0.06

Table 1

Simulation Results

Customer Foreclosure that Deters Entry Upstream

θ	Output without Bundling			Outputs with Bundling			Profits No Bundling		Profits Bundling		Welfare No Bundling		Welfare Bundling	
	q_{1A}	q_{1B}	q_{2B}	q_{1A}	q_{1B}	q_{2B}	π_1	π_2	π_1	π_2	Consumer Surplus	Total Surplus	Consumer Surplus	Total Surplus
-0.90	105.00	101.50	7.00	103.67	103.67	5.32	2143.75	49.00	2149.53	28.26	1145.38	3338.13	1144.01	3321.81
-0.75	42.00	38.50	7.00	40.64	40.64	5.42	820.75	49.00	826.01	29.37	483.88	1353.63	482.76	1338.10
-0.50	21.00	17.50	7.00	19.60	19.60	5.60	379.75	49.00	384.16	31.36	263.38	692.12	262.64	678.16
0.00	10.50	7.00	7.00	9.00	9.00	6.00	159.25	49.00	162.00	36.00	153.12	361.38	153.00	351.00
0.50	7.00	3.50	7.00	5.38	5.38	6.46	85.75	49.00	86.98	41.75	116.38	251.12	116.56	245.29
0.75	6.00	2.50	7.00	4.32	4.32	6.72	64.75	49.00	65.32	45.16	105.88	219.62	106.04	216.52
1.00	5.25	1.75	7.00	3.50	3.50	7.00	49.00	49.00	49.00	49.00	98.00	196.00	98.00	196.00

Table 2

Bundling: Substitutes and Complements in Martin (1999)

Number of Components	Bundle Price Firm 1	Independent Component Price	Rival System Price	Market Share of Firm 1	Profits of Firm 1	Individual Component Supplier Profits	Stand Alone Profits Individual Component Suppliers	Retaliation Profits
2	1.45	0.86	1.72	0.63	0.91	0.32	0.64	0.50
3	2.09	0.88	2.64	0.70	1.47	0.26	0.78	0.66
4	2.84	0.92	3.68	0.76	2.15	0.22	0.88	0.75
5	3.63	0.94	4.70	0.79	2.88	0.19	0.95	0.83
6	4.48	0.96	5.76	0.82	3.69	0.17	1.02	0.91
7	5.40	0.99	6.93	0.84	4.56	0.15	1.08	0.97
8	6.36	1.02	8.16	0.86	5.48	0.14	1.12	1.02

Table 3

The Effect of the Number of Components on the Impact of Bundling with System Competition

Product Differentiation (*c*)	Stand Alone Profits Pre-Merger A_1 and B_1	Pure Bundling Profits Merged Firm	Pure Bundling Stand Alone Profits A_2 and B_2	Retaliation Profits (A_2 and B_2 Merge)	All Components Supplied Independently Equilibrium Price	Bundle Price	Independent Component Price with Bundling	Retailiation Price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0.025	0.49	0.29	0.25	0.28	0.354	0.536	0.356	0.533
0.050	0.54	0.33	0.29	0.32	0.377	0.577	0.381	0.571
0.100	0.68	0.45	0.39	0.43	0.435	0.681	0.445	0.670
0.150	0.89	0.65	0.54	0.61	0.513	0.829	0.535	0.800
0.200	1.25	1.01	0.82	0.90	0.625	1.060	0.673	1.000
0.250	1.92	1.76	1.38	1.48	0.800	1.454	0.909	1.333
0.300	3.46	3.96	2.96	2.97	1.111	2.308	1.410	2.000
0.325	5.14	7.24	5.62	4.89	1.379	3.246	1.957	2.667
0.330	5.63	8.41	6.08	5.51	1.449	3.531	2.123	2.857

Table 4

Product Differentiation and the Effect of Bundling under System Competition

Product Differentiation (c)	Stand Alone Profits Pre-Merger A_1 and B_1	Pure Bundling Profits Merged Firm	Mixed Bundling Profits Merged Firm	Monopoly Profits Merged Firm	Pure Bundling Stand Alone Profits A_2 and B_2	Mixed Bundling Stand Alone Profits A_2 and B_2
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.025	0.49	0.29	1.44	0.29	0.25	1.33
0.050	0.54	0.33	1.48	0.34	0.29	1.34
0.100	0.68	0.45	1.55	0.49	0.39	1.36
0.150	0.89	0.65	1.65	0.75	0.54	1.41
0.200	1.25	1.01	1.79	1.25	0.82	1.50
0.250	1.92	1.76	2.02	2.50	1.38	1.69
0.300	3.46	3.96	2.43	8.125	2.96	2.07
0.325	5.14	7.24	2.81	37.86	5.62	2.47
0.330	5.63	8.41	2.92	97.79	6.08	2.58

Table 5

Incentives for Mixed Bundling, Pure Bundling, and Counter Merger

**Effect of Product Differentiation under System Competition**
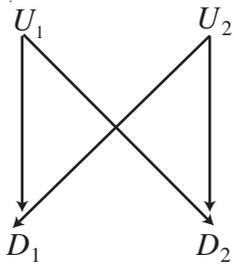
Figure 1

Unintegrated Industry Structure
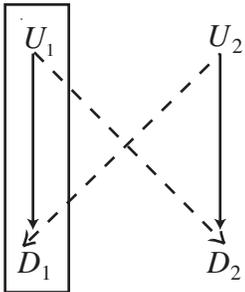
**Figure 2**

Industry Structure Post-Vertical Merger
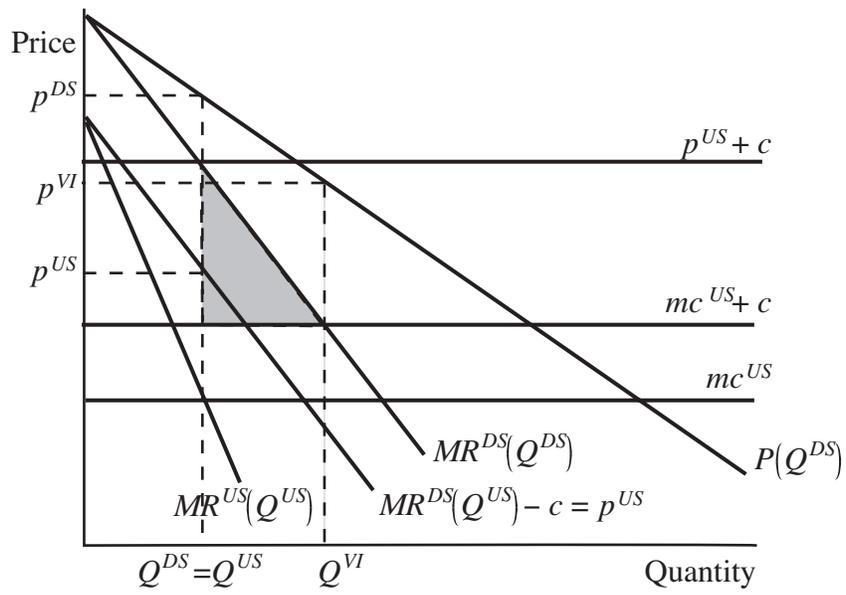
Figure 3

Double Marginalization

$R^{vi}(p_s^{DS}) = p_{vi}^{DS}$

p_s^{DS}

B

$R^s(p_{vi}^{DS}, p^{US} > mc^{US}) = p_s^{DS}$

$p_s^{DS}(p^{US})$

C

$R^s(p_{vi}^{DS}, mc^{US}) = p_s^{DS}$

$p_s^{DS}(mc^{US})$

A

$p_{vi}^{DS}(mc^{US})$ $p_{vi}^{DS}(p^{US})$ p_{vi}^{DS}
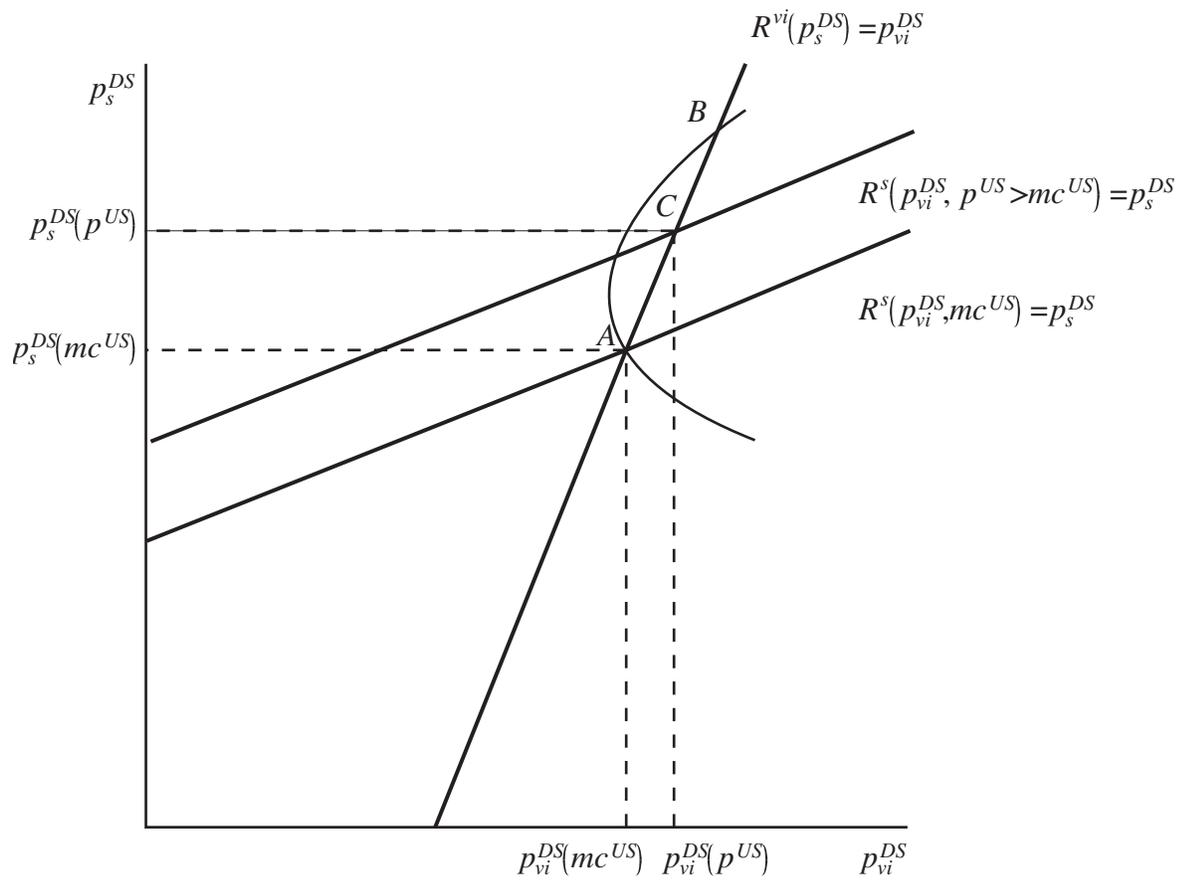
Figure 4

Ordover, Saloner, and Salop
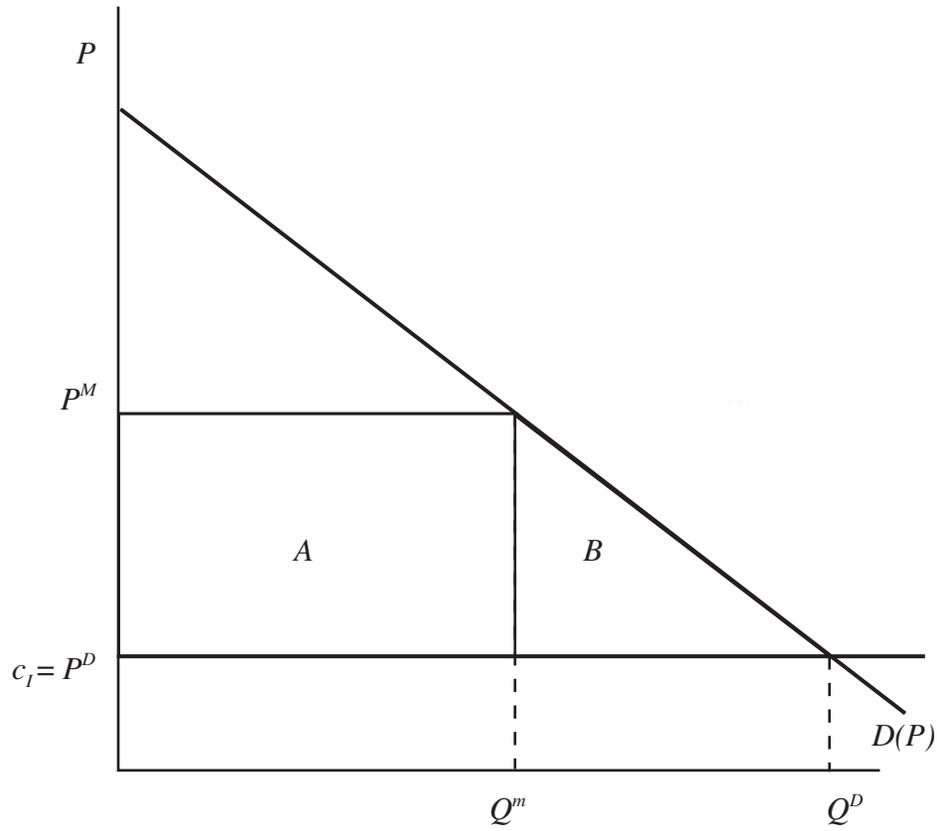
Figure 5

Non-Profitability of Exclusive Dealing
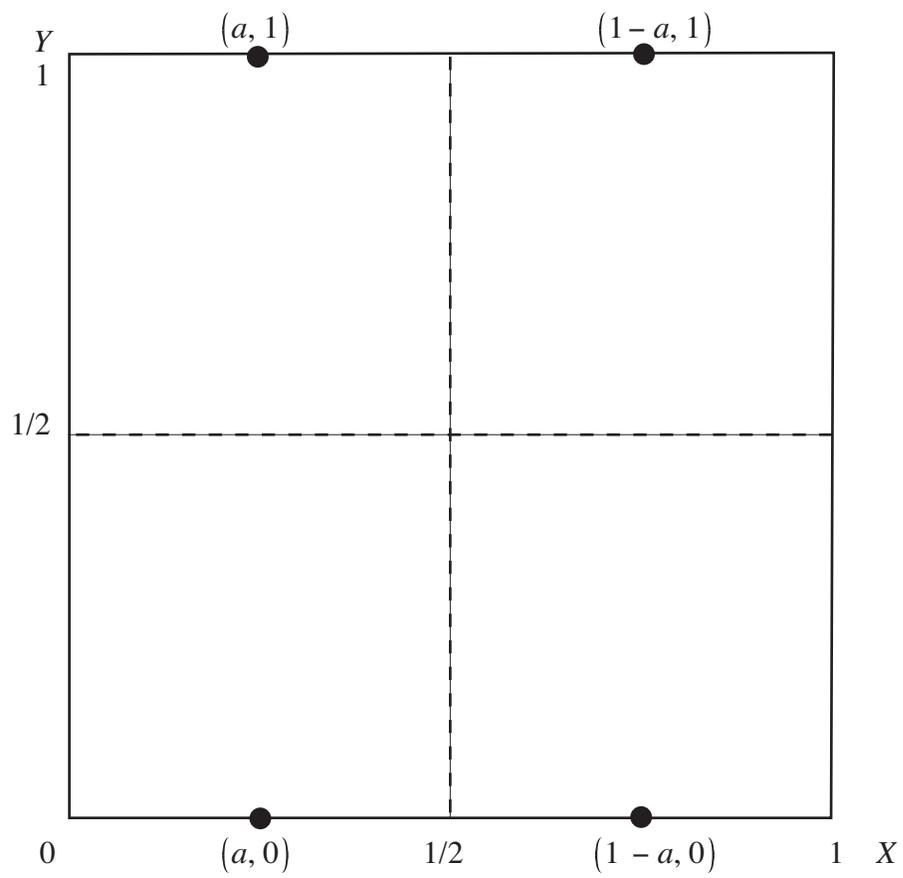
Figure 6

**Location of Four Systems under Compatibility**

(Source: Denicolo (2000, p. 180))
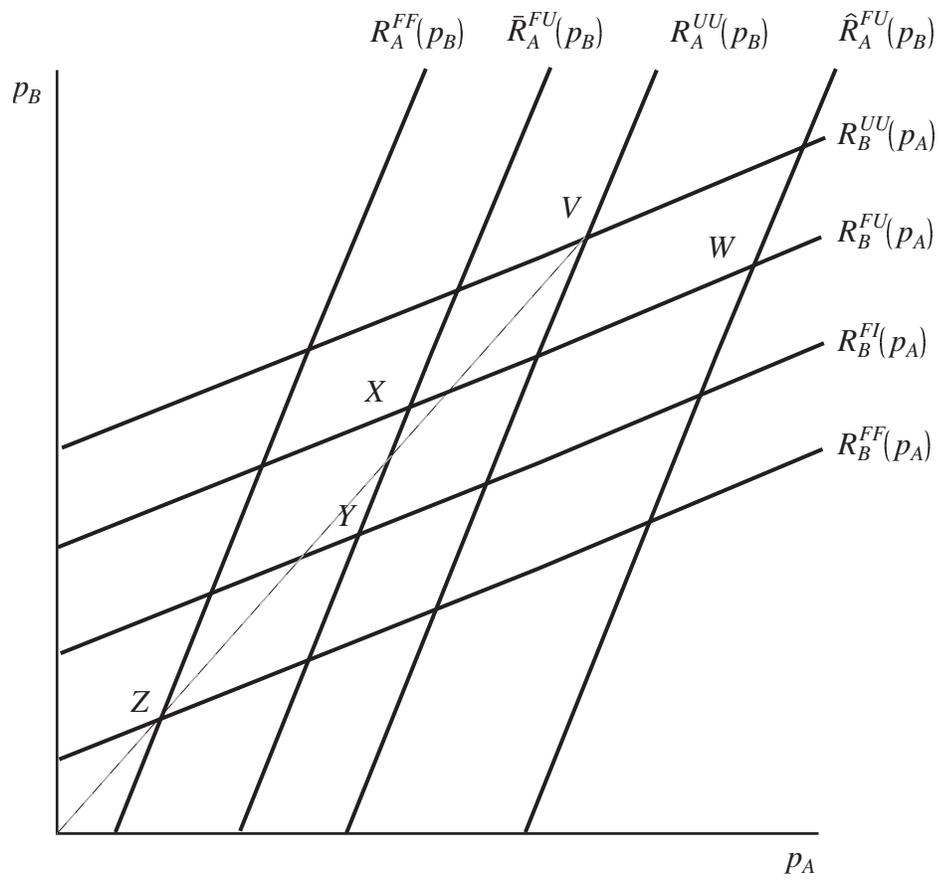
Figure 7

Price Effects in Church and Gandal