Chapter 33

A PRIMER ON FORECLOSURE[1]

PATRICK REY

University of Toulouse (IDEI and GREMAQ)

JEAN TIROLE

University of Toulouse (IDEI and GREMAQ) and MIT

Contents

[1] Financial support for the initial research that eventually led to this chapter was provided by a grant from BellSouth New Zealand. The authors are grateful to Mark Armstrong, Paul Seabright, Chris Snyder, John Vickers and Lucy White for helpful comments on a previous draft.

Handbook of Industrial Organization, Volume 3
Edited by M. Armstrong and R. Porter

DOI: 10.1016/S1573-448X(06)03033-0

Abstract

This chapter analyzes the private rationale and the social costs and benefits of market foreclosure, here defined as a firm's restriction of output in one market through the use of market power in another market. The chapter first focuses on *vertical foreclosure* (in which full access to a bottleneck input is denied to competitors) and provides an overview of the theory of access to an essential facility in an unregulated environment. It considers a wide array of contexts: possibility of bypass of the bottleneck facility, upstream vs downstream location of this facility, and various exclusionary activities such as vertical integration and exclusive dealing. It identifies a number of robust conclusions as to the social and private costs and benefits of foreclosure. The chapter then turns to *horizontal foreclosure*, where the monopoly good is sold directly to the end-users, and analyzes recent theories of anti-competitive bundling aimed at reducing competition in the adjacent markets or at protecting the monopoly market. Finally, the chapter tackles exclusive customer contracts and discusses potential efficiency defenses for exclusionary behavior.

Keywords

Essential facility, Foreclosure, Vertical integration, Tie-ins, Antitrust

JEL classification: D4, K21, L42

1. Introduction

1.1. What is foreclosure?

This chapter provides a framework for the analysis of the private rationale as well as the social costs and benefits of market foreclosure. According to the received definition, foreclosure refers to a dominant firm's denial of proper access to an essential good it produces, with the intent of extending monopoly power from that segment of the market (the bottleneck segment) to an adjacent segment (the potentially competitive segment). Foreclosure can arise when the bottleneck good is used as an input (e.g., an infrastructure) by a potentially competitive downstream industry, or when it is sold directly to customers, who use the good in conjunction with other, perhaps complementary goods (e.g., system goods or aftersale services). In the former case, the firms in the competitive segment that are denied access to the essential input are said to be "squeezed" or to be suffering a secondary line injury. In the latter case, a tie may similarly distort or even eliminate effective competition from the rivals in the complementary segment.

An input produced by a dominant firm is essential if it cannot be cheaply duplicated by users who are denied access to it. Examples of inputs that have been deemed essential by antitrust authorities include a stadium, a railroad bridge or station, a harbor, a power transmission or a local telecommunications network, an operating system software and a computer reservation system.[2] The foreclosure or essential facility doctrine states that the owner of such an essential facility has an incentive to monopolize complementary or downstream segments as well. This doctrine was first elaborated in the U.S. in *Terminal Railroad Association v. U.S.* (1912), in which a coalition of railroad operators formed a joint venture owning a key bridge across the Mississippi River and the approaches and terminal in Saint Louis and excluded non-member competitors. The Supreme Court ruled that this practice was a violation of the Sherman Act. A version of the doctrine was invoked by the European Court of Justice in the celebrated *United Brands* (1978) decision, in which it held that United Brands Corporation enjoyed substantial market power in the banana market in Europe and engaged in exclusionary practices in related markets (distribution, ripening).[3]

Foreclosure varies in extent. It can be complete, as in the case of a refusal to deal (equivalently, an extravagant price can serve as "constructive refusal") or in the case of technical integration between complementary goods, or partial, as when the bottleneck owner favors some firms or products in the adjacent market to the detriment of other competitors. It can also be performed in various ways:

– The bottleneck owner can *integrate* with one or several firms in the complementary segment. For example, computer reservations systems were developed by major

[2] Extensive legal discussions of foreclosure can be found in Areeda (1981) and, especially, Hancher (1995).

[3] More recently still, the *Queensland Wire* case (which involved vertical integration and a vertical price squeeze) is perhaps the first such Australian case in 1989. The *Clear* case provides an example of application of the doctrine in New Zealand, in which the incumbent's local network is the essential facility.

airlines. Before the Civil Aeronautics Board (CAB)'s 1984 famous decision, it was perceived that smaller airlines, especially those competing head-to-head with the integrated firms, had to pay a high price for access to the reservation systems and received poor display of their flights on the travel agents' screens (a key competitive disadvantage given that most travel agents do not browse much through screen displays). The CAB attempted to impose equal access in price and quality to what were perceived to be essential facilities, namely computer reservation systems,[4] but did not demand the major airlines' divestiture of their computer reservation systems. In contrast, in the same year, U.S. courts forced AT&T to divest its regional operating companies (known as the RBOCs). Other examples of forced vertical separation include the UK brewing industry, in which, following an investigation by the Monopoly and Mergers Commission in 1989, the "majors" were instructed to divest pubs,[5] and the high voltage electricity transmission systems, that have been separated from generation in most countries.

The integrated firm can *refuse to deal* with potential competitors. Relatedly, it may make the bottleneck good incompatible with competitors' products or technologies, or engage in *tie-in* and refuse to unbundle, thereby denying access to the essential facility. For example, in *Port of Genoa* (1991), the European Court of Justice held that the harbor was an essential facility and that its use should not be reserved to the undertaking managing it[6]; in the U.S., *Otter Tail Power Co v. United States* (1973) established a duty for a vertically integrated power company to supply other companies. Famous tie-in cases in the U.S. include *International Salt* (1947), in which the producer of salt dispenser equipment bundled salt with the equipment, and *Chicken Delight* (1971), in which the franchiser tied various inputs (ingredients, cooking equipment) with the franchising contract. In Europe, the Commission charged IBM in 1980 for abusing its dominant position in CPUs for large mainframe computers, by tying other elements such as main memory or basic software. In *Tetra Pak* (1994), cartons were tied to the filling machines. On both sides of the Atlantic, a number of cases have also surfaced in the context of "after-markets", when a durable good manufacturer with market power excludes competitors from providing repairs, maintenance or spare parts.[7]

– In the presence of economies of scope or scale calling for cooperation among firms in the same market, a dominant group of firms may put its competitors at a disadvantage

[4] Similarly in 1988, the European Commission imposed a fine on Sabena for denying access to its computer reservation system to the price-cutting airline London European.

[5] Snyder (1994) performs an event study analysis of this industry and provides some evidence of non-competitive behavior. Slade (1998) however stresses that the vertical separation led to softer competition. These "beer orders" have been repealed in 2002.

[6] A related case is the *Sealink* decision (1992), where the same company operated ferry services and controlled the harbor.

[7] See, e.g., in Europe, *Hugin v. Commission* (1979), in which a manufacturer refused to supply spare parts for its cash machines and the Commission held that the manufacturer had a dominant position on its own spare parts. A hotly debated case in the U.S. is *Kodak*, who refused to sell replacement parts for photocopiers to owners unless the latter agreed not to use independent service organizations [see Borenstein, MacKie-Mason and Netz (1995) and Shapiro (1995) for a discussion of this case].

by *refusing to cooperate*. Famous cases include *Aspen Skying Co v. Aspen Highlands Skying Co* (1985),[8] in which the common owners of three mountains on the site discontinued the All-Aspen ski passes which enabled skiers to use these mountains as well a fourth, independently owned, one; and *Associated Press v. United States* (1945), in which members of the newspapers' cooperative could block membership by competing newspapers. Such cases have obvious implications for network industries.[9]

– Short of integration, the bottleneck owner can grant *exclusivity* to a subset of firms or *tie* its essential product with selected products on the complementary segment, and thus de facto exclude their rivals. For example, the Court held that the granting of exclusive rights by *Auckland Regional Authority* to Avis and Hertz for operating in the Auckland airport terminal violated sections 27 and 36 of the New Zealand Commerce Act. Similarly, the European Commission has investigated the 65 year contract between Eurotunnel and the incumbent operators, British Rail and SNCF, allocating the entire capacity available for passenger and freight rail transport to the two companies.

– Another instrument in the "forecloser's" toolbox is *second- and third-degree price discrimination*. Third-degree discrimination consists in charging different (cost-adjusted) prices to different customers. It generalizes exclusivity or tying arrangements by favoring some customers over the others, but gives the bottleneck owner some flexibility in serving discriminated-against customers. Even if outright third-degree price discrimination is prohibited, the bottleneck owner may be able to duplicate it in an apparently anonymous way, that is through second-degree price discrimination. For example, a loyalty program offered to all or rebates based on the rate of growth of purchases may target specific customers even though they formally are available to all customers. Similarly, substantial price discounts may allow the survival of only a few customers; for instance, a large enough fixed (that is, consumption independent) fee transforms a potentially competitive downstream industry into a natural monopoly industry. And in the case of complementary goods, conditional discounts (also known as "mixed bundling") can allow the firm to discriminate de facto among consumers according to their preferences for the different varieties of products. Such considerations (besides many others) played a role in the process of enacting the Robinson–Patman Act in the U.S. in 1936.[10] There was in particular a concern that independent wholesalers or retailers might not be able to compete with powerful chains buying their supplies at favorable prices.

[8] See, e.g., Ahern (1994).

[9] In *Aer Lingus* (1992), the European Commission condemned Aer Lingus for refusing to interline (a technique enabling the marketing of single tickets for combined flights) with British Midland.

[10] Interestingly, in *Hoffman La Roche*, the European Court of Justice upheld the Commission's condemnation of purchasing agreements or loyalty rebates while asserting the company's right to offer volume discounts as long as they are extended to all customers.

1.2. Remedies

Assuming that the intellectual argument underlying the rationale for and the detrimental impact of foreclosure is compelling, one must still design an informationally feasible policy that either reduces the incentive to exclude or impedes the impact of foreclosure, and verify that the cure has no strong side-effect.

A number of remedies have been considered by competition law practitioners. While we clearly should not restrict ourselves to the existing set of policies and should attempt to design better ones, it is useful to review the most prominent ones. It is convenient to group existing policies into five categories:

– *Structural policies*. Structural policies such as divestitures and line of business restrictions are often considered as a last resort, as they may involve substantial transaction costs of disentangling activities and may jeopardize the benefits of integration. Yet, in specific instances (as for the AT&T 1984 divestiture) policy makers may come to the conclusion that it is hard to design proper rules for access to the integrated bottleneck, and that alternative methods of foreclosure can be prevented under vertical separation.

Milder forms of vertical separation are sometimes considered; for instance, antitrust authorities may demand that the essential facility be commonly owned by all users, with the provision that new entrants be able to purchase shares and membership into the network "at a reasonable price" (as in the *Associated Press* case mentioned above). The joint ownership of an essential facility by competitors must then be granted an exemption from certain antitrust provisions (as is done for example for certain types of R&D joint ventures, of cooperatives and of patent pools).

– *Access price control*. In the tradition of fully distributed cost regulation of access in regulated industries, antitrust authorities sometimes compare the price of access with some measure of its cost. The principle of such a comparison was for example accepted by the European Court of Justice in *United Brands* (1978), although it did not apply it in the specific instance. As is well known, the measurement of marginal cost is a difficult empirical matter, while the allocation of common costs among product lines has weak theoretical underpinnings. Clearly, antitrust authorities lack the expertise and staff that is needed for conducting extensive cost studies; at best can one put the onus of proving overpricing on the excluded competitors, who may well have better cost information than the authorities.

– *Access quantity control*. Instead of trying to define the "right" access price, the authorities sometimes focus on the quantity of access. For example, following an investigation of the *Eurotunnel* exclusivity contract mentioned above, the European Commission asked that 25% of each operator (British Rail, SNCF)'s capacity be allocated to new entrants for passenger and freight services.

– *Price linkages*. Antitrust authorities often try to use other prices – for access or retail goods – as benchmarks for the access price.

A famous rule, variously called the *Efficient Component Pricing Rule* (ECPR), the Baumol–Willig rule, the imputation rule, the parity principle, and the non-discrimination rule, links the integrated monopolist's access and retail prices. The idea is to avoid "margin squeezes", so that an equally efficient competitor should be able to enter the downstream market: the access price charged to competitors should therefore not exceed the price charged by the integrated firm on the competitive segment, minus the incremental cost of that firm on the competitive segment. For example, in the U.S. the Interstate Commerce Commission expressed a preference for the use of ECPR in railroad disputes.

There are also various forms of mandated linkages between access charges. The bottleneck firm may be forced to offer the same tariffs to all users (nondiscrimination rules, ban on tying), or even to charge a single per-unit price. Or, it may be required to charge a price of access not exceeding its price for the final use of the bottleneck segment (for example, the access charge for the local telephone network may not be allowed to exceed the price of local calls for residential or business consumers).

Last, there may be mandated linkages between several firms' access prices, as in the case of reciprocity in access charges for two competing telecommunications networks (to the extent that each network, regardless of its size, enjoys monopoly power on the termination of calls to its subscribers, each network is an essential facility for the other).

– *"Common Carrier" policies*. By this expression, we mean the policy of turning the vertical structure of the industry upside down. It might appear that in a complementary goods industry, labeling one segment the "upstream segment" and the other the "downstream segment" is purely semantic. The analysis of Section 2 shows that it is not, because the downstream firms not only purchase goods (inputs) from the complementary segment but also are the ones who interact with the final consumers. Later, we will ask whether, in presence of differential competitiveness of the two segments, it is desirable to locate the more competitive segment upstream or downstream. The relevance of this question is illustrated (in a regulatory context) by Order 436 which created a structure that allows U.S. gas producers to directly sign contracts with the gas customers (and purchase access from the pipeline bottleneck) rather than staying mere suppliers of inputs to pipelines packaging a bundle of production and transport to final customers.

– *Disclosure requirements*. Another tool in the policymaker's box is the requirement that contracts for intermediate goods be made public, with the hope that more "transparency" in supply contracts will promote downstream competition. Note that transparency is not equivalent to the prohibition of access price discrimination among buyers. A disclosure requirement does not preclude different tariffs for different buyers.

1.3. Roadmap

Foreclosure can be defined in different ways. For the purpose of this survey, we will define foreclosure as a situation in which: (i) a firm dominates one market (bottleneck good); and (ii) it uses its market power in the bottleneck good market to restrict output in another market, perhaps but not necessarily by discouraging the entry or encouraging the exit of rivals. As discussed earlier, we analyze two types of situation:

- *Vertical foreclosure* may arise when a firm controls an input that is essential for a potentially competitive industry. The bottleneck owner can then alter competition by denying or limiting access to its input.[11]
- When instead the bottleneck good is not an input but is sold directly to final users, *horizontal foreclosure* may arise when the firm somehow bundles the potentially competitive good and the bottleneck good.

With this distinction between vertical and horizontal foreclosure come two distinct views on exclusionary behavior. Vertical foreclosure is motivated by the desire to restore a market power that is eroded by a commitment problem; that is, the exclusionary practice aims at increasing the perpetrator's profit. By contrast, horizontal foreclosure is an act of predation; as other predatory behaviors, it reduces the predator's current profit and is meant to lower the competitors' profitability, with the ultimate goal of inducing their exit and ultimately recouping the lost profit.[12]

We will focus on theories based on the exploitation or protection of *market power*. We will not discuss alternative theories of foreclosure which are based for example on bargaining power,[13] price discrimination [where, say, the complementary and potentially competitive product is used as a counting device; see, e.g., Bowman (1957)], the avoidance of "multiprincipal externalities" [Bernheim and Whinston (1986), Martimort (1996), Segal (1999)], the preservation of industry rents [Comanor and Rey (2000)],[14] or "information-based favoritism" (in which the bottleneck segment favors a subsidiary in the procurement of the complementary good, because it has superior information about the subsidiary or because it internalizes part of its rent).[15]

[11] Vertical relations involve many other facets than foreclosure. In the first volume of the *Handbook*, Katz (1989) offers for example an overview of the use of vertical restraints to improve vertical coordination and to soften interbrand competition between rival vertical structures, as well as of the early literature on foreclosure; and Perry (1989) discusses other motivations for vertical integration, such as price discrimination, rent extraction or the avoidance of double marginalization.

[12] In Europe, a refusal to deal was assessed in *Commercial Solvents* (1974) from the point of view of the elimination of competitors; however, starting with *United Brands* (1978), the European Court of Justice no longer requires that the refusal to deal may lead to the competitors' exit.
The link between tie-ins and predation is discussed in more detail in Tirole (2005).

[13] On this, see Hart and Tirole (1990) and especially, Bolton and Whinston (1993); de Fontenay and Gans (2005) revisit the issue using the more flexible multilateral bargaining developed by Stole and Zwiebel (1996).

[14] While we will focus on the consequences of the existence of a bottleneck in one market, Comanor and Rey study some of the implications of multi-stage incumbency.

[15] There is also an abundant literature on the strategic commitment effect of vertical arrangements; see, e.g., Caillaud and Rey (1995) for a review.

We will also abstract from the closely related access issues in regulated industries.[16] In such industries, price controls (and/or explicit or implicit earnings-sharing schemes)[17] often prevent regulated firms from making money in the bottleneck segment and create incentives for them to reap supra-normal returns in the competitive segment, which can only be achieved by foreclosing access to the bottleneck. For example, the regulation of access prices may induce the bottleneck owner to delay interconnection or degrade interconnection quality. Of course, to the extent that competition policy looks into the regulatory toolbox for possible remedies, some of the most salient public policies in the regulatory context are also prominent in the antitrust environment.

Finally, our definition of foreclosure, which involves two distinct markets, also rules out some exclusionary practices which may prevail within a single market, such as the use of long-term exclusive dealing arrangements as entry barriers [see Aghion and Bolton (1987) and Rasmusen, Ramseyer and Wiley (1991)]. We will nevertheless discuss the relationship between the long-term contracting literature and our notion of foreclosure in Section 4.

The objective of this chapter is twofold. First, it summarizes recent developments in the analysis of foreclosure, and sometimes extends the existing literature, by considering new modes of competition or by studying the impact of various forms of competition policy. In so doing, it develops a critical view of what, we feel, are misguided or insufficient policy interventions. Second, it builds a preliminary checklist of exclusionary complaints and bottleneck defenses, which may be useful for thinking about foreclosure.

The chapter is organized as follows. Section 2 focuses on vertical foreclosure. It first provides an informal overview of the argument, before developing the conceptual framework and identifying the private rationale for foreclosure. It also examines the impact of policies such as nondiscrimination laws and "common carrier" type policies, and applies the foreclosure argument to an analysis of vertical mergers and exclusive contracts. Section 3 turns to horizontal foreclosure through tie-ins. After an informal overview of the main arguments, it first focuses on Whinston's (1990) theory of entry deterrence, and then turns to recent developments relative to the impact of tie-ins on innovation and entry. Section 4 reviews theoretical contributions on exclusionary contracts, while Section 5 studies possible defenses for exclusionary behaviors. Section 6 concludes.[18]

[16] We refer the reader to existing surveys of the access pricing question: Laffont and Tirole (1999), Armstrong (2002).

[17] For example, the firm that is subject to cost-plus regulation in one market and is unregulated in another, potentially competitive market, has an incentive to allocate as much as possible of the common and fixed costs to the regulated market, with the result that entry will be more difficult in the competitive market. More generally, what matters is the sensitivity of the firm's profit to cost reductions in the various markets in which it is active: the firm will wish to "inflate" its costs in the markets that are subject to cost-based regulation and thus "subsidize" the goods that are either not regulated or subject to a more "price-cap" oriented regulation; see the discussion in Section 3.5.2 of Armstrong and Sappington (2007).

[18] Some of the themes covered in Sections 2 and 4 are covered in a more informal way by Vickers (1996).

2. Vertical foreclosure

For all its prominence in competition law, the notion of foreclosure until recently had poor intellectual foundations. Indeed, the intellectual impetus in the late seventies (reflected in the American antitrust practice of the eighties) cast serious doubt about its validity. In particular, the Chicago School, led, in this instance, by Bork (1978) and Posner (1976), thought that the "leverage" concept resulted from a confusion about the exercise of monopoly power. It argued that there is a single source of monopoly profit, and that a bottleneck monopolist can already earn the entire monopoly profit without extending its market power to related segments; and so in the absence of efficiency gains, vertical integration cannot increase the profitability of the merging firms. Relatedly, it questioned the rationale for excluding downstream competitors, who by offering product diversity, cost efficiency or simply benchmarking of the internal downstream producer, can be the source of extra monopoly profits.

Consider the following quintessential bottleneck situation: An upstream monopolist, U, produces a key input for downstream use. There is potential competition in the downstream segment, but it can emerge only if competitors have proper access to U's essential input. The bottleneck owner can therefore alter and even eliminate downstream competition by favoring one downstream firm – e.g., a downstream affiliate – and excluding others. According to the foreclosure doctrine, U has indeed an incentive to do so, in order to extend its monopoly power to the downstream segment. However, as pointed out by the Chicago School critique, in such a situation there is a single final market and therefore only one profit to be reaped, which U can get by exerting its market power in the upstream segment; U thus has no incentive to distort downstream competition – imperfect competition in the downstream market may actually adversely affect U's bargaining power and/or create distortions that reduce the profitability of the upstream market.

The Chicago School view has had the beneficial effect of forcing industrial economists to reconsider the foreclosure argument and to put it on firmer ground. The reconciliation of the foreclosure doctrine and the Chicago School critique is based on the observation that an upstream monopolist in general cannot fully exert its monopoly power without engaging in exclusionary practices. This fact is little acknowledged except in the specific contexts of patent licensing and of franchising. Consider for example a patent that covers the unique technology that can be used in a given productive process. The patentholder is then the owner of an essential facility (in the economic sense; on the legal front, courts are unlikely to mandate access, the traditional corollary of the "essential facility" labeling). Yet the patentholder is unlikely to make much money if it cannot commit not to flood the market with licenses; for, if everyone holds a license, intense downstream competition destroys the profit created by the use of the patent. Therefore, a patentholder would like to promise to limit the number of licenses. There is however a commitment problem: Once the patentholder has granted n licenses, it is then tempted to sell further licenses. Such expropriation is ex post profitable for the licensor, but depreciates the value of the first n licenses and, if anticipated, reduces the patentholder's ex ante profit. Intellectual Property (IP) law explicitly acknowledges this fact by conferring entire freedom to contract on the patentholder (except in a set of specified cases, in which compulsory licensing may be applied by competition authorities and/or governments to force access to the bottleneck piece of IP against "proper compensation"). A similar point can be made for franchising. Franchisees are unlikely to pay much to franchisors if they do not have the guarantee that competitors will not set up shop at their doorsteps.

A bottleneck owner faces a commitment problem similar to that of a durable-good monopolist: Once it has contracted with a downstream firm for access to its essential facility, it has an incentive to provide access to other firms as well, even though those firms will compete with the first one and reduce its profits. This opportunistic behavior ex ante reduces the bottleneck owner's profit (in the example just given, the first firm is willing to pay and buy less). There is thus a strong analogy with Coase's durable good analysis.[19] As is well known, a durable-good monopolist in general does not make the full monopoly profit because it "creates its own competition": By selling more of the durable good at some date, it depreciates the value of units sold at earlier dates; the prospect of further sales in turn makes early buyers wary of expropriation and makes them reluctant to purchase. As we will see, the analogy with the durable-good model also extends to the means of restoring monopoly power: the upstream monopolist's keeping ownership of supplies, exclusive dealing, retail price floor, reputation of the monopolist not to expropriate, and so forth.

The licensing and franchising examples mostly involve binary decisions for input transfer (grant or not a license or franchising agreement). But the commitment problem is very general and extends to situations in which downstream firms purchase variable amounts of the essential input. It is then not surprising that the loss of monopoly power associated with the commitment problem is more severe, the more competitive the downstream segment.[20] This proposition has two facets. First, the upstream bottleneck's profit is smaller, the larger the number of downstream firms. Second, for a given number of downstream firms, the upstream profit is smaller, the more substitutable the downstream units.

Bottlenecks are rarely pure bottlenecks. They most often compete with inferior goods or services. In the presence of such "bypass opportunities", an upstream bottleneck owner must face both the commitment problem and the threat of second sourcing by the downstream firms. A couple of interesting insights result from this extension of the basic framework. First, a vertically integrated firm controlling the bottleneck in general may want to supply a limited but positive amount of the essential input to the downstream affiliate's competitors, who would otherwise purchase the inferior good. The prospect

[19] See Coase (1972), as well as Tirole (1988, ch. 1) for an overview.

[20] In a recent debate in France on manufacturer–retailer relationships, some have advocated that the tough competition observed in the French retail market (which appears to be tougher than in neighboring countries, and in part due to the presence of large chains of independent retailers) generates "too much" destructive competition among their suppliers.

of productive inefficiency creates scope for profitable external sales by the bottleneck owner. Second, and relatedly, bypass possibilities create a distinction between two ways of restoring monopoly power, vertical integration and exclusive dealing. While exclusive dealing does not enable the bottleneck owner to supply several downstream firms, vertical integration in contrast provides enough flexibility to supply non-affiliates and yet favor the affiliate.

Our analysis has three broad policy implications. First, it does matter whether the more competitive of two complementary segments lies upstream or downstream. We show that prices are lower when the bottleneck owner lies upstream. This result is robust to the existence of bypass opportunities, and to the vertical structure of the industry (independent or vertically integrated bottleneck). Intuitively, an upstream bottleneck location has two benefits from a social welfare point of view. First, it creates a commitment problem not encountered by a downstream monopolist and thus reduces monopoly power. Second, in the presence of bypass opportunities, an upstream location of the bottleneck prevents productive inefficiency by creating a stage of competition that eliminates inferior substitutes. Our analysis thus shows that common carrier policies lower prices and raise production efficiency.

The second policy implication is that non-discrimination laws may have the perverse effect of restoring the monopoly power that they are supposed to fight. When an upstream bottleneck practices foreclosure by discriminating among competitors, it is tempting to impose a requirement that all competitors be offered the same commercial conditions. Non-discrimination rules however benefit the upstream bottleneck because, by forcing it to sell further units at the same high price as the initial ones, they help the bottleneck commit not to flood the market. A non-discrimination law is thus a misguided policy in this situation.[21]

The third policy implication is that ECPR (which was designed for a regulated environment, but is also used in antitrust contexts) often has little bite in unregulated environments. As pointed out by William Baumol in testimonies, ECPR only provides a link between access and final prices and is therefore only a partial rule. Moreover, the higher the final price, the higher the access price can be. In an unregulated environment, an integrated firm with upstream market power can thus exercise its market power by setting a high price for the final good and, at the same time, set a high access charge to prevent other firms in the competitive segment from becoming effective competitors.

Our analysis has also implications for business strategy. Interestingly, while the desire to foreclose often motivates vertical integration, it may alternatively call for divestiture. For example, we develop a rationale for the 1995 divestiture of AT&T manufacturing arm that is related to the official justification of this divestiture. With the impending competition in telecommunications between AT&T and the RBOCs, the latter, who were major buyers of AT&T equipment, would have been concerned that the AT&T

[21] To better focus on the impact of discrimination on the (in)ability to commit, this analysis does not account for potentially beneficial effects of bans on discrimination.

manufacturing arm would exclude them in order to favor its telecommunication affiliate.[22] The RBOCs might therefore have turned to alternative manufacturers. We provide necessary and sufficient conditions under which this smaller-customer-base effect dominates the foreclosure effect, and thus divestiture is preferred by the bottleneck owner to vertical integration.

2.1. A simple framework

As indicated above, when the monopolized market supplies an input used by a downstream industry, the motivation for foreclosure cannot be the desire to extend market power, since there is a single final product and thus a single monopoly profit. Foreclosure can however serve to protect rather than extend monopoly power. We analyze this rationale using the simplest framework.

An upstream firm, U, is a monopoly producer of an intermediate product with marginal cost c. It supplies two undifferentiated downstream firms, D_1 and D_2 (see Figure 33.1). We will refer to the upstream segment as the "bottleneck" or "essential facility" segment and to the downstream segment as the "competitive" segment (although it need not be perfectly competitive[23]). The downstream firms transform the intermediate product into an homogeneous final one, on a one-for-one basis and at zero marginal cost. They compete in the final goods market characterized by an inverse demand function $p = P(q)$. We will assume that the demand function is "well-behaved", in that the profit functions are (strictly) quasi-concave and that the Cournot game exhibit strategic substitutability.[24] Let Q^m, p^m, and π^m denote the whole vertical structure's or industry's monopoly output, price, and profit:

$$\begin{aligned}
Q^m &= \arg\max_q \big\{ \big(P(q) - c\big) q \big\},\\
p^m &= P\big(Q^m\big),\\
\pi^m &= \big(p^m - c\big) Q^m.
\end{aligned}$$

The interaction between the firms is modeled according to the following timing:

- Stage 1: U offers each D_i a tariff $T_i(\cdot)$; D_i then orders a quantity of the intermediate product, q_i, and pays $T_i(q_i)$ accordingly.
- Stage 2: D_1 and D_2 transform the intermediate product into the final good, observe each other's output and set their prices for the final good.

[22] In the absence of vertical separation, the integrated firm may attempt to create a level-playing field downstream through other means. A case in point is Nokia's creation of Nokia Mobile Software, an independent division separated from the rest of Nokia by a "Chinese Wall". This division writes the Nokia Series 60 middleware platform (running on top of the Symbian operating system) that is used not only by Nokia's phone division, but also by a number of its rival mobile makers. See Evans, Hagiu and Schmalensee (2006) for more detail.

[23] Despite perfect substitutability. The downstream firms may for example compete à la Cournot (see below); they could alternatively engage in some tacit collusion.

[24] A sufficient condition for that is $P'(q) + P''(q)q < 0$ for all q.

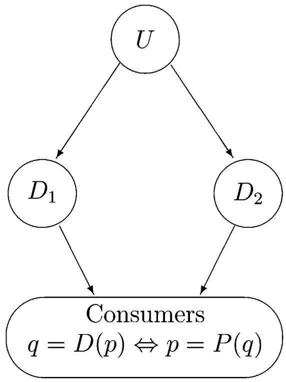

Figure 33.1. Basic framework.

This timing depicts a situation in which the supplier produces to order before the final consumers formulate their demand. The downstream firms are capacity constrained by their previous orders when they market the final product. Alternatively, the transformation activity is sufficiently time consuming that a downstream firm cannot quickly reorder more intermediate good and transform it if its final demand is unexpectedly high, or reduce its order if its final demand is disappointingly low. In Appendix C, we discuss the case in which final consumers are patient enough and the production cycle is fast enough that the downstream firms produce to order. Technically, the difference between these two modes of production resembles the distinction between Cournot and Bertrand competition.

We focus on perfect Bayesian equilibria. Given the quantities purchased in the first stage, the downstream firms play in the second stage a standard Bertrand–Edgeworth game of price competition with capacity constraints. For simplicity, we assume that the marginal cost c is sufficiently large relative to the downstream marginal cost (zero) that if the downstream firms have purchased quantities q_1 and q_2 in the viable range, they find it optimal to transform all units of intermediate product into final good and to set their price at $P(q_1 + q_2)$.[25] The second stage can then be summarized by Cournot revenue functions $P(q_1 + q_2)q_i$. As for the first stage, two cases can be distinguished, according to whether the tariff offered to one downstream firm is observed by the other or not.

2.1.1. *Commitment, observability and credibility*

Let us first consider, as a benchmark, the case where both tariffs offered by U are observed by both D_1 and D_2. In that case, U can fully exert its market power

[25] See Tirole (1988, ch. 5) for more detail.

and get the entire monopoly profit [see for example Mathewson and Winter (1984) and Perry and Porter (1989)]. For example, U can achieve this result by offering $(q_i, T_i) = (Q^m/2, p^m Q^m/2)$[26]: both D_1 and D_2 accept this contract and together sell the monopoly quantity, Q^m, at the monopoly price p^m.[27] In this world, there is no rationale for foreclosure. The upstream monopolist can preserve its monopoly power without excluding one of the competitors.

Sticking to those contracts, however, is not credible if the contracts are secret or can be privately renegotiated. Suppose for example that U and D_2 have agreed to $q_2 = Q^m/2$ (and $T_2 = p^m Q^m/2$); U and D_1 would then have an incentive to agree to the quantity, q_1, that maximizes their joint profit, i.e.:

$$q_1 = \arg\max_q \big\{\big[P\big(Q^m/2 + q\big) - c\big]q\big\} = R^C\big(Q^m/2\big) > Q^m/2,$$

where R^C denotes the standard Cournot reaction function, and the last inequality derives from a standard revealed preference argument.[28] Hence, U has an incentive to secretly convince D_1 to buy more than $Q^m/2$. Anticipating this, firm D_2 would turn down the monopolist's offer.

2.1.2. *Secret contracts*

From now on, we consider the game in which in the first stage, U offers *secret* contracts (that is, D_i observes the contract it is offered, but not the contract offered to D_j). In this game, U is subject to the temptation just described and thus faces a credibility problem. The contracts offered by U in equilibrium, as well as the responses from D_1 and D_2, depend on the nature of each downstream firm's conjectures about the contract offered to its rival. Since there is considerable leeway in specifying those beliefs, there are many perfect Bayesian equilibria: but, as we will see, one equilibrium stands out as the only plausible one in this context and we will therefore focus on this equilibrium.

[26] Since U has perfect information on D_1 and D_2 it can actually dictate their quantity choices – subject to their participation constraint – via adequately designed tariffs of the form "(q_i, T_i)": $T(q) = T_i$ if $q = q_i$ and $+\infty$ otherwise. Since U moreover makes take-it-or-leave-it offers, it can set T_i so as to extract D_i's entire profit.

[27] Although downstream firms are symmetric, an asymmetric allocation of the monopoly output between them would do as well. The symmetric allocation is however strictly optimal when downstream cost functions are (symmetric and) strictly convex.

[28] The first-order conditions for $q \equiv Q^m/2$ and $\hat{q} \equiv R^C(Q^m/2)$ are respectively $P(2q) - c + 2qP'(2q) = 0$ and $P(q+\hat{q}) - c + \hat{q}P'(q+\hat{q}) = 0$; since $P' < 0$, they cannot coincide for $\hat{q} = q$, and thus $\hat{q} \neq q$. From a revealed preference argument,

$$\big[P(q+q) - c\big](q+q) \geqslant \big[P(q+\hat{q}) - c\big](q+\hat{q}),$$

$$\big[P(q+\hat{q}) - c\big]\hat{q} \geqslant \big[P(q+q) - c\big]q,$$

implying $P(q+q) \geqslant P(q+\hat{q})$, and thus (since $\hat{q} \neq q$), $\hat{q} > q$.

To illustrate the role of conjectures, suppose that D_1 and D_2 assume that U makes the same offer (even unexpected ones) to both of them. Then it is credible for U to offer $(q_1, T_1) = (q_2, T_2) = (Q^m/2, p^m Q^m/2)$: Expecting that any offer it receives is also made to its rival, D_i refuses to pay more than $P(2q)q$ for any quantity q; U thus maximizes $(P(2q) - c)2q$ and chooses $q = Q^m/2$. Hence, under such a *symmetry* assumption on the downstream firms' conjectures, U does not suffer from any lack of credibility.

This symmetry assumption, which concerns unexpected offers (i.e., out-of-equilibrium ones) as well as expected ones, is however not very appealing. When the supplier supplies to order, it is more plausible to assume that, when a firm receives an unexpected offer it does not revise its beliefs about the offer made to its rival. Secrecy together with upstream production on order implies that, *from the point of view of the upstream monopolist*, D_1 and D_2 form two completely separate markets (of course, D_1 and D_2 themselves perceive a strong interdependency). Thus the monopolist has no incentive to change its offer to D_j when it alters D_i's contract. Such conjectures are called *passive* or *market-by-market-bargaining* conjectures.[29]

Under passive conjectures, D_i, regardless of the contract offer it receives from U, expects D_j to produce the candidate equilibrium quantity, q_j, and is thus willing to pay up to $P(q+q_j)q$ for any given quantity q. U, who extracts all of D_i's expected profit by making a take-it-or-leave-it offer, offers to supply q_i so as to maximize the joint profit in their *bilateral* relationship, namely:

$$q_i = \arg\max_q \big\{ \big(P(q + q_j) - c\big)q \big\} \equiv R^C(q_j).$$

Hence, under passive conjectures the equilibrium is unique and characterized by the Cournot quantities, price and profits:

$$\begin{aligned}
&q_1 = q_2 = q^C, \quad \text{where } q^C = R^C\big(q^C\big) > Q^m/2,\\
&p_1 = p_2 = p^C = P\big(2q^C\big) < p^m,\\
&\pi_U = \big(p^C - c\big)2q^C = 2\pi^C < \pi^m,\\
&\pi_{D_1} = \pi_{D_2} = 0.
\end{aligned}$$

[29] Conjectures can be passive only if the downstream units have perfect information about the bottleneck's marginal cost; for example, assume that the bottleneck has private information about this marginal cost. The tariff offered to D_1, say, then signals information about the marginal cost; for example, a two-part tariff with a low marginal price may reveal a low marginal cost and therefore signal that D_2 is also offered a tariff with a low marginal cost and will produce a high quantity.
Thus, when the bottleneck has private information about its marginal cost, the downstream firms' conjectures can no longer be "passive". But they may still reflect the fact that the bottleneck bargains "market-by-market", that is attempts to maximize its profit in any given intermediate market (where an "intermediate market" corresponds to a D_i) without internalizing the impact of the contract on the other market, since its profits in the two markets are unrelated. A lack of transparency of the bottleneck's cost may nevertheless improve the bottleneck's commitment ability. The Coase problem with incomplete information about the bottleneck's cost function is developed in White (2000).

This result, due to Hart and Tirole (1990), and further analyzed by O'Brien and Shaffer (1992) and McAfee and Schwartz (1994), highlights the commitment problem faced by the supplier. Even though it is in a monopoly position, its inability to credibly commit itself gives room for opportunistic behavior and prevents it from achieving the monopoly outcome.

As already mentioned, this outcome is closely related to the phenomenon underlying the Coasian conjecture on the pricing policy of a durable good monopolist. If the monopolist can commit to future prices, it can obtain the monopoly profit by committing itself to never set its price below the monopoly level. However, once all monopoly sales have taken place (in the first period), it has an incentive to lower its price and exploit the residual demand. If the monopolist cannot commit itself on its future pricing policy, the buyers then delay their purchase in order to benefit from lower future prices, and the profit is reduced.

Suppose more generally that there are n identical downstream competitors. Then, by the same argument, the passive conjectures equilibrium is symmetric and satisfies

$$q = R^C\big((n-1)q\big),$$

where q is the output per downstream firm. Thus, the commitment problem becomes more severe, the larger the number of downstream firms. Indeed, the retail price on the competitive segment tends to marginal cost c and the industry profit tends to zero as the number of firms tends to infinity. Thus, we would expect bottleneck owners to be keener to foreclose access to the essential facility, the more competitive the downstream industry. The analogy with the durable good model again is obvious. There, the monopolist's commitment problem increases with the number of periods of sales. Indeed, and this is Coase's famous conjecture, the monopolist's profit vanishes as opportunities to revise prices become more and more frequent.[30]

Adding downstream firms is one way of increasing the intensity of downstream competition. Another relevant impact of competition on the extent of the commitment problem is obtained by varying the degree of downstream product differentiation. Let us, for the sake of this exercise only, depart from the perfect substitutes assumption and allow the two downstream firms to produce differentiated products. Under our assumptions, Bertrand–Edgeworth competition with capacities q_1 and q_2 yields retail prices $p_1 = P_1(q_1, q_2)$ and $p_2 = P_2(q_2, q_1)$. The equilibrium of the overall game is *still the Cournot equilibrium* of the simpler game in which the downstream firms face marginal cost c. If, as we would normally expect, the ratio of Cournot industry profit over monopoly profit increases with the degree of differentiation, the incentive to restore monopoly power is stronger, the more substitutable the downstream products.

[30] Caprice (2005a) shows that this effect is mitigated when the upstream dominant firm competes with an alternative supplier. In that case, while an increase in the number of downstream firms still decreases industry profits, it also allows the dominant supplier to get a bigger share of this smaller pie.

• *Restoring monopoly power*. In contrast with conventional wisdom, foreclosure here aims at *reestablishing rather than extending* market power: In order to exert its market power the upstream monopolist has an incentive to alter the structure of the downstream market. For example, excluding all downstream firms but one eliminates the "Coasian pricing" problem and restores U's ability to sustain the monopoly price; *exclusive dealing*, which de facto monopolizes the downstream market, thus allows U to exert more fully its upstream market power. [We define here exclusive dealing as an upstream firm's commitment not to deal with alternative downstream firms. Examples include exclusive license or franchise contracts.]

Alternatively, U may want to *integrate downwards* with one of the downstream firms, in order to eliminate the temptation of opportunism and credibly commit itself to reduce supplies to downstream firms.[31] For, suppose that the upstream firm internalizes the profit of its downstream affiliate, and that it supplies the monopoly quantity Q^m to this affiliate and denies access to the bottleneck good to non-integrated downstream firms. The integrated firm then receives the monopoly profit π^m. Any deviation to supply non-integrated producers can only result in a lower industry profit, and therefore in a lower profit for the integrated firm.

The bottleneck monopolist may conceive still other ways of preserving the monopoly profit. For instance, as noted by O'Brien and Shaffer (1992), a *market-wide resale price maintenance* (RPM), in the form of a price floor, together with a return option[32] would obviously solve the commitment problem; O'Brien and Shaffer further show that squeezing downstream margins through individual price ceilings can also help eliminate the scope for opportunism. Alternatively, allowing *tariffs* to be *contingent on both firms' outputs* is another such instrument: A contract of the form "$q_i = Q^m/2, T_i = p^m Q^m/2,$

[31] Again, there is an analogy with Coase's durable good model. A standard way for a durable-good monopolist of restoring commitment power is to refrain from selling. A durable-good monopolist who leases the good assumes ownership of existing units and thus is not tempted to expropriate the owners of previous production by flooding the market (it would expropriate itself), in the same way the integrated bottleneck owner is not tempted to expropriate its affiliate by supplying other downstream firms.

[32] The possibility for downstream units to return the wares at the marginal wholesale price is in general needed for obtaining the monopoly solution. Suppose that $c = 0$, and that when both sellers charge the same price but supply more than the demand at this price, the rationing follows a proportional rule (so, sellers sell an amount proportional to what they bring to the market). Let the upstream firm supply $q^m/2$ to each downstream firm and impose price floor p^m. Then the upstream firm can supply some more units at a low incremental price to one of the sellers, thus expropriating the other seller.

Relatedly, McAfee and Schwartz (1994) consider *most-favored-customer* (MFC) clauses. They allow downstream firms who have accepted a "first-stage" individualized contract offer to replace it in a "second stage" (that is, before downstream product market competition) by any offer made to any other downstream firm. They show that such MFC clauses do not quite solve the monopolist's commitment problem. By contrast, De Graba (1996) shows that, by offering two-part tariffs and by allowing downstream firms to apply the MFC term-by-term (that is, to choose the contract $(\min\{F_i\}, \min\{w_i\})$, where $\min\{F_i\}$ is the minimum of the fixed fees and $\min\{w_i\}$ is the minimum of the wholesale unit prices offered in the first stage), the monopolist restores its commitment power and is able to achieve the monopoly profit.

Table 33.1
Solving the commitment problem

Exclusionary behavior	Analogue for the durable-good monopolist
Exclusive dealing	Destruction of production unit
Profit sharing/vertical integration	Leasing
Retail price floor	Most favored nation clause
Reputation for implicit exclusive dealing	Reputation for not flooding the market
Limitation of productive capacity	Limitation of productive capacity

together with a hefty penalty paid by the supplier to the buyer if the buyer's competitor is delivered a higher quantity of the intermediate good, and thus produces a higher quantity of the final good" solves the opportunism problem.[33]

Recalling the various ways in which a durable-good monopolist can restore its commitment power[34] suggests several other commitment policies for the bottleneck owner. In an oft repeated relationship, the bottleneck owner may build a reputation with D_1, say, for practicing "implicit exclusive dealing". That is, the bottleneck owner may sacrifice short-term profit by not supplying D_2 in order to build a reputation and extract high payments from D_1 in the future, in the same way a durable-good monopolist may gain by refraining from flooding the market. In another analogy with the durable-good model, the bottleneck owner gains from facing a (publicly observed) tight capacity constraint (or more generally from producing under decreasing returns to scale). The downstream firms are then somewhat protected against expropriation by the capacity constraint.[35] Some of these analogies with the durable-good model are listed in Table 33.1.

2.1.3. *Empirical evidence*

2.1.3.1. Experimental evidence Martin, Normann and Snyder (2001) test this theory of foreclosure (with an upstream monopolist and a downstream duopoly) using experimental techniques. They compare three possible games: non-integration with public or secret offers and vertical integration. The first and the third, according to the theory, should yield the monopoly outcome, while the second should result in the Cournot outcome.

Martin et al. find only partial support for the theory. The monopolist's commitment problem is apparent in the data: total output and profit are similar and close to the

[33] In a smoother vein, the upstream monopolist could mimic vertical integration with contracts that capture all realized downstream profits, e.g., tariffs $T_i(q_i, q_j) = P(q_i + q_j)q_i$ that charge D_i according to the level of input delivered to D_i and D_j – a small discount for the particular choice $q_i = Q^m/2$ might help downstream firms to coordinate on the desired outcome – or contracts based on downstream revenues, if observable, rather than input – a contract of the form "give back (almost) all of your revenue" also eliminates the risk of opportunistic behavior.

[34] On this, see Tirole (1988, pp. 84–86).

[35] Alternatively, the upstream firm benefits if the downstream firms face capacity constraints.

monopoly level in the first and third games; by contrast, output is often, although not always, significantly higher and profit lower in the second game. But in addition, integration allows more surplus to be extracted from the unintegrated downstream firm, suggesting that bargaining effects play also a role. Under vertical integration, in the majority of cases the integrated player gets all the profit, as the theory predicts; downstream firms thus accept to get only a small profit, contrasting with other experiments in which players tend to reciprocate (retaliate) by wasting value when they are offered a small share of the pie.[36] In the non-integrated treatments, the industry profits are instead more evenly shared between the upstream monopolist and downstream firms.

Relatedly, Martin et al. indirectly investigate the nature of out-of-equilibrium beliefs under secret offers, by looking at downstream acceptance decisions as functions of the contract offer. They find that these beliefs are highly heterogeneous, and on the whole somewhere in between passive and symmetric beliefs. (Note, incidentally, that, as in other experiments, the rational behavior of a "rational player" does not coincide with the rational behavior under common knowledge of rationality. In particular, deviations by the upstream monopolist may signal some irrationality and it is not longer clear that passive conjectures are as rational as they are under common knowledge of rationality.)

2.1.3.2. Field studies Alternatively, one can look at the impact of vertical mergers on downstream rivals and end users. According to the foreclosure theory reviewed above, vertical integration may help upstream bottlenecks solve their commitment problem.[37] (At least) three implications may be tested:

(a) downstream rivals (D_2) receive less input from or pay a higher price to the upstream firm with market power (U), or more generally discrimination between D_1 and D_2 tilts market shares in the favor of D_1;
(b) if D_2 is publicly traded, then D_2's stock price goes down when the merger is announced;[38]
(c) the final customers suffer from the merger. Their decrease in welfare can be measured in (at least) two ways:
   – a decrease of their stock price if they are publicly listed,
   – an increase in the futures price if there is a future market for the final good.

As usual, the potential anti-competitive effects need to be traded off against potential benefits of vertical integration (such as the encouragement of investment in specific

[36] See, however, Roth et al. (1991) on the lack of fairness concerns in competitive environments.

[37] We are not aware of any empirical study testing another implication of foreclosure theory, namely that "turning an industry upside down" by mandating access to bottlenecks may make it more competitive (see below the discussion of the U.S. gas industry). This implication might be tested for example in the railroad or airline industries.

[38] This is not strictly the case in the model above, because U is assumed to extract the entire rents of the downstream units, and thus D_2's stock price does not react to the merger $U - D_1$. Relaxing this extreme assumption, e.g., by conferring some bargaining power on the downstream firms or by introducting private information about the latter's costs (so as to generate downstream rents), yields implication (b).

aspects), and more generally the various social benefits that are invoked in favor of a more lenient attitude of antitrust authorities toward market foreclosure (see Section 5).

Nor are individual tests perfect evidence of foreclosure effects. Test (a) (the destruction of the level-playing field between D_1 and D_2), if positive, may be alternatively interpreted through a standard monopoly pricing story, and might be positive even if D_1 and D_2 did not compete in the same product market (in which case foreclosure could not be a motive for vertical integration): When U has asymmetric information about D_1 and D_2's technology and profit, U may charge wholesale prices largely above its marginal cost because a fixed fee then does not suffice to handle the allocation of the downstream firm's rent. By contrast, if D_1's profit accrues to U, then U has an incentive to charge an internal marginal transfer price to D_1, regardless of whether D_1 and D_2 compete in the product market.[39]

Test (b) is subject to the potential criticism that specific increases in the merged entity's efficiency may hurt downstream rivals even in the absence of foreclosure intent. Namely, a merger that, say, encourages specific investments and reduces D_1's marginal cost makes D_1 a fiercer rival in the downstream product market. By contrast, mergers whose efficiency gains result from a reduction in fixed costs would have no such effect.

Test (c) is subject to the caveat that pre-merger stock or futures prices reflect market anticipations. Therefore, the evolution of such a price at the time of the merger depends on the impact of that particular merger, but also on what alternative scenario was anticipated as well. For example, if U was a potential entrant in the downstream market and decides instead to acquire one of the existing competitors, then market indicators may react negatively to the merger even in the absence of any foreclosure concern.[40]

We are aware of few empirical studies of modern foreclosure theory. Needless to say, this is an area that would deserve further investigations. Chipty (2001) considers implication (a) in the cable industry, and shows that integrated cable operators exclude rival channels. Snyder (1994, 1995a, 1995b) takes route (b), and conducts event studies looking at downstream rivals' stock market price reaction to various public announcements of a merger or of antitrust authorities's steps to undo existing mergers. His study of the vertical integration of beer manufacturers and pubs in the UK (Snyder, 1994, 1995a) looks at the reaction of the stock price of Guinness (then the only publicly listed non-integrated major beer producer) to the Monopolies and Mergers Commission's successive moves during its investigation of foreclosure in the brewing industry. He documents a positive reaction of Guinness's stock price to the MMC's and the government's anti-integration moves. His study of vertical integration of upstream crude

[39] While a vertical merger would thus generate discrimination between the integrated and non-integrated downstream firms, this would occur through a modification of the contract with the integrated subsidiary, while foreclosure motives would also involve a modification of the terms offered to the non-integrated firms. Thus, in principle, one might be able to distinguish the two types of motivations.

[40] Fridolfsson and Stennek (2003) stress a similar point in the context of horizontal mergers. When a merger is announced, the share prices of formerly potential targets and acquirers are reduced, since they are now out of play. Anti-competitive mergers may thus reduce competitors' share prices, despite increasing their profits; as a result event studies may not detect the competitive effects of mergers.

oil production and downstream refining in the U.S. oil industry (Snyder, 1995a, 1995b) delivers a small effect (negative impact of integration decision on rivals' stock price in event studies). Mullin and Mullin's (1997) study U.S. Steel's 1905–1906 "acquisition"[41] of a huge amount of low-extraction-cost iron ore properties on the Western Mesabi Range. Mullin and Mullin follow, inter alia, route (c), by measuring the event-study impact of the merger on the largest net consumers of iron and steel (railroads); they argue that the merger turned out to benefit these final consumers, suggesting that vertical integration was motivated by efficiency considerations (on which they bring another form of evidence).[42]

2.1.4. Policy implications

The previous subsection has presented the basic motivation for foreclosure and stressed the strong analogy with the Coasian pricing problem. We now derive some policy implications.

Upstream versus downstream bottlenecks The "Coasian pricing problem" is more likely to arise when bottlenecks are at more upstream levels, that is, when they have to supply (competing) intermediaries to reach final consumers. To see this, consider the more general framework, where two complementary goods, A and B, must be combined together to form the final good (on a one-to-one basis: one unit of good A plus one unit of good B produces one unit of the final good), good A being produced by a monopolist M (at constant marginal cost (c) whereas good B is produced by two competing firms C_1 and C_2 (at no cost).[43] In the case of telecommunications, for example, good A may correspond to the local fixed link segment and good B to the long distance segment. To stick to the previous framework, we denote by $p = P(q)$ the inverse demand for the final good.

The case where M is "upstream" (Figure 33.2a) is formally equivalent to the one analyzed above: M sells good A to C_1 and C_2, who combine it with good B to provide consumers with the final good. If M can make secret offers to both C_1 and C_2, then opportunism prevents M from fully exerting its monopoly power. The upstream monopolist obtains the Cournot profit.

If instead M is "downstream" (that is, C_1 and C_2 supply M, who then deals directly with consumers, as in Figure 33.2b), the situation is different: Being at the interface with consumers, M is naturally inclined to "internalize" any negative externality between C_1 and C_2, and is thus induced to maintain monopoly prices. Assuming M can still make

[41] More properly, the signing of a long-term lease giving U.S. Steel the exclusive right to mine.

[42] Riordan (1998) however questions their conclusions. In particular, he argues that incumbent railroads might well have benefited from *rising* steel prices, which would have limited entry and expansion plans.

[43] We use the generic notation $\{M, C_1, C_2\}$ when the location is endogenous – as here – or irrelevant – as in the horizontal foreclosure case studied in Section 3 – and the specific one $\{U, D_1, D_2\}$ for fixed vertical structures – such as studied previously.

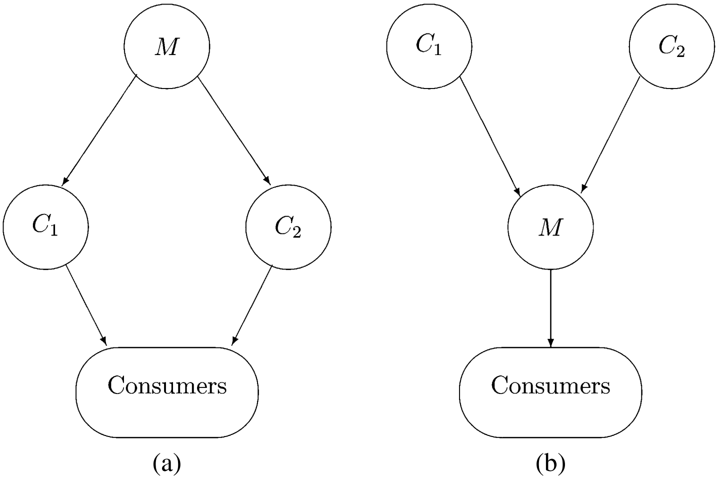

Figure 33.2. Upstream (a) versus downstream (b) bottlenecks.

take-it-or-leave-it offers to both C_1 and C_2, M can now at the same time extract all profits from them and charge the monopoly price to final consumers.[44] Hence, from either the consumers' or total welfare perspective, it is preferable to put the more competitive segment downstream. For example, in the above mentioned telecommunications example, it is preferable to let consumers deal directly with the competing long distance operators who then buy access from the fixed link operator. This idea may provide a rationale for the U.S. gas reform (FERC order 436, 1985)[45] and the "common carrier" concept, although some caution must be exerted in view of the regulatory constraints in those industries.

Non-discrimination laws Non-discrimination laws are often motivated by the protection of final consumers against abuses of a dominant position. It is well known that in

[44] Does this result depend on the assumption that the monopolist has all the bargaining power? Consider for example the opposite extreme: The upstream competitors make take-it-or-leave-it contract offers $T_i(q_i)$ to the downstream monopolist. This situation has been analyzed in depth by the literature on "supply functions equilibria" [e.g., Back and Zender (1993), Bernheim and Whinston (1986, 1998), Green and Newbery (1992), and Klemperer and Meyer (1989)]. As is well known, supply function games have multiple equilibria [see, e.g., Back and Zender (1993) and Bernheim and Whinston (1998)]. On the other hand, it is possible to select among differentiable equilibria by introducing enough uncertainty [Klemperer and Meyer (1989)]. This selection yields the same Bertrand competition outcome ($T_i(q_i) = 0$ for all q_i) as for the polar distribution of bargaining powers.

[45] Before the reform, pipelines (the bottleneck) sold gas to customers (distribution companies, large industrial customers) and purchased their gas internally or from independent producers who had no direct access to customers. Since the reform, producers can purchase access from pipelines and intereact directly with customers.

other contexts non-discrimination laws may have ambiguous effects, since they may favor some consumers to the detriment of others. But in the context described above, these laws adversely affect all consumers and total welfare: they eliminate opportunistic behavior and allow the bottleneck owner to fully exercise its monopoly power.[46]

To see this, return to the basic (Cournot) framework in which the monopolist is located upstream, and assume that U is restricted to offer the same tariff to both D_1 and D_2[47]:

- Stage 1: U offers the same tariff $T(\cdot)$ to both D_1 and D_2; D_i then orders a quantity of intermediate product, q_i and pays $T(q_i)$ accordingly.
- Stage 2: D_1 and D_2 transform the intermediate product into final good, observe each other's output and set their prices for the final good.

This game is played under complete information at each point of time. Thus there is no scope for opportunistic behavior from U. Formally, the situation is the same as with secret offers but "symmetric" beliefs, and in equilibrium U gets the entire monopoly profit. An *example* of an optimal tariff is $T(q) = F + wq$, where the fixed fee F and the wholesale price w satisfy:

$$q^C(w) = Q^m/2,$$
$$F = \left(p^m - w\right)Q^m/2,$$

where $q^C(w)$ denotes the Cournot equilibrium quantity (per firm) when firms' unit cost is w:

$$q^C(w) = \hat{q} \quad \text{such that} \quad \hat{q} = \arg\max_q \left\{\left(P(q+\hat{q}) - w\right)q\right\}.$$

In other words, the marginal transfer price w is set so as to lead to the desired monopoly price and quantities, and F is used to extract D_i's profit. Hence, if the upstream firm cannot discriminate between the two downstream firms (but can still offer a non-linear tariff, or at least require a – uniform – franchise fee), it can fully exert its market power and maintain the monopoly price: Non-discrimination laws here reduce consumer surplus and total welfare by enabling the monopolist to commit.

To obtain the monopoly profit, the upstream monopoly can alternatively offer the following non-discriminatory two-part tariff:

$$T(q_i) = \pi^m + cq_i.$$

[46] O'Brien and Shaffer (1992) already made this point in the context of Bertrand downstream competition. Caprice (2005b) notes that restoring commitment by banning price discrimination is not necessarily undesirable when there is an alternative supplier, since the dominant supplier may then want to commit to lower wholesale prices – see the discussion in footnote 52.

[47] This supposes some degree of ex post transparency; yet, in the absence of a ban on discrimination, there would still scope for opportunism if the downstream firms must sign their own contracts before observing the terms offered to the rivals.

That is, the wholesale price is equal to marginal cost and the fixed fee equal to the monopoly profit. It is then an equilibrium for D_1 to sign an agreement and for D_2 to turn it down.[48] The competitive sector then makes no profit, and the upstream monopolist obtains the full monopoly profit by monopolizing the downstream sector. Note that *the fixed fee de facto transforms a potentially competitive downstream industry into a natural monopoly* (*increasing returns to scale*) *industry*. Price discounts, an instance of second-degree price discrimination, are here a perfect substitute for the prohibited third-degree price discrimination. It is also interesting to note that such foreclosure ideas partly underlied the rationale for the 1936 Robinson–Patman Act in the U.S., although considerations such as differential access to backward integration (not to mention intense lobbying) were relevant as well.[49]

2.2. *Restoring monopoly power: vertical integration*

As we observed, vertical integration helps the upstream monopolist U to circumvent its commitment problem and to (credibly) maintain monopoly prices. Suppose that U integrates with D_1 as in Figure 33.3b. The upstream monopolist, if it receives D_1's profit, internalizes the impact of sales to D_2 on the profitability of units supplied to its subsidiary. Consequently, the "expropriation" problem disappears and U restricts supplies to D_2 as is consistent with the exercise of market power. We first analyze in detail the foreclosure effect of vertical integration under the possibility of bypass and then derive some policy implications.

2.2.1. *Vertical integration and bypass of the bottleneck segment*

In the simple framework above, vertical integration leads to the complete exclusion of the non-integrated downstream firm. This is clearly an extreme consequence, driven in particular by the absence of alternative potential supplier for D_2. We show however that the same logic holds, even when there exists a competing but less efficient second source for D_2.[50] The new feature is then that the vertically integrated firm may supply its competitor on the downstream segment, a sometimes realistic outcome.

48 To be certain, there is a coordination problem here. But this problem is readily solved if U contacts one of the downstream firms first.

49 If U is restricted to use *linear* prices, then the outcome is even worse for consumers and economic welfare, as well as for the monopolist, who still can commit but cannot prevent double marginalization.
Formally, when the above game is modified by restricting the tariff $T(\cdot)$ to be of the form $T(q) = wq$, U sets w so as to maximize $\Pi_U \equiv (w(Q) - c)Q$, where $w(Q) \equiv (q^C)^{-1}(Q/2)$ satisfies, from the downstream first-order conditions: $w(Q) = P(Q) + P'(Q)Q/2$. Hence, $\Pi'_U = P - c + P'Q + (2P' + P''Q)Q/2$ is negative for $Q = Q^m$, since the sum of the first three terms is then equal to zero and the term in bracket is then negative. Therefore, U "picks" a total quantity $Q < Q^m$ whenever its objective function is quasi-concave. This reflects the fact that U does not take into account the impact of a decrease of output on the downstream firms' profits.

50 Here the other upstream firm produces a substitute. An interesting topic for future research would look at a bottleneck consisting of *complementary* goods produced by different upstream suppliers. Amelia Fletcher

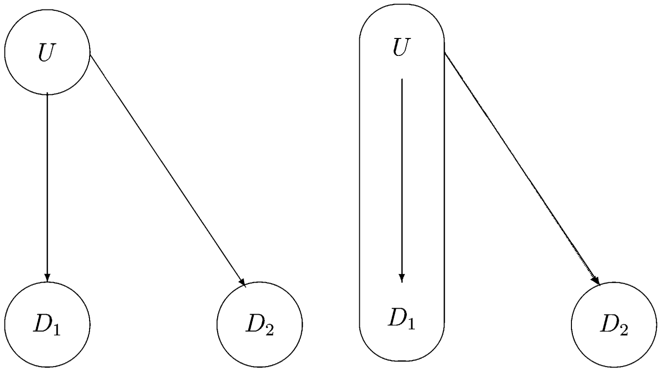

Figure 33.3. Vertical integration.

We generalize the model by introducing a second supplier, $\hat{U}$, with higher unit cost[51] $\hat{c} > c$. The timing is now as follows:

- Stage 1: U and $\hat{U}$ both secretly offer each D_i a tariff, $T_i(\cdot)$ and $\hat{T}_i(\cdot)$; each D_i then orders a quantity of intermediate product to each supplier, q_i and $\hat{q}_i$, and pays $T_i(q_i)$, $\hat{T}_i(\hat{q}_i)$, accordingly.
- Stage 2: D_1 and D_2 transform the intermediate product into final good, observe each other's output and set their prices for the final good.

In the absence of integration (Figure 33.4a), U, being more efficient, ends up supplying both D_1 and D_2, although under conditions that are more favorable to downstream units (lower fixed fees) than before, due to the potential competition from $\hat{U}$. More precisely [see Hart and Tirole (1990) for a formal proof], U supplies, as before, q^C to both downstream firms, but for a payment equal to $\pi^C - \max_q\{(P(q + q^C) - \hat{c})q\}$, since each downstream firm can alternatively buy from $\hat{U}$, who is willing to supply them at any price $\hat{p} \geqslant \hat{c}$. That is, the introduction of the alternative supplier does not affect final prices and quantities or the organization of production, but it alters the split of the profit between U and the downstream firms.[52]

suggested to us that a joint-marketing agreement (for example through the formation of a patent pool without independent licensing) might reduce welfare, despite the fact that the goods are complements, if it inhibits secret price discounts by creating protracted negotiations between upstream firms.

[51] We assume that the suppliers' costs are known. Hart and Tirole (1990) allow more generally the costs to be drawn from (possibly asymmetric) distributions. They show that U has more incentive to integrate vertically than $\hat{U}$ if realizations of c are statistically lower than those of $\hat{c}$, in the sense of first-order stochastic dominance.

[52] Interestingly, this may not be true in the case of public contracts. In the absence of $\hat{U}$, U could for example maintain the monopoly outcome by offering both firms ($q_i = Q^m/2$, $T_i = \pi^m/2$). When $\hat{U}$ is present, U could try to maintain the monopoly outcome ($q_i = Q^m/2$) and simply reduce the price to $\pi^m/2 - \hat{\pi}$, where $\hat{\pi} = \max\{[P(Q^m/2 + q) - \hat{c}]q\}$. However, if $\hat{U}$ is not too inefficient, namely, if $\hat{Q}^m = \max\{[P(q) - \hat{c}]q\} >$

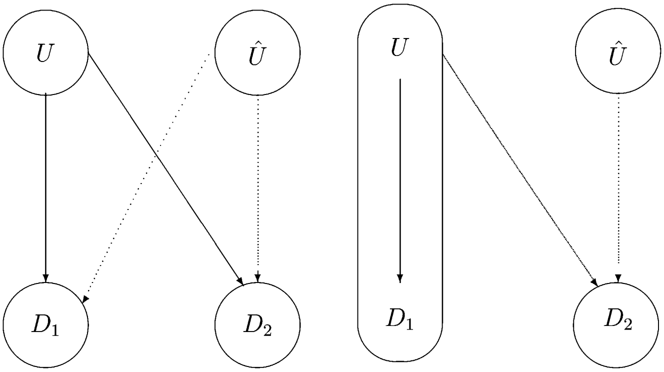

Figure 33.4. Vertical integration and bypass.

If U and D_1 integrate (Figure 33.4b), however, they again have an incentive to restrict supplies to D_2 as much as possible; however, D_2 can turn to $\hat{U}$ and buy $\hat{R}^C(q_1) \equiv \arg\max_q\{[P(q+q_1)-\hat{c}]q\}$. Consequently, in equilibrium U still supplies both downstream firms (and $\hat{U}$ does not sell), but the equilibrium quantities $\{q_1^C, q_2^C\}$ correspond to the "asymmetric" Cournot duopoly with costs c and $\hat{c}$, characterized by

$$q_1^C = R^C\big(q_2^C\big) \quad \text{and} \quad q_2^C = \hat{R}^C\big(q_1^C\big),$$

where $\hat{R}^C(q_1) \equiv \arg\max_q\{[(P(q+q_1)) - \hat{c}]q\}$.

Hence, vertical integration between U and D_1 still leads to a reduction in the supply to D_2, who now faces a higher opportunity cost ($\hat{c}$ instead of c). This new configuration entails a reduction of aggregate production as $-1 < R^{C\prime}(q) < 0$ and $\hat{R}^C(q) < R^C(q)$ imply $2q^C < q_1^C + q_2^C$ (see Figure 33.5); although q_1 increases, it increases less than q_2 decreases. Note however that production efficiency is maintained: Although U wants to reduce q_2 as much as possible, it still prefers to supply q_2^C rather than letting $\hat{U}$ supply it. Denoting by π_1^C and π_2^C the corresponding Cournot profits, the equilibrium profits are given by

$Q^m/2$, $\hat{U}$ would destroy this candidate equilibrium by offering $\hat{Q}^m$ to one downstream firm, at a lump-sum price between $\hat{\pi}$ and $\hat{\pi}^m$: that downstream firm would accept this contract, thereby discouraging the other firm from accepting U's offer. The analysis of competition in public contracts can actually be surprisingly complex – see Rey and Vergé (2002). Even when the alternative supply comes from a competitive fringe that does not behave strategically, the dominant manufacturer may deviate from joint profit maximization, e.g., by offering lower input prices, in order to reduce the rents obtained by the downstream firms – see Caprice (2005b), who notes that banning price discrimination may be a good idea in that case, since doing so may allow the dominant manufacturer to commit itself to low prices; this effect disappears, however, when contracts can be contingent on who supplies who: the dominant supplier can then reduce downstream rents by offering lower prices only "off the equilibrium", if one firm were to go to the alternative supplier.

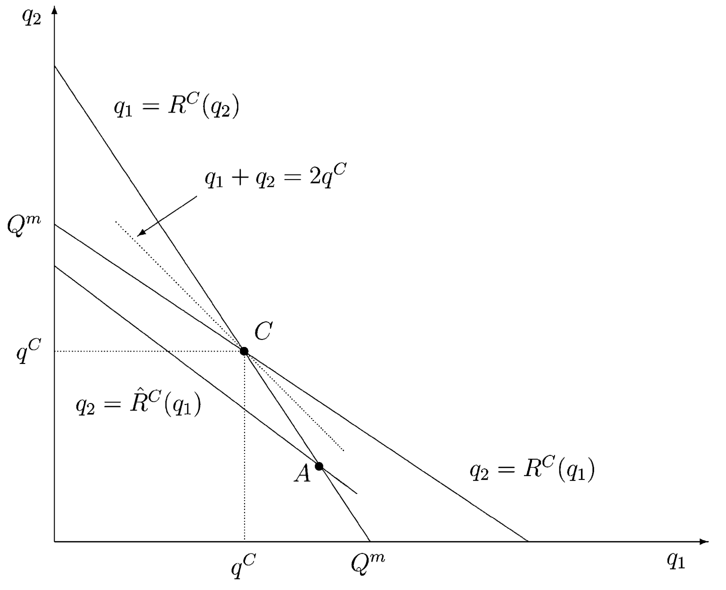

Figure 33.5. C: Cournot equilibrium ($c_1 = c_2 = c$). A: Asymmetric Cournot equilibrium ($c_1 = c < c_2 = \hat{c}$).

$$\pi_{U+D_1} = \pi_1^C + (\hat{c} - c)q_2^C, \qquad \pi_{D_2} = \pi_2^C.$$

Hence, D_2 is hurt by vertical integration, while $U - D_1$'s aggregate profit is higher, since industry profit is higher.[53] Vertical integration thus benefits the integrated firms and hurts the non-integrated one. Although it maintains production efficiency, it lowers consumer surplus and total welfare. Furthermore, the higher the cost of bypassing the bottleneck producer, the larger the negative impacts on consumers and welfare.[54] Last, it is interesting to note that vertical integration is more profitable, the less competitive the bypass opportunity (the higher $\hat{c}$ is).

The motivation for foreclosure is again here the preservation of an *existing* market power in a segment. By contrast, in Ordover, Saloner and Salop (1990), an upstream firm has no such market power and faces instead an equally efficient supplier. Yet, it is shown that such a firm may have an incentive to integrate vertically if (i) it can commit to limit its supplies to the downstream rivals and hence to expose them to the upstream competitor's market power thus created, and (ii) the upstream competitor can charge only linear prices so that its exercise of market power on the non-integrated down-

[53] The aggregate quantity is now lower, and lies between Q^m and $Q^C = 2q^C$ (and $q_1^C + q_2^C = Q^m$ for $\hat{c}$ sufficiently large), and production efficiency is maintained.

[54] Note that $\hat{U}$ or D_2 cannot gain by "fighting back" and integrating themselves. In equilibrium, D_2 gets actually exactly as much as it would being integrated with $\hat{U}$. For more general situations, in which "band-waggoning" may occur, see Hart and Tirole (1990).

stream firm operates through a high wholesale price rather than a high fixed fee. Several authors have built on Ordover et al. and relaxed some of their assumptions. In particular, Choi and Yi (2000) and Ma (1997) dispense in different settings with the commitment assumption, although not with the linear pricing one.[55]

2.2.2. *Policy implications*

Since vertical integration can lead to foreclosure and have a negative impact on consumers and total welfare, it is natural to ask which type of policy, short of structural separation, might nullify or at least limit this negative impact.

Upstream versus downstream bottleneck We noted that, in the absence of vertical integration, it is socially desirable to ensure if feasible that the most competitive segment of the market has access to final consumers. This is still the case under vertical integration as we now show.

Let us first consider the *no bypass* case, with a monopolist M in one segment (good A) and a competitive duopoly (C_1 and C_2) in the other segment (good B). Integration between M and, say, C_1, then leads to the perfect monopoly outcome even if the competitive segment is downstream (see the above analysis). In that case, whether the competitive segment (good B) or the monopolistic one (good A) is downstream does not matter (that is, given vertical integration between M and C_1, which segment is at the interface with consumers is irrelevant; however, M and C_1 only have an incentive to integrate if the bottleneck is upstream because a downstream bottleneck does not face the commitment problem).

In the richer framework with *possible bypass of the bottleneck segment*, however, whether this bottleneck is upstream or downstream again matters. The idea is that, when the bottleneck is downstream, then the less efficient alternative supplier cannot be shut down, which results in productive inefficiency. To see this, assume that there is now an alternative, but inferior supplier, $\hat{M}$, for good A. If the segment for good A is upstream, then formally the situation is the same as the one described in the previous subsection: The outcome is the asymmetric Cournot outcome $\{q_1 = R^C(q_2),\ q_2 = \hat{R}^C(q_1)\}$, but production is efficient (M supplies both C_1 and C_2). If instead good A is downstream (that is, M and $\hat{M}$ deal directly with final consumers), then, whether M is integrated with D_1 or not, both M and $\hat{M}$ have access to good B at marginal cost (zero), and M chooses to offer $q_1 = R^C(q_2)$, whereas $\hat{M}$ offers $q_2 = \hat{R}^C(q_1)$. As a result, the equilibrium quantities and prices are the same in both cases and correspond to the asymmetric Cournot duopoly, but production is organized inefficiently (q_2^C is produced by the inefficient alternative supplier $\hat{M}$, entailing a social loss $(\hat{c} - c)q_2^C$). [Note that M, if located downstream, is indifferent between integrating upstream with C_1 and remaining

[55] See also Salinger (1988) and Gaudet and Long (1996).

Table 33.2
Equilibrium allocation

	VI	NI		VI	NI
BU	M	C	BU	AC	C
BD	M	M	BD	AC	AC
				IP	IP
	No bypass (without $\hat{M}$)			Bypass (with $\hat{M}$)	

Notes. Vertical Integration (VI) or No Integration (NI); Bottleneck Upstream (BU) or Downstream (BD); M: pure Monopoly outcome; C: Cournot equilibrium ($c_1 = c_2 = c$); AC: Asymmetric Cournot equilibrium ($c_1 = c,\ c_2 = \hat{c}$); IP: Inefficient Production (loss $(\hat{c} - c)q_2^C$).

unintegrated.] Furthermore, whether the bottleneck is integrated or not, *it is again socially desirable to have the most competitive segment* (*good B*) *downstream, i.e. at the interface with final consumers*. Table 33.2 summarizes the equilibrium allocation.

ECPR[56] We now show that ECPR may not preclude or impose any constraint on foreclosure in our framework. That is, assuming that vertical integration between the upstream bottleneck and a downstream firm has taken place, the equilibrium outcome in the absence of ECPR satisfies ECPR.

Let us assume as a first step that bypass of the bottleneck is infeasible. As seen above, in the absence of any constraint the integrated firm $U - D_1$ *de facto* excludes D_2 and charges the monopoly price, p^m, in the final good market. We can check that the integrated bottleneck's optimal policy can be made consistent with ECPR by offering a linear access price w_2 to D_2 that (a) satisfies ECPR and (b) excludes D_2. Assuming as above that downstream unit costs are zero, to meet ECPR the access price must satisfy $w_2 \leqslant p^m - 0 = p^m$. But this cap on the access price does not really help D_2 to enter the market effectively. Indeed, suppose that the integrated firm sets a linear access charge $w_2 = p^m$, and that it produces $q_1 = Q^m$ in equilibrium. Buying q_2 units of intermediate good at that price p^m and transforming (at no cost) this intermediate good into final good yields:

$$\left[P\left(Q^m + q_2\right) - w_2\right]q_2 < \left[P\left(Q^m\right) - w_2\right]q_2 = 0.$$

D_2 has thus no viable activity under ECPR.

Second, consider the case where there is an alternative, less efficient supplier for the intermediate good ($\hat{U}$, with unit cost $\hat{c} > c$). In that case, the integrated firm $U - D_1$ produces $q_1^C > q^C$ whereas the non-integrated one, D_2, buys the intermediate good at $w_2 = \hat{c}$ and produces $q_2^C < q^C$; note that the equilibrium price for the final good,

[56] A much broader analysis of the impact of ECPR (in regulated and unregulated markets) can be found in Armstrong (2002).

$\hat{p}^C \equiv P(q_1^C + q_2^C)$, is necessarily higher than D_2's marginal cost, $\hat{c}$. Since $\hat{p}^C > \hat{c}$ and $w_2 = \hat{c}$ in the range where the threat of bypass is a constraint for the upstream monopolist, ECPR is again satisfied by the foreclosure outcome.

We conclude that, with or without the possibility of bypass, ECPR has no bite. The problem of course is not that ECPR is "wrong" per se, but rather that it is expected to perform a function it was not designed for.[57]

2.3. Restoring monopoly power: exclusive dealing

The previous section reviewed the dominant firm's incentives to vertically integrate in order to extend its market power. When used for that purpose, vertical integration gives rise to foreclosure and thus generates a social cost (vertical integration may also yield social benefits, which we discuss in the next section). To evaluate the social costs and benefits of preventing vertical integration, however, it may be necessary to investigate the alternative strategies available to dominant firms for implementing foreclosure and the relative costs of these strategies. One such strategy is "exclusive dealing" or "exclusive supply" agreements.[58]

2.3.1. Basic framework: exclusive dealing as a substitute for vertical integration

Consider, first, the basic framework, in which an upstream monopolist, U, sells to two downstream firms, D_1 and D_2. Vertical integration with, say, D_1, then allows U to monopolize the entire industry in the Cournot case. Consequently, D_2 is excluded from the market. Assuming now that vertical integration is prohibited, the upstream monopolist U can nevertheless achieve the same outcome by signing an exclusive agreement with D_1: By entering into such an agreement, U de facto commits itself not to sell to D_2 and thus eliminates the risk of opportunism. In this simple framework, an exclusive dealing arrangement is thus a perfect substitute for – and arguably a more straightforward solution to the commitment problem than – vertical integration. In particular, a policy that would prevent vertical mergers would have no effect if exclusive dealing were allowed.

Because it introduces a rigid constraint, exclusive dealing may actually be privately and socially less desirable than vertical integration. This is for example the case if there is some room for other upstream or downstream firms under vertical integration, as we now demonstrate.[59]

[57] See, e.g., Baumol, Ordover and Willig (1995) and Laffont and Tirole (1999) for a discussion of the facts that ECPR is only a partial rule, and that ECPR, even when it is optimal in the presence of other well-calibrated instruments, cannot achieve the optimum in the absence of these other instruments.

[58] Depending on the context, exclusive dealing agreements can take various forms: exclusive territories for retailers, exclusive license, and so form. These exclusive dealing agreements involve a commitment not to deal with other downstream firms, which may be easier to monitor and to enforce, and thus more credible than a commitment to deal with them "up to some level" (e.g., half of the monopoly quantity).

[59] Conversely, there may be circumstances where vertical integration might be an inferior substitute to exclusive dealing (e.g., because of internal organizational costs); a policy that would be more restrictive against exclusive deals than against vertical integration might then lead again to an alternative, less desirable solution.

2.3.2. Exclusive dealing generates production inefficiency in the presence of bypass

Consider next the case where there is an alternative, less efficient supplier, $\hat{U}$, with higher cost than U: $\hat{c} > c$. Although vertical integration with D_1 does not allow U to maintain the monopoly outcome, it nevertheless entails some foreclosure of D_2 and leads to a reduction of total output. However, in this context, the most efficient supplier, U, still supplies both downstream firms D_1 and D_2: U indeed does not want D_2 to buy from its rival (and in equilibrium, U supplies D_2 exactly the amount that D_2 would have bought from $\hat{U}$). In contrast, an exclusive agreement with D_1 would lead to the same reduction in output, but would moreover introduce an additional efficiency loss, since in that case D_2 would have to buy from $\hat{U}$ (compared with vertical integration, the additional welfare loss is equal to the loss in profit, namely $(\hat{c} - c)q_2^C$).[60]

Exclusive dealing is clearly profitable when the alternative supplier is quite inefficient, since in the limit case where $\hat{U}$ does not impose any competitive constraint, U gets the full monopoly profit with exclusive dealing and only the Cournot profit otherwise. When $\hat{U}$ is quite efficient (that is, $\hat{c}$ close to c), however, U may prefer serving both downstream firms. To see this, suppose that, before negotiating with D_1 and D_2, U can choose to auction off an exclusive dealing contract. If U does not offer exclusivity, the Cournot outcome (q^C, q^C) is achieved but each D_i gets a rent, equal to $r^N = \max_q\{(P(q^C + q) - \hat{c})q\}$; U thus obtains $\pi_U^N(\hat{c}) = 2(\pi^C - r^N)$, which is positive as long as $\hat{c} > c$. If instead U auctions the right to be supplied exclusively, the asymmetric Cournot outcome $(q_1^C(\hat{c}), q_2^C(\hat{c}))$ is achieved (where q_1^C and q_2^C, which coincide with q^C when $\hat{c} = c$, are respectively increasing and decreasing in $\hat{c}$) and each downstream firm bids up to what it would earn if it were to lose the auction, which is equal to $r^E = \max_q\{(P(q_1^C(\hat{c}) + q) - \hat{c})q\}$. Thus, by auctioning an exclusive deal, U can earn $\pi_U^E(\hat{c}) = \pi_1^C - r^E$. Both options (offering exclusivity or not) yield zero profit when the second supplier is equally efficient ($\pi_U^N = \pi_U^E = 0$ when $\hat{c} = c$) and become more profitable as $\hat{U}$ becomes less efficient; as already noted, the second option clearly dominates when $\hat{U}$ is sufficiently inefficient (π_U^1 is capped by the Cournot profit, while π_U^2 increases up to the full monopoly profit), but the first option might dominate when $\hat{U}$ is quite efficient ($\hat{c}$ close to c) and Cournot quantities do not react too much to cost asymmetry.[61]

[60] Chen and Riordan (in press) point out that a vertically integrated firm might still be able to monopolize the industry by entering into an exclusive deal with D_2, thereby committing itself not to compete in the downstream market; thus, vertical integration and exclusivity may together succeed in monopolizing the industry, even when vertical integration or exclusivity alone would not achieve that result.

[61] If a small asymmetry had no impact on quantities (i.e., $q_1 = q_2 = \hat{q}$ in the various configurations for $\hat{c}$ close to c), then clearly $\pi_U^N(\hat{c}) = 2(\hat{c} - c)\hat{q} > \pi_U^E(\hat{c}) = (\hat{c} - c)\hat{q}$. When both demand and costs are linear, however, quantities respond "enough" to cost asymmetry to make exclusive dealing always profitable; one can check that, for $P(q) = 1 - q$ and $c = 0$, U's profits are respectively $\pi_U^N(\hat{c}) = \frac{2}{9}(1 - (1 - \frac{3}{2}\hat{c})^2)$ and

2.3.3. Exclusive dealing and downstream product differentiation

Consider now the case where there is no alternative supplier, but there are two downstream firms producing differentiated products, which are sufficiently valuable that an integrated monopoly would choose to produce both. As in Section 2.3.2, vertical integration of the bottleneck with D_1 may again not lead to the full monopolization of the industry, but in general maintains D_2 alive. That is, the integrated firm $U - D_1$ may want to supply D_2, although in a discriminatory way, rather than forcing D_2 completely out of the market. In contrast, an exclusive agreement with D_1 would lead *de facto* to the exclusion of D_2, and might thus result in yet another inefficiency and reduction in welfare.[62]

2.3.4. Discussion

In the two situations just analyzed, exclusive dealing yields less profit to U than vertical integration, and ruling out vertical mergers but not exclusive dealing arrangements thus forces U to choose a socially less desirable outcome. In the first case, an exclusive dealing arrangement between the efficient upstream supplier and one of the downstream firms forces the other downstream firm(s) to switch to an alternative, less efficient supplier. In the second case, the exclusive dealing arrangement *de facto* excludes rival downstream firms and thus reduces the choice offered to final consumers, in contrast to what happens under vertical integration.

This raises an important issue for policy design: There is no point forbidding one practice (here, vertical integration) if it leads the firms to adopt practices (here, exclusive agreements) that are even less desirable from all (firms' and consumers') perspectives.

2.4. Further issues

Needless to say, our treatment is far from exhaustive. Let us mention a number of important topics or further developments.

– *Private incentives not to exclude*. We have emphasized the bottleneck's incentive to exclude in order to restore market power. To be certain, exclusion need not be complete, as when the bottleneck producer faces competition from a less efficient rival; but still

$\pi_U^E(\hat{c}) = \frac{1}{9}((1+\hat{c})^2 - (1-2\hat{c})^2)$, and thus

$$\mathrm{d}\pi_U^E(\hat{c})/\mathrm{d}\hat{c} = \frac{2}{3}(1-\hat{c}) > \mathrm{d}\pi_U^N(\hat{c})/\mathrm{d}\hat{c} = \frac{2}{3} - \hat{c}.$$

[62] There again, exclusive dealing is profitable as long as downstream differentiation remains limited, but may otherwise become unprofitable (in particular, U prefers serving both D_1 and D_2 when they do not really compete against each other).

then, the bottleneck owner does everything it can to restrict downstream output and just prefers to substitute its own production for that of the upstream rival. There are at least two situations, though, in which the bottleneck producer is less eager to exclude (we only sketch the reasoning; details and further discussion is provided in Appendix A).

First, independent users of the intermediate good may sink investments that orient their technology toward that of the upstream bottleneck or toward an alternative technology, for which there are competitive suppliers. They will choose the latter if they anticipate that the upstream bottleneck will practice foreclosure, for example if it has integrated downstream. The problem is one of commitment: to prevent inefficient choices of bypass technologies, the bottleneck owner would like to commit not to foreclose, which may require divesting downstream units, committing not to choose an exclusive customer, and so forth. Appendix A discusses in this light the voluntary divestiture of AT&T's equipment division (Lucent Technologies).

Second, and reversing the protection-of-specific-investments argument, an upstream bottleneck owner who has to sink specific investment does not want to face the prospect of hold-up in a bilateral monopoly situation with a favored downstream user [Chemla (2003)]. It is well known that competition protects investments in environments in which efficient long-term contracts are difficult to write. Certain forms of foreclosure may have the undesirable side-effect of leading to the expropriation of the upstream monopolist's investment through ex post bargaining.

– *The "Coasian logic" applies beyond industrial markets*. For example, in Cestone and White (2003), a financial intermediary (bank, venture capitalist, etc.) must develop some expertise in order to assess whether a line of business is promising, how to tailor the contract to the technology, or how to monitor the borrower. But once the intermediary has sunk the corresponding investment, nothing prevents it from funding another venture in the same line of business. That is, the financial intermediary becomes an upstream bottleneck who may be (sequentially) tempted to finance many competing ventures and may therefore not be able to extract rents (and possibly recoup the initial investment). The response to Coase's problem emphasized in Cestone–White is the ownership of equity stakes by the intermediary, which, at the cost of diluting the borrower's incentives, at least force the intermediary to internalize some of the loss of profit associated with the funding of competing ventures, while a debt contract would be more efficient in the absence of a commitment problem.

– *General results on contracting with externalities*. In an important, more abstract paper on contracting with externalities, Segal (1999) looks at more general situations in which a principal contracts with multiple agents and the contract with a particular agent exerts externalities on other agents (product-market-competition externalities in our framework). He obtain general results on the extent of trade between the principal and the agents when contracts are secret, as a function of the nature of the externalities, and then studies the case in which the principal is able to make public commitments.

– *Alternative conjectures*. As we have seen, the passive-conjecture assumption is a reasonable one in the Cournot situation in which the upstream monopolist produces to order. It is much less appealing in the case of Bertrand competition, and indeed in many games of contracting with externalities, where the contract signed with one downstream competitor affects the contracting terms that the upstream monopolist would like to offer to the competitor's rivals.

This strategic interdependence among the contracts signed with the different competitors has two implications. First, at the technical level, it creates non-concavities and, as a result, pure-strategy equilibria with passive beliefs may not exist anymore. This is because the gain from a multilateral deviation, i.e. a simultaneous change in the contracts offered to D_1 and D_2, may then exceed the total gains of the unilateral deviations, i.e. stand-alone modifications of the contract offered to one of the downstream firms. Rey and Vergé (2004) show that the unique "contract equilibrium", characterized by O'Brien and Shaffer (1992) using bilateral deviations, does not survive multilateral deviations when the cross elasticity is at least half of the direct demand elasticity.[63] Second, a downstream firm should anticipate that, if the supplier offers it an out-of-equilibrium contract, the latter has an incentive to change the contracts offered to the others. Passive beliefs thus appear less plausible. McAfee and Schwartz (1994) propose to consider instead *wary beliefs* where, when it receives an unexpected offer, a downstream firm anticipates that the supplier acts optimally with its rivals, given the offer just received. Rey and Vergé (2004) show that, when demand is linear, wary beliefs equilibria exist even when passive beliefs equilibria fail to exist, and these equilibria exhibit some degree of opportunism: the upstream firm does not fully exploit its market power, although it performs better than when downstream firms hold passive beliefs; in addition, prices are lower with Cournot than with Bertrand downstream competition.[64]

Segal and Whinston (2003) take another route and investigate in more general settings the set of conclusions that are robust to the choice of conjectures. They fully characterize equilibrium profits in offer games.

– *Bidding games*. We have mostly supposed so far that the upstream firm has the initiative and makes a take-it-or-leave-it offer to each downstream firm. Another stream of the literature studies situations where instead downstream rivals bid for the input supplied by an upstream monopolist. In the bidding games considered by Segal and Whinston (2003) and Martimort and Stole (2003), where the downstream rivals make

[63] Segal and Whinston (2003) note a similar existence problem when the manufacturer faces non-constant returns to scale. McAfee and Schwartz (1995) also point out that, when contracts are observed before the actual stage of downstream competition, the unique candidate equilibrium for passive beliefs may generate negative profits.

[64] Rey and Vergé also confirm the insight of O'Brien and Shaffer (1992), who pointed out that RPM can help an upstream manufacturer to exploit its market power. The idea is that RPM allows the upstream monopolist to squeeze its retailers' margins, thereby eliminating any scope for opportunism.

the offers but the upstream monopolist eventually chooses how much to supply, the equilibrium outcome is again competitive; in essence, each bidder then exerts an externality on the other, which the contracts cannot internalize despite using a common supplier.

In contrast, when the downstream firms eventually determine quantities and the offers are public, they can protect themselves again opportunistic behavior by the rivals, by offering a flexible contract that allows them to adapt their actual purchases to the terms offered by the rivals' contracts. Marx and Shaffer (2004) stress however that, even when contracts are public, coordination among the downstream firms may still fail and exclusive dealing may arise instead. The intuition is as follows: in any equilibrium where both downstream firms are active, the supplier must be indifferent between supplying both or only one firm, but each firm benefits from being an exclusive agent. This can be achieved through an exclusive dealing contract or, as noted by Marx and Shaffer, by making the fixed fee partly conditional on the downstream firm's eventually purchasing a positive quantity; in effect, a high enough conditional fixed fee deters the upstream monopolist from supplying its input to the rival, as the downstream firm would not purchase – and thus not pay the fee – in that case.[65] Rey, Thal and Vergé (2005) however show that allowing for contingent offers, where the terms of the contract depend on exclusivity, leads to the industry integrated outcome, with both retailers active and each receiving its contribution to total profits.

Another strand of literature looks at how downstream rivals may want to lock in the supplies of a competitively supplied input in order to monopolize the downstream market. In Stahl (1988) and Yanelle (1997), competing downstream firms bid up to corner supplies so as to become a downstream monopoly. In equilibrium, a single firm acquires all supplies and charges the monopoly price in the downstream price in the downstream market. This firm however makes no profit because it spends this monopoly profit to bid up supplies.

In Riordan (1998), the upstream market is served by a competitive industry, with an upward sloping supply curve. The downstream market is populated by a dominant firm and a competitive fringe. The dominant firm enjoys a first mover advantage in contracting for its input requirements. The upstream industry then supplies the downstream competitive fringe. An increase in the dominant firm's purchase of the input raises the fringe's marginal cost of production through a higher wholesale price (since the upstream supply curve is upward sloping) – a foreclosure effect; at the same time, the downstream dominant firm is not eager to produce much downstream and therefore to buy much upstream.

In this context, Riordan analyzes the impact of a prior and exogenous ownership stake in the upstream industry ("vertical integration"); that is, the dominant firm starts with input supplies $k_0 \geqslant 0$ and may want to increase its supplies beyond k_0. Riordan shows that an increase in k_0 raises both the wholesale and the final prices. Intuitively,

[65] The conditional fixed fee can for example be set equal to the profit that the downstream firm can expect to achieve under exclusivity; the non-conditional part of the fee can then take the form of an upfront payment from the supplier to the downstream firm (as in the case of listing fees paid by manufacturers to large retailers).

the initial ownership stake makes it cheaper for the dominant firm to raise the fringe's marginal cost though an increase in the wholesale prices (the dominant firm is protected by ownership against the price increase for the first k_0 units). This increased foreclosure raises the downstream price as well. It would be interesting to investigate[66] whether the dominant firm has an incentive to buy the ownership stake k_0, though. In fact, the expectation of higher wholesale price raises the cost of acquiring a unit ownership stake, as k_0 grows. So the dominant firm ends up paying for the wholesale price increase, which may well dissuade it from acquiring the stake in the first place.

3. Horizontal foreclosure

We now turn to horizontal foreclosure, referring to situations in which: (i) a firm M is present in two final markets, A and B; and (ii) this firm M has substantial market power in market A, called for simplicity the "monopoly segment" and faces actual or potential competition in market B, labeled the "competitive segment". In such a situation, the traditional "leverage" concern is that M could foreclosure competitors in market B by tying the bottleneck good A to its own offering in B. This leverage theory has been used in many high-profile cases involving complements – particularly when product B has low value, or is even useless, unless combined with product A (memory or software and CPUs for mainframe computers, parts or maintenance services and original equipment, and so forth).

However, as the Chicago School pointed out, tying need not be a rational anticompetitive strategy for M. The key point is that, even though good A is sold separately, so there are indeed two markets and two profits to be made, M can extract its profit through its pricing in the monopoly market A rather than through seeking to exercise monopoly power in the adjacent market B. Furthermore, when the second product is a complement to the first, a monopolist that can exploit its market power for its own monopolized product has no interest in excluding low-cost and high-quality varieties from the market since their presence makes its own product more attractive to consumers: reducing competition in market B makes good A less desirable to the consumers.

To illustrate this, suppose that good B is useless unless combined with good A.[67] To simplify, suppose that consumers want one unit of each good. With a slight abuse of notation, consumers derive surplus A from good A alone, and an additional surplus B from M's version of good B, while several independent producers can produce a better version of good B, yielding a higher surplus $\hat{B} \geqslant B$ (provided, of course, that they also consume good A). M has constant unit costs a and b, respectively, in the two markets, while B-rivals produce at a lower cost $\hat{b} \leqslant b$.

[66] Along the lines of Burkart, Denis and Panunzi (1998), Joskow and Tirole (2000) and Gilbert, Neuhoff and Newbery (2004).

[67] A situation that would look very similar to that considered for vertical foreclosure. The crucial difference, though, is that good B (the counterpart of the "downstream" good) and good A are here sold separately.

– *Bundling*. By tying the bottleneck good A to its own version of B, M can foreclose rivals in market B and thus become a monopolist in both markets; it can then either sell the bottleneck good at price A and the other good at price B or the combination of the two goods at price $P^M = A + B$; both options result in a per-customer profit of

$$\pi^M = A - a + B - b.$$

– *Unbundling*. By contrast, in the absence of foreclosure, competition among the independent B producers leads them to offer the better version of B at their low marginal cost; consumers thus derive on market B a surplus equal to $\hat{B} - \hat{b}$; but then, M can increase the price it charges for good A from A to up to $A + \hat{B} - \hat{b}$ and realize a per-customer profit of

$$\pi^M + \Delta,$$

where

$$\Delta \equiv (\hat{B} - B) + (b - \hat{b})$$

denotes the technological advantage of the rivals. In other words, M loses from foreclosing access and becoming a B-monopolist. The point is that any additional surplus provided by B-competitors increases consumers' valuation of the bottleneck good, which M can then extract (at least partially) by exerting its market power on that segment.

Here again, the Chicago School view has led industrial economists to reconsider the leverage argument. Three lines of argument have been developed.[68]

First, when the products are relatively independent, the above observation does not apply: a second source of monopoly power does not devalue M's original monopolized product. If in addition the monopolist has a realistic chance of driving competitors out of – or of discouraging entry in – the adjacent market, then committing to sell the two goods as a bundle, and only as a bundle, can serve as a strategic commitment to be a tough competitor in market B – since then, any lost sale in B implies a lost sale as well in the core market A – and can thus deter potential competitors in market B.

Second, even when the two goods are complements, entry in the adjacent market B may facilitate entry in the monopolized market A. Then, the incumbent monopolist M may be tempted to deter entry in the adjacent market in order to help prevent entry in its core market.

Last, the mere fact that the integrated firm M is present in two complementary markets A and B affects that firm's incentives to invest in B, since any increase in competition in B enhances consumers' willingness to pay for the monopolized product in A. This, in turn, alters rivals' incentives to invest and innovate in the adjacent market.

These arguments are discussed in turn in the next three sections.

[68] See Whinston (2001) for an informal survey of this literature.

3.1. Entry deterrence in the tied market

The first response to the Chicago critique in the case of adjacent markets is Whinston's (1990) classic paper. His idea is best illustrated in the case in which goods A and B are *independent*. Suppose that M, the monopolist in market A, faces potential competition in market B from an entrant E, who has not yet incurred a fixed cost of entry. Whinston's key insight is that tying the two goods makes M de facto more aggressive in market B, and thus may discourage the rival from entering that market. A tie-in may thereby increase M's overall profit.

For example, consider the same example as above, except that:

- the demands for the two goods A and B are independent; that is, consumers as before have unit demands for each good, but now derive utility from good B whether or not they buy good A;
- in the B market, one potential entrant, E, must incur a sunk cost of entry in order to be active in the market;
- before the entry decision, M decides whether to sell the two goods as a bundle – and only as a bundle. Bundling then cannot be undone and therefore has commitment value.

So the timing goes as follows: (i) M chooses whether to bundle; (ii) E decides whether to enter, in which case it incurs a fixed cost f (in per-customer terms); (iii) M and E choose their prices (that is, depending on the bundling decision, M sets either a price P for the bundle or two distinct prices for A and B, while E sets a price for its B version if it entered the market).

– *Unbundling*. If goods A and B are sold separately, M sells the former at price A, so as to extract all consumer surplus, and thus makes a per-customer profit or margin $m_A = A - a$ on the A segment; in market B, E enters and drives M out of the market, yielding a profit Δ for E and a surplus $B - b$ for the consumers.

– *Bundling*. Suppose instead that M decides to sell the two goods as a bundle. For consumers, buying this bundle amounts to buying M's version of good B at an effective price of $P - A$. For M, the opportunity cost of a sale of good B is no longer b, but

$$b' = b - m_A;$$

that is, M's fictitious margin on good B should not be computed simply using B's marginal cost of production, b, but should also reflect the fact that M loses a sale on A (with value m_A) every time it loses a sale of B. This generates a more aggressive behavior by M in case of entry, since M would be willing to charge an effective price as low as b'; in other words, in order to maintain its sales M would be willing to charge for the bundle a price P as low as its marginal cost of production: $P = a + b$. This, of course, reduces E's profit, since E is now facing a more aggressive behavior from M in market B.

Tying can then successfully deter entry if E's competitive advantage, Δ, is small compared to the surplus generated by the bottleneck good, $m_A = A - a$; more precisely:

– if $\Delta < m_A$, M wins the competition since consumers prefer buying the bundle at marginal cost $a + b$ rather than buying the entrant's product at marginal cost $\hat{b}$:

$$(A + B) - (a + b) > \hat{B} - \hat{b} = B - b + \Delta \quad \Leftrightarrow \quad \Delta < m_A;$$

in that case, E cannot win the B market since M is willing to charge an "effective" price below the entrant's quality-adjusted cost;

– if $\Delta > m_A > \Delta - f$, if it enters E wins the competition but at a price which is too low to cover the cost of entry; E's margin m_E must be such that

$$\hat{B} - \hat{b} - m_E = B - b + \Delta - m_E \geqslant (A + B) - (a + b)$$

or

$$m_E \leqslant \Delta - m_A,$$

and thus does not allow E to recoup the per-customer entry cost f.

In both cases, bundling allows M to discourage E from entering the market. In the end, M charges $P = A + B$ for the bundle, and enjoys de facto per-customer profit $B - b$ in market B.[69]

This simple example identifies several conditions for a tie-in to be profitable[70]:

(a) *M must commit itself to a tie-in*. Otherwise, once entry occurs, M no longer has an incentive to bundle A and B. Suppose indeed that the potential competitor has already sunk the entry cost and is thus present in market B. In the absence of bundling M loses market B but makes a per-customer profit m_A in market A. In contrast, bundling reduces M's profit by Δ even if M wins the competition with the entrant: in order to maintain its position, M charges a maximal price of

$$P = A + b - \Delta$$

and makes a per-customer profit of only $m_A - \Delta$.

Therefore, the use of tying as an entry barrier relies on a strong commitment. Such commitment is more likely to obtain through technological choices (for example, making A irreversibly incompatible with competitive B versions, or by designing the two goods as a single integrated system) than through purely commercial bundling, where prices or conditional rebates can be subject to renegotiation, particularly in response to entry.

(b) *The strategy must deter entry (or induce exit) of competitors in market B*. As just observed, a tie-in is self-defeating if competitors stay in the market, because it increases the intensity of price competition: firms are more eager to make such price concessions, since a concession for one component then generates sales for all the components of the bundle.

69 With variable demands (e.g., heterogeneous preferences) for the two goods, bundling per se can reduce M's profitability; even in that case, however, bundling may be a profitable strategy when it deters entry – see the discussion in Whinston (1990).

70 Nalebuff (2003a) provides a full discussion of tying issues in the light of recent cases.

(c) *Goods A and B must be rather independent*. As pointed out by Whinston, when goods A and B are complementary the Chicago critique applies: the exit of competitors from market B mutilates good A (which it did not do under independent demands) and thus anticompetitive tie-ins are less likely for very complementary segments; if for example good B were useless unless combined with good A, then M would have no incentive to deter entry, since the entrant's competitive edge on B would reinforce consumer demand for the monopolized good A.

Suppose for instance that M is a price leader and modify the above-described stage (iii) as follows: M first choose its price(s) – for the bundle or for its components – and then E, if it entered, sets its price for B. Then, absent bundling and following E's entry, M would charge a low price (slightly above) $\hat{b} - (\hat{B} - B) = b - \Delta$ (thus below its own cost) for its B component, forcing E to sell at cost, and would recover (almost) all of E's added value through a high price $(A + B + \Delta)$ on the bottleneck component A. Of course, in practice M may not be able to extract all of E's added value: in the absence of price leadership, competition may allow E to keep part or even all of its technological advantage (Δ).[71] Still, M would have no incentive to bundle and deter entry, and as long as it extracts *some* of E's efficiency gain, it would actually have an incentive *to unbundle* and to encourage entry in the B-market.[72]

REMARK (*bundling and competition*). The fact that bundling intensifies competition has been further emphasized by Matutes and Regibeau (1988) and Economides (1989), who focus on the compatibility choices of competing firms that each offer all components of a system.[73] When firms opt for compatibility, "market-by-market" competition prevails, where firms compete separately for each component; in contrast, under incompatibility, consumers cannot "mix-and-match" rival firms' components: competition in bundles thus prevails and competition is again more intense.[74] The argument applies as

[71] When M and E set their prices simultaneously, there are many equilibria, generating any sharing of the gain Δ – see, e.g., Ordover, Sykes and Willig (1985). In particular, the prices that emerge when M acts as a price leader still constitute an equilibrium outcome when M and E set their prices simultaneously; the equilibrium that would obtain under the price leadership of E is also an equilibrium, in which E keeps all of its technological advantage Δ. Eliminating weakly dominated strategies however excludes any below cost pricing strategy for M and would thus single out the equilibrium where the entrant obtains all the benefits of its competitive advantage Δ.

[72] See Whinston (1990) for a fuller discussion of situations where tying can be a profitable entry deterrence device.

[73] Bundling, like (in-)compatibility choices, are examples of endogenous switching costs. Therefore, many insights from the analysis of switching costs [see Farrell and Klemperer (2007) for a detailed survey] apply here as well.

[74] These papers thus focus on the case of perfect complements, whereas Whinston (1990) studies mainly the case of independent goods. The distinction between independent goods and complements tends however to be blurred when total demand is fixed (the "whole market" is served, say). In the absence of bundling, or with compatible technologies in the case of complements, the same market-by-market competition then obtains whether the goods are complements or independent, while bundling or incompatible technologies

well to the case of mixed bundling, where firms set different prices for stand-alone components and bundles (in practice, this can take the form of conditional discounts, where consumers receive a discount on one component if they buy another component from the same firm).[75] Nalebuff (2000) extends the analysis to the case of an integrated firm competing against non-integrated rivals for a system with many components (that is, one firm offers a version of all components, and competes with a different firm for each component). Nalebuff points out that, while bundling intensifies price competition, it also gives a larger market share to the integrated firm than the latter would have without bundling; this is because the unintegrated firms face double – or multiple – marginalization problems.[76] Nalebuff further shows that, as the number of components becomes large (and double marginalization problems thus pile up), the gain in market share may become so important as to offset the price reduction that stems from the more intense competition. In that case, bundling may actually *benefit* the integrated firm.

In many markets, the complementary goods are or may be purchased sequentially (examples include razors and blades, mobile telephones and accessories such as car chargers, new cars and spare parts, and computers and component upgrades). In such markets, it is sometimes feared that manufacturers may tie the additional equipment to the original one, or else make their original equipment incompatible with the additional equipment of rival manufacturers, in order to "lock in" consumers and weaken price competition in the subsequent market. In that case, however, anticipating this risk of opportunism consumers are willing to pay less for their initial purchases.[77] That is, such as strategy would backfire, since the weakened ex post competition in the additional equipment market triggers stronger competition for the original sales.[78,79]

lead in both cases to the same system competition (a possible caveat concerns the possibility of buying two bundles in order to "mix and match", which may be relevant when unit costs are low and in the absence of technical integration). The distinction between independent and complementary goods plays a more important role when total demand is elastic; with complements, there is then an interaction across markets even in the absence of bundling.

[75] Choi submitted to the European Commission, in the context of the GE/Honeywell merger, a model in which a firm produces two complementary goods (e.g., aircraft engines and avionics) and competes with unintegrated firms in each market. Assuming linear demand and cost, Choi showed that rivals face tougher competition and can lose market share, in spite of lower prices, when the integrated firm is allowed to set a price for the bundle, in addition to component prices – see Choi (2001) and Nalebuff (2003b) for a fuller discussion of this case.

[76] The integrated firm recognizes that cutting the price of one component boosts the demand for complementary components. In the absence of bundling, however, this benefits all components – its own and the rivals' ones; in contrast, with bundling the integrated firm knows that any sacrifice in the price of one component benefits its own complementary components – and only its own – while unitegrated firms still fail to take into account such positive feedback.

[77] Even if consumers rationally anticipate this opportunism, the incentive still exists ex post as long as the supplier is unable to commit to future prices.

[78] See Klemperer (1995) for a comprehensive survey of oligopolistic competition with switching costs.

[79] Manufacturers will thus have an incentive to limit their ability to hold up the consumers. This can be done by developing a reputation; however, reputation building may prove difficult when the prices of the

3.2. Protecting the monopolized market

While a monopolistic supplier would suffer from the exit of efficient producers of complementary goods, this exit may make it easier to protect the position of the bottleneck supplier in its core market. This is for example the case when entry in one segment facilitates or encourages entry in the other segment. Two variants of this idea have been explored. Choi and Stefanadis (2001) emphasize that, when entry is risky (e.g., when it involves R&D projects that may or may not succeed), tying the two goods A and B reduces the expected return of entry in *each* market, since entry in one market is then profitable only when entry is successful in the other market as well; tying may in that case deter entry in *both* markets. Carlton and Waldman (2002) focus instead on the presence of economies of scope between entry decisions in the two markets. We explore these two ideas in turn.

We use a framework similar to the one above, except that M initially benefits from a monopoly position in both markets A and B, and that the two goods are valuable only when used together (perfect complementarity). In addition, we suppose now that an entrant E can potentially enter both markets.[80]

– *Risky entry*. Following Choi and Stefanadis (2001), suppose that in each market E can invest in R&D in order to enter that market. More precisely, by investing f in R&D in any of the two markets, E succeeds with probability ρ in developing a better variety of the good in question, which it can then produce at a lower cost; as before, we will denote by Δ the total gain in quality and cost. For simplicity, we assume symmetry between the two goods, and in particular Δ is the same for both. The R&D projects in the two markets are stochastically independent and the timing is as follows:

- M decides whether to bundle the two goods; tying is then irreversible and, in addition, customers cannot undo the tie, nor do they want to add a second version of a good they already have (either the technologies are incompatible or the marginal cost, and therefore the price of a component is high)[81];

subsequent purchases are not readily observable or when there is uncertainty about the exact need for additional equipment or services. Another possibility is to reduce endogenous switching costs and opt for "open standards" [Garcia Mariñoso (2001)], grant licenses, and so forth, so as to commit to strong competition in the additional equipment and services, as stressed in the second-sourcing literature – see Farrell and Gallini (1988) and Shepard (1987), and Kende (1998) for a recent application.

80 The analysis would apply as well to the case of independent entrants in the two markets. Potential coordination problems might then reinforce M's incentive to bundle and deter entry; see Choi and Stefanadis (2001) for an example of such a coordination problem with variable levels of investment.

81 This latter possibility is less relevant in the case of information goods since the marginal cost is very small (indeed, many Windows equipped computers now have at least three media players besides Microsoft's own version).
In the absence of a technological constraint, customers would be willing to pay up to Δ to use the entrant's component on top of the bundle and the impact of tying then largely depends on the production cost of the component. If the entrant produces one component at a marginal cost $\hat{a}$, it cannot sell that single component

- in each market, E decides whether to invest in R&D;
- M and E (in case of successful entry) set their price(s).

If E succeeds in entering both markets, it replaces M and gets 2Δ. If instead E succeeds in one market only, its profits depend on whether M tied the two goods. If M bundled the two goods, E gains nothing if it enters only one market, since one good is useless without the other. Since there is no point investing in only one market, E does not invest at all whenever

$$2f > 2\rho^2\Delta.$$

In the absence of bundling, and when E enters in one market only, competition takes place between M and E. As already noted, many equilibria then exist, in which M and E share the efficiency gain Δ in different ways.

If E fully appropriates Δ whenever a R&D project is successful, whatever the outcome of the other R&D project. E therefore chooses to invest – and then invests in both markets – if and only if

$$f < \rho\Delta.$$

Therefore, tying deters R&D and thus entry in both markets whenever

$$\rho^2 < \frac{f}{\Delta} < \rho.$$

Tying is then a profitable strategy for M since with probability ρ^2 it prevents E from replacing M in both markets, and M gains nothing when E enters a single market.[82]

As the analysis makes clear, the riskiness of entry projects plays a key role here. If both R&D projects were certain, entry would occur whenever $f < \Delta$, with or without bundling.[83]

at a profitable price if $\hat{a} > \Delta$, but can still get $\Delta - \hat{a}$ otherwise. Thus, when marginal costs are very small, in the absence of some form of technical integration tying would not prevent the entrant from retrieving most of its added value.

[82] If M can appropriate a share λ of E's technological gain when E enters in only one market (e.g., if M has a chance to act as a price leader), tying deters investment and entry occurs "less often", namely if and only if (R&D investments are strategic complements, so that E undertakes either both projects or none):

$$\rho\left[1 - \lambda(1 - \rho)\right] < \frac{f}{\Delta} < \rho;$$

furthermore, if it does deter investment, tying is profitable only when avoiding eviction by the entrant (with would otherwise happen with probability ρ^2) matters more to the monopolist than getting a share λ of the technological gain when only one project succeeds (which would happen with probability $2\rho(1 - \rho)$).

[83] It suffices that entry be risky in at least one market; tying may then deter investment and entry in the other market – which in turn may deter entry in the first one. For example, suppose that investing f brings the technological gain Δ with certainty in market A, whereas investing $\hat{f} = \rho f$ brings the innovation with probability ρ in market B. Then, in the absence of tying, entry would occur in both markets whenever $\Delta > f$, whereas with tying, entry (in both markets) only occurs when $\rho(2\Delta) > (1 + \rho)f$, that is, when $\Delta > (1 + \rho)f/(2\rho)(> f)$.

– *Economies of scale and scope*. Suppose now, following Carlton and Waldman (2002), that entry takes more time in one market than in the other. By reducing the profitability of being in one market only, tying may then again deter E from entering either or even both markets.[84] More precisely, suppose that:

- there are two periods, 1 and 2, and two perfect complements A and B; in each period, consumers have unit demands as before; to simplify notation we suppose that the interest rate is zero (firms maximize the sum of the profits obtained in the two periods);
- at the beginning of period 1, M decides whether to bundle the two goods; as before, tying is then irreversible and cannot be undone by customers;
- it is initially easier to enter the "adjacent market" (B) than the "core market" (A): E can enter market B in either period, while it can enter market A only in period 2; to market $i = A, B$, E must incur a fixed cost f_i (once for all);
- for simplicity, entry is not risky[85];
- in the absence of tying, when E enters in one market only, it fully appropriates its efficiency gain in that market;
- absent tying, entry in market A is profitable (we relax this assumption below), whereas entry in market B is profitable only when it generates profits in both periods: letting f_i and Δ_i denote, respectively, the cost of entry and E's technological edge in market i, we have:

  $$f_A < \Delta_A, \qquad \Delta_B < f_B < 2\Delta_B;$$

  in addition, entry in both markets is profitable only if E enters market B in period 1:

  $$\Delta_A + \Delta_B < f_A + f_B < \Delta_A + 2\Delta_B.$$

In the absence of tying, E enters market B in period 1 and market A in period 2, and then drives M out of the market. By tying the two goods together, M reduces the profitability of E's entering market B, from $2\Delta_B - f_B > 0$ to $\Delta_B - f_B < 0$. Tying thus deters E from entering market B, which allows M to protect its position and maintain its monopoly profit over the two periods.

Carlton and Waldman also point out that E may want to enter the core market in order to get a larger share of its efficiency gain in the adjacent market, rather than to exploit any efficiency gain in the core market itself. In that case again, tying may block entry in both markets. To see this, suppose now that: (i) when E enters market B only, in the absence of tying M appropriates a share λ of E's efficiency gain; and (ii) the following conditions hold:

$$\Delta_A < f_A < \Delta_A + \lambda\Delta_B,$$

[84] The analysis would formally be the same if, instead of two periods, there were two independent demands for good B: a stand-alone demand for B and a demand for the system $\{A, B\}$. In that case again, tying would reduce E's profitability, by restricting its customer base to those consumers that are interested in B on a stand-alone basis.

[85] That is, $\rho = 1$ in the previous notation.

$$\Delta_A + \Delta_B < f_A + f_B < (1 - \lambda)\Delta_B + \Delta_A + \Delta_B.$$

The first set of conditions asserts that, while entry in A is not per se profitable, it becomes profitable when it allows E to fully appropriate the share of the technological gain Δ_B that M would otherwise appropriate; thus, absent bundling, E enters both markets rather than market B only. The second set of conditions asserts that, as before, entering both markets in period 2 is not profitable whereas, absent bundling, entering market B in period 1 and market A in period 2 is profitable. In such a situation, tying the two goods blocks entry in both markets, since entry then generates profits in the second period only.

The analyses of Choi and Stefanadis and of Carlton and Waldman apply to industries where innovating in adjacent segments is sufficiently costly: if E were to enter the B-market anyway, there would be no point tying the two goods. For the sequential entry scenario, entry in the core segment must moreover be sufficiently delayed that the entrant does not want to incur the cost of entering the adjacent markets only; as pointed out by Carlton and Waldman, the argument is therefore more relevant when the core product A has both a long imitation lag (so that tying reduces the profitability of entering the B-segment during a significant amount of time) and a short lifetime (so that the profitability of eventually entering both segments is limited).

Finally, it would be interesting to explore further the dynamics of these models. If dominance and the strategic use of the multi-entry problem lead to high incumbency profits, then there is a high incentive to become the new incumbent.[86] E may therefore decide to enter, even if entry is unprofitable in the "short run" (period 2). It would therefore be important to add periods 3, 4, ..., to see if tying can still play a significant role.

3.3. *Innovation by the monopoly firm in the competitive segment*

It is sometimes argued that incumbent firms have an incentive to strategically invest in R&D in adjacent markets, in order to discourage competitive efforts (including innovation) by rival producers. On the face of it, this concern seems at odds with the standard intuition that innovation is desirable, that competition should apply to the innovation process as well as to manufacturing processes, and that intellectual property should be protected. Forcing M to share its innovation with its B-competitors might for example create an undesirable asymmetry in the competitive process. First, sharing induces the independent B-suppliers to free ride, reducing their R&D effort and probably product diversity. Second, access policies of this type could imply a de facto line-of business restriction, as M might stop engaging in innovations that would be competed away (note, though, that from the Chicago School argument, M still has *some* incentive to innovate even if it is forced to share the resulting intellectual property, as improvements in the

[86] For analyses of dynamic contestability in different environments, see Fudenberg and Tirole (2000), Maskin and Tirole (1987, 1988) and Segal and Whinston (2007).

adjacent market benefits M's core activity). Both arguments advocate protecting M's rights over its innovation.

While this simple analysis is broadly correct, there is a twist, though, that has been analyzed by Farrell and Katz (2000)[87]: R&D competition in market B is affected by the presence of one of the competitors, M, in the adjacent market A. Suppose for the sake of argument that A is sold on a stand-alone basis (a similar analysis applies to the case in which M produces an input that is then used internally by its B-division or sold to independent producers of good B). Then the value of A is higher, the lower the quality-adjusted price of the product offered (by M or its competitors) in segment B. This implies that M benefits from innovation in market B in two ways: directly through sales of component B if M's innovation in the B market is superior to those of its rivals; and indirectly through the increase in demand for good A – and this even if M's B-component remains inferior to its rivals'. The direct effect involves no asymmetry with B-market competitors, but the indirect effect exists only for the multi-product firm.

To fix ideas, suppose for example that all B-competitors produce the same good (no differentiation) and that innovations reduce production costs in that market. The indirect or spillover effect is then clearly identified when M's innovation in market B is dominated by a rival's innovation, in which case M makes no profit in the B-segment. In that case, a small increase in the quality of M's innovation in market B still leaves it dominated and thus does not generate any profit to M's B-division. Yet it increases M's profit if it forces the efficient B-rival to lower its price (squeezing quasi-rents from the independent B-producer), and thereby boosts the demand for complementary good A. This indirect effect takes another form when M's innovation in the B-segment dominates its rivals'. Then, beyond the direct impact on market B, a marginal increase in the quality of M's innovation increases the demand for M's integrated solution (this is an example of the vertical externality effect identified in Section 2).

The spillover effect implies that M's R&D efforts in segment B are higher than they would be if M's R&D division did not internalize the profit in the A segment. In turn, M's enhanced R&D effort reduces that of its rivals. As Farrell and Katz (2000) show, the overall welfare impact of M's B-division internalizing M's A-division's interests is ambiguous.

As usual, we should clarify the nature of the policy intervention that is being contemplated. Short of imposing structural remedies, no antitrust decision will prevent M's B-division from internalizing the A-division's interests; hence, the above analysis may seem irrelevant as it stands. One remedy that antitrust authorities may be tempted to adopt consists in mandating M to share its innovation in market B for some reasonably low licensing fee. This would not impact M's indirect benefit of innovation, which would still exert pressure on B-competitors and contribute to enhance demand for systems; however, this duty to share would reduce the direct benefit of innovation on market B; innovation sharing thus reduces investments by M (and may eliminate

[87] See also Choi et al. (2003).

them if there are fixed costs of R&D), and raises investments by rivals, with potentially detrimental welfare consequences, especially if M has substantial R&D expertise and is likely to produce a superior innovation.

The ambiguity of the welfare analysis suggests that such antitrust involvement is overall unlikely to foster innovation unless one demonstrates that (a) the reduction in independent B-producers' R&D effort due to M being vertically integrated more than offsets the increase in that of M, and (b) M's B-division can be effectively duplicated by entry in the B-market (e.g., through an effective divestiture and in the absence of economies of scope). It is therefore not surprising that antitrust authorities have traditionally shunned direct intervention in the competitive market.

Even if an analysis of this kind were used in a particular case as the basis for anti-trust intervention, the resulting intervention would run counter to the tradition of intellectual property law. That tradition seeks to resolve the tension between the benefits of competition and the protection of innovation by protecting the innovation from direct imitation, while encouraging rival innovations. Indeed (as the analysis above makes clear), while the quality of the best innovation determines the gross benefits to consumers who purchase it, the price at which they buy (and therefore the net benefits of the purchase) is determined by the quality of the second-best innovation (this is the same phenomenon as the fact that the price paid by the winner in an auction is determined by the valuation of the second-highest bidder). Consequently an innovation by rivals plays an important role in the process of keeping prices low, a role that IP law has consistently sought to protect. By contrast, intervention to restrict innovation by M in the B-segment would essentially consist in removing one firm's IP protection in order to protect the innovation of another firm from post-innovation rivalry.

Choi (2004) analyzes the impact of tying, rather than integration as such, on R&D incentives in the tied market. He considers a situation where M has a monopoly position in market A and faces competition in adjacent market B (goods A and B may, but need not be complements).[88] Choi starts from the observation that, in such a situation, tying generally increases competition and lowers prices, but also allows M to capture a larger share in the tied good market (as discussed in Section 3.1); as a result, tying tilts the R&D incentives in favor of M; tying can thus be interpreted as a credible commitment device to more aggressive R&D investment by M, and can discourage rivals' R&D investments. The change in R&D incentives allows M to increase its profits in the future, and can thus make tying a profitable strategy even if it intensifies competition in the short-term. The welfare implications are again ambiguous, since in the short-run tying reduces prices but restricts customer choice, and in the longer run it increases one firm's R&D incentives but reduces it rivals'.

[88] Relatedly, Choi (1996) considers the case where firms engage in a pre-emptive patent race for systems (that is, firms compete for both components); he shows that tying can mitigate the rent dissipation that can arise in such situations.

3.4. Summary

Competition in the adjacent market brings product variety, lower costs and lower prices. The Chicago School pointed out that competition in that market thereby enhances the value of the bottleneck good and boosts its owner's profit when the bottleneck good is marketed on a stand-alone basis and the two goods are complements. Bundling and foreclosure therefore must be either efficiency-driven or motivated by predatory intents. We reviewed two predation stories and hinted at their strengths and limits. First, bundling may be a way of deterring entry in (or inducing exit from) the adjacent market when goods are not complements (at least for a substantial fraction of the users). Second, bundling may allow a dominant firm to maintain its dominant position in its bottleneck market.

Given that the motivations for bundling may be rather unrelated to anti-competitive motives,[89] and that most firms, dominant or not, bundle goods and services on a routine basis, a rule of reason seems appropriate. The issue for economists is then to guide competition authorities in their handling of antitrust cases. To the extent that the anti-competitive foreclosure theories reviewed in this section are in fine predation stories (foreclosure in general leading, from the Chicago School argument, to a short-term profit sacrifice by the tying firm, with the prospect of a later recoupment), one possible approach is to treat tying cases through the lens of predatory behavior.[90] Whether one agrees with this viewpoint or not, there is clearly a need for economists to come up with clearer guidelines for the antitrust treatment of tying behaviors by dominant firms.

4. Exclusive customer contracts

Following our definition of foreclosure, we have so far discussed alternative ways in which an incumbent firm may strategically use its market power in one market in order to restrict competition in a related market. In some situations, the incumbent may use this market power to protect its position in the *same* market, even in the absence of interaction with related markets. For example, a supplier that currently benefits from a monopoly position may deter entry by locking customers into long-term exclusive arrangements. However, a Chicago critique again applies: customers should be reluctant to agree to such exclusive arrangements and should demand an appropriate compensation, that would dissipate the profitability of these arrangements.

To see this more precisely, suppose that an incumbent monopolist, M, faces a customer, C. This user is willing to buy one unit, which costs c and brings a gross surplus

[89] Among them: distribution cost savings, compatibility cost savings, accountability (liability, reputation) benefits, protection of intellectual property, market segmentation and metering; we discuss these efficiency motives in Section 5.

[90] For a discussion of the costs and benefits of this approach, see Tirole (2005) and the comments thereupon by Carlton and Waldman and by Nalebuff.

of S; and assume that a potential entrant E can enter with a lower cost $\hat{c} \leqslant c$ and generate a higher surplus $\hat{S} \geqslant S$. In the absence of entry, M could exploit its monopoly position, charge a price of S and thus get $S - c$ in profit. If instead entry occurs, competition drives the price down to $c + (\hat{S} - S)$; consumers then get a net surplus $S - c$, while E earns $\Delta = \hat{S} - S + c - \hat{c}$ and M is out of the market.

To prevent entry, M could try to lock-in the user through an exclusive contract. To capture this possibility, consider for example the following two-stage game:

- in the first stage, the incumbent offers C an exclusive contract at a given price p;
- in the second stage, if the exclusive contract has been accepted, C buys from M at price p; otherwise, E chooses whether to enter and then compete with M as above.

In the first stage, C anticipates that it will no longer benefit from competition if it signs an exclusive contract; thus, C does not accept an exclusive contract at a price p higher than c (which gives him the "competitive" surplus of $S - c$), so that such an exclusive contract cannot be profitable for M.

4.1. Exclusionary clauses as a rent-extraction device

Recognizing this issue, Aghion and Bolton (1987) pointed out that M could still use exclusive contracts in order to extract some of the entrant's technological advantage, Δ. For example, consider the following penalty contract: C buys from M at price p, or else must pay a penalty for breach d to M.[91] Then, in order to attract C, E must offer a price $\hat{p}$ such that $\hat{p} + d \leqslant p + \hat{S} - S$, or

$$\hat{p} \leqslant (p + \hat{S} - S) - d.$$

That is, the penalty for breach d is actually paid by E, and thus plays the role of an entry fee. It is then optimal for M to set d so as to reap the entrant's technological advantage. For example, the contract $(p = c, d = \Delta)$ forces the entrant to offer a price $\hat{p} = \hat{c}$, thus allowing M to appropriate Δ.

In this simple example, M can fine-tune the penalty for breach so as to extract the entire efficiency gain of the entrant, and thus entry occurs whenever it is efficient. The penalty for breach may discourage the entrant from investing in the new technology, though. Furthermore, Aghion and Bolton point out that, in practice, there may be some uncertainty about the entrant's technological superiority; in that case, maximizing its expected profit, the incumbent takes the risk of foreclosing entry if E is not much more efficient than M, so as to extract more of the efficiency gains when E has a large technological advantage.

EXAMPLE. Suppose that (i) E faces initially an uncertain cost (the same logic would apply to uncertainty about the quality advantage); and (ii) M and C sign a contract before this uncertainty is resolved. Once the cost $\hat{c}$ is realized, E decides whether to

[91] An alternative interpretation of this contract is that C pays d for the option of buying a unit at a price $p - d$.

enter the market, in which case it incurs an infinitesimal fixed cost of entry.[92] If for example $\hat{S} = S = 1$, $c = 1/2$ and $\hat{c}$ is uniformly distributed over [0, 1], in the absence of any exclusivity entry occurs whenever $\hat{c} < 1/2$: if $\hat{c} \geqslant 1/2$, E does not enter and M earns $S - c = 1/2$ while if $\hat{c} < 1/2$, E enters and earns $\hat{c} - c$; since entry occurs with probability $1/2$, and E's expected cost is $1/4$ in case of entry, M's and E's expected profits are respectively $1/4$ and $1/8$. Now, suppose that M and C could levy a (non-contingent) *entry fee* f from E, and share the proceeds as desired; entry would then only occur when $\hat{c} + f \leqslant c$, thus with probability $(1/2 - f)$. Since entry per se does not affect M and C's total surplus (since E appropriates all the gain from its cost advantage when it enters), M and C would maximize the expected revenue from the fee, $(1/2 - f)f$ and thus choose $f = 1/4$, generating in this way an extra expected gain of $1/16$; entry would thus be restricted, and would only occur when $\hat{c} \leqslant 1/4$. But M and C can precisely achieve this outcome be signing a penalty contract of the form ($p = 3/4$, $d = 1/2$). Indeed, with this contract C is assured to pay no more than $3/4$ and thus earns the same expected profit as in the absence of exclusivity ($1/4$), while E only enters when $\hat{c} \leqslant p - d = 1/4$ and M earns either $p - c = 1/4$ in the absence of entry or $d = 1/2$ in case of entry. This contract thus replicates the optimal entry fee; entry is again restricted, while M's expected profit is increased by $1/16$.[93]

RENEGOTIATION. That exclusive contracts (in the form of a penalty for breach) have an exclusionary impact relies on the assumption that M and C cannot renegotiate their contract (say, M would forgive some of the penalty for breach) once E has made an offer. Otherwise, whenever this offer generates a surplus higher than $S - c$, M and C would indeed renegotiate the terms of their contract (say, M would forgive some of the penalty for breach) so as to benefit from E's offer. Given this, E would and could enter whenever entry is efficient. This point is recognized by Spier and Whinston (1995), who however emphasize that M may still have an incentive to block entry by over-investing in improving its own technology: by doing so, M forces E to concede a better deal; this strategic benefit can then be shared by M and C, e.g., through a lump-sum transfer in their initial contract.[94]

To see this more precisely, suppose for simplicity that M and E only differ in their costs of production ($\hat{S} = S$) and consider the following timing:

[92] This assumption ensures that E enters only if it can earn a positive profit. In the absence of any fixed cost, E would always "enter" the market and exert pressure on M; the analysis would be similar, in the sense that M's exclusionary behavior would lead to production inefficiency (that is, E may not supply C although it is more efficient than M).

[93] While M gets here the entire revenue from the fee, this revenue could be redisbuted to C through a simultaneous reduction in p and d.

[94] The general issue here is the commitment value of a contract that can be renegotiated later on. Katz (1991) and Caillaud, Jullien and Picard (1995) point out that such a contract may still involve some commitment when the relationship is subject to agency problems; e.g., in the form of moral hazard or adverse selection. See Caillaud and Rey (1995) for an introduction to this literature. In Spier and Whinston's model, there is indeed "moral hazard" since signing an exclusive agreement affects M's incentives to invest in its own technology.

(i) M offers an exclusive contract at a stipulated price of p, which C accepts or refuses.
(ii) M decides whether to invest in its technology: investing I reduces M's cost from $c = \bar{c}$ to $c = \underline{c}$; M's investment decision and/or actual cost is publicly observed.
(iii) E's cost $\hat{c}$ is drawn from a distribution over $[0, S]$ and publicly observed; E then sets its price, $\hat{p}$.
(iv) M and C can renegotiate their initial agreement (or sign one if M's first offer had been rejected); we assume that M and C bargain efficiently – as we will see, the division of the gains from trade is however irrelevant.
(v) C chooses its supplier.

Suppose that C accepts an exclusive contract with a stipulated price $p \leqslant S$. At stages (iv) and (v), either there is no renegotiation and C buys from M at p (this occurs if $\hat{p} > c$, since there is then no gain from renegotiation) or renegotiates the exclusivity agreement (if $\hat{p} \leqslant c$).[95] Anticipating this, at stage (iii) E does not enter if $\hat{c} > c$, otherwise it enters and quotes a price equal to c, leading M and C to renegotiate their initial agreement while minimizing their gains from renegotiation.[96] Therefore, entry occurs whenever it is efficient, *given* M's cost level, c. However, under an exclusive contract, M's ex post payoff is $p - c$, with or without renegotiation: C must buy at price p absent any renegotiation, and when renegotiation takes place, E leaves (almost) no gain from it, implying that M gets again $p - c$. This, in turn, implies that M chooses to invest whenever

$$\bar{c} - \underline{c} > I.$$

By contrast, M's investment is socially desirable only if

$$\left[1 - \hat{F}(\bar{c})\right](\bar{c} - \underline{c}) + \int_{\underline{c}}^{\bar{c}} (\hat{c} - \underline{c})\, \mathrm{d}\hat{F}(\hat{c}) > I,$$

where $\hat{F}$ denotes the cumulative distribution of E's cost. Note that the social benefit, which appears on the left-hand side of the above inequality, is lower than $\bar{c} - \underline{c}$; therefore, exclusivity leads to over-investment relative to what would be socially desirable, whenever

$$\left[1 - \hat{F}(\bar{c})\right](\bar{c} - \underline{c}) + \int_{\underline{c}}^{\bar{c}} (\hat{c} - \underline{c})\, \mathrm{d}\hat{F}(\hat{c}) < I < \bar{c} - \underline{c}.$$

In that case, after signing up a customer into a (renegotiable) exclusivity contract, M invests in its technology in order not only to reduce its cost when E is inefficient, but also

[95] Technically, there is no need for renegotiation when $\hat{p} = c$. To avoid an "openess" problem, however, we assume that M and C then take E's offer.

[96] This is why the relative bargaining power of M and C is irrelevant, as long as they bargain efficiently. Since it is strictly desirable for the two parties to renegotiate as long as $\hat{p} < c$, by setting a price (close to) $\hat{p} = c$, E induces renegotiation but actually appropriates (almost) all of the gains from it.

to force E to offer a better price ($\underline{c}$ instead of $\bar{c}$) when it efficient; this, however, implies that E enters less often than it would if M did not invest in its technology (E no longer enters when $\underline{c} < \hat{c} < \bar{c}$).[97]

More generally, exclusivity contracts in which downstream customers commit to purchase from an upstream supplier have the potential to deter investments by competing upstream suppliers. In Aghion and Bolton (1987), these investments take the form of an all-or-nothing entry decision. But the investment choice may more generally refer to an investment scale. In Stefanadis (1997), two upstream firms compete in the R&D market to obtain a patent on a process innovation that reduces the marginal cost of supplying the input. An exclusive contract with a downstream customer reduces the profitability of R&D for the upstream rival, and therefore the rival's R&D effort. In equilibrium, upstream firms lock in customers through exclusive contracts in order to reduce their rival's R&D expenditures in the subsequent innovation markets.

4.2. Scale economies and users' coordination failure

In a second contribution in the same paper, Aghion and Bolton (1987) also point out that the incumbent supplier, M, can play customers against each other in other to deter the entry of a more efficient competitor. While Aghion and Bolton's original analysis relies on commitment to conditional contracts[98] that may be difficult to implement (e.g., because of legal restrictions), Rasmusen, Ramseyer and Wiley (1991) and Segal and Whinston (2000) have shown that their insight is robust in the presence of scale economies.[99] To see this, suppose for example that there are n customers and that entry is viable only if E can sign up at least $m + 1 < n$ customers. M can therefore block entry by "bribing" a targeted group of $n - m$ customers into exclusive arrangements, by sharing the rents it gets from exploiting its monopoly power vis-à-vis the remaining m customers. This strategy is clearly successful when the monopoly rents exceed the benefits that the targeted customers can hope to derive together from free entry.

Even if this condition does not hold, however, M can still successfully deter entry by "playing customers against each other", that is, by relying on poor coordination among the customers: while customers may be better off if all reject exclusivity, they may fail to coordinate and accept exclusivity if they anticipate that the others will do – M may then not even need to bribe any customer.

Segal and Whinston (2000) stress that M's ability to discriminate among customers enhances the scope for successful exclusion. Without discrimination, M would fail to

[97] Whether M would invest in the absence of any initial agreement depends, among other things, on the price that E charges when it is less efficient than M and on C's ex post bargaining power. Spier and Whinston (1995) however confirm that M's incentive to invest (and thus limit entry) is maximal under exclusivity.

[98] Aghion and Bolton assumed that M could commit itself to charge prices that are conditional on how many customers accept exclusivity.

[99] Rasmusen, Ramseyer and Wiley (1991) meant to focus on non-discriminatory contracts but actually assume some form of discrimination. Segal and Whinston (2000) clarify this issue as well as the respective role of discriminatory offers and of customers' coordination problems.

deter the entry of an equally efficient competitor if customers coordinate – even only tacitly – on their favored equilibrium. By contrast, with discriminatory offers the above-mentioned scheme may succeed even if customers can explicitly coordinate their buying decisions.[100]

A related insight is obtained by Bernheim and Whinston (1998), who study a situation in which two suppliers compete sequentially for two customers. Bernheim and Whinston in particular show that the first customer may strategically choose to "exclude" one supplier so as to share with the other supplier the additional profits from its enhanced bargaining position vis-à-vis the second customer. To see this more precisely, consider the following framework:

- M and E simultaneously offer a contract to a first customer, C_1; each contract can be conditional on exclusivity (that is, it can stipulate different terms, depending on whether C_1 contracts with the other supplier as well). C_1 then accepts or rejects each offer; if C_1 buys a positive quantity from E (exclusively or not), E enters and incurs a fixed cost f;
- Then, M and E offer conditional contracts to a second customer, C_2; there again, contracts can be conditional on exclusivity and C_2 then chooses its supplier(s).

The payoffs are as follows. Let S_i denote the surplus that C_i can generate from dealing with both M and E (assuming that E enters) and S_i^M and S_i^E the surplus that C_i generates when dealing with M or E only. We assume that M and E offer partial substitutes:

$$S_i^M + S_i^E > S_i\big(> S_i^M, S_i^E > 0\big).$$

We will moreover assume that E's entry is socially efficient; that is,

$$S > S^M,$$

where

$$S \equiv S_1 + S_2 - f$$

denotes the total net surplus generated by the two suppliers and

$$S^M \equiv S_1^M + S_2^M$$

denotes the total surplus generated by M only.

Consider now the last stage of the game. Bernheim and Whinston show that, while this "common agency subgame" may involve both exclusive and non-exclusive equilibria, there is a Pareto-dominant equilibrium (for the suppliers); this equilibrium maximizes the joint surplus of the suppliers and the customer. If E entered the market, the

[100] This scheme is an example of "divide-and-conquer" strategies that were initially explored by Innes and Sexton (1994). Fumagalli and Motta (2006) stress however that such strategies are more difficult to implement when buyers are competing against each other, since then it is more difficult to compensate a deviant buyer who wants to buy from the more efficient entrant.

equilibrium involves no exclusivity and each supplier gets its “contribution” to the total surplus; that is, M gets $S_2 - S_2^E$, while E gets $S_2 - S_2^M$.[101] If instead E did not enter, then M enjoys a monopoly position and gets S_2^M.

Consider now the first stage. The same logic prevails, except that the relevant surpluses account for the suppliers' payoffs in the subsequent contracting stage. Thus, if C_1 chooses to deal with E (exclusively or not), E enters and the joint surplus of M, E and C_1 is given by

$$\hat{S} \equiv S_1 + \left(S_2 - S_2^E\right) + \left(S_2 - S_2^M - f\right);$$

the substitutability between the two suppliers implies that $\hat{S}$ is smaller than the total surplus S. If this substitutability is large enough, $\hat{S}$ may be even smaller than S^M, the surplus generated by M. In this case, while entry would be efficient (since $S > S^M$), the outcome of the first stage is that C_1 deals exclusively with M, so as to make M the monopoly supplier of C_2. That is, taking into account M's monopoly profit on C_2, M and C_1 can together generate more profits by excluding E, even if they could extract all of E's contribution to their joint surplus. Exclusive dealing then emerges as an anti-competitive device against (E and) C_2. The argument relies again on some form of coordination failure between the customers: if the two customers could side-contract, C_2 would be willing to compensate C_1 for opting for a non-exclusive relationship with M.

4.3. Summary

The Coasian or commitment theory of foreclosure reviewed in Section 2 insisted on the detrimental impact of downstream competition on upstream profit. To avoid the erosion of profit, downstream access to the upstream bottleneck was reduced relative to what would be socially optimal (assuming the very existence of this upstream bottleneck). By contrast, in the theories reviewed in this section, downstream users (who do not compete against each other) in a sense receive “too much” access to the bottleneck. In the rent-extraction theory, penalties for breach are used to force a more efficient upstream entrant to reduce its price; in the entry-deterrence theory, penalties for breach expose customers to a free-riding problem when the entrant faces a large fixed cost of entry and therefore needs a broad and profitable enough market in order to become a competitive threat. Either way, long-term contracts may create inefficiencies.

We have only touched on the issues associated with penalties for breach and dynamic price discrimination. More general approaches are surveyed by Armstrong (2006), Fudenberg and Villas-Boas (2005) and Stole (2007). Also, to draw tentative guidelines such as the ones that are currently debated for the application of European Article 82 on abuses of dominance, one needs to discuss possible efficiency defenses; we review some of them in the next section.

[101] The condition $S_2 - S_2^M < f$ would thus ensure that E does not want to enter when it fails to deal with C_1.

5. Potential defenses for exclusionary behaviors

Vertical or horizontal foreclosure may be socially beneficial in certain circumstances. First, it may enhance innovators' benefit from R&D efforts and thus foster their incentives to innovate or develop new products. Second, in situations where unrestrained competition in downstream or adjacent markets leads to excessive entry and duplication of fixed costs, foreclosure may help reducing excessive entry. Finally, integration may improve coordination between firms, for example by providing better incentives to monitor their efforts; foreclosure then is an undesired by-product of a useful institution. We briefly examine these defenses in turn. For expositional purposes we first focus on defenses that are relevant for vertical foreclosure, although some of them apply as well to horizontal foreclosure; we then turn to defenses that are specific to tying.

5.1. Efficiency arguments for (vertical) foreclosure

– *Forbearance as a reward to investment or innovation*. The antitrust authorities may refrain from prosecuting foreclosure activities because the monopoly position thus obtained compensates the bottleneck for its investment or innovative activity. This efficiency defense is similar to the logic underlying the patent system – as already noted, a prospective licensee would not pay much for using a new technology if it anticipates the licensor to "flood the market" with licensees. In both cases society is willing to tolerate static inefficiency, such as monopoly pricing, in order to promote dynamic efficiency. The same issue as for patents then arises: To what extent is forbearance an optimal mechanism for providing innovators with a rent? As recognized in *Aspen*, one cannot impose a general duty to deal with competitors. And even when such a duty is warranted, it would be unreasonable to mandate competitors' access to each and every aspect of a firm's activity on an unbundled basis.

Our discussion suggests one plausible dividing line to answer the question of when it is most desirable to force access: Is the origin of the bottleneck increasing returns to scale or scope (as may be the case of a bridge, a stadium, or a news agency) or an historical accident? Or does the bottleneck result from an innovative strategy? Intervention to avoid foreclosure and consequently to reduce the bottleneck profit seems more warranted in the former than in the latter case.

– *Free-riding by the downstream units on the marketing expenses of the upstream firm*. This argument states that the upstream firm must be able to recoup marketing expenses that will benefit downstream units. This argument is related to the above argument of forbearance as a reward to investment (see the discussion of Chemla's work in Appendix A.2).

– *Excessive entry*. Entry typically involves significant fixed costs, and excessive entry can therefore result in an inefficient duplication of these costs. In the absence of foreclosure, excessive entry can indeed occur due to the so-called "business-stealing" effect: when contemplating entering the market, a firm does not take into account that its prospective customers will in part simply switch away from existing products; the revenue generated by its product may thus exceed its social value.[102] In this context, foreclosure may be socially desirable when the duplication of the fixed cost is particularly harmful, and vertical or horizontal integration may yield a socially better outcome than no integration. We provide in Appendix B a short analysis of this issue using our vertical foreclosure framework.[103] The validity of this argument may however be difficult to assess in practice, since the characterization of the socially optimal number of firms is generally a complex matter.

– *Monitoring benefits of vertical integration*. Benefits of vertical integration are often mentioned as efficiency defenses. For example, control of a supplier by one of the buyers may put someone in charge of making sure that the technological choices of the supplier are in the best interest of the buyers. To be certain, the integrated buyer may then use its control right over the supplier to engage in non-price foreclosure, for instance by insisting on technological specifications that are biased in its favor. And, as in this paper, it may overcharge the buyers while keeping an internal transfer price equal to marginal cost and thus practice price foreclosure. These foreclosure practices are then arguably an undesirable by-product of an otherwise desirable activity, namely monitoring.

– *Costly divestitures*. Antitrust enforcers and regulators are often reluctant to force vertical separation because of the disruptive cost of disentangling deeply intertwined activities. That is, even if they would have prohibited the merger of two vertically-related firms, they do not order a divestiture when faced with the fait accompli of vertical integration.

– *Costly expansion of capacity or the costs incurred in order to provide access*. We have assumed that the cost of supplying competitors of a vertically integrated firm is the same as the cost of internal purchases. In practice, the former may exceed the latter, either because upstream decreasing returns to scale make marginal units more costly to supply than inframarginal ones, or because there is a genuine asymmetry between the costs of supplying the downstream affiliate and its competitors, due for example to compatibility costs. In essence, this efficiency defense amounts to saying that there is no foreclosure because discrimination among competitors is cost-based.

[102] See Salop (1979) and Mankiw and Whinston (1986) for detailed analyses of this issue.

[103] See Vickers (1995) for a related analysis of the relative cost and benefits of vertical integration in the context of a *regulated* upstream monopolist in which the regulator (i) controls the upstream firm's price but not its profit, (ii) operates direct transfers to the firm, and (iii) has no statutory power to regulate downstream entry. In this context, vertical integration leads to a higher (regulated) access price (since it is more difficult to extract the information from the integrated firm, the incentive scheme must be more high-powered, resulting in a higher access charge) but less duplication of fixed cost (because of foreclosure).

– *Fear of being associated with inferior downstream partners who might hurt the firm's reputation*. We have assumed that the only negative externality of supply by a downstream firm on the other downstream firms and thus indirectly on the upstream bottleneck is price mediated. That is, downstream entry depresses the final price and thus the industry profit; but it increases social welfare. There may be some other negative externalities on the upstream firm that are less socially desirable. In particular, misbehavior by a downstream firm may spoil the reputation of other downstream firms and of the upstream bottleneck. This argument, which relies on the existence of monitoring of the downstream firms, is often invoked for example in a franchising context, and used to justify strict quality controls.

– *Universal service*. It is sometimes argued that universal service obligations imposed by the regulator or the law should be compensated by a greater leniency vis-à-vis foreclosing behaviors; see, e.g., the 1993 decision of the European Commission in *Corbeau* (Decision *C 320/91*). This argument is simply a variant of the general argument that fixed costs must be recouped by market power in some market. And again one must wonder whether foreclosure is the most efficient means of creating market power.[104]

5.2. *Efficiency arguments for tying*

As we said earlier, some of the defenses listed above apply also in the horizontal context. Others are specific to that context. The most obvious such defense is the distribution cost savings associated with marketing two products together instead of separately. Other standard defenses of tying include:

– *Preventing inefficient substitution*. When two separately marketed goods are combined in variable proportions, market power over one good distorts customers' choices over the relative use of the two goods.[105] Consider for example a monopolist that produces a durable good, for which maintenance and repair services can be supplied by independent providers. If the monopolist prices its original equipment above (marginal) cost while maintenance is priced at cost, customers rely excessively on maintenance and replace their equipment insufficiently often. By tying the aftermarket services to the original purchase of the equipment, the monopolist generates more efficient replacement decisions, which improves social welfare. A similar argument applies when there is competition among original equipment manufacturers and customers face switching costs – in that case, tying can also improve both social and consumer welfare.[106]

[104] There is a further debate as to whether universal service should be financed through mark-ups on specific segments, as opposed to the policy of creating a competitively neutral universal service fund financing universal service through industry-wide taxes.

[105] See Vernon and Graham (1971), Schmalensee (1973), Su (1975), Warren-Boulton (1974) and Rust (1986).

[106] See Carlton and Waldman (2001), who further stress that monopolizing the used parts markets can be efficient when the supplier of the original equipment is also in the best position for re-manufacturing used parts into replacement parts.

– *Metering*. Relatedly, tying consumables may allow a supplier to meter usage and thus discriminate between high- and low-intensity users.[107] While such third-degree price discrimination has in general ambiguous welfare implications,[108] it can allow the supplier to recoup large investments and foster incentives to develop new products.

– *Signaling quality*. Tying consumables to the sale of the original equipment can give a high-quality seller an effective tool for signaling the quality of its product, when quality is not readily observable to buyers.[109] Indeed, if the manufacturer charges usage (through the tied consumables) rather than the initial purchase of the equipment, consumers then "pay" for the equipment only if they really use it, once they have found out its true quality.

6. Concluding remarks

Despite recent advances, some progress must still be made in order to better anchor the concept of foreclosure within the broader antitrust doctrine. First, a better integration between theory and applications should be achieved. This chapter has offered some guiding principles for thinking about the incentives for, and the feasibility and welfare implications of foreclosure. The link could be further strengthened. Relatedly, further empirical investigations will allow us to get a better feel for the magnitude of the effects involved and to assess the relevance of not only the scope for foreclosure, but also the theoretical factors affecting this scope (such as the competitiveness of upstream segments, the availability of alternative foreclosure strategies, or the location of the bottleneck).

In our discussion of efficiency defenses we hinted at some considerations calling for a milder antitrust treatment of exclusionary behavior, as when the bottleneck results from innovation or investment rather than returns to scale or scope, legal and regulatory interventions, or historical accident. Still, this discussion of efficiency defenses was somewhat of an addendum to the treatment of the anticompetitive effect, and the two should be better integrated.

This call for a unified treatment actually does not solely apply to theory. Indeed, the legal and regulatory framework exhibits, as we noted, a remarkable dichotomy between the treatment of intellectual property in which the practice of foreclosure is widely viewed as acceptable (except for some recent pushes for compulsory licensing and open access in certain contexts) and other areas in which foreclosure is systematically

107 In *Chicken Delight* (1971), for example, the franchiser used packing items to measure the volume of activity of its franchisees; the franchiser's mark-up over the packing items then implemented a reliable revenue-sharing scheme. See Chen and Ross (1993, 1999) for applications to aftermarket services with, respectively, monopolistic and competitive manufacturers.

108 See Katz (1987) and Tirole (1988).

109 See Schwartz and Werden (1996).

viewed as socially detrimental. We have shown that the broad conceptual framework is the same, and offered guiding principles as to when foreclosure should be opposed or tolerated.

While we have tried to provide a comprehensive theoretical treatment within the confines of the topic of this paper, it would be desirable to broaden the scope of analysis in several directions. More complex forms of essential facilities have emerged, and corresponding theoretical frameworks should be developed. First, in markets such as telecommunications or the Internet, in which final consumers interact with each other through the mediation of the platforms' operator they are connected to, bottlenecks are endogenous in that they depend on the outcome of the "downstream" competition for consumers (by contrast, in our analysis, the bottleneck pre-exists downstream competition). Namely, each operator must rely on its competitors to terminate the connections initiated by their own consumers.[110] This competitive bottleneck problem, in which each operator needs access to its rivals' customers, exhibits many new and interesting features.[111] For example, an operator can reduce its need for access to a bottleneck it does not control by gaining market share and "internalizing" the interactions demanded by its customers. Furthermore, small players have more, rather than less, market power than big players in the wholesale market, provided that the latter are forced to interoperate; for, all players have the same – full monopoly – power on terminations toward their customers, and small players can demand very high termination prices without moving final prices much.

Bottlenecks that are governed by a cooperative arrangement rather than owned by a single entity would also deserve a full treatment on their own. Such bottlenecks can result from a desire to reap economies of scale, as in the case of a credit card or agricultural cooperative, or to eliminate multiple marginalization and offer a one-stop-shopping facility, as in the case of patent pools and joint marketing agreements. They can be run as for-profit entities or as not-for-profit associations. They raise interesting questions about the extent of access that should be granted to customers and for potential members. The previous considerations as to where the bottleneck nature comes from are relevant here as well. So, for example, a bottleneck created by economies of scale should in principle grant broad access, as long as this access does not amount to pure free riding on investments (financial and informational-learning) made by previous members. But the joint provision of the bottleneck gives rise to new questions such as the impact of new members on the governance of the bottleneck (with the possibility that dissonant objectives may hamper the functioning and reduce the efficiency of the bottleneck). We leave these and other fascinating issues for further research.

[110] Unless consumers "multi-home" on several platforms, a topic that has been studied only recently; see, e.g., Rochet and Tirole (2003).

[111] See, e.g., Armstrong (1998) and Laffont, Rey and Tirole (1998a, 1998b) for early analyses of telecommunications networks competition in a deregulated environment. More recent developments and further references to the subsequent literature can be found in Armstrong (2002), Laffont et al. (2003) and Jeon, Laffont and Tirole (2004).

Appendix A. Private incentives not to exclude

Section 2 emphasized the bottleneck owner's incentive to use various foreclosure strategies to preserve its market power. This section investigates whether the foreclosure activity can backfire on the bottleneck owner.

A.1. The protection of downstream specific investment: the 1995 AT&T divestiture

Interestingly, the foreclosure logic implies that a bottleneck owner may in some circumstances want to refrain from integrating vertically. To understand this, recall that under vertical integration, the excluded rivals on the competitive segment suffer a secondary line injury. Anticipating this, they may refrain from investing in assets that are specific to their relationship with the bottleneck owner, as these have low value if their firms have limited access to the essential input. This in turn may hurt the upstream bottleneck, which has a smaller industrial base downstream. And the independent downstream firms may start investing in assets that are specific to other upstream firms ($\hat{U}$) rather than to the bottleneck (U).

These ideas shed light on AT&T's 1995 voluntary divestiture of its manufacturing arm, AT&T Technology (now Lucent). One must recall that until then, AT&T and the RBOCs, who are major purchasers of AT&T made equipment, hardly competed in the final good markets. With AT&T's slow entry into the Intralata and the local telecommunications markets and with the 1996 Telecommunication Act allowing the RBOCs to enter the long distance market (provided that local loop competition developed sufficiently), competition between AT&T and the RBOCs on the final good markets was likely to become substantial. Consequently, the RBOCs may have been concerned about a possible foreclosure by AT&T Technology whenever such exclusion would favor the telecommunication branch of AT&T. There was thus a possibility that in a situation of vertical integration and increased product competition, the RBOCs would have turned more and more to alternative and non-vertically integrated manufacturers such as Northern Telecom, Alcatel, Siemens, or the Japanese manufacturers. The very threat of foreclosure could have substantially hurt AT&T's manufacturing arm, with the short-term gain from foreclosure more than offset by a long-term loss of manufacturing market share.

Let us formalize this argument in an extended version of the foreclosure model of Section 2. There are two upstream firms (manufacturers): U with unit cost c, and $\hat{U}$ with unit cost $\hat{c} > c$; U can be thought of as being AT&T Technology and $\hat{U}$ as being a rival manufacturer, since we will be primarily interested in those segments in which AT&T Technology had some competitive advantage and therefore foreclosure may occur. There are two downstream firms D_1 and D_2, both with unit cost 0; we will think of D_1 as being the telecommunications services branch of AT&T and D_2 as being the RBOCs. Last, there are two markets: market A (long distance) and market B (local).

Recall our basic argument: The integrated firm $U - D_1$ may want to divest when the competition between D_1 and D_2 gets more intense because D_2 then becomes more concerned about foreclosure and wants to sever or at least limit its relationship with U. We model this idea in a very simple albeit extreme way: We start from a situation of line-of-business restrictions in which D_1 is in market A only and D_2 is in market B only. Then line-of-business restrictions are lifted and D_1 and D_2 compete head-to-head in both markets. To formalize the idea that D_2 makes technological decisions (choice of standard, learning by using, etc.) that will in the future make purchases from U or $\hat{U}$ more desirable, we assume that ex ante D_2 makes a costless, but irreversible choice between U and $\hat{U}$. That is, ex post D_2 can purchase from a single supplier. This assumption is much stronger than needed, but models the basic idea in a very straightforward way. We also assume, without loss of generality, that D_1 picks U as its supplier.

The timing is as follows:

- Stage 1: U and D_1 decide whether they stay integrated or split.
- Stage 2: D_2 makes a technological choice that determines its supplier (U or $\hat{U}$).
- Stage 3: U and D_1 secretly agree on a tariff $T_1(\cdot)$. Simultaneously and also secretly, with probability α, the supplier chosen by D_2 at stage 2 makes a take-it-or-leave-it offer $T_2(\cdot)$ to D_2; with probability $1-\alpha$, D_2 makes a take-it-or-leave-it offer $T_2(\cdot)$ to this supplier. Then, the downstream firms order quantities from their suppliers and pay according to the agreed upon tariffs.
- Stage 4: D_1 and D_2 transform the intermediate product into the final goods. In case of line-of-business restrictions, each downstream firm sells the output in its own turf (markets A and B, respectively). In case of head-to-head competition, D_1 and D_2 observe each other's output in each market and set their prices for the final good in each market.

This timing calls for some comments. The last two stages are standard, except that we here have two final markets. Also, we introduce a more evenly distributed bargaining power: D_2 obtains on average a fraction $1-\alpha$ of the profit made in its relationship with the selected supplier (the same can be assumed for D_1, but this is irrelevant). We had earlier assumed that $\alpha = 1$, so D_2 never made any profit when facing a single supplier; we could maintain this assumption but find it more elegant to introduce some sharing of profit so that D_2 not be indifferent as to its choice of technology at stage 2.

We now analyze this game.

A.1.1. Line-of-business restrictions

Under line-of-business restrictions, D_1 and D_2 are monopolists in their respective markets. At stage 2, D_2 selects U as its supplier, as

$$(1-\alpha)\pi_B^m(c) > (1-\alpha)\pi_B^m(\hat{c}),$$

where $\pi_B^m(\tilde{c})$ is the monopoly profit in market B for unit cost $\tilde{c}$. Thus, the RBOCs turn to AT&T Technology if the latter has a competitive advantage.

Note also that, under line-of-business restrictions, vertical integration between U and D_1 has no impact on markets as foreclosure is not an issue.[112]

[112] A $U - D_1$ merger could however be motivated by (unmodeled) efficiency considerations.

A.1.2. Head-to-head competition

Let us now assume that D_1 and D_2 are in both markets. If U and D_1 are *vertically integrated*, then from Section 2.2, we know that if D_2 selects U at stage 2, D_2 is completely foreclosed from both downstream markets at stage 3. It then makes zero profit. By contrast, when selecting the inefficient supplier $\hat{U}$, D_2 makes a strictly positive profit as long as $\hat{U}$ is not too inefficient, that is as long as $\hat{c}$ is below the monopoly price for cost c in at least one of the markets. This formalizes the notion that the non-integrated downstream firm is likely to switch supplier when competition is introduced and the former supplier remains vertically integrated. Note that such switching generates production inefficiency.

Let $\pi_i^C(c, \hat{c})$ denote the Cournot profit in market $i = A, B$ of a firm with marginal cost c facing a firm with marginal cost $\hat{c}$; and let

$$\pi^C(c, \hat{c}) \equiv \pi_A^C(c, \hat{c}) + \pi_B^C(c, \hat{c})$$

be the overall profit.[113] This is the profit made by the integrated firm $U - D_1$ under head-to-head competition.

Let us now assume *vertical separation* of U and D_1. Then, for the same reason as under line-of-business restrictions, D_2 selects U at stage 2 as

$$(1-\alpha)\pi^C(c, c) > (1-\alpha)\pi^C(\hat{c}, c).$$

The aggregate profit of U and D_1 is then $(1+\alpha)\pi^C(c, c)$. We thus conclude that it is in the interest of U and D_1 to split if and only if:

$$(1+\alpha)\pi^C(c, c) > \pi^C(c, \hat{c}).$$

This condition admits a simple interpretation: Vertical integration results in foreclosure and in a flight of the non-integrated firm to the rival manufacturer. Foreclosure has a beneficial impact on the merging firms' profit but the loss of a downstream consumer is costly if U has some bargaining power in negotiations, that is if $\alpha > 0$. For $\hat{c}$ large, the *foreclosure effect* dominates[114]; conversely, the *smaller-customer-base effect* dominates for $\hat{c}$ close to c. More generally, strong downstream competition (e.g., from the removal of line-of-business restrictions) and/or weak upstream competition make foreclosure, and thus vertical integration, more attractive.[115]

113 $\pi_i^C(c, \hat{c})$ should be replaced with $\pi_i^m(c)$ if $\hat{c} \geqslant p_i^m(c)$.

114 For example, if $\hat{c} \geqslant \max(p_A^m(c), p_B^m(c))$, then $\pi^C(c, \hat{c}) = \pi^m(c) = \pi_A^m(c) + \pi_B^m(c) > 2\pi^C(c, c)$.

115 We have assumed that D_2 has the same bargaining power $(1-\alpha)$ vis-à-vis U and $\hat{U}$. A new effect appears if D_2 has more bargaining power with $\hat{U}$, say because $\hat{U}$ is competitive, than with U. Then, due to differential bargaining positions, under head-to-head competition a divestiture may not suffice for U to keep D_2 as a customer. For example, if $\hat{U}$ is a competitive fringe producing at cost $\hat{c}$, D_2 buys from an unintegrated U if and only if $(1-\alpha)\pi^C(c, c) > \pi^C(\hat{c}, c)$. It is easy to show that there exists α such that it is optimal for

A.2. Protecting upstream investment through downstream competition

Chemla (2003) develops the (Williamsonian) argument that downstream competition protects the bottleneck's investment against expropriation in a situation in which the downstream firms have non-negligible bargaining power. There is then a general trade-off between foreclosing competition downstream so as to exploit monopoly power and preserving competition there in order to protect upstream rents.

The thrust of his analysis is as follows: A bottleneck owner U faces n identical downstream firms $D_1, \dots, D_n$. Consider the Cournot set up of Section 2, except that the bargaining power is split more evenly:

- Stage 1: U picks the number of downstream firms $m \leqslant n$ that are potentially active later on. For example, it communicates its technical specifications to m firms and these specifications are indispensable due to compatibility requirements. Without these specifications a downstream firm starts development "too late" and cannot compete at stages 2 and 3.
- Stage 2: With probability α, U makes secret take-it-or-leave-it offers $T_i(\cdot)$ to each D_i (in the subgroup selected at stage 1). With probability $1-\alpha$, all D_i's make (separate) take-it-or-leave-it offers $T_i(\cdot)$ to U. D_i then orders a quantity of intermediate product q_i and pays $T_i(q_i)$ accordingly.
- Stage 3: The D_i's that were selected at stage 1 transform the intermediate product into the final good, observe each other's output and set their prices for the final good.

Chemla further assumes that the bottleneck's cost $C(Q)$ is strictly convex rather than linear. The role of this assumption will become apparent shortly. The intuition for his results can be grasped from looking at the two polar cases of bargaining power. When $\alpha = 1$, the bottleneck has the entire bargaining power, and is only limited by the Coasian commitment problem. To commit not to supply beyond the monopoly output at stage 2, U optimally selects $m = 1$, that is forecloses the market. When $\alpha = 0$, the downstream firms have all the bargaining power. Under linear costs, they would entirely extract the bottleneck's rent at stage 2. This is not so under decreasing returns to scale in the provision of the essential input, as long as $m \geqslant 2$. In order for an offer by D_i to be accepted by U, D_i's payment must be at least equal to the incremental cost of q_i, and therefore each downstream firm must pay its incremental cost (close to the marginal cost for m large), leaving a rent to the bottleneck owner (as inframarginal costs are lower than incremental costs under decreasing returns to scale). Thus a bottleneck owner

$U - D_1$ to divest (for that α) if and only if

$$2\pi^C(c, c) > \pi^C(c, \hat{c}) + \pi^C(\hat{c}, c).$$

This condition is the necessary and sufficient condition for the existence of franchise-fee (or royalty-free) licensing in a Cournot duopoly (the firm with cost c licenses its technology to its rival with initial cost $\hat{c}$ for a franchise fee). It holds if $\hat{c}$ is close to c and does not hold for large $\hat{c}$'s [Katz and Shapiro (1985)], a conclusion in line with that obtained in the text.

may not want to engage in exclusionary practices when contracts are incomplete, in the sense that the bottleneck owner cannot contract on price when selecting the number m of buyers, and when the bottleneck owner has limited bargaining power against the remaining buyers of the essential input.

In this bargaining power story the upstream bottleneck has a motivation not to foreclose, namely the transfer of bargaining power. But this motivation is unrelated to social concerns, and it has actually too little incentive from a social viewpoint not to foreclose. Chemla also considers a second variation of the basic framework, in which U chooses some non-contractible investment e in marketing or design, that shifts the demand curve $p = P(Q, e)$ upwards: $\partial P/\partial e > 0$. This industry specific investment is chosen between stage 1 and stage 2 in the timing above and is observed by the downstream firms. Picking $m > 1$ protects somewhat the upstream firm against expropriation of the benefits of its investment when bargaining power lies downstream. That is, downstream competition at stage 2 gives the bottleneck owner an incentive to invest that would not exist if there were a single downstream firm ($m = 1$) that would impose a payment exactly equal to the bottleneck cost. Chemla shows that the bottleneck investment increases with the number of competing downstream firms m. This gives the upstream bottleneck a second incentive not to foreclose, which fits with the social concern of protecting investments.

Appendix B. Excessive entry and vertical foreclosure

As mentioned in Section 5, foreclosure may have the merit of limiting entry in situations where entry would otherwise be excessive. We briefly analyze this potential benefit in the context of vertical foreclosure. Consider our basic framework, except that there is now a large number of potential competitors, $D_1, D_2, \ldots,$ for the production of the downstream good, and that in the first stage, after U's contract offer, each downstream firm D_i chooses whether to enter (and accept the contract), in which case it has to pay a fixed cost f. [This fixed cost is a technological production cost and does not include the fixed fee associated with a two-part tariff for the intermediate good.]

All downstream firms produce the same homogeneous good, so that efficiency would dictate only one downstream entrant. To capture the risk of excessive entry, we further suppose that each D_i does not observe its competitors' entry decisions.[116] Under passive conjectures, U then offers each D_i an efficient bilateral contract, which can be thought of as a two-part tariff with a marginal access price equal to marginal cost c.

Let us denote by $\pi^C(n)$ and $Q^C(n) = nq^C(n)$ the per firm gross profit and the total output in the standard (Cournot) oligopolistic equilibrium with n active firms:

$$\pi^c(n) = \max_q \big\{ \big[P\big((n-1)q^C(n) + q\big) - c \big] q \big\}.$$

[116] If entry were observable and contracts made contingent on the number of active firms, then U could perfectly monitor the number of active firms and achieve the entire monopolization of the industry by allowing only one active firm downstream.

And let us define:

$$\hat{\pi}(n) = \max_q \{ [P(Q^C(n) + q) - c]q \}.$$

In words, $\hat{\pi}(n)$ is the maximum profit gross of the fixed cost that a non-entering downstream could obtain if it entered, assuming that there are already n active firms, offering the output corresponding to the standard n-firm oligopolistic equilibrium. The functions $\pi^C(\cdot)$ and $\hat{\pi}^C(\cdot)$ are decreasing.

In the absence of vertical integration, a necessary and sufficient condition for an equilibrium with n active downstream firms is

$$\pi^C(n) \geqslant f \geqslant \hat{\pi}(n).$$

There may be several such equilibria. The optimal number of entrants for the industry, i.e. for U who in equilibrium recovers all profits through the fixed fee, maximizes total Cournot net profit $n[\pi^C(n) - f]$ in the relevant range defined above. Since total Cournot gross profit, $n\pi^C(n)$, is decreasing in n, so is total Cournot net profit. So the industry optimum has n_b entrants such that $\hat{\pi}(n_b) = f$, and the lowest industry profit is reached for n_w entrants such that $\pi^C(n_w) = f$; this latter equilibrium corresponds to the standard free entry equilibrium and yields zero profit to all firms.

Under vertical integration, U forecloses the downstream market. As a result the number of active downstream firms is equal to the one that is desirable from the point of view of productive efficiency ($n_i = 1$), but the price is the monopoly one. For example, in the linear demand case ($P(Q) = d - Q$), $n_w = (d-c)/\sqrt{f} - 1$, $n_b = (d-c)/2\sqrt{f} - 1$, and $Q^C(n) = (n/(n+1))(d-c)$. If in the absence of foreclosure the firms end up in the "worst" equilibrium (from their point of view, but also from the point of view of the duplication of fixed costs), then foreclosure is socially desirable when the parameter $(d-c)/\sqrt{f}$ lies between 2 and 6.

Appendix C. Vertical foreclosure with Bertrand downstream competition

In the vertical foreclosure framework of Section 2, downstream competition was modeled in a Cournot, or more precisely in a Bertrand–Edgeworth way. It should however be clear that the commitment problem described above is robust to the nature of downstream competition. This Appendix notes however that a formalization "à la Bertrand" rather than "à la Bertrand–Edgeworth" is by no means straightforward and has not been properly addressed in the literature. With Bertrand competition, the marginal price charged to one downstream firm directly affects the profitability of the contracts signed with its competitors. Passive beliefs (which, recall, are the natural conjectures in the Bertrand–Edgeworth timing) thus appear less plausible, since downstream firms should anticipate that, if the supplier deviates with one of them, it has an incentive to change the contracts offered to the others. In addition, there may exist no equilibrium with passive beliefs, because the gain from a multilateral deviation may now exceed the total gains of the unilateral deviations.

To study this existence problem, let us assume that downstream firms produce differentiated goods, with symmetric final demands $D^i(p_1, p_2) = D(p_i, p_j)$, and change the timing as follows:

- Stage 1: U secretly offers each D_i a tariff $T_i(q_i)$.
- Stage 2: D_1 and D_2 simultaneously set their prices, p_1 and p_2, and then order q_1 and q_2 so as to satisfy demand (consumers observe both prices and choose freely between D_1 and D_2).

Assuming passive conjectures, D_i expects D_j to set the same equilibrium price p_j, regardless of the contract D_i is offered by U. Hence, given this expected price p_j, when facing a tariff $T_i(q_i)$, D_i chooses p_i so as to maximize $p_i D(p_i, p_j) - T_i(D(p_i, p_j))$. Assume that U can only charge two-part tariffs:

$$T_i(q_i) = F_i + w_i q_i.$$

D_i's first-order condition is

$$(p_i - w_i)\partial_1 D(p_i, p_j) + D(p_i, p_j) = 0, \tag{C.1}$$

which defines a reaction function $\tilde{R}^B(p_j; w_i)$ that is increasing in w_i ("B" stands for "Bertrand competition"). Given the candidate equilibrium price p_j, U will then "choose" D_i's price so as to maximize their aggregate profit:

$$(p_i - c)D(p_i, p_j) + (w_j - c)D(p_j, p_i).$$

This price p_i is characterized by

$$(p_i - c)\partial_1 D(p_i, p_j) + D(p_i, p_j) + (w_j - c)\partial_2 D(p_j, p_i) = 0. \tag{C.2}$$

Combining (C.1) and (C.2) yields:

$$(w_i - c)\partial_1 D(\cdot) + (w_j - c)\partial_2 D(\cdot) = 0. \tag{C.3}$$

Conditions (C.3), where $\partial_i D(\cdot)$ is evaluated at the Nash equilibrium retail prices, provide a system of two equations with two unknowns, the wholesale prices. A full rank argument then implies $w_1 = w_2 = c$: The equilibrium marginal transfer price equals the marginal cost. This in turn implies that a *candidate* equilibrium (for passive conjectures) must yield the Bertrand price and profit (with $R^B(p) \equiv \tilde{R}^B(p; c)$):

$$p_1 = p_2 = p^B < p^m \quad \text{such that} \quad p^B \equiv R^B\big(p^B\big)$$
$$\pi_U = 2\pi^B < \pi^m.$$

The reader may find this result, due to O'Brien and Shaffer (1992),[117] surprising for the following reason. The presumption under passive conjectures is that the downstream competitors wage whatever form of competition is relevant, internalizing exactly the

[117] They moreover show that the Bertrand equilibrium is still the unique candidate equilibrium, even when U can offer general non-linear tariffs.

marginal cost of upstream production. There is an extra twist under Bertrand competition, though: Because orders lag price setting, a change in the wholesale price w_i charged to a downstream competitor i affects its final price p_i and thus the profit $(w_j - c)D(p_j, p_i)$ made on downstream competitor j. But this indirect effect (which does not exist when orders are placed before demand is realized) vanishes exactly when $w_i = c$, that is when the wholesale price is equal to marginal cost.

Let us now show that, if demands are symmetric and the cross-price elasticity is at least one-half of the own-price elasticity, there exists no passive conjectures equilibrium. [Note that in the Hotelling case, the cross-price elasticity is equal to the own-price elasticity at a symmetric equilibrium. More generally what is needed for the reasoning below is that there is enough substitutability between the two products.]

With passive conjectures, the upstream firm's profit can be written as $\pi_i(w_i, w_j) + \pi_j(w_j, w_i)$, where

$$\pi_i(w_i, w_j) = \big(p_i^r(w_i) - w_i\big)D\big(p_i^r(w_i), p_j\big) + (w_i - c)D\big(p_i^r(w_i), p_j^r(w_j)\big),$$

and π_j is defined analogously. Fixing anticipated equilibrium prices (this is the passive conjectures assumption), $p_i^r(w_i)$ is defined by

$$p_i^r(w_i) = \arg\max(p_i - w_i)D\big(p_i, p_j^e\big).$$

Using the first-order condition for $p_i^r(\cdot)$, it is easy to show that at the candidate equilibrium $(w_i = c)$,

$$\frac{\partial^2 \pi_i}{\partial w_i^2} = \frac{\partial D^i}{\partial p_i}\frac{\mathrm{d}p_i^r}{\mathrm{d}w_i}, \qquad \frac{\partial^2 \pi_i}{\partial w_i \partial w_j} = \frac{\partial D^i}{\partial p_j}\frac{\mathrm{d}p_j^r}{\mathrm{d}w_j}, \qquad \frac{\partial^2 \pi_i}{\partial w_j^2} = 0.$$

And so, the Hessian of $\pi_i + \pi_j$ is semi-definite negative only if

$$-\frac{\partial D^i}{\partial p_i} > 2\frac{\partial D^i}{\partial p_j}$$

(using the symmetry of the candidate equilibrium). Thus, if the cross-price elasticity is at least half of the own-price elasticity, U's above profit is not locally concave, implying that there exists a profitable multilateral deviation; therefore, there exists no passive conjectures equilibrium.

To circumvent this existence problem, Rey and Vergé (2004) consider the notion of *wary beliefs* introduced by McAfee–Schwartz, where a downstream firm that receives an unexpected offer then anticipates that the supplier acts optimally with its rivals, given the offer just received. In the context of linear model, Rey and Vergé show that wary beliefs equilibria exist even when passive beliefs equilibria fail to exist, and these equilibria exhibit some degree of opportunism: the upstream firm does not fully exploit its market power, although it performs better than when downstream firms have passive beliefs.

Vertical integration

Let us now assume that U and D_1 merge. The thorny issue of conjectures no longer arises since the non-integrated unit then knows that the integrated one purchases at marginal cost, and by construction the integrated downstream firm knows the tariff offered to the other one.

Through the choice of the marginal transfer price to D_2, w_2, U generates for D_2 a response to its expected price p_1^e given by

$$p_2^r(w_2; p_1^e) = \arg\max_{p_2}(p_2 - w_2)D(p_2, p_1^e).$$

[This is the same reaction curve as previously, but we now explicit the rival's expected price.]

Conversely, given a transfer price w_2 and an expected retail price p_2^e, $U - D_1$'s optimal response is given by

$$p_1^r(w_2; p_2^e) = \arg\max_{p_1}\{(p_1 - c)D(p_1, p_2^e) + (w_2 - c)D(p_2^e, p_1)\}.$$

Hence, a marginal transfer price w_2 generates a conditional equilibrium $(\hat{p}_1(w_2), \hat{p}_2(w_2))$ given by $p_1 = p_1^r(w_2; p_2)$ and $p_2 = p_2^r(w_2; p_1)$. The optimal transfer price then maximizes

$$(\hat{p}_1(w_2) - c)D(\hat{p}_1(w_2), \hat{p}_2(w_2)) + (\hat{p}_2(w_2) - c)D(\hat{p}_2(w_2), \hat{p}_1(w_2)).$$

Assuming the retail prices are strategic complements, both $\hat{p}_1$ and $\hat{p}_2$ increase with w_2. Moreover, the curve $\mathcal{F} \equiv (\hat{p}_1(w_2), \hat{p}_2(w_2))_{w_2}$ of feasible price pairs goes through the Bertrand equilibrium point (for $w_2 = c$), and never crosses the curve $p_1 = R^m(p_2)$.[118] Moreover, as w_2 goes to $+\infty$ (which amounts to exclusive dealing with D_1), $p_2(w_2)$ goes to $+\infty$ too (since $p_2(w_2) > w_2$). Hence the curve $\mathcal{F}$ crosses the curve $p_2 = R_2^m(p_1)$ to the left of the monopoly point M (see Figure 33.6).

It is clear that, starting from B $(w_2 = c)$, a small increase in w_2, which increases both prices $\hat{p}_1$ and $\hat{p}_2$, strictly increases $U - D_1$'s aggregate profit. Hence vertical integration yields $w_2 > c$. The point I which represents the optimal pair of prices (p_1^*, p_2^*) actually lies above the curve $p_2 = R^m(p_1)$. To see this, evaluate the impact of a slight increase in w_2, starting from the value w_2 such that $\hat{p}_2 = R^m(\hat{p}_1(w_2))$:

$$\begin{aligned}
&\frac{\mathrm{d}}{\mathrm{d}w_2}\Big((\hat{p}_1(w_2) - c)D(\hat{p}_1(w_2), \hat{p}_2(w_2)) + (\hat{p}_2(w_2) - c)D(\hat{p}_2(w_2), \hat{p}_1(w_2))\Big) \\
&\quad = \frac{\mathrm{d}}{\mathrm{d}w_2}\Big((\hat{p}_1(w_2) - c)D(\hat{p}_1(w_2), p_2) + (p_2 - c)D(p_2, \hat{p}_1(w_2))\Big)\Big|_{p_2 = \hat{p}_2(w_2)} \\
&\quad = (\hat{p}_2(w_2) - w_2)D_2(\hat{p}_2(w_2), \hat{p}_1(w_2))\frac{\mathrm{d}\hat{p}_1}{\mathrm{d}w_2} > 0,
\end{aligned}$$

[118] $p_1(w_2) = R^m(p_2(w_2)) \equiv \arg\max_{p_1}(p_1 - c)D(p_1, p_2(w_2)) + (p_2(w_2) - c)D(p_2(w_2), p_1)$ would require $p_2(w_2) = w_2$, which is impossible.

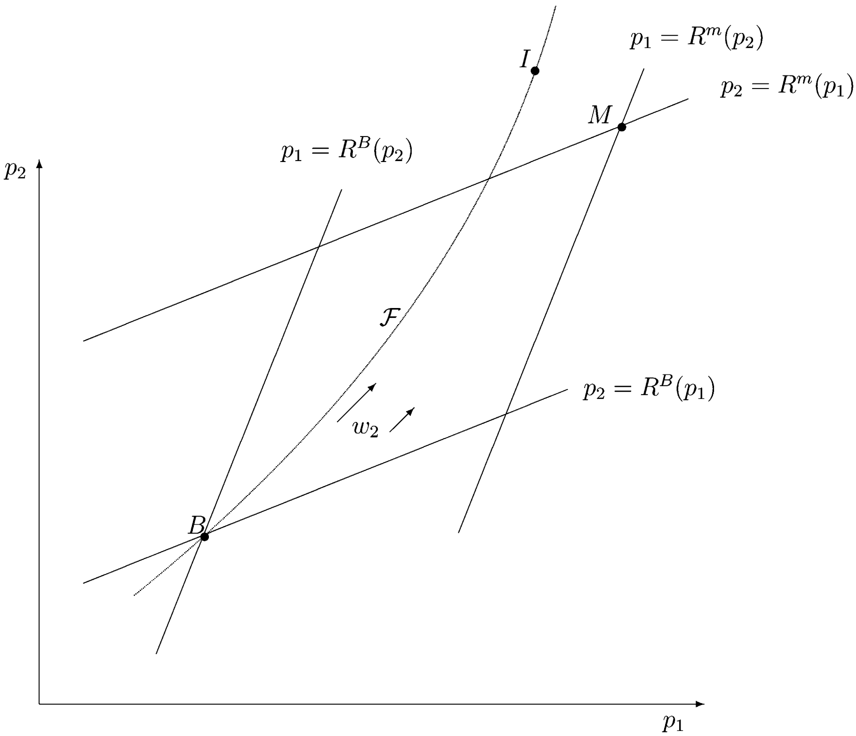

Figure 33.6. Bertrand competition and vertical integration.

where the first equality stems from $\hat{p}_2 = R^m(\hat{p}_1)$. Note finally that the equilibrium prices satisfy $w_2 > c$ and $p_2^* > p_1^*$ (since I lies to the right of $p_1 = R^m(p_2)$ and above $p_2 = R^m(p_1)$). In that sense, vertical integration does lead to foreclosure: The unintegrated firm D_2 faces a higher marginal transfer price and sets a higher price than its rival. Foreclosure in general is incomplete, however, when the two downstream firms are differentiated: In that case, vertical integration yields more profit than exclusive dealing (which would correspond here to $w_2 = \infty$).

References

Aghion, P., Bolton, P. (1987). “Contracts as a barrier to entry”. American Economic Review 77, 388–401.

Ahern, P.J. (1994). “Refusal to deal after aspen”. Antitrust Law Journal 63, 153–184.

Areeda, P. (1981). Antitrust Analysis, third ed. Little, Brown and Company, Boston.

Armstrong, M. (1998). “Network interconnection in telecommunications”. Economic Journal 108, 545–564.

Armstrong, M. (2002). “The theory of access pricing and interconnection”. In: Cave, M., Majumdar, S., Vogelsang, I. (Eds.), Handbook of Telecommunication Economics, vol. I. North-Holland, Amsterdam.

Armstrong, M. (2006). “Recent developments in the economics of price discrimination”. In: Blundell, R., Newey, W., Persson, T. (Eds.), Advances in Economics and Econometrics: Theory and Applications, Ninth World Congress, vol. 2. Cambridge Univ. Press, Cambridge.

Armstrong, M., Sappington, D. (2007). "Recent developments in the theory of regulation". In: Armstrong, M., Porter, R. (Eds.), Handbook of Industrial Organization, vol. III. North-Holland, Amsterdam (this volume).
Back, K., Zender, J. (1993). "Auctions of divisible goods: On the rationale for the treasury experiment". Review of Financial Studies 6, 733–764.
Baumol, W., Ordover, J., Willig, R. (1995). "Notes on the efficient component pricing rule". Paper given at the Montreal Conference on Regulated Industries.
Bernheim, B.D., Whinston, M.D. (1986). "Common agency". Econometrica 54, 923–942.
Bernheim, B.D., Whinston, M.D. (1998). "Exclusive dealing". Journal of Political Economy 106, 64–103.
Bolton, P., Whinston, M. (1993). "Incomplete contracts, vertical integration, and supply assurance". Review of Economic Studies 60, 121–148.
Borenstein, S., MacKie-Mason, J.K., Netz, J.S. (1995). "Antitrust policy in aftermarkets". Antitrust Law Journal 63, 455–482.
Bork, R. (1978). Antitrust Paradox. Basic Books, New York.
Bowman Jr., W.S. (1957). "Tying arrangements and the leverage problem". Yale Law Journal 67, 19–36.
Burkart, M., Denis, G., Panunzi, F. (1998). "Why higher takeover premia protect minority shareholders". Journal of Political Economy 106, 172–204.
Caillaud, B., Rey, P. (1995). "Strategic aspects of delegation". European Economic Review 39, 421–431.
Caillaud, B., Jullien, B., Picard, P. (1995). "Competing vertical structures: Precommitment and renegotiation". Econometrica 63 (3), 621–646.
Caprice, S. (2005a). "Incentive to encourage downstream competition under bilateral oligopoly". Economics Bulletin 12 (9), 1–5.
Caprice, S. (2005b). "Multilateral vertical contracting with an alternative supplier: Discrimination and nondiscrimination". INRA-ESR Working Paper 2005-03.
Carlton, D.W., Waldman, M. (2001). "Competition, monopoly, and aftermarkets". NBER Working Paper 8086.
Carlton, D.W., Waldman, M. (2002). "The strategic use of tying to preserve and create market power in evolving industries". RAND Journal of Economics 33, 194–220.
Cestone, G., White, L. (2003). "Anti-competitive financial contracting: The design of financial claims". Journal of Finance 58 (5), 2109–2141.
Chemla, G. (2003). "Downstream competition, foreclosure and vertical integration". Journal of Economics, Management and Strategy 12, 261–289.
Chen, Y., Riordan, M.H. (in press). "Vertical integration, exclusive dealing, and ex post cartelization". RAND Journal of Economics.
Chen, Z., Ross, T. (1993). "Refusal to deal, price discrimination and independent service organizations". Journal of Economics and Management Strategy 2 (4), 593–614.
Chen, Z., Ross, T. (1999). "Refusal to deal and orders to supply in competitive markets". International Journal of Industrial Organization 17, 399–417.
Chipty, T. (2001). "Vertical integration, market foreclosure, and consumer welfare in the cable television industry". American Economic Review 91 (3), 428–453.
Choi, J.P. (1996). "Preemptive R&D, rent dissipation, and "leverage theory" ". The Quarterly Journal of Economics 110, 1153–1181.
Choi, J.P. (2001). "A theory of mixed bundling applied to the GE-Honeywell merger". Antitrust (Fall), 32–33.
Choi, J.P. (2004). "Tying and innovation: A dynamic analysis of tying arrangements". Economic Journal 114, 83–101.
Choi, J.P., Stefanadis, C. (2001). "Tying, investment, and the dynamic leverage theory". RAND Journal of Economics 32 (1), 52–71.
Choi, J.P., Yi, S.-S. (2000). "Vertical foreclosure with the choice of input specifications". RAND Journal of Economics 30, 717–743.
Choi, J.P., Lee, G., Stefanadis, C. (2003). "The effects of integration on R&D incentives in systems markets". Netnomics 5 (1), 21–32.
Coase, R. (1972). "Durability and monopoly". Journal of Law and Economics 15, 143.

Comanor, W.S., Rey, P. (2000). "Vertical restraints and the market power of large distributors". Review of Industrial Organization 17 (2), 135–153.

de Fontenay, C.C., Gans, J.S. (2005). "Vertical integration in the presence of upstream competition". RAND Journal of Economics 36 (3), 544–572.

DeGraba, P. (1996). "Most-favored-customer clauses and multilateral contracting: When nondiscrimination implies uniformity". Journal of Economics and Management Strategy 5, 565–579.

Economides, N. (1989). "The desirability of compatibility in the absence of network externalities". American Economic Review 71 (5), 1165–1181.

Evans , D., Hagiu , A., Schmalensee , R. (2006). "Invisible Engines: How Software Platforms Drive Innovation and Transform Industry". MIT Press, Cambridge.

Farrell, J., Gallini, N.T. (1988). "Second-sourcing as a commitment: Monopoly incentives to attract competition". The Quarterly Journal of Economics 103, 673–694.

Farrell, J., Katz, M. (2000). "Innovation, rent extraction and integration in systems markets". Journal of Industrial Economics 48 (4), 413–432.

Farrell, J., Klemperer, P. (2007). "Co-ordination and lock-in: Competition with switching costs and network effects". In: Armstrong, M., Porter, R. (Eds.), Handbook of Industrial Organization, vol. III. North-Holland, Amsterdam (this volume).

Fridolfsson, S.-O., Stenneck, J. (2003). "Why event studies do not detect the competitive effects of mergers – The out of play effect". Mimeo. Research Institute of Industrial Economics (IUI), Stockholm.

Fudenberg, D., Tirole, J. (2000). "Pricing under the threat of entry by a sole supplier of a network good". Journal of Industrial Economics 48 (4), 373–390.

Fudenberg, D., Villas-Boas, M. (2005). "Behavior-based price discrimination and customer recognition". Mimeo. Harvard University and UC Berkeley.

Fumagalli, C., Motta, M. (2006). "Exclusive dealing and entry: When buyers compete". American Economic Review 96 (3), 785–795.

Garcia Mariñoso, B. (2001). "Technological incompatibility, endogenous switching costs and lock-in". Journal of Industrial Economics 49 (3), 281–298.

Gaudet, G., Long, N.V. (1996). "Vertical integration, foreclosure and profits in the presence of double marginalisation". Journal of Economics and Management Strategy 5, 409–432.

Gilbert, R., Neuhoff, K., Newbery, D. (2004). "Allocating transmission to mitigate market power in electricity markets". RAND Journal of Economics 35 (4), 691–709.

Green, R., Newbery, D. (1992). "Competition in the British electricity spot market". Journal of Political Economy 100, 929–953.

Hancher, L. (1995). "European competition law implications for access pricing. Report for European Commission DGIV". Mimeo. Erasmus University, Rotterdam.

Hart, O., Tirole, J. (1990). "Vertical integration and market foreclosure". Brookings Papers on Economic Activity (Microeconomics) 1990, 205–285.

Innes, R., Sexton, R.J. (1994). "Strategic buyers and exclusionary contracts". American Economic Review 84 (3), 566–584.

Jeon, D.-S., Laffont, J.-J., Tirole, J. (2004). "On the receiver pays principle". RAND Journal of Economics 35, 85–110.

Joskow, P., Tirole, J. (2000). "Transmission rights and market power on electric power networks". RAND Journal of Economics 31, 450–487.

Katz, M. (1987). "The welfare effects of third-degree price discrimination in intermediate goods market". American Economic Review 77, 154–167.

Katz, M. (1989). "Vertical contractual relations". In: Schmalensee, R., Willig, R. (Eds.), Handbook of Industrial Organization, vol. I. North-Holland, Amsterdam.

Katz, M. (1991). "Game-playing agents: Unobservable contracts as precommitments". RAND Journal of Economics 22–23, 307–328.

Katz, M., Shapiro, C. (1985). "On the licensing of innovations". RAND Journal of Economics 16, 504–520.

Kende, M. (1998). "Profitability under an open versus a closed system". Journal of Economics and Management Strategy 7 (2), 307–326.

Klemperer, P. (1995). "Competition when consumers have switching costs". Review of Economic Studies 62 (4), 515–539.

Klemperer, P., Meyer, M. (1989). "Supply function equilibria in oligopoly under uncertainty". Econometrica 57, 1243–1277.

Laffont, J.-J., Tirole, J. (1999). Competition in Telecommunications. MIT Press, Cambridge.

Laffont, J.-J., Rey, P., Tirole, J. (1998a). "Network competition. I. Overview and nondiscriminatory pricing". RAND Journal of Economics 29 (1), 1–37.

Laffont, J.-J., Rey, P., Tirole, J. (1998b). "Network competition. II. Price discrimination". RAND Journal of Economics 29 (1), 38–56.

Laffont, J.-J., Marcus, S., Rey, P., Tirole, J. (2003). "Internet interconnection and the off-net-cost pricing principle". RAND Journal of Economics 34 (2), 370–390.

Ma, C.-T.A. (1997). "Option contracts and vertical foreclosure". Journal of Economics and Management Strategy 6, 725–753.

Mankiw, N.G., Whinston, M.D. (1986). "Free entry and social inefficiency". RAND Journal of Economics 17 (1), 48–58.

Martimort, D. (1996). "Exclusive dealing, common agency and multiprincipal incentive theory". RAND Journal of Economics 27 (1), 1–31.

Martimort, D., Stole, L.A. (2003). "Contractual externalities and common agency equilibria". Advances in Theoretical Economics 3 (1). Article 4.

Martin, S., Normann, H.-T., Snyder, C. (2001). "Vertical foreclosure in experimental markets". RAND Journal of Economics 32, 466–496.

Marx, L., Shaffer, G. (2004). "Upfront payments and exclusion in downstream markets". Mimeo.

Maskin, E., Tirole, J. (1987). "A theory of dynamic oligopoly. III. Cournot competition". European Economic Review 31, 947–968.

Maskin, E., Tirole, J. (1988). "A theory of dynamic oligopoly, I and II". Econometrica 56 (3), 549–599.

Mathewson, G.F., Winter, R. (1984). "An economic theory of vertical restraints". RAND Journal of Economics 15 (4), 27–38.

Matutes, C., Regibeau, P. (1988). "Mix and match: Product compatibility without network externalities". RAND Journal of Economics 19 (2), 219–234.

McAfee, R.P., Schwartz, M. (1994). "Opportunism in multilateral vertical contracting: Nondiscrimination, exclusivity, and uniformity". American Economic Review 84 (1), 210–230.

McAfee, R.P., Schwartz, M. (1995). "The non-existence of pairwise-proof equilibrium". Economics Letters 49, 251–259.

Mullin, J., Mullin, W. (1997). "United States Steel's acquisition of the Great Northern Ore properties: Vertical foreclosure or efficient contractual governance". Journal of Law, Economics and Organization 13, 74–100.

Nalebuff, B. (2000). "Competing against bundles". In: Hammond, P., Myles, G. (Eds.), Incentives, Organization, and Public Economics. Oxford Univ. Press, Oxford.

Nalebuff, B. (2003a). "Bundling, tying, and portfolio effects". DTI Economics Paper No. 1. Available at: http://www.dti.gov.uk/economics/papers.html.

Nalebuff, B. (2003b). "Bundling and the GE-Honeywell merger". In: Kwoka, J., White, L. (Eds.), The Antitrust Revolution, fourth ed. Oxford Univ. Press, Oxford.

O'Brien, D.P., Shaffer, G. (1992). "Vertical control with bilateral contracts". RAND Journal of Economics 23 (3), 299–308.

Ordover, J., Saloner, G., Salop, S.C. (1990). "Equilibrium market foreclosure". American Economic Review 80, 127–142.

Ordover, J.A., Sykes, A.O., Willig, R.D. (1985). "Nonprice anticompetitive behavior by dominant firms toward the producers of complementary products". In: Fisher, F.M. (Ed.), Antitrust and Regulation: Essays in Memory of John J. McGowan. MIT Press, Cambridge.

Perry, M.K. (1989). "Vertical integration: Determinants and effects". In: Schmalensee, R., Willig, R. (Eds.), Handbook of Industrial Organization, vol. I. North-Holland, Amsterdam.

Perry, M.K., Porter, R.H. (1989). "Can resale price maintenance and franchise fees correct sub-optimal levels of retail service?". International Journal of Industrial Organization 8 (1), 115–141.

Posner, R. (1976). Antitrust Law. University of Chicago Press, Chicago.
Rasmusen, E.B., Ramseyer, J.M., Wiley, J.S. (1991). "Naked exclusion". American Economic Review 81, 1137–1145.
Rey, P., Vergé, T. (2002). "RPM and horizontal cartels". CMPO Working Papers Series No. 02/047. Available at: http://www.bris.ac.uk/Depts/CMPO/workingpapers/wp47.pdf.
Rey, P., Vergé, T. (2004). "Bilateral control with vertical contracts". RAND Journal of Economics 35 (4), 728–746.
Rey, P., Thal, J., Vergé, T. (2005). "Slotting allowances and conditional payments". Mimeo. Université de Toulouse.
Riordan, M.H. (1998). "Anticompetitive vertical integration by a dominant firm". American Economic Review 88 (5), 1232–1248.
Rochet, J.-C., Tirole, J. (2003). "Platform competition in two-sided markets". Journal of the European Economic Association 1, 990–1029.
Roth, A.E., Prasnikar, V., Okuno-Fujiwara, M., Zamir, S. (1991). "Bargaining and market behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: An experimental study". American Economic Review 81, 1068–1095.
Rust, J. (1986). "When is it optimal to kill off the market for used durable goods". Econometrica 54, 65–86.
Salinger, M.A. (1988). "Vertical mergers and market foreclosure". The Quarterly Journal of Economics 77, 345–356.
Salop, S.C. (1979). "Monopolistic competition with outside goods". Bell Journal of Economics 10, 141–156.
Schmalensee, R. (1973). "A note on the theory of vertical integration". Journal of Political Economy 81, 442–449.
Schwartz, M., Werden, G. (1996). "A quality-signaling rationale for aftermarket tying". Antitrust Law Journal 64, 387–404.
Segal, I. (1999). "Contracting with externalities". The Quarterly Journal of Economics 114 (2), 337–388.
Segal, I., Whinston, M.D. (2000). "Naked exclusion: Comment". American Economic Review 90 (1), 296–309.
Segal, I., Whinston, M.D. (2003). "Robust predictions for bilateral contracting with externalities". Econometrica 71 (3), 757–791.
Segal, I., Whinston, M.D. (2007). "Antitrust in innovative industies". American Economic Review. In press.
Shapiro, C. (1995). "Aftermarkets and consumer welfare: Making sense of Kodak". Antitrust Law Journal 63, 483–511.
Shepard, A. (1987). "Licensing to enhance demand for new technologies". RAND Journal of Economics 18 (3), 360–368.
Slade, M.E. (1998). "Beer and the tie: Did divestiture of brewer-owned public houses lead to higher prices?". The Economic Journal 108, 565–602.
Snyder, C.M. (1994). "Vertical foreclosure in the British beer industry". In: Buyers, Suppliers, Competitors: The Interaction between a Firm's Horizontal and Vertical Relationship. PhD thesis. Department of Economics, MIT.
Snyder, C.M. (1995a). "Empirical studies of vertical foreclosure". In: Industry Economics Conference Papers and Proceedings, vol. 23. University of Melbourne and Bureau of Industry Economics, AGPS, Canberra, pp. 98–127.
Snyder, C.M. (1995b). "Interfirm effects of vertical integration: Event studies of the U.S. oil industry". Mimeo. George Washington University.
Spier, K.E., Whinston, M.D. (1995). "On the efficiency of privately stipulated damages for breach of contract: Entry barriers, reliance, and renegotiation". RAND Journal of Economics 26, 180–202.
Stahl, D.O. (1988). "Bertrand competition for inputs and walrasian outcomes". American Economic Review 78, 189–201.
Stefanadis, C. (1997). "Downstream vertical foreclosure and upstream innovation". Journal of Industrial Economics 65, 445–456.
Stole, L.A. (2007). "Price discrimination in competitive environments". In: Armstrong, M., Porter, R. (Eds.), Handbook of Industrial Organization, vol. III. North-Holland, Amsterdam (this volume).

Stole, L.A., Zwiebel, J. (1996). "Intra-firm bargaining under non-binding contracts". Review of Economic Studies 63, 375–410.

Su, T.T. (1975). "Durability of consumption goods reconsidered". American Economic Review 65, 148–157.

Tirole, J. (1988). The Theory of Industrial Organization. MIT Press, Cambridge.

Tirole, J. (2005). "The analysis of tying cases: A primer". Competition Policy International 1, 1–25.

Vernon, J.M., Graham, D.A. (1971). "Profitability of monopolization by vertical integration". Journal of Political Economy 79, 924–925.

Vickers, J. (1995). "Competition and regulation in vertically related markets". Review of Economic Studies 62, 1–18.

Vickers, J. (1996). "Market power and inefficiency: A contracts perspective". Oxford Review of Economic Policy 12, 11–26.

Warren-Boulton, F.R. (1974). "Vertical control with variable proportions". Journal of Political Economy 82, 783–802.

Whinston, M.D. (1990). "Tying, foreclosure, and exclusion". American Economic Review 80, 837–860.

Whinston, M.D. (2001). "Exclusivity and tying in U.S. v. Microsoft: What we know, and don't know". Journal of Economic Perspectives 15, 63–80.

White, L. (2000). "Foreclosure with incomplete information". Mimeo. Oxford University and University of Toulouse.

Yanelle, M.-O. (1997). "Banking competition and market efficiency". Review of Economic Studies 64, 215–239.