The Economics of Margin Squeeze[*]

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Abstract

The paper discusses economic theories of harm for anti-competitive margin squeeze by unregulated and regulated vertically integrated firms. We review both predation and foreclosure theories, as well as the mere exploitation of upstream market power. We show that foreclosure provides an appropriate framework in the case of an unregulated firm, whereas a firm under tight wholesale regulation should be evaluated under the predation paradigm, with an adequate test that we characterize. Finally, although non-exclusionary exploitation of upstream market power may also induce a margin squeeze, banning such a squeeze has ambiguous effects on the competitive outcome; hence, alternative measures, such as a cap on the access price, may provide a better policy.

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Executive summary

A margin squeeze may occur when the dominant provider of an input is vertically integrated in retail activities that compete with its downstream customers. The notion refers to the possibility that the combination of retail and wholesale prices adopted by the vertically integrated firm may make downstream competitors unprofitable, even though their services are socially valuable.

Margin squeeze may be viewed as a particular form of predation or of vertical foreclosure, or as an abuse of different nature. Whether or not a margin squeeze is treated as a separate abuse should ultimately depend on whether there is a specific theory of harm, distinct from existing theories. Hence, we first discuss classic as well as more recent theories of harms and their implications. We identify two very different rationales that may result into a margin squeeze, and which raise different issues both for the economic analysis and for the policy implications. On the one hand, margin squeeze can be viewed as an exclusionary abuse, targeting downstream competitors. One the other hand, a margin squeeze can be viewed as an exploitative abuse by dominant firms.

In the first approach, the behavior is the result of the willingness to exclude competitors from the market. A coherent theory of harm must here overcome the well-known Chicago critique: As there is "only one monopoly profit," one must explain why a vertically integrated upstream monopoly wishes to exclude efficient downstream retailers from the market, given that it could use the wholesale price to appropriate the value of efficiencies. This is particularly relevant for predation theories, at least in the case of unregulated firms. By contrast, modern foreclosure theories overcome this critique. These include vertical foreclosure scenarios - where the market power of upstream monopoly may be undermined by problems of opportunism and credibility - and horizontal foreclosure scenarios - where the integrated firm attempts to protect its upstream monopoly from potential competition by downstream customers.

An alternative approach to margin squeeze is to explain the behavior as a mere result of the exercise of upstream market power and the attempt, by the owner of an upstream bottleneck, to maximize its monopoly rent. We show that it is often optimal for the integrated firm to combine a positive access margin, so as to extract rents from competitors, with appropriate retail margins designed to extract rents from final consumers. The optimal retail prices are then based on an "opportunity cost" that accounts for the fact that foregone retail sales by the downstream unit of the integrated firm are partially compensated by wholesale revenue.

Because of the access margin, the retail price of the downstream unit of the integrated firm acts as a constraint on competitors that reduces double marginalization issues. As a result, the prices of the integrated firms may fail to comply with a margin squeeze test; this, however, does not imply that there is inefficient exclusion of competitors. Banning margin squeeze may lead the integrated firm to reduce the wholesale price or to raise its retail price. While this always benefits downstream competitors, in the latter case the "umbrella effect" may generate an increase in all retail prices; the effect of a ban on consumer surplus and total welfare is therefore

ambiguous. As an alternative, a cap on the wholesale price would reduce all retail prices.

In the last part, we point out that the Chicago critique no longer applies to predation scenarios when the access price is regulated. Although a high wholesale margin reduces incentives to do so, the integrated firm may then wish to engage into predatory behavior. Hence, in that case an traditional approach based on predation theories of harm may apply. However, the appropriate benchmark is the opportunity cost introduced above, which leads us to propose a new sacrifice test for predation by vertically integrated firms.

1   Introduction

A margin squeeze may occur when the dominant provider of an input is integrated in retail activities that compete with its downstream customers. The notion refers to the possibility that the combination of retail prices and wholesale prices chosen by the vertically integrated firm renders the services of other retailers unprofitable, even though these services are socially valuable.

As stated by the European Commission, *"a dominant undertaking may charge a price for the product on the upstream market which, compared to the price it charges on the downstream market, does not allow even an equally efficient competitor to trade profitably in the downstream market on a lasting basis (a so-called 'margin squeeze')."*[1]

The margin squeeze doctrine constitutes one point of divergence between the US and EU anti-trust policies. Whereas European courts have repeatedly considered[2] that a margin squeeze may constitute a specific and independent abuse, in *Trinko* and *LinkLine*,[3] the US Supreme Court expressed a different view: It asserted instead that a margin squeeze was not a separate abuse, requiring a specific doctrine, but should fall under existing types of abuse, namely, refusal to deal or predation. Similar views have been expressed by US economists as well – see for instance Carlton (2008) and Sidak (2008). In the EU, Bouckaert and Verboven (2004) distinguish between predation and foreclosure, and conclude that a ban on margin squeeze should be targeted only at predatory squeeze; Spector (2008) also discusses the practice in the context of "raising rivals' costs" theory,[4] which does not require the exclusion of competing downstream retailers.

Whether or not a margin squeeze is treated as a separate abuse should ultimately depend on whether there is a specific theory of harm, distinct from existing theories. For instance, if a margin squeeze is just one particular form of predation (e.g., costless predation, as stated by Spector (2008)), than the legal standards should be those of predation, possibly adapted to the presence of vertical integration. Indeed, as mentioned by the Commission itself,[5] identifying the economic impact of an undertaking's behavior is essential for the assessment of vertical practices. The reason is that the same practice may have pro and anti-competitive effects depending on the context, and conversely different practices may be used for a given goal. This is in particular true for margin squeeze practices. Thus the legal treatment should be grounded in sound economic analysis and a well understood theory of harm. However, despite an extensive legal literature and numerous comments by

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[1] Communication from the Commission — Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings (2009/C 45/02).

[2] See, e.g., *Deutsche Telekom* case (T-271/03, C-280/08, and *Telefonica* C-295/12P).

[3] *Verizon Communications, Inc. v. Law Offices of Curtis V. Trinko*, 540 U.S. 398 (2004), and *Pac. Bell Tel. Co. v. Linkline Commc'ns, Inc.*, 129 S. Ct. 1109, 1123 (2009).

[4] Salop and Scheffman (1983, 1987), Ordover, Saloner and Willig (1990).

[5] See for instance *Communication from the Commission — Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings* (2009/C 45/02).

economists, there is surprisingly little formal academic work devoted specifically to this issue. Moreover, most comments on margin squeeze are not clear about the theory of harm underlying the reasoning.

In what follows we shall identify two very different rationales that may result into a margin squeeze, and which raise different issues both for the economic analysis and for the policy implications. In the first part of the report, we shall review theories that explain the behavior as a result of the willingness to exclude competitors from the market. The issue in this approach is to overcome the well-known Chicago critique, and explain why a vertically integrated upstream monopoly wishes to exclude efficient downstream retailers from the market. As we will argue, this may be grounded in foreclosure theory. According to this view, there is no sound basis for a notion of margin squeeze abuse independent of other exclusionary abuses.

In the second part of the report, we will explore an alternative approach that explains the behavior as a result of the exercise of upstream market power and the attempt, by the owner of an upstream bottleneck, to maximize its monopoly rent. Typically, maximizing short-run profit will not require the exclusion of efficient downstream retailers, but the behavior may involve exploitative pricing. A margin squeeze test[6] may be violated if the technologies or products of the downstream retail competitors differ from those of the upstream monopoly, and particularly so if they are more efficient. We will see that while banning margin squeeze helps the downstream competitors, this may not always benefit consumers or society as a whole.

Distinguishing between these two economic approaches highlights the dual nature of a theory of harm for margin squeeze. On the one hand, a margin squeeze can be viewed as an exploitative abuse by dominant firms. One the other hand, it can be viewed as an exclusionary practice that is predatory by nature. Such a distinction indeed appears in many policy discussions, where the practice is sometimes presented as a form of predation and sometimes as a form of discriminatory pricing - because the implicit internal transfer price is lower than the price charged to competing retailers when a squeeze is observed. This distinction sheds also some light on the source of divergence between the US and the EU, as the former has always been more reluctant than the latter when addressing issues associated with the exploitation of market power.

The objective of this article is first to clarify the economic analysis of margin squeeze, so as to evaluate the implications for its assessment as a stand-alone abuse, before drawing the lessons for competition policy. As the issue of margin squeeze arises mostly in regulated industries, we discuss in the last section its interaction with the regulation of wholesale tariffs.

Before turning to the analysis, we should point that several imputation tests may be used to evaluate a margin squeeze, depending on the costs taken into account. The most common test is the *Equally Efficient Competitor* (EEC) test,

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[6]We refer here to the "equally efficient competitor" test, presented below.

which is described as follows by the European Commission:[7] *"Margin squeeze can be demonstrated by showing that the SMP [Significant Market Power] operator's own downstream operations could not trade profitably on the basis of the upstream price charged to its competitors by the upstream operating arm of the SMP operator ('equally efficient competitor' test) [...]"*. Other tests are possible, such as the *Reasonably Efficient Competitor test*. However, our objective here is not to discuss the appropriate test; as the Commission has identified the EEC test as the appropriate test – at least for the purpose of ex-post anti-trust implementation[8] – unless stated otherwise, we will focus on that test in what follows.

2 Overview of margin squeeze case law

Most of the literature on margin squeeze emphasizes the diverging transatlantic positions: whereas European courts have considered that margin squeeze constitutes a stand-alone antitrust doctrine, the US Supreme Court asserted instead that a margin squeeze should fall under existing types of abuse, namely, refusal to deal or predation. This section offers a brief discussion of margin squeeze case law in the US and in Europe in the last few years.[9]

Case law in the US

Margin squeeze was first in the US recognized as a form of antitrust infringement by the 1945 judgment of *Alcoa*.[10] In this case, a vertically integrated firm was found liable for not ensuring 'fair price' of its monopoly input and 'living profit' to its competitors downstream. This view on margin squeeze seeking only to protect competitors' profits and hence incompatible with modern competition policy has undergone important developments.

In 2004, the judgment of the Supreme Court in *Trinko*[11] opened the way for a reassessment of price squeeze as an antitrust theory. In *Trinko*, the incumbent local exchange carrier (Verizon) was accused of providing insufficient services assistance to its rivals in regulated wholesale market. As a first structuring element, the Supreme Court warned against the use of antitrust rules to impose duties to deal on dominant firms reducing the possible circumstances under which such a duty would exist. In particular, it derived that the existence of a regulation does not create an antitrust duty to deal, which was the case of the then regulated carrier. And as a second element, it suggested that if a firm has no duty to deal with its

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[7]The European Commission's Recommendation 2010/572/EU on regulated access to Next Generation.

[8]One reason is that it provide some legal safety to dominant undertalking as they can implement it internally.

[9]For a more detailed exposition, see e.g., Hay and McMahon (2012).

[10]United States v Aluminum Co of Am, 148 F 2d 416 (2d Cir 1945).

[11]Verizon Communications, Inc. v. Law Offices of Curtis V. Trinko, 540 U.S. 398 (2004). Also *Aspen* (Aspen Skiing Co. v. Aspen Highlands Ski Corporation, 472 U.S. 585 (1985).) was decisive on margin squeeze case law.

competitors at wholesale, it has no duty to deal under conditions that the rivals find advantageous.[12]

In *linkLine*,[13] the regulated incumbent (AT&T) was accused of monopolizing the downstream market by refusing to deal with its competitors, denying them access to essential facilities, and engaging in a margin squeeze. The Supreme Court applied the reasoning in *Trinko* to pricing conditions (rather than service assistance) to conclude that if there is no antitrust duty to deal at the wholesale level and no predatory pricing at the retail level, then a firm is not required to price both upstream and retail services in a manner that preserves its rival's profit margin. The Court found that in order to establish harm from the margin squeeze accusation, it must be shown that the incumbent's retail price was predatory as defined by the standards of *Brooke Groupe*.[14]

Although some lower courts in the past had more recognized margin squeeze as a theory of harm, the decision in *linkLine* in 2009 definitely excluded margin squeeze as a stand-alone abuse for firms with no duty to deal.

Case law in Europe

Contrary to the US, recent court rulings in Europe have characterized margin squeeze as independent antitrust doctrine. Three cases in the telecommunications sector concerning former national monopolies have set the tone for european case law : *Deutsche Telekom*[15] in 2003 (upheld by the CFI and the ECJ in 2008 and 2010 respectively), *Telefonica*[16] in 2007 (confirmed by the GC in 2012 and currently on appeal on the ECJ), and the guidance provided by the ECJ to the the Stockholm District Court in *TeliaSonera*. [17]

First of all, the Commission established in *Deutsche Telekom* that the Equally Efficient Competitor (EEC) imputation test is the appropriate approach for competition law. It assesses the undertaking pricing practices on the basis of its own charges and costs, rather than on the basis of actual or potential competitors. This approach is said consistent with the general objectives of competition policy and mostly it guarantees legal certainty as the dominant undertaking would be in position to assess the lawfulness of its conduct.[18]

The CFI decision in *Deutsche Telekom* stated that the abusive nature of the incumbent's conduct is directly connected with the "unfairness" of the spread between its prices for wholesale access and its retail prices, which takes the form of a margin squeeze. In this view, it was not required to demonstrate that retail prices are predatory or that input prices are excessive, qualifying it as a stand-alone an-

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[12] *Trinko*, at 410

[13] Pac. Bell Tel. Co. v. Linkline Commc'ns, Inc. 129 S. Ct. 1109, 1123 (2009)

[14] Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209 (1993).

[15] Deutsche Telekom AG v Commission of the European Communities, Case T?271/03 (2008)

[16] Wanadoo Espa–a v Telefónica, Case COMP/38.784

[17] Konkurrensverket v TeliaSonera Sverige AB, Case C-52/09 (2011)

[18] Further specification on the methodology to follow for a margin squeeze imputation test was given by *Telefonica*. For instance, the Commission acknowledged long term competition considerations by employing a discounted cash flow method for the test.

titrust infringement. It further considered that the abusive effects of margin squeeze can in principle be derived from the fact that the incumbent's input is regulated as considered indispensable to compete.[19]

However in *TeliaSonera*, the ECJ went a step further as it rejected the commonly made parallel between margin squeeze and "constructive refusal to supply." It stated that a margin squeeze might constitute an abuse independently on whether the input is or not indispensable. However, when the input is indispensable at least potential anticompetitive effects are probable. And whenever the input is not indispensable, abuse may also be possible but anticompetitive effects need to be proven.

3 Margin squeeze and exclusionary abuse

Margin squeeze cases typically involve a vertically integrated firm and one or several downstream competitors, the concern being that the integrated firm engages in pricing strategies that tend to exclude (some of) the downstream competitor(s). It is therefore natural to begin with a brief overview of the "economics toolkit" on exclusionary conduct. We will organize this discussion in three parts, depending on whether the targeted firm is in the same market (predation), in a vertically related market (vertical foreclosure), or in an adjacent market (horizontal foreclosure).[20]

3.1 Predation and margin squeeze

3.1.1 The nature of predatory pricing

A key feature of predation scenarios is their temporal dimension, which involves two phases, as illustrated in Figure 1:

- *Sacrifice*: In the first phase, the predator engages in aggressive behavior, aiming at reducing the (actual or expected) profitability of the target, so as to drive it out of the market; alternatively, the aim can be to prevent entry or discourage expansion.

- *Recoupment*: In the second phase, once the entrant has been forced to exit (or disciplined into assuming a passive role), or the potential entrant has been discouraged, the predator exploits its increased market power to recoup the initial losses.

In the initial phase, the "aggressive behavior" can take various forms. For instance, the predator may provide a very high level of quality, offer additional varieties (product proliferation), over-invest in capacity, expand its advertising efforts, and so forth; however, for our purposes the relevant option is *predatory pricing*, which

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[19]*Deutsche Telekom*, para 237.

[20]This typology builds on EAGCP (2005). On predation, see e.g., Rey and Tirole (1997) for a more detailed overview of the economics, and Bolton *et al.* (2001) for an extensive discussion of the law of economics; on foreclosure, Rey and Tirole (2007) offer a comprehensive survey of the economic literature.
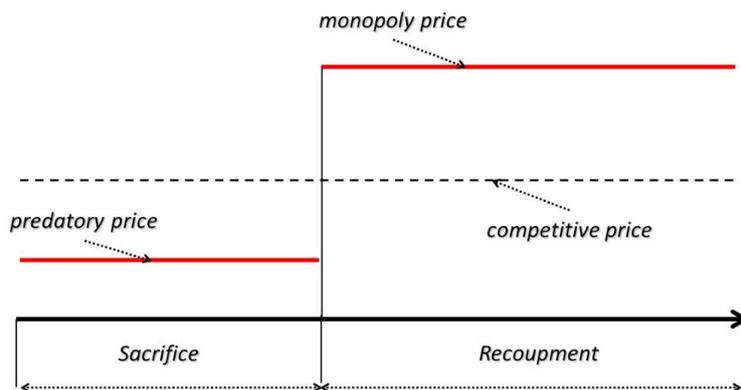
Figure 1: The two phases of a predation scenario

simply consists in reducing the price (predatory pricing) – alternatively, the predator may offer targeted rebates to those customers that are more likely to switch to the targeted firm.

Although this "aggressive behavior" aims primarily at reducing rivals' profits, during this initial phase we can also expect an adverse effect on the predator's profits, and an improvement in consumer welfare. The reduction in the predator's profits comes from a distortion in the strategies, compared with normal oligopolistic competition, generating a suboptimal performance in the short-term. By the same token, the short-term effect on consumers is usually positive, as rivals' demand and profits can only be reduced if one offers more attractive terms to the customers.

The longer-term effects of exclusionary behavior, in the second phase of the scenario, move in the opposite direction, as the predator exploits its increased market power at the expense of consumers (and possibly some allocative inefficiency). The overall profitability of the exclusionary strategy hinges on the ability to get rid of the competitors and to prevent further entries into the market.

3.1.2 Existing predatory theories of harm

The economic literature has identified three main theories of predation, based respectively on reputation, signal jamming and financial fragility.

The *reputation* approach hinges on the competitor's lack of information about the predator's incentives to adopt an aggressive market strategy. When the predator's incentives are uncertain, the beliefs of a potential entrant on the likely reaction of the predator play a crucial role on its entry decision. By behaving aggressively early on, the predator can then tilt the probability assessment of potential entrants (this is the reputation effect), so as to prevent entry. In a similar vein, an aggressive behavior can convince an actual competitor to exit the market and/or to refrain from developing its activities in that market. In all these instances, the predator's profits are consequently protected in the long-run; hence, even when the predator would have incentives to adopt a less aggressive behavior in the short-term, the recoupment opportunities offered by reputation can lead the predator to adopt an

exclusionary strategy.

A second setting where exclusion can be realized involves *signal jamming*. When small or new competitors have imperfect information on market profitability, a safe strategy would require selective entry into specific market segments. By testing the market the firm can reach a better local knowledge of demand in the neighborhood of the prevailing prices. In such a situation, the predator can lower its price to an abnormal level so as to prevent the competitor from learning the features of demand in the relevant conditions – even when accounting for the predator's artificially low price. Signal jamming can in this way allow the predator to delay or deter entry.

Finally, *financial predation* consists in creating the preconditions for a negative performance of the competitor, so as to drive it out of the market. The traditional "deep pocket" theory simply assumes that the predator has a financial advantage over the target, which allows the predator to afford the losses of a price war until the target is driven out of the market. Today, however, modern Industrial Organization theory challenges this simplistic story, as it ignores the possibility, for the target, to obtain external financing during the predation phase, thereby restoring symmetry between the two firms and making predation unprofitable for the predator. A theory of financial predation must therefore explain why this solution does not arise, invoking capital market imperfections that affect the relation between the entrant and its investors. Indeed, even if the predator does not make an exclusionary attack, the target has to rely on investors, who have a limited ability to monitor the firm's effort, the risk taken, the private benefits extracted, and so forth. This is particular important if the target is a new entrant. Hence, the financial contract has to provide incentives to induce the firm to repay the investors. Threatening to liquidate the firm or to deny loan extensions in case of insufficient performance are examples of such clauses. Unfortunately, financial contracts that are designed to alleviate agency problems also offer predation opportunities to the predator. Aggressive conduct that reduces the cash flow and the profits of the competitor will in fact tighten the conditions for its external finance, reducing the ability of the rival to sustain a prolonged price war. On the other side of this dilemma, any attempt to reduce exposure to predation, for instance by ensuring finance to the competitor even if it performs poorly, would exacerbate the agency problems of the investor.

Learning-by-doing provides another rationale when firms acquire experience in production or retailing, and thus become more competitive over time. By depressing competitors' market shares, an incumbent may then prevent them from moving down the learning curve, and limit in this way their competitiveness. As shown by Cabral and Riordan (1994,1997), this may lead incumbents to adopt strategies that are excessively aggressive from a social perspective and induce inefficient exit of their competitors. Although the possibility of inefficient exit relies on the presence of economies of scale,[21] due to fixed costs, a closer look shows that, more generally, some inefficiency may arise solely from the learning-by-doing process itself. We develop this point in Appendix A, where we show, within a simple two-period model, that excessive aggressive pricing by the incumbent arises, even without exclusion, when firms have different learning curves. The intuition is as follows. As competition

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[21]See also Motta and Fumagalli (2009) for a simple theory based on scale economies.

tends to align prices on costs, total industry profit is lower when firms have similar costs than when there is a large cost differential between them. Thus, consider a competitor currently less efficient than the incumbent, but with better learning-by-doing capability. If the initial cost differential is large enough, the competitor may be unwilling to sacrifice much current profit (in order to expand output and benefit from learning-by-doing), as this eventually yields only a moderate cost advantage. By contrast, the incumbent may be willing to sacrifice a lot to preserve this situation. The incumbent may then win current competition and maintain its cost advantage in situations where efficiency would require the competitor to sell so as to move down the learning curve.

3.1.3 The difficulties for applications to margin squeeze

Summing-up, predation scenarios follow a common pattern: a short-run sacrifice in profits, followed by a long-run recoupment of the losses. In margin squeeze cases, predation theories may be relevant for the analysis of downstream competition between the dominant firm and its competitor(s).

A first difficulty with predation analysis, common to all theories, stems from the fact that the predator's "aggressive behavior" during the initial phase may as well be adopted when exclusion is not on the agenda, and "normal" oligopolistic rivalry prevails. For example, a reduction in prices is a normal reaction to the entry of a competitor, but can also be part of a predatory strategy. Likewise, firms may have an objective, non-exclusionary reason to incur a current sacrifice – e.g., it may simply be willing to speed the learning process. It is therefore necessary to identify carefully the precise story that is supposed to characterize the abusive behavior, and to compare it with possible alternative explanations, if there are any, that derive from a non-abusive oligopolistic practice. This requires identifying the relevant elements and facts that distinguish the pro- and anti-competitive interpretations of a given situation.

For instance, financial predation theory provides a clear setting, highlighting the key importance of the following dimensions: i) Does the target rely on external funding? ii) Do the financing conditions depend on the performance of the borrower? iii) Does the aggressive conduct of the predator reduce the ability of the target to obtain external finance? iv) Is the impact of the reduced cash flow on the predator's financing opportunities limited? v) Is the predator able to recoup the reduced profits once exclusion is realized? The first two conditions require an analysis of the financial contracts of the competitor; condition iii) does not necessarily imply that the predator is pricing below its (short-run, incremental) cost, as it would in other predatory stories, since even an efficient competitor might be in trouble with financial obligations when revenues do not cover all the costs. Finally, condition iv) can be verified by looking at the possibilities for internal financing from other lines of business, or at the impact of localized losses of the predator on the volumes of credit received, while point v) can be assessed by considering the prospects of future entry into the market.[22]

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[22]Including "entry" in the form of resale of the prey's assets to another competitor.

This difficulty in screening out undesirable predation while preserving firms' incentives and ability to engage in pro-competitive behavior partly explains why there are few predation cases in practices. It may also explain why competition authorities tend to favour margin squeeze tests whenever relevant. However, in margin squeeze cases an additional difficulty stems from the fact that the dominant firm is vertically integrated and supposed to control access to a bottleneck – an "essential facility," say. This begs the question of why does the integrated firm wish to eliminate downstream competitors, an issue that we discuss in the next section.

3.2 Foreclosure theory as a theory of harm

3.2.1 The nature of vertical and horizontal foreclosure

Foreclosure refers to a dominant firm's denial of proper access to an essential good it produces, which distorts competition on a related market. Two situations can be distinguished:

- *Vertical foreclosure* arises when the bottleneck good is either used as an input (e.g., an infrastructure) by a potentially competitive downstream industry (input foreclosure – the relevant situation for margin squeeze), illustrated in Figure 2a, or when the bottleneck is needed to access final consumers (customer foreclosure, as for instance when a dominant retailer refuses to distribute a manufacturer's products), as illustrated in Figure 2b.

(a) Input foreclosure   (b) Customer foreclosure
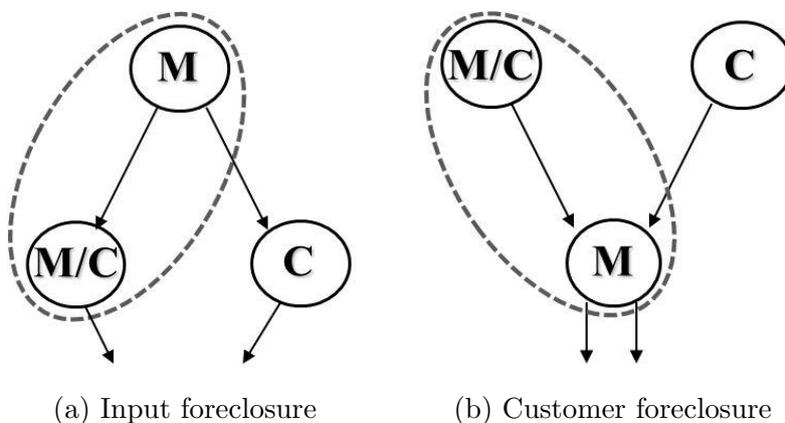
Figure 2: Vertical foreclosure

- *Horizontal foreclosure* arises when the monopolized good is sold directly to customers, who use it in conjunction with complementary goods (e.g., system goods or aftersale services),[23] as illustrated in Figure 3.

Foreclosure can be complete,as in the case of technical integration between complementary goods, or partial, as when the bottleneck owner favors some firms or

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[23]Horizontal foreclosure may also arise when the goods are not complements; the case complementary products is however more relevant for margin squeeze cases.
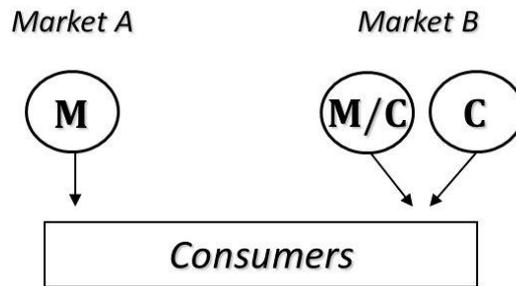
Figure 3: Horizontal foreclosure

products in the adjacent market to the detriment of other competitors. It can also be performed in various ways:

- If the bottleneck owner is integrated, it can refuse to deal – equivalently, an extravagant price can serve as "constructive refusal".[24] Alternatively, 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.[25] In the presence of economies of scope or scale calling for cooperation among firms in the same market, as is the case in many network industries, a dominant group of firms may put its competitors at a disadvantage by *refusing to cooperate*.[26]

- In the absence 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.[27] 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.[28]

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[24]Famous cases involve computer reservations systems developed by major airlines, in both the EU and the US. This led antitrust authorities to impose vertical separation, as in the case of AT&T in the US or in the brewing industry in the UK (where brewers had to sell their pubs); in the same vein, high voltage electricity transmission systems have been separated from generation in most countries.

[25]See e.g., *Otter Tail Power* (1973) and *International Salt* (1947) in the US, and *Port of Genoa* (1991), *Sealink* (1992) and *Tetra Pak* (1994) in the EU.

[26]Famous cases include *Associated Press* (1945) and *Aspen Skying* (1985) in the US, and *Aer Lingus* (1992) in the EU.

[27]For example, the European Commission investigated the 65-year contract allocating the entire capacity to the incumbent operators, British Rail and SNCF.

[28]For example, a loyalty program based on the growth of purchases may target specific customers even though they formally are available to all customers. Similarly, a large enough fixed fee can

3.2.2 The Chicago critique

The traditional "monopoly leverage" concern was that the dominant firm would seek to extend its monopoly power from the bottleneck segment to the potentially competitive segment. The Chicago School[29] however pointed out that this concern resulted from a confusion about the exercise of monopoly power:

- The starting point of this Chicago critique is that there is a single source of monopoly profit: the demand from downstream customers in the case of vertically related markets, or the users' demand for the system good in the case of adjacent markets.

- But the bottleneck monopolist can already earn the entire monopoly profit without extending its market power to related segments: it suffices to charge the monopoly margin on the bottleneck good.

- Therefore, in the absence of efficiency gains, the dominant firm cannot benefit from distorting competition in the related market: by offering product diversity, cost efficiency or simply benchmarking, competition can instead be the source of extra monopoly profits.

To illustrate this, consider the following simple example: An upstream monopolist, M, produces a key input for downstream use; for the sake of exposition, we will suppose that the production cost is zero (for instance, most of the costs have been sunk in developing the input, as in the case of an essential patent). The monopolist is also present downstream, and can transform at cost c the input into a final good, which consumers value at v. There is potential competition in the downstream segment, but it can emerge only if competitors have proper access to M'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 leverage doctrine, M 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 M can get by exerting its market power in the upstream segment. In the absence of downstream competition, M can charge the monopoly price, equal to consumers' full value v, and earns in this way a margin of $v - c$. But M can still secure this margin in case of downstream competition, by offering the essential input at a wholesale price $w = v - c$; in this way, any more efficient competitor (i.e., any competitor with a price c_E lower than c) will be able to enter the market, attract consumers (by charging slightly less than v), and still make a profit, based on a positive margin $c - c_E$. But M can do even better, as it can appropriate the competitor's efficiency gain by raising the wholesale price to (almost) $w' = v - c_E$. This simple example thus

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transform a potentially competitive downstream industry into a natural monopoly industry. And in the case of complementary goods, conditional discounts can discriminate consumers according to their preferences for the different product varieties.

[29]See, e.g., Bork (1978), Posner (1976) and Posner and Easterbrook (1981).

confirms that M has no incentive to distort downstream competition – imperfect competition in the downstream market may actually adversely affect M's bargaining power and/or create distortions that reduce the profitability of the upstream market.

An illustration of the Chicago critique may well be extended to a dynamic context. In the presence of learning-by-doing, as we show in Appendix A, it is in the interest of the integrated monopoly to induce the efficient market structure downstream whenever it is not constrained on the choice of wholesale price. To see this, consider a situation where an incumbent and a competitor face a unit demand, with maximal price 5, over two periods. The incumbent cost is 3 each period, the competitor's cost is 4 but will fall to 1 in the second period if it acquires experience by actively selling in the first period. The incumbent is vertically integrated upstream and is the monopolistic supplier of an essential input, with a zero variable cost. The discounted total intertemporal cost is then $4 + \delta$ if the competitor sells each period, and $3(1 + \delta)$ if the incumbent sells each period, where δ is the discount factor. It is thus efficient that the competitor serves the market in both periods if δ is larger than $1/2$.

To analyze the competitive outcome, consider the second period. If the competitor's cost is 4, then the integrated firm charges a wholesale price above 1, and directly sells the downstream good at reservation price 5, thus obtaining a profit of 2. If instead the competitor's cost is 1, then the incumbent sets a price of (almost) 4 for the input, so that the competitor can sell at a price 5 with (almost) no profit, and the incumbent's profit is 4; that is, the integrated firm lets the competitor serve the market, and appropriates the resulting gains from trade by adjusting its wholesale price accordingly.

Consider now competition in the first stage. The competitor anticipates that it will make no profit in the future (either because it will be less efficient, if it loses the first-period competition, or because the monopolistic supplier will appropriate all profits through the access price). Hence, the competitor will not accept to sell at a price below its initial cost of 4. On the other hand, the incumbent knows that letting the competitor sell today will increase its future profit by 2 (from 2 to 4). Anticipating this additional profit from not selling, the incumbent would not be willing to sell at a price below an "opportunity cost" of $3 + 2\delta$. It follows that the competitor sells in the first period (and thus in the second period as well) whenever $4 < 3 + 2\delta$, or $\delta > 1/2$, that is, precisely when this is efficient. Thus, the fact that efficiencies are dynamic does not invalidate the Chicago critique.

The Chicago School view led economists to reconsider the foreclosure argument and to put it on firmer ground. In essence, the post-Chicago theories of harm focus on *protecting* or *exploiting* more effectively the market power of the dominant firm in its core market, rather than on leveraging market power from the core market to other markets.

3.2.3 The modern theory of vertical foreclosure

The reconciliation of the vertical 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 was first understood in specific contexts such as patent licensing and franchising, or in the context of durable goods. Franchisees are for instance unlikely to pay much to franchisors if they do not have the guarantee that competitors will not set-up shop at their doorsteps; franchisors would thus like to promise to limit the number of franchisees. There is however a commitment problem: Having already negotiated with some franchisees, the franchisor is tempted to accept additional franchisees; but this depreciates the value of the first franchisees which, if anticipated, reduces the franchisor's ex ante profit.[30]

A bottleneck owner faces a similar commitment problem: 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; but this opportunistic behavior ex ante reduces the bottleneck owner's profit – the first firm is willing to pay and buy less; more generally, the bottleneck owner would like to commit to a certain volume of access, so as to limit competition and profit dissipation, but it may be tempted to grant more access when dealing bilaterally with each competitor; as a result, competition in downstream markets "percolates" in the bottleneck market and dissipates the dominant firm' profit.

Hart and Tirole (1990) were the first to point out that the logic described above for discrete variables such as the number of franchisees or licensees applied as well to continuous variables such as the volume or quality of access.[31]

Suppose for instance that two homogeneous downstream firms, C_1 and C_2, face an inverse demand $p = P(Q)$ and compete in setting quantities. Ideally, the upstream bottleneck owner M would like to sell the monopoly quantity Q^M that maximizes total industry profit - including the monopoly and the two downstream firms - because this maximizes the revenue to be shared. It could for instance offer half of it to each downstream competitor, at a unit price equal to the monopoly price, $p^M = P(Q^M)$, minus the downstream cost, c. But having sold the quantity $Q^M/2$ at a price $w = p^M - c$ to C_1, the monopoly would have a joint interest with C_2 to negotiate a quantity q, different than $Q^M/2$, that maximizes their joint profit. Typically q is larger than $Q^M/2$.[32] Anticipating this opportunistic behavior, leading

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[30]The same reasoning directly applies to the owner of a essential patent. In the case of a durable good, even a monopolist *de facto* "creates its own competition," as consumers will not be willing to pay a high price today if they anticipate that, in order to exploit the residual demand, the monopolist will lower its price tomorrow. See Coase (1972), as well as Tirole (1988, chapter 1) for an overview.

[31]O'Brien and Shaffer (1992) show that the logic applied to price as well as to quantity competition in the downstream market, and McAfee and Schwartz (1994) further generalize the analysis to arbitrary forms of downstream competition. See Rey and Tirole (2007) for an overview of that literature.

[32]For a quantity Q sold to C_1, the upstream monopoly offers $Q' = R^C(Q)$ to C_2 where $R^C(Q) = \arg\max_q [P(Q+q) - c] q$ denotes the "Cournotian" best response to a given rival's quantity Q (we

to a retail price below p^M, C_1 will refuse such contract offer, and only accept a lower input price. Hart and Tirole show that, in equilibrium, the upstream monopolist supplies each downstream competitor so as to enable it to "best respond" to its rival, leading to an outcome replicating that of standard Cournot competition.

In order to restore the full exercise of its market power – rather than extending its market power – the bottleneck owner may thus wish to restrict or eliminate downstream competition. For example, refusing to deal with all downstream firms but one, or entering into an exclusive dealing agreement with that particular firm, eliminates downstream competition and thus fosters the upstream firm's ability to exploit its market power. Remarkably, banning discrimination would also help the bottleneck owner to resist demands for selective price cuts and thus contribute to maintaining high prices. Finally, vertical integration also constitutes an alternative solution to the upstream firm's commitment problem, as the integrated firm no longer has an incentive to "free-ride" on its own downstream subsidiary when negotiating access conditions with a competitor; that is, vertical integration leads *de facto* to foreclosure (which can be complete if competitors bring no efficiency, or partial otherwise – e.g., the integrated firm may keep dealing with "niche" competitors geared towards specific customer groups).

3.2.4   Horizontal foreclosure and dynamic linkages

As for vertical foreclosure, the Chicago critique has prompted the development of economic theories providing a sound analytical rationale for the existence of strategic leveraging of market power in adjacent markets by dominant firms.

Some of the arguments focus on those cases where the products of the two markets are independent. For instance, by bundling independent goods a dominant firm can commit itself to a very aggressive pricing behaviour in case of entry.[33] Anticipating tougher competition, potential competitors may then renounce to enter.

For the case of complementary products, the thrust of the arguments has been about protecting the dominant firm's core market, in situations where entry in adjacent markets could facilitate entry in that core market. Suppose for example that a firm M initially monopolizes the markets for two complementary products, A and B. On these markets, firms compete through up-front R&D investments and, as a consequence, entry is risky. A potential entrant can enter the market if it succeeds in innovation and obtains a superior technology. By irreversibly tying the two products to one another, the incumbent firm may be able to diminish the expected return in any one market - because successful entry now requires entering both markets simultaneously. Thus, tying makes the prospects of investment less certain, reducing the entrant's incentive to invest and innovate.[34]

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normalize to 0 the upstream cost). Then $R^C \left(Q^M/2 \right) > Q^M/2$.

[33]The aggressive pricing is due to the fact that the dominant firm loses sales in both the home and the adjacent market when it faces competition in the adjacent market. See Whinston (1990).

[34]See Choi and Stefanadis (2001) for a formal analysis. The argument applies even if a same firm can invest in both markets, as tying still deprives it from revenue when succeeding in only one market.

Alternatively, when there are economies of scale and/or scope across markets, by bundling its products the incumbent may deny entrants access to a large fraction of the market, and thereby the possibility of achieving minimum efficient scale. For instance, if entry is easier (or faster) in the adjacent than in the home market, then bundling makes entry in the adjacent market impossible, allowing the incumbent to prevent entry into its home market.[35] To see this, suppose that, instead of being risky, entry simply takes more time in market A (M's core market, say), than in market B (the adjacent market); that is, a potential competitor E can enter market B in period 1, in which case it can also enter market A in period 2. Entering market $i \in \{A, B\}$ requires sinking a fixed cost f_i, and then brings a profit π_i in each period where E is active. Letting δ denote the discount factor, if

$$f_A < \pi_A, \quad f_B < (1 + \delta) \, \pi_B;$$

then E would find it profitable to enter both markets: entering market B in period 1 brings an overall net discounted benefit $(1 + \delta) \, \pi_B - f_B > 0$, and then entering market A in period 2 brings an additional net benefit $\pi_A - f_A > 0$ in that period. Suppose now that M ties its product B to its product A. If E enters market B in period 1, in which it cannot offer product A, it will not be able to obtain as much profit as before; if for instance its profit becomes $\hat{\pi}_B < \pi_B$ and[36]

$$\hat{\pi}_B + \delta \, (\pi_A + \pi_B) < f_B + \delta f_A,$$

then tying makes E's entry unprofitable. It does not pay to enter market B in period 1 even if this allows entering market A later on, and *a fortiori* it does not pay to enter market B in period 2.[37] Hence, by reducing E's profit during the initial phase, in which E can only enter the adjacent market, M is able to discourage E from entering *both* markets, including its core market, and preserve in this way its monopoly position in the entire industry.[38]

The situation just described above involves an intertemporal linkage between current market outcome and future conditions of competition, namely, entry in market B reduces the cost of entering market A. The dominant firm can then alter the future position of its competitors in its favour. Situations of this type are quite common – examples include switching costs, durable goods, experienced goods (where firms need to convince consumers to buy the product before knowing whether they like it or not). In these circumstances firms will account for the intertemporal linkage in their pricing decisions, which makes the notion of predatory behavior

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[35]See Carlton and Waldman (2002); the authors show that similar strategies can successfully deter entry in the presence of network effects on the demand side.

[36]This inequality is indeed compatible with the previous one; if for instance the case $\delta = 1$, $\pi_A = \pi_B = 10$, $f_A = 5$, and $\hat{\pi}_B = 0$, then all inequalities are satisfied whenever $15 < f_B < 20$.

[37]Although we have assumed for simplicity that entry in market A is not feasible if E did not enter market B in period 1, this assumption can easily be relaxed; what matters if that there are economies of scale (sunk entry costs), and that entry is easier or faster in one market than in the other. See Carlton and Waldman (2002) for a detailed analysis.

[38]See Carlton and Waldman (2002) for a detailed analysis; the authors show that similar strategies can successfully deter entry in the presence of network effects on the demand side.

complex to evaluate. Indeed it is difficult to define when an introductory pricing is excessively low for experienced goods, or when an acquisition price is too low in the case of switching costs – where a firm must compensate consumers for the cost of future lock-in.

One instance of dynamic leverage is the so-called "ladder of investment" theory (Cave 2006). This refers to a situation where investment occurs step by step (the ladder), and firms need to complete one step before moving to the next. For instance, a telecommunication operator may need to gain enough expertise and scale before moving away from resale and developing its own network infrastructure. If such a ladder exists,[39] the above discussion suggests that an aggressive behavior against competitors in the first step may prevent them from progressing on the ladder.

3.3 Lessons for margin squeeze

As margin squeeze cases involve a vertically integrated firm, at first glance the vertical foreclosure paradigm appears to be the relevant one. The horizontal foreclosure strategies described in section 3.2.4, in which the dominant firm blocks entry in order to protect its core market, can however be transposed to apply as well to vertically related markets. Thus, the lesson is that foreclosure theory seems to better capture the anti-competitive effects for unregulated firms.

The conditions under which downstream competitors can access an essential facility have triggered numerous disputes over the years (going back to at least 1912, with the famous case *Terminal Railroad Association v. U.S.*), and competition authorities have often tried to use other prices as benchmarks for access prices. Baumol and Willig proposed a famous rule, called the *Efficient Component Pricing Rule* (ECPR), which precisely aims at avoiding "margin squeezes," and enabling an equally efficient competitor to enter the downstream market: the access price charged to competitors should not exceed the price charged by the integrated firm on the competitive segment, minus the incremental cost of that firm on the competitive segment.[40] However, it should be stressed that ECPR 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. Thus, in an unregulated environment the integrated firm can 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 downstream firms from exerting any competitive pressure.[41]

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[39]For a recent empirical study challenging the existence of such ladder in the fixed broadband industry, see Bacache, Bourreau et Gaudin (2013).

[40]See Willig (1979) and Baumol (1983). The rule was first adopted in the US by the Interstate Commerce Commission in railroad disputes. Later on, it was adopted in New Zealand (and confirmed by a decision of the British Privy Council) in a famous dispute between the incumbent telecom operator and a new entrant.

[41]See, e.g. Baumol et al. (1995) and Laffont and Tirole (2000) 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. Armstrong (2002) offers a broader analysis of the impact of ECPR in both regulated and unregulated markets.

We will examine the implications for a regulated industry in section 5. In the context of unregulated industry, we can already notice that, although a ban on margin squeeze may prevent the exclusion of more efficient competitors, it does not prevent the exercise of monopoly power upstream and may introduce other distortions. To evaluate these distortions, we need to understand the implications of banning margin squeeze by vertically integrated upstream monopolies, absent any exclusionary motivation. This is the object if the next section.

4   Margin squeeze and exploitative abuse

4.1   Introduction

This section discusses situations where a margin squeeze may arise as a by-product of pure exploitation of upstream market power by a vertically integrated firm. As is well-known, an upstream monopolist raises prices above the competitive level, so as to appropriate some of the value created by downstream firms.[42] This leads to the well-known monopoly price distortion, which can be socially harmful in both the short-term and the long-term: In the short-term, excessive retail prices reduce the sales of downstream retailers; and in the long-run, they may impede incentives to enter the market with new products.

The same logic also applies when the monopolistic supplier is vertically integrated downstream. Indeed, if the firm were focussing on its profit derived from its wholesale operations, then access prices should never be so high so as to eliminate retail competitors, because this would also eliminate wholesale profits; more generally, whenever downstream competitors create some added value, beyond that proposed by its downstream subsidiary, the wholesale price allows the integrated firm to capture some of this additional value, and this is likely to be more profitable than completely choking-off these competitors. Yet, excessive wholesale tariffs may still be socially harmful, for the same reasons as above.

When wholesale customers are competing with the retail activity of the vertically integrated firm, several economic logics may however conflict, as the integrated firm derives revenue from two sources, the wholesale and the retail activities, and each activity may cannibalize the sales on the other activity. Indeed, the key feature distinguishing wholesale pricing by a vertically integrated firm and by a non-integrated upstream producer is that, in the former case, raising the wholesale price reduces the competitiveness of downstream competitors, thereby enabling the integrated subsidiary to raise its sales at the expense of rivals. According to the *raising rivals' costs* logic (Salop and Scheffman (1983)), an increase of the wholesale margin that reduces wholesale revenue (due to lower demand) may be profitable if it reduces the competitive pressure on the downstream activity and, consequently, fosters the profit of the downstream unit. When this is the case, access prices may be excessively high and even evict competitors. It thus appears that the basis for margin

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[42]The discussion that follows assume linear prices. More generally, exploitation of monopoly power induces market distorsions whenever perfect price discrimination is not possible, which is a key assumption for inefficient margin squeeze to occur.

squeeze concerns (even in a static framework) is two-folded: it may stem from concerns of *excessive price* (thus an exploitative abuse) or from concern of *raising rivals' cost* practices.

In any event, banning margin squeeze constrains the prices of the integrated firm and thus limits its ability to exercise market power. Yet, the consequences are not necessarily positive for competition and consumers, as the firm will react to the regulation in the most profitable way, which may not be the most desirable way from a competition policy perspective. The firm may well reduce its wholesale tariff to some extent, but it may also cope with the constraint by raising its retail price. Raising retail prices results in higher prices by competitors as well, as they can take advantage of the weaker competitive pressure exerted by the downstream subsidiary. This is sometimes referred to as the "price umbrella effect"[43] and implies that a ban on margin squeeze may induce a lessening of ex-post competition. As we will discuss, this could be desirable in the context of ex-ante regulation aiming at encouraging entry, but from an efficiency standpoint, the desirability of a ban on margin squeeze hinges on whether it will likely result into higher retail prices or lower wholesale prices.

We discuss below recent work on margin squeeze that builds on these insights. We first sketch a simple framework, with a single homogenous good, and then use this framework to discuss the contributions.

4.2 The exercise of market power may lead to a margin squeeze

4.2.1 The case of homogenous product: pricing and opportunity cost

To start the discussion, let us consider the textbook case where an integrated firm M enjoys a monopoly position in the upstream market and faces in the downstream market a competitor, E, selling a perfect substitute to M's retail product. Consumers buy from the firm with the lowest price; hence, if E were less efficient than M's retail unit, then E could not profitably attract consumers, with or without a ban on margin squeeze. Hence, from now on we will focus on the more interesting case where E is more efficient than M in the downstream market.

To highlight some implications of market power, we allow firms to rely to different extents on the integrated firm's input, as may be the case for instance if they rely on different technologies: The integrated firm's downstream subsidiary and its rival may then combine inputs in different ways. For example, a retailer distributing video services on the physical network of a vertically integrated network operator may have a different compression method, leading to a different bandwidth usage. For the sake of exposition, we will suppose that M uses 1 unit of its input to produce 1 unit of retail good, whereas E needs x units of M's input. We provide a detailed analysis in Appendix B.2, and present here the main insights.

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[43]See, e.g., Bourckaert and Verboven (2004), Carlton (2008), Sidak (2008), Choné et al (2010), and Petulowa and Saavedra (2013).

With homogenous goods and price competition, firms compete mostly for consumers "in the market," meaning that, when a firm raises its price above that of its rival, its customers simply switch to the competitor. For the integrated firm M, it means that the sales lost on the retail market transform into sales on the wholesale market, as the rival E needs M's input. It follows that M will not accept to serve final consumers at a margin below that it could obtain on the wholesale market, by letting E serve these consumers. Letting w denote M's wholesale price, M is therefore willing to sell at price p only if

$$p - c_U - c \geq (w - c_U)\, x,$$

where c_U and c respectively denote M's upstream and downstream unit costs, and $(w - c_U)\, x$ represents the wholesale revenue per unit of competitor's retail sale.

In other words, the integrated firm will be willing to sell only if the retail price exceeds its total cost, augmented by the margin that the firm foregoes on the wholesale market by selling on the retail market:

$$p \geq c + c_U + (w - c_U)\, x.$$

In economic terms, the firm faces an *opportunity cost* (the right hand term), which is larger than its total cost because it incorporates the cannibalization of sales on the wholesale market by the retail activity. As firms selling with multiple channels, the relevant driver for prices is not only the physical cost but also the indirect effects of each channel on the sales of the others. This opportunity cost may not coincide with the cost of M evaluated at the wholesale price, $w + c$, even in the present case of substitute goods. To see this, suppose that E uses less input than M to produce the retail good (that is, $x < 1$). Then the revenue $(w - c_U)\, x$ is smaller than $w - c_U$, and the opportunity cost of selling the retail good is smaller than $w + c$ whenever the wholesale margin is positive.

Once the opportunity cost is properly taken into account, the analysis of competition follows standard reasoning. The integrated firm and the competitor compete on the retail market as two independent companies, except that the total cost of M is equal to the opportunity cost $c + c_U + (w - c_U)\, x$ instead of the physical cost $c_U + c$. Under standard Bertrand competition, the most "efficient firm" then wins the market. Hence, when E is the more efficient firm, head-to-head competition leads to a situation where E serves the market, at a price equal to M's opportunity cost, $c + c_U + (w - c_U)\, x$ – in particular, although M does not sell in the downstream market, its retail price still constrains the competitor. In this situation, M derives all of its revenue from the wholesale activity, and can exercise market power by raising its wholesale margin. Letting $r = (w - c_U)\, x$ and denoting by $D(p)$ the retail demand, M's profit can be expressed as $r D (c + c_U + r)$. As usual, the profit-maximizing margin then trade-offs a higher margin against higher sales.

Note here that, although M's retail activity does not generate any profit, it still finds it profitable to maintain this activity so as to limit double marginalization by the competitor: If M were to exit the retail market, E would be free to increase its

price, reducing the demand and thus M's sales on the wholesale market.[44]

This simple model, with homogenous retail goods and Bertrand price competition, thus describes a situation where, faced with a more efficient competitor, the vertically integrated firm focuses its activity on the wholesale market, where it can expect the largest profit, and relies on its downstream activity mainly to discipline the competitor, so as to maintain low prices and large sales on the downstream market. Whether a margin squeeze occurs or not then depends on the definition of the squeeze, and on the technologies. Clearly, there would be no squeeze if the imputation is done with the most efficient technology, as the most efficient firm can always sell in the situation described. By contrast, M could fail a *equally efficient competitor* (EEC) squeeze test, as it would require M to sell profitably on the retail market if it had to buy the input at the wholesale price. There is then a margin squeeze whenever M's retail price is such that[45]

$$p < w + c. \tag{1}$$

To discuss the implication of margin squeeze regulations, we develop in Appendix a simple model illustrating situations where M's prices would fail a margin squeeze test, and discuss the implications of such a constraint on prices and quantities. When E is more efficient, the market outcome fails the test whenever E can produce the retail good with less upstream input than the integrated firm (i.e., $x < 1$).

To understand this, recall that the minimal price at which M is willing to sell is its opportunity cost, which includes not only the physical total cost $c_U + c$, but also the margin $r = (w - c_U) x$ obtained on E's retail sales:

opportunity cost = total cost + wholesale margin × E's access need

Furthermore, the competitor serves downstream consumers whenever its own cost lies below M's opportunity cost, in which case the market price is precisely equal to M's opportunity cost. Hence, M would then fail the test whenever its downstream unit's cost would be above the opportunity cost if it had to buy the upstream input at the wholesale price w. Using $w = c_U + (w - c_U)$, the EEC price threshold is equal to the total cost $c_U + c$ plus the wholesale margin $w - c_U$. Thus M will fail the margin squeeze test when

opportunity cost < total cost + wholesale margin × M's access need

But whenever (i) the wholesale price lies above cost (i.e., $w > c_U$), and (ii) E's technology uses less input (i.e. $x < 1$), M's (virtual) wholesale margin $w - c_U$ on the units that it would directly sell to consumers exceeds the margin $r = (w - c_U) \times x$ that M actually obtains on E's sales. Therefore M fails the test.[46]

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[44]This argument of course relies on market power by the competitor; it would be less relevant in case of intense downstream competition.

[45]Note that we impute the cost w to the integrated firm, not the competitor's cost xw. That is, we evaluate costs using the vertically integrated monopoly's technology.

[46]Recently, Kitamura, Maztsushima and Sato (2013) makes the related point that, under a uniform price rule, a non-integrated upstream monopoly may enter into an exclusive agreement with a retailer, foreclosing access to other retailers with technologies that are less intensive in the upstream input.

The above discussion can be summarized as follows:

With homogenous retail goods and price competition, a (EEC) margin squeeze is observed when the competitor makes more efficient use of the upstream input.

We will discuss in section 4.3 whether banning such a margin squeeze is desirable or not.

4.2.2 More strategic effects

In the above scenario the competitor, benefitting from the price umbrella, is able to charge a positive margin on top of its cost. As pointed by Choné, Komly and Meunier (2010), this is not the best scenario for the integrated firm: As it derives profit from its wholesale activity, it would benefit from a boost in the competitor's sales, and thus from lower retail prices – provided that this is achieved without reducing the wholesale margin. The same insight led for instance Sibley and Weisman (1998) and Gilbert and Hasting (2001) to argue that, under specific circumstances, a vertically integrated firm may indeed benefit from reducing rivals' cost.

As the price of the integrated firm's retail service acts as a cap on the price of the competitor, one way to achieve this is to tighten the cap. That is, the integrated firm may wish to commit to an aggressive pricing behavior on the retail market, so as to force the competitor to reduce its prices. Choné, Komly and Meunier[47] show that this can occur when the integrated firm is a price leader in the retail market, setting its price before competitors react. The integrated firm will then cut its price below its "opportunity cost," inducing competitors to sell more, thereby boosting the wholesale demand.[48] As shown in Appendix, in this context a margin squeeze occurs whenever the competitor is more efficient than the integrated firm.

4.2.3 The case of differentiated products: a similar analysis

Product differentiation limits the intensity of competition, which raises several interesting features. First, the definition of a relevant market is notoriously difficult with differentiated products – an issue that goes beyond the scope of this article.[49] Moreover, considering that all products using the input must face the same wholesale price can be counterproductive. To see this, consider an extreme case where there are two non-rival retail products. Product A is sold solely by the integrated firm M, whereas product B is sold by independent downstream sellers. Both products exhibit the same upstream and downstream unit costs, $c_U = 1$ and $c = 1$. The demand for each product is inelastic, with a reservation price of 3 for product A and 4 for product B. The integrated firm would then: (i) sell product A at the maximal (monopoly) price, 3; and (ii) sell its input at price $w = 3$ to the independent sellers of product B, so as to induce them to charge the monopoly price for that product,

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[47]They analyse a situation where there is no leader, which raises some theoretical issues, but their main insight can be recasted in a model of price leadership.

[48]Alternatively, one could envision that a non-leading firm builds a reputation of aggressive behavior on the retail market, so as to induce competitors to lower their prices.

[49]For instance, Briglauer, Götz and Swartz (2004) stress that downstream market definition can be problematic when there is both intra-platform and inter-platform competition.

$3 + 1 = 4$. If an antitrust authority overlooks the lack of rivalry between products A and B, then it may conclude that M's prices fail to pass a nondiscriminatory EEC margin squeeze test, as the price of product A should cover the total cost $w + c = 3 + 1 = 4$. Confronted with such a margin squeeze test, M would have two options. One option is to reduce the wholesale price down to 2, so as to comply with the test on product A. But if market B is relatively large, M could simply drop product A and maintain the wholesale price at 3.

Second, with differentiated products, variety matters, and there can be excessive or insufficient entry. In addition, the market shares of the different varieties also matter. Both dimensions are affected by the pricing policy of the integrated firm, which now trades-off two sources of revenue, upstream and downstream – its ability to control the independent retailer's price is moreover more limited, and double marginalization becomes an issue.

The analysis, although more complex, shares many similarities with the case of homogenous goods. First, the integrated firm raises the input price above cost, so as to capture part of the value created by the competing retailer. Second, the retail activity of the integrated firm exerts a competitive pressure on the rival retailer, thereby limiting somewhat its market power. The more differentiated are the products, or the more efficient is the competitor, the lower is this competitive pressure. Finally, the concept of opportunity cost can be extended to this case, although it becomes more difficult to evaluate.

To see that, let us evaluate the economic equation that governs sales by the retail unit of the integrated firm. When the firm loses a sale, it saves the production cost $c_U + c$. However, there is a chance that the lost sale will go to the competing retailer; let $d < 1$ denote the diversion ratio,[50] defined as the fraction of lost sales that goes to the competing retailer. This notion is commonly used in merger analysis, and in particular for UPP evaluations,[51] as well also in the economics of access charge regulation.[52] On this fraction of sales, the integrated firm obtains a wholesale revenue $d \times x \times (w - c_U)$. Therefore, with differentiated products, the total "opportunity cost" of a retail sale can be defined as the sum of the cost and of this wholesale revenue:

$$c_U + c + d \times x \times (w - c_U). \tag{2}$$

As before, the integrated firm will rather not sell at a retail price below this level. As $d < 1$, the opportunity cost is lower than in the case of homogenous goods: As a fraction $(1 - d)$ of lost retail sales does not generate any upstream revenue anymore, the integrated firm is now more aggressive on the retail market. This effect is however countervailed by the existence of market power in the downstream market, due to product differentiation: As the firm adds a positive markup to its opportunity cost, the resulting retail price (for a given wholesale price) may be higher or lower than in the case of homogenous goods.

Petulowa and Saavedra (2013) analyze these effects in a model where the downstream subsidiary and its rival rely equally on the input of the integrated supplier,

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[50]The case $d = 1$ corresponds to perfect substitutes.

[51]See Farrell and Shapiro (2010).

[52]See Armstrong, Doyle and Vickers (1996).

but offer differentiated products. The conclusions are in line with those obtained with homogenous goods and are summarized in the next figure.
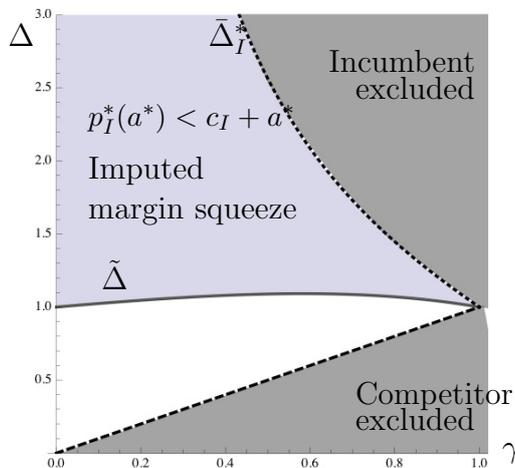

Figure 4: Differentiated products
Source: Petulowa and Saavedra

Figure 4 shows when a margin squeeze is observed, as well as when only one firm actively sell in the downstream market, as a function of the degree of product differentiation (horizontal axis) and of the competitor's cost efficiency Δ (vertical axis, where $\Delta = 1$ corresponds to when the two downstream firms are equally efficient).[53] It can be seen that, as before, a margin squeeze can only occur if the competitor is more efficient than the integrated retail unit. Unlike the case of homogenous products, however, the squeeze is observed only if the cost differential is moreover large enough.

4.3 Banning margin squeeze: pro and anti-competitive effects

The general lesson from the above discussion is that the exercise of market power by the integrated supplier may lead to wholesale tariffs that inefficiently restrict competitors' output; when this is the case, prices may fail to satisfy an EEC margin squeeze test when the competitor is more efficient. Banning such margin squeeze thus constrains the integrated firm, thereby limiting its ability to extract rents from competitors. Whether this can also enhance efficiency, promote competition and benefit consumers is a more complex question, however, as the integrated firm can react to the ban in two ways: It can choose to lower its wholesale prices, but may also raise its retail prices; and although both reactions may benefit competitors, the former one is less likely to benefit consumers than the latter one.

To further explore this issue, suppose first that the integrated firm maintains its wholesale price, and simply raises its retail price so as to pass the test. As we

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[53]The vertical axis can also be interpreted as a quality dimension.

have seen, the price of the integrated firm exerts a competitive pressure that limits competitors' retail margins; hence, if the integrated firm raises its retail price, competitors will also raise their prices. Due to this *price umbrella effect,* the regulation induces a less competitive retail allocation. The integrated firm may however choose to moderate this retail price increase, by reducing its wholesale price. This relaxes the constraint on its retail prices, thereby allowing a better mix of retail and wholesale revenues; in particular, this may avoid excessive output contraction.[54]

Overall, the ban on margin squeeze thus induces both a pro-competitive effect and an anti-competitive effect: On the one hand, the integrated firm is less aggressive on the retail market; on the other hand, reducing the wholesale price decreases downstream rivals' costs, which leads to more aggressive pricing. The balance between these two effects depends on both technology and demand, making it impossible to conclude unambiguously. Instead, we provide several examples showing that banning margin squeeze can lead to either higher or lower retail prices. We summarize here the main insights, and develop these examples in the Appendix.

In the case of head-to-head price competition with homogenous goods studied in section 4.2.1, it turns out that the regulation has no impact on consumers: A ban on margin squeeze does not affect retail price and output; instead, it triggers a reduction in the wholesale price which transfers profit from the integrated firm to the competitor, and may result in the competitor supplying the market despite being less efficient than the integrated firm.

We then consider several variants in which a ban on margin squeeze affects retail prices as well. If for instance E's reliance on M's input (as measured by x) varies with the scale of operation, then banning margin squeeze leads to higher retail prices when the competitor has increasing returns to scale in the use of the upstream input; it leads instead to lower prices when the competitor optimizes its input mix with overall constant returns to scale. And in the case of a price leadership by the integrated firm, a ban again induces an increase in the retail prices and a reduction of output.

For the case of differentiated products, Petulowa and Saavedra (2013) show that the decline in the wholesale price is sufficient to induce the retail competitor to reduce its price. The retail price of the integrated firm may however increase or decrease, depending on product differentiation.

Banning margin squeeze also tends to foster entry. This is a double-edged sword, however. On the one hand, it may prevent the exclusion of a more efficient competitor; this occurs for instance in the case of price-leadership discussed in Section 4.2.2 if there is a positive entry cost (see Appendix B.5). On the other hand, it may also enable an inefficient competitor to benefit from a price umbrella and supply the market despite its higher cost. In the head-to-head price competition setting studied in section 4.2.1, this can occur (namely, if the entry cost is not too large) when E does not rely much on M's input (x small) and/or the monopoly margin is

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[54]In the case of homogenous products, due to a strong umbrella effect, raising the price of the integrated firm leads to lower retail sales of the competitor and thus lower wholesale demand. In the case of differentiated products, this can also lead to an excessive reduction of the retail activity of the integrated downstream subsidiary.

substantial (see Appendix B.2).

The above discussion assumes that the integrated firm supplies the wholesale market. However, if the integrated firm is not subject to a mandatory duty to deal,[55] it may prefer to deny access altogether and be only active downstream. We show in Appendix that, for homogenous products, under margin squeeze regulation selling the input to a more efficient competitor generates only a fraction of the profit that the integrated firm would obtain in the absence of entry. As a consequence, it is more profitable to exit from the upstream market and act solely as a retail monopoly. The analysis of Petulowa and Saavedra shows that although the concern is less acute under product differentiation, this may occur if differentiation is small.

This discussion can be summarized as follows: *Absent exclusionary effects, banning margin squeeze benefits the independent competitor, hurts the integrated firm, and may or may not benefit final consumers. In addition, a ban on margin squeeze may promote excessive entry and it raises the integrated firm's foreclose incentives.*

Remark: Technology distortions. One aspect not discussed above is the potential for a margin squeeze regulation to distort technology choices. Indeed, the integrated firm may try to relax the constraint by choosing a technology that facilitates coping with the test, namely, by reducing the downstream cost and passing some of it to the upstream level. Indeed, the vertically integrated bottleneck may well prefer an inefficient technology with lower upstream cost if this allows relaxing the margin squeeze constraint.[56]

Remark: Recovery of fixed costs. Paul Grout (2004) points to a potential viability problem when there are large fixed costs in the upstream market and several substitutable usages in the downstream market(s). The issue arises when a vertically separated upstream producer would need to price discriminate in order to be profitable. In this case, a vertically integrated firm would have to rely on implicit internal transfer prices that differ across downstream usages. But then, any wholesale price above the upstream average cost may induce a squeeze on some products. In his example, the issue is mostly related to the inability to discriminate between usages of the input. Another way to see the issue is to note that an integrated firm would allocate its fixed costs across its full product line, thereby selling any product that has a value above its incremental cost. But the extent of necessary price discrimination may not be compatible with competition in the retail market on all products at a fair upstream price.

5 Margin squeeze and access regulation

So far, we have studied the impact of margin squeeze tests in otherwise unregulated markets. Yet, in practice margin squeeze tests have often been used in industries where the integrated firm is subject to some form of access regulation. To be sure, in

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[55] A duty to deal may exist if the upstream input is an essential facility.

[56] The minimal retail price is $w + c$. Suppose there is a technogy using $x' < 1$ units of upstream input and a downstream cost c'. The alternative technology is less efficient if $x'c_U + c' > c_U + c$, or $c' - c > (1 - x) c_U$, and yet the integrated firm may adopt it if reduces the total perceived cost: $x'w + c' < w + c$, or $(1 - x) w > c' - c$.

practice regulation can be imperfect, which raises a number of issues.[57] For instance, the regulator may have limited information on the costs of the integrated firm; incentive schemes can alleviate the problem, without eliminating it completely.[58] Also, long-term relationships between the regulated firm and the regulator may sometimes generate concerns of capture. To the extent that access regulation is imperfect, the previous analysis can still be relevant, thereby calling for antitrust scrutiny and *ex post* intervention in case of abuse. For the sake of exposition, however, we will now abstract from these issues, and simply assume in this section that the wholesale price is exogenously set by a regulator, the integrated firm remaining free to set its retail price as it wishes (absent margin squeeze regulation).[59]

An immediate implication of wholesale price regulation (assuming that it is binding, that is, that the regulated price is lower than what the integrated firm would like to charge) is that the integrated firm has now a clear incentive to eliminate downstream competitors: As the regulation constrains its ability to appropriate independent retailers' profits, the integrated firm may find it profitable to eliminate these downstream competitors, and appropriate downstream profit by raising its retail price – that is, the regulation invalidates the Chicago critique of predation theories.

To see that, let us consider again the simple example of section 3.2.2, and suppose now that the wholesale tariff is set by the regulator at some level w above the upstream cost, which is zero in the example. If the integrated firm M, with downstream cost c, faces a more efficient competitor E, then M does not sell in the downstream market, and obtains instead a margin w on the wholesale market. But if M succeeds in eliminating E, then M can raise its retail price to the monopoly level, v, and obtain in this way a total margin equal to $v - c$. With an inelastic demand, eliminating E is then profitable if $w < v - c$ – that is, when $v - w > c$: Eliminating the competitor is profitable precisely when the monopoly price would pass a margin squeeze test. Whenever this is the case, M could recoup the losses from a predatory episode by raising future prices. This holds as well when E, being less efficient than M's downstream subsidiary, faces a cost c_E larger than c, so long as $w + c_E < v$: The competitive pressure exerted by E then prevents M firm from charging a price above $w + c_E$, which reduces M's profit.

It thus appears that introducing access price regulation re-opens the door for standard predatory theories of harm. This, in turn, suggests that these margin squeeze cases should be similar to traditional predation tests:[60] one should first demonstrate a sacrifice, and then establish the possibility of recoupment following the eviction of the competitor. Yet, beyond this similarity, vertical integration has some implications that are worth discussing.

First, the profit loss that competitors impose on the vertically integrated firm decreases as the wholesale price w increases (so long as it remains below the monopoly

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[57]See Jullien and Sand-Zantman (2010) for a recent exposition.

[58]See Laffont and Tirole (1993).

[59]We do not consider a regulation of the form "retail minus," as it is similar to margin squeeze regulation.

[60]This conclusion need not apply, however, if some access conditions (e.g., quality, or interconnection capacity) remain unregulated.

level), as doing so not only increases the wholesale margin but also raises retail prices. This is particularly obvious in the above example with homogenous goods: When $c_E < c$, M derives its profit from the upstream market, where it obtains a margin w; and when $c_E > c$, M sells instead in the downstream market at price $w + c_E$, and thus its profit again increases with w. More generally, with differentiated products, relaxing an initially tight access price regulation may increase the profits achieved by the integrated firm in both the wholesale and retail markets. As pointed out by Biglaiser and DeGraba (2001), it follows that raising the regulated wholesale price reduces the incentives to engage into predation.[61]

Second, the relevant notion of sacrifice is not the same as if the firm were only active in the downstream segment. We discuss this in the next Section.

6   A sacrifice test adjusted for vertical integration

As discussed above, vertical integration and the existence of a positive upstream margin alters the nature of downstream competition. It follows that standard predation tests, such as the Areeda-Turner rule in the U.S. or those proposed by the AKZO jurisprudence in the EU, and which rely on the predator's downstream cost, no longer provide a proper benchmark.

Indeed, a nonintegrated firm is willing to compete as long as its price covers its own marginal cost, which thus provides a relevant benchmark for competitive pricing. By contrast, as seen in the previous sections, when setting its retail price an integrated firm considers the impact on its wholesale profits as well as its retail profits. As a result, the optimal retail price increases with the wholesale price; hence, whenever the wholesale margin is positive, the integrated firm will be unwilling to compete with a retail price close to its marginal cost.

This may seem to provide a rationale for using a margin squeeze test when evaluating sacrifice by vertically integrated firms in predatory cases, as doing so accounts for foregone wholesale profits. And indeed, in our basic setup, when downstream offerings are homogenous ($d = 1$) and access needs are identical ($x = 1$), the integrated firm is willing to compete in the retail market so long as its retail price p does not fall below its downstream cost, *evaluated with the wholesale price*, $w + c$ (see Section 4.2.1); this corresponds to the ECPR rule and amounts to passing an EEC margin squeeze test.

However, when either the technologies or the products and services differ, the above test induces an *umbrella effect* that protects competitors at the expense of competition and may induce excessive entry by competitors. The analysis thus calls for a more relevant sacrifice test, which we may call a *VI-adjusted sacrifice test*. Indeed, the analysis of competition with differentiated technologies and products has shown that, under static competition, the firm would not sell at a price below the total *opportunity cost* given by equation (2) in Section 4.2.3; that is, the suggested test can be expressed as:[62]

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[61]For a formal analysis of the interplay between excessive access pricing and downstream predation, see Gonzalez (2004).

[62]A similar point is made in Vickers (2010).

The VI adjusted sacrifice test: *Let $m_R \equiv p - c$ denote the retail margin of the integrated firm, c_U its upstream cost, d the diversion ratio, and r the net wholesale revenue per competitor's retail sale.[63] The integrated firm satisfies the adjusted margin squeeze test if:*

$$m_R \geq c_U + d \times r.$$

The corresponding price threshold is smaller than the downstream cost of the integrated firm, evaluated with the wholesale price, whenever the revenue per retail sale is smaller than the implicit wholesale revenue. The rationale for this sacrifice test is that any price that violates the test would be suboptimal in the short run, while prices passing the test could be the outcome of price competition at the prevailing wholesale price. This is particularly appealing when firms are regulated on the upstream market. A difference with the EEC imputation (that is, $m_R \geq w$) is that the adjusted test requires knowledge of the diversion ratio, which depends on the characteristics of the competitor (technology and demand). These characteristics may evolve over time and, while the information may be available ex post, it may not be fully predictable by the integrated firm when it sets prices. This makes the practical implementation of the test more difficult and raises the issue of legal security.

Finally, note that recoupment may be less likely when some retail regulation is present as well. The dominant firm may indeed hesitate to start a price war if it anticipates that a regulator will be likely to object to any significant price increase afterwards.

7   Conclusion

The above discussion first highlights that, in unregulated industries, vertical integration exposes standard predation theories to the so-called Chicago critique; yet the modern economic literature has identified a number of situations in which an integrated firm, controlling an essential input, may wish to *foreclose* downstream markets (exclusionary abuses), or simply exercise its market power in the upstream market (exploitative abuse) in a way that would violate a standard EEC margin squeeze test.

In this context, introducing a ban on margin squeeze does reduce the scope for excluding efficient competitors and also limits the extent to which the integrated firm can exert its market power. However, due to the so-called umbrella effect, this may also generate inefficient downstream market structures, by protecting inefficient competitors, and may also result in excessive retail prices, as the integrated firm may react to the ban by raising its retail prices rather than cutting the wholesale price. Hence, a ban on margin squeeze has both pros and cons, and its application must be considered with care.

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[63]Recall that if the competitor uses x times more input than the integrated firm for one unit of retail good, $r = x \times (w - c_U)$.

The issue is reminiscent of the discussion on the ECPR rule; indeed, in unregulated environments, limiting the downstream margin of the integrated firm constitutes only a partial rule, which does not constrain the overall price level: The firm can raise the final price by simply increasing the access price. The implication is that serious concerns about market power in the upstream market may call for regulating access. And indeed, most margin squeeze cases have involved regulated industries, such as telecoms or postal services.

Adopting access regulation is a direct way to deal with vertical foreclosure and the potential distortions stemming from market power in the upstream market. But in response to such regulation, the integrated firm may become tempted to engage in predatory pricing in the downstream market; that is, access regulation is a good way to address the concerns identified above, but restores some ground for predation concerns.

The general conclusion from this analysis is that at least two credible theories may justify ex-post intervention in case of vertical integration: foreclosure, in the case of no or weak regulation, and predation, in the case of tight access price regulation. While the mere exploitation of market power may also result in a margin squeeze, this does not provide a sound basis for intervention, as banning margin squeeze has an ambiguous impact on consumer surplus and social welfare.

We have also seen that standard predation tests, based on the actual costs of the dominant firm, may fail to properly address predatory concerns. They need to be adapted in order to account for vertical integration, which calls for some form of margin squeeze test. However, as emphasized by the above discussion, the relevant benchmark need to rely on the opportunity cost of the integrated firm in the downstream market; and as losing a sale to a competitor in the downstream market generates a revenue in the upstream market, this opportunity cost must account for the profits derived from the upstream market. A more relevant test is desirable, such as the VI-adjusted sacrifice test presented in the last section, which raises however some implementation and legal security issues that would need to be addressed.

Appendix

This appendix presents the formal models on which some of the claims in the main text are based.

A   Learning-by-doing

We develop here a simple learning-by-doing model illustrating the points discussed in Sections 3.1.2 and 3.2.2. A vertically integrated firm M competes with a downstream competitor E over two periods; in each period, there is a unit mass of demand with reservation price v. Producing one unit of downstream good requires one unit of input, which is produced in the upstream market at unit cost c_U.

Downstream costs are initially c for M and c_E for E, and benefit from learning-by-doing: The firm that wins the demand in the first period reduces its downstream cost for the second period; the cost reduction is l for M and l_E for E. The entrant is initially less efficient than M, but more efficient through learning:

$$c_E - l_E < c < c_E.$$

The final product is homogenous and firms engage in Bertrand price competition in each period. In particular, the competitor E cannot be excluded from the market, and $v > c_U + c_E$. The timing is as follows:

- In period 1, M can procure the input at some wholesale price w_1 (more on this below); M and E then compete in the downstream market, with respective costs $c_U + c$ for M, and $w_1 + c_E$ for E.

- In period 2, M can procure the input at wholesale price w_2; M and E then compete in the downstream market – with costs that depend on which firm won the competition in the previous period.

A.1   Efficiency

As the firm selling in the first period benefits in the second period from a lower cost than its rival, it is efficient to have the same firm serving the market in both periods. Assuming no discounting, the efficient outcome is then that E serves the market in both periods if

$$\Delta_c = 2c - l - (2c_E - l_E) > 0. \tag{3}$$

Conversely, M should serve the market when $\Delta_c < 0$.

A.2   Competitive upstream market

Let us start by assuming that there is a competitive supply of upstream good, so that $w_1 = w_2 = c_U$.

To derive the equilibrium we first consider the second period. If M won the competition in the first period, then its costs is lower than its rival's: $c_U + c - l <$

$c_U + c_E$; M thus wins again the competition, by charging a price equal to (or slightly below) its rival's cost, $c_U + c_E$, and obtains a profit equal to $c_E - c + l$. If instead E won the first-period competition, its cost is now $c_U + c_E - l_E$, lower than M's cost. Thus, E wins again at price $c_U + c$, with profit $c - c_E + l_E$.

Consider now the first-period competition. M's profit from winning the market is

$$p - c - c_U + (c_E - c + l) = p - (2c - c_E - l + c_U),$$

whereas E's profit from winning the first-period competition is

$$p - c_E - c_U + (c - c_E + l_E) = p - (2c_E - c - l_E + c_U).$$

It follows that E wins the first-period competition whenever it faces a lower opportunity cost, namely, when[64]

$$2c - c_E - l + c_U > 2c_E - c - l_E + c_U,$$

which we can rewrite as

$$E \text{ wins the market if } \Delta_c > c_E - c.$$

As $c_E - c > 0$, we can conclude that, in the absence of any constraint on prices, there can be insufficient sales by the competitor: Whenever Δ_c lies between 0 and $c_E - c$, E will not sell in the first period, and as a result will be deprived of the possibility of becoming competitive in the second period, even though, because of learning-by-doing, it would efficient that E sells in both periods.

A.3 Unregulated upstream monopoly

We now consider the case where M is a monopoly on the upstream market, and is free to set the wholesale price it wishes.

Starting again with the last period. If M won the competition in the first period sale, it is more efficient than E and can appropriate the full industry-wide monopoly profit by charging a retail price $p = v$, together with wholesale price at least equal to $w_2 = v - c_E$: E then cannot compete,[65] and M's profit is $v - c + l - c_U$.

If instead E won the first-period competition, it is more efficient than M in the second period; but there again, M can appropriate the full industry-wide monopoly profit, this time by charging a wholesale price $w_2 = v - c_E + l_E$, together with a prohibitively high retail price. E then charges a retail price equal to v, and M indeed chooses not to compete in the downstream market, as the wholesale profit $v - c_E + l_E - c_U$ is larger than the maximal retail profit $v - c - c_U$.

In the first period, E anticipates that it will make no profit in the second period due to M's monopoly power. Hence, it is not willing to sell at a price below $c_E + w_1$. Let us fix $w_1 \leq v - c_E$, and consider retail competition. The profit of M is given by:

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[64]In case of equality, we take the convention that M wins the market.
[65]Notice that there is no EEC squeeze as $p - w_2 = c_E > c - l$.

$\Pi_w = p - c - c_U + v - c + l - c_U$ if it wins in the first period,
$\Pi_l = w_1 - c_U + v - c_E + l_E - c_U$ if it loses in the first period.

Winning therefore brings a gain

$$\Pi_w - \Pi_l = p - (2c - l + w_1 - c_E + l_E).$$

It follows that E wins the market if $2c - l + w_1 - c_E + l_E > w_1 + c_E$, which reduces to

$$E \text{ wins the market if } \Delta_c > 0.$$

That is, any wholesale price $w_1 \leq v - c_E$ enables E to win the competition whenever it is efficient to do so. By contrast, charging a higher wholesale price would prevent E from winning the competition.

The optimal choice of w_1 is then straightforward: By setting $w_1 = v - c_E$, M can i) induce the maximal intertemporal profit, and ii) capture all of this profit. It follows that the efficient outcome emerges when the vertically integrated firm is free to adjust wholesale prices over time.

A.4   Regulated upstream monopoly

Suppose now that the upstream wholesale price is regulated: it is exogenously set to some $w_t \in [c_U, v - c_E]$ in each period $t = 1, 2 - w_1 = w_2 = c_U$ yields the same outcome as the competitive market; $w_t > c_U$ allows instead for the recovery of upstream fixed costs, and $w_t \leq v - c_E$ ensures that E exerts an effective competitive pressure in each period – even when it does not benefit from learning-by-doing.

Let us start again with the last period. As before, if M served the market in the first period, then it wins again the competition in the last period, at the maximal price that E could not match, $p = c_E + w_2$; M's profit is then $c_E + w_2 - c - c_U + l$. If instead E won the first-period competition and benefited from learning-by-doing, it can match any price above $c_E - l_E + w_2$. On the other hand, in response to E's price $p \leq v$, M has the choice between:

- Serving directly consumers, by undercutting E's price, results in (retail) profit $p - c - c_U$;

- Supplying E and letting it serve the market results instead in (wholesale) profit $w_2 - c_U$.

M is thus willing to undercut E whenever $p > c + w_2$. As this price threshold exceeds E's cost (i.e., $c + w_2 > c_E - l_E + w$), E serves the market, at the maximal price not matched by M, $w_2 + c$. M therefore obtains a profit equal to $w_2 - c_U$ whereas E obtains a profit reflecting the cost differential, $c - c_E + l_E$.

Note that M is better-off in period 2 when it has won the market in the first period: M earns a baseline profit of $w_2 - c_U$ in any event but, as regulation prevents

it from adjusting the wholesale price to capture the competitor's efficiency gain, it earns an additional

$$\Delta_M = c_E - c + l$$

when it wins the competition in period 1. Conversely, E earns a positive profit

$$\Delta_E = c - c_E + l_E$$

when (and only when) it wins the competition in period 1.

Let us now turn to the first period. E is now willing to incur a short-term loss to win the first-period competition, as it anticipates that this will generate future profits Δ_E: That is, E is willing to undercut any price above $\underline{p}_E \equiv w_1 + c_E - \Delta_E$ to obtain the benefits from learning-by-doing. On the other hand, when responding to E's price p, M can again choose between two options:

- Losing downstream competition and supplying E yields an overall profit $(w_1 - c_U) + (w_2 - c_U)$.

- Winning instead downstream competition yields $(p - c - c_U) + (w_2 - c_U + \Delta_M)$.

It follows that M will undercut E if $p > \underline{p}_M \equiv w_1 + c - \Delta_M$. E wins if $\underline{p}_E < \underline{p}_M$ or, using $\underline{p}_M = w_1 + 2c - l - c_E$ and $\underline{p}_E = w_1 + 2c_E - l_E - c$:

$$E \text{ wins the market if } \Delta_c > c_E - c.$$

The analysis under regulation is thus similar to that with a competitive upstream segment, the main difference being that the "relevant" upstream cost in each period is w_t instead of c_U. But again there are excessive sales by the vertically integrated firm.

A.5 Banning margin squeeze

Suppose now that margin squeeze is banned, and consider first the case where the wholesale price is unregulated. In the second period, the ban on margin squeeze then has no bite: it is obviously irrelevant if M is more efficient than E and, if instead E is the more efficient competitor, then M prefers not to compete, and rather raises its wholesale price. In the first period, banning margin squeeze imposes a constraint $p > c + w_1$ on M's prices. But this constraint is never binding as the retail price is always v and the wholesale price is always $w_1 = v - c_E < p - c$, because $c_E > c$. Hence, introducing a ban on margin squeeze in an otherwise unregulated market would have no effect in this simple example.[66]

Things are different when access is regulated. To be sure, a ban on margin squeeze still has no bite in the second period; this is because the integrated firm competes with an opportunity cost $c + w_2$ and thus passes the margin squeeze test. However, in the first period M is now constrained to set a retail price above

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[66]As we show in the next model, this would no longer be so under more general conditions.

$w_1 + c$, which is higher than $\underline{p}_M$.[67] Hence, the margin squeeze test has no bite only when either $\underline{p}_E < \underline{p}_M$ (in which case E wins with or without the ban), or $\underline{p}_E > w_1 + c \left(> \underline{p}_M \right)$ (in which case M wins at price $\underline{p}_E$). But when $\underline{p}_M < \underline{p}_E < w_1 + c$, or

$$c_E - c > \Delta_c > -l,$$

then M loses the market at price $w_1 + c$, whereas it would win the market in the absence of a ban. Introducing a ban thus restores efficiency when $c_E - c > \Delta_c > 0$. But when instead $0 > \Delta_c > -l$, then the competitor wins the market even though it is less efficient than the integrated firm; imposing a margin squeeze ban on a regulated firm then results in inefficient sales by the competitor.

B   Exploitative abuse

We now present a simple model sustaining the points discussed in Section 4.

B.1   Framework

From now on, we will suppose that, whereas M still requires 1 unit of input to produce a unit of final good, E needs instead x units of input. M's profit is thus

$$(p - c - c_U) S + (w - c_U) x S_E,$$

where S and S_E denote the sales of M and E. In addition, we will suppose here that products are perfect substitutes and demand is elastic, of the form $Q = D(p)$.

Let us consider a given wholesale price w. In response to E's price p_E, M compares selling the profit derived from selling to consumers at price (almost equal to) p_E, namely, $(p_E - \varepsilon - c - c_U) D(p_E)$, with the profit achieved instead from supplying E in the wholesale market, namely, $(w - c_U) x D(p_E)$. M therefore chooses to undercut E if

$$p_E > c_U + c + (w - c_U) x.$$

In equilibrium, E wins the market when the lowest price that M would undercut remains profitable, that is, if $c_U + c + (w - c_U) x > wx + c_E$, or:

$$c_U x + c_E < c_U + c.$$

That is, E supplies the downstream market whenever it is more efficient than E.

Assume that this is indeed the case and, for the sake of exposition, that in the relevant range for w, the monopoly price based on a cost $wx + c_E$ exceeds M's opportunity cost, $c_U + c + (w - c_U) x$; that is, E is more efficient but M does exert a competitive pressure on E. It follows that the final market price is equal to M's opportunity cost:

$$p(w) \equiv c_U + c + (w - c_U) x. \tag{4}$$

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[67]We have

$$\underline{p}_M = w_1 + 2c - l - c_E = w_1 + c - (c_E - c) - l < w_1 + c.$$

M's equilibrium profit is then

$$(w - c_U) x Q(w) = [p(w) - c_U - c] Q(w),$$

where $Q(w) \equiv D(p(w))$ denotes the output sold by E in the downstream market; letting $P(Q) = D^{-1}(Q)$ denote the inverse demand, M's profit can also be expressed as:

$$[P(Q(w)) - c_U - c] Q(w).$$

As M can "choose" the retail output Q by adjusting the wholesale price w, it is in the same situation as an unconstrained monopolist seeking to maximize the industry profit (based on M's technology), $[P(Q) - c_U - c] Q$. As a result, the price and output are the same as in the absence of any competition: $p = p^m \equiv \arg\max_p (p - c_U - c) D(p)$ and $q = q^m \equiv D(p^m)$. M obtains its monopoly profit: $\pi^m \equiv (p^m - c_U - c) q^m$, whereas E obtains a profit reflecting its cost advantage, equal to $(c_U + c - x c_U - c_E) q^m$ – implying that a potential competitor enters the market only if entry is efficient, that is, if the entry cost is lower than the reduction in variable costs. This leads to:

When the integrated firm is not constrained, the competitor supplies the downstream market whenever it is more efficient. The integrated firm then chooses a wholesale price that induces the same retail price and quantity than if it were a monopoly; in this way it obtains its monopoly profit (as in the absence of any competition), whereas the competitor obtains a profit equal to the cost differential – as a result, entry occurs when and only when it is efficient.

B.2   Margin squeeze regulation

A ban on margin squeeze, with imputation based on an equally efficient competitor, imposes on M's prices the constraint $p_M > w + c$. Obviously, this constraint is not binding when $x \geq 1$, because then $w + c \leq c_U + c + (w - c_U) x$ for any positive wholesale margin. Thus: *There can be a squeeze (EEC type) only when the competitor's technology is less intensive in the upstream input $(x < 1)$.*

From now, we will suppose that this is indeed the case: $x < 1$.

When margin squeeze is banned, M's retail price is then constrained at $p_M = w + c$; E thus wins the market if $w + c > wx + c_E$, or

$$c_U + c > c_U x + c_E - (1 - x)(w - c_U). \tag{5}$$

In such a case, the retail price is $p^b(w) \equiv w + c$ and final output is $Q^b(w) = D(w + c)$; M's profit can now be expressed as

$$(w - c_U) x D(p^b(w)) = [P(Q^b(w)) - c_U - c] x Q^b(w).$$

It is then immediate that M will choose the wholesale price w so as to induce the same price and quantity as before: $w = p^m - c$; that is, a prohibition of margin squeeze is fully accommodated by a reduction of the wholesale price. Hence, the prohibition has no impact on consumers. However, it transfers a fraction of **the**

revenue from M to E; and as a result, E may end-up supplying the downstream market even though it is less efficient. This occurs when (5) holds for $w = p^m - c$ despite E having a higher cost, which amounts to

$$(1 - x)\, p^m + xc > c_E > c + (1 - x)\, c_U. \tag{6}$$

This condition is more likely to hold when E does not rely much on M's input (x small) and/or the monopoly price is substantially above cost.

In the same vein, banning margin squeeze may trigger inefficient entry – when the above condition holds and the entry cost is low enough, E would enter even though it will lead to supplying consumers at a higher cost . Summing-up, we have: *A ban on margin squeeze does not affect the retail price and quantity, and thus has no impact on consumers; it operates a transfer of profit from the integrated firm to the competitor, however, which may result in the competitor supplying the downstream market despite being less efficient, and may also foster inefficient entry.*

We now show that a ban on margin squeeze can also affect price and output when x is variable.

B.3   Variable relative efficiency

Suppose now that the relative efficiency of the two firms depends on the scale of production: E's demand of input (per unit of output) becomes $x\,(Q)$ (assumed to be only mildly affected by the scale, in order to preserve the existence of an equilibrium).

In the absence of any constraint on M's prices, the equilibrium analysis remains the same as above: as long as E has a lower total cost, the unconstrained price is $P\,(Q) = c_U\,(Q) + c\,(Q) + x\,(Q)\,(w - c_U)$. As $(w - c_U)\,x\,(Q) = P\,(Q) - c_U - c$, M's profit coincides again with industry profit, $[P\,(Q) - c_U - c]\,Q$. It follows that retail price and output remain the same as before. But when M's prices are subject to a margin squeeze test, its profit becomes

$$(P\,(Q) - c_U - c)\,x\,(Q)\,Q.$$

Hence, when $x\,(Q)$ is decreasing, M would react to the margin squeeze test by reducing Q: *If the competitor relies relatively more on the input supplied by the integrated firm as scale increases, then a ban on margin squeeze yields higher price and lower output in the downstream market. The reverse conclusion holds if the competitor's relative reliance on the input decreases with scale.*

B.4   Input mix

The above knife-edge result relies on the assumptions of factor complementarity. Suppose instead that E can substitute the upstream input with others: it chooses x and c_E within a decreasing convex technology frontier $c_E = g\,(x)$. Minimizing the unit cost $wx + g\,(x)$ will then lead $g'\,(x) = -w$, which defines a function $x\,(w)$ that decreases as w increases.

With no constraint on prices, M's profit can now be expressed as $(w - c_U) x(w) Q(w)$, where as before $Q(w) = D(c + c_U + (w - c_U) x(w))$ and $(w - c_U) x(w) = P(Q) - c - c_U$; hence M's profit still coincides with industry profit, $[P(Q) - c_U - c] Q$, and retail price and output are again the same as before. However, under the margin squeeze constraint, M's profit becomes $(w - c_U) x(w) Q^b(w)$, or, using $w^b(Q) = P(Q) - c$,

$$[P(Q) - c_U - c] x(w^b(Q)) Q.$$

A $w^b(Q)$ is decreasing in Q and $x(w)$ is decreasing in w, the profit-maximizing output is larger than before: *When the competitor can optimize its input mix, a ban on margin squeeze yields lower price and higher output in the downstream market.*

B.5   Price leadership

Finally, let us suppose that M is a price leader: It sets its retail price p prior to E's setting its own price; for the sake of exposition, assume further that E relies no more than M on M's input: $x \leq 1$, and is more efficient than M: $c_U x + c_E < c_U + c$.

As long as $p \geq wx + c_E$, E will match the price p and serve the demand. Hence M's profit is equal to its wholesale profit, $(w - c_U) x D(p)$. As the wholesale margin is positive, M finds it optimal to maximize output, and will thus reduce its retail price p to the minimum level matched by E: $p = wx + c_E$. The margin squeeze test would thus be violated whenever $wx + c_E < w + c$, which is always the case when E is more efficient than M.

Consider now M's choice of the wholesale price. Absent any constraint on prices, M's profit is $(w - c_U) x D(wx + c_E)$, which, using $P(Q) = wx + c_E$, can be expressed as $[P(Q) - c_U x - c_E] Q$. This corresponds to total industry profit based on E's technology: Using its own retail price as an effective price cap, so as to curb E's pricing policy, M can here fully appropriate E's efficiency gain. It will thus induce the industry-wide monopoly outcome based on E's more efficient technology.

With a ban on margin squeeze, the analysis is the same as in the absence of price leadership: As in Section B.2, the retail market price is then determined by the wholesale price, $p = p^b(w) = w + c$; it follows that M's constrained optimal pricing policy yields again the monopoly retail output, but based this time on M's less efficient technology. *A ban on margin squeeze thus tends to raise the retail price.*

Note that, in contrast with the case of head-to-head competition, a ban on margin squeeze may here foster efficient entry. To see this, suppose that E has to pay en entry cost to be able to compete. In the absence of regulation, E would not enter because M could appropriate all of E's profit. Under a margin squeeze regulation, E will instead be able to obtain some profit when (**6**) holds, and will thus enter if the entry cost is not too large.

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