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Abstract

We examine the incentives for a gatekeeper controlling a competitive bottle neck, whether it be a digital platform, supermarket shelf space, or a classical infrastructure such as a telecommunications network, to exploit or exclude competitors by means of self-preferencing. Our focus is on pricing conduct, so called price squeeze, but we also touch on non-price conduct. We characterize the welfare effects of restricting price squeeze through antitrust intervention or regulation. We also examine how such policies affect incentives to undertake cost reducing investments, both for the gatekeeper as well as for its competitors.

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Keywords: Price squeeze; bundling; price discrimination; foreclosure; antitrust; pass through.

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1 Introduction

As digital markets play an ever greater role in the life of the consumer, and as economic forces propel these markets to be dominated by a handful of firms, concerns have grown over how these firms can control market access and, in extension, how they may exercise this control to exclude their competitors.[1] This has led to a profusion of antitrust proceedings in Europe in the last decade, followed by an EU regulation specifically targeting so called digital gatekeepers, the Digital Markets Act (DMA), which entered into force in November 2022. Antitrust proceedings targeting the technology giants are now under way also in the US.

A principal concern in many of these antitrust cases, and dealt with in part also under the DMA, is a practice known as self-preferencing, or self-favouring. This refers to a situation where a platform offers its own products in competition with those of commercial users on the platform, but skews the playing field in its own favour.[2]

The renewed policy interest in self-preferencing has also kindled academic interest in the competitive harm of self-preferencing. For instance, Motta [2023] discusses economic rationales for self-preferencing and foreclosure practices in digital markets in relation to high-profile antitrust cases. Padilla et al. [2022] examine the incentives for a vertically integrated device seller to favor its own apps and extract rents from rival app developers. They find that foreclosure is unlikely when demand for devices grows, but becomes more likely as demand becomes saturated. Salinger [2020] sets self-preferencing in the context of complementary goods producers and discuss how the same incentives are analyzed in vertical mergers as well as in models of leveraging.

Hagiu et al. [2022] consider whether a platform should be prohibited from selling on its own market place altogether, reflecting legislative proposals in that vein in the United States[3] and legislation in India effectively requiring this. Building a model capturing the ability of the platform to imitate successful products and to steer consumer to the own product, the authors compare the effect of different policy measures. They find policies addressing the two separate concerns directly are likely to be better than not allowing the platform to sell it own products. Anderson and Özlem Bedre-Defolie [2022] also consider the effect of banning a platform from offering its own product on its marketplace. They develop a two sided markets model

[1] See Crémer et al. [2019], Furman et al. [2019], Morton et al. [2019] and Konkurrensverket [2021].

[2] Self-preferencing was for example the principal concern in the case brought by the European Commission against Google ("Google Shopping"), as well as the investigation into Amazon, which ended in commitments. See Peitz [2022] for a discussion of the prohibition of self-preferencing in Article 6(5) of the DMA from an economic perspective.

[3] The Ending Platform Monopolies Act proposed in 2021.

where consumers make discrete choice between differentiated products, dealers choose whether to sell on the platform and the platform chooses whether to use the platform to only sell others product, only its own product or both. A ban on selling the own product in competition with others only benefits consumers if it results in the platform becoming a pure marketplace but harms them if it becomes a pure reseller of the gatekeeper's own product.

While the sheer pervasiveness and global reach of the leading digital platforms have put these competition concerns at the top of the antitrust agenda, the problem of dominant firms controlling the market access of their competitors is not one unique to digital markets, nor is it new. Following the deregulation of telecommunication markets for example, new service providers found themselves dependent on access to the incumbent operator's network, while at the same time competing with the incumbent for end users. This gave rise to numerous antitrust cases regarding a self-preferencing pricing practice known as *price squeeze*, or margin squeeze. Another example, although perhaps not commonly litigated, is that of producers complaining that leading supermarket chains, whose retail services are needed to reach end consumers, favour their own private label products on the shelves over those of branded products. Finally, data is another area where producers of data analysis more and more often have to compete with the data provider itself, giving rise to the same set of problems.

In this paper we examine the incentives for a dominant firm, a gatekeeper, controlling a competitive bottle neck, whether it be a digital platform, supermarket shelf space, or a classical infrastructure such as a telecommunications network, to exploit or exclude competitors by means of self-preferencing. Such self-preferencing can take the form of either price or non-price behaviour on the part of the gatekeeper.[4] Our focus is mainly on pricing practices, in the form of price squeeze, but we consider also other forms of self-preferencing.

As an antitrust offence, price squeeze has been a fairly contentious issue. Not so much more blatant conduct where a firm with a regulated duty to supply would try to circumvent that obligation by setting a wholesale price to its competitors so high, and a retail price to its consumers so low, that it effectively refuses to deal. The disagreements concern instead those cases of price squeeze when there is no such duty to deal. This type of conduct arose in many countries simultaneously at time when telecom providers started offering access to their networks to new operators, while at the same time

[4]Pricing conduct (price squeeze), could be the gatekeeper setting a high wholesale price in relation to its own retail price, or similarly, not operating a standalone downstream operation profitably (compare the compliance with the order in "Google Shopping"). It could also be setting high price on a standalone product versus a bundle price. Non-pricing conduct could be the gatekeeper's prominent display of its own products on its digital platform or on the shelves in its stores, favourable ranking algorithms, default options, or non-price terms that otherwise favour the own product.

competing with them downstream. Carlton [2008] and Sidak [2008] argue strongly that those situations should not be considered an antitrust offence and point out that such bottleneck firms in order to avoid liability could stop supplying downstream competitors altogether, or alternatively raise downstream prices, creating a so called *price umbrella* that shields the competitors from competitive pressure. Thus creating inefficiencies. Foreclosure of efficient downstream competitors also tends to be less of a concern absent a duty to deal, see Bouckaert and Verboven [2004].

Price squeeze was initially treated as a variation of refusal to supply, see Communication from the Commission [2009]. But this view was challenged in two telecom cases in the U.S. and in Europe, resulting in entirely different precedents. The US Supreme Court held in Pacific Bell Telephone Co. v. linkLine Communications Inc. [2009] that a price squeeze does not constitute an antitrust violation separate from a refusal to deal. Price squeeze absent an antitrust duty to deal did not violate Section 2 of the Sherman Act, an extension of principles established in Verizon Communications v. Law Offices of Curtis V. Trinko [2004]. In contrast, The Court of Justice of the European Union held in Konkurrensverket v. TeliaSonera Sverige AB [2011] that margin squeeze was a standalone infringement, that indeed could constitute an abuse also in the absence of a duty to supply.

Jullien et al. [2013] provide a broad perspective on the economics of margin squeeze, including a brief overview of the legal developments in the US and Europe. They discuss both exclusionary and exploitative motives for price squeeze. In terms of the latter, they note that the dominant firm can implement a price squeeze to limit the market power of a downstream competitor, and thus reduce double marginalization. To evaluate the welfare effects of prohibiting price squeeze in this context, they discuss the balance between the resulting price umbrella effect (i.e. the dominant firm increasing its retail price) and the dominant firm decreasing its wholesale price.

Choné et al. [2010] examine this type of effect in a regulated market with potential downstream entry. When regulation is lax and may allow the incumbent to deter entry a ban on margin squeeze could induce efficient entry and lower prices, in that case dominating the umbrella effect. Petulowa and Saavedra [2014] consider a differentiated products setting where the upstream good is imperfectly regulated and find that the regulation may offset the scope for lowering the upstream price in response to a ban and therefore strengthen the umbrella effect.

Nalebuff [2005] applies similar principles to identifying price squeeze to a horizontal setting.

In our model, we examine a gatekeeper's incentives to squeeze its competitors by charging a high fee for access to its bottleneck asset while at the same time charging a low price to consumers. We show that total foreclosure is an unlikely response to a policy that restricts the gatekeeper's ability to squeeze, and we then proceed to analyze the static welfare effects from the gatekeeper lowering its access fee while increasing its consumer price (the umbrella effect) in response to a policy restriction. These price changes have opposite effects on welfare, and we characterize when one dominates over the other. The result depends on the curvature of demand and whether cost pass-through is decreasing or not. The significance of the pass-through properties echoes the insights in Bulow and Pfleiderer [1983], and in a sense our analysis resembles studies of the effects of price discrimination, notably Aguirre et al. [2010] and Cowan [2013], where pass-through plays a central part. Here, we also draw on the work of Weyl and Fabinger [2013] and Fabinger and Weyl [2012].

In our model, when the gatekeeper gives market access to only on competitor, price squeeze can be a tool to solve the problem of marginalization, as noted in Jullien et al. [2013] . Intervening against price squeeze then leads to higher consumer prices. When there is perfect competition on the other hand, price squeeze can be a tool to enable price discrimination. And just as price discrimination can be either efficient or inefficient, closely related demand curvature and whether it has positive effects on volume or not, the efficiency of price squeeze in our model also depends on these demand properties. With decreasing or constant pass-through, eliminating price squeeze tends to lower prices, whereas when pass-through is increasing, it is never optimal to fully eliminate price squeeze.

A common concern with antitrust intervention is how it affects the incentives to invest and innovate. To investigate this issue, we extend the model with some stylized dynamics, and look at how restricting price squeeze could affect the incentives for undertaking cost-reducing investments. In this framework we also introduce a hold-up problem between the gatekeeper and its competitors, and analyse how restricting price squeeze can affect investments through this channel.

In the static framework, the gatekeeper's motives for squeezing were entirely exploitative. As we introduce investments and hold-up we now finally also touch on some purely exclusionary motives. Adding an alternative but inferior bottleneck asset, we discuss how prohibiting price squeeze can serve to prevent the gatekeeper from using hold-up as a strategy to prevent its competitors from investing, investments that otherwise can increase competitive pressure.

The paper proceeds as follows. We present the basic static model in section 2 and examine how a restriction on price squeeze would affect prices and welfare under different assumptions about the competitive situation. In section 3, we consider how the same restriction would affect incentives for the gatekeeper and its competitors to undertake cost reducing investments. Some concluding comments are offered in section 4.

2 A model of gatekeeper pricing

Consider a gatekeeper offering one or several competitors access to its bottleneck asset for a fee, allowing them to sell their goods to consumers in competition with the gatekeeper's own good.

In the model we consider two aspects of competition in the goods market in a stylized way. First, the extent of competition between the gatekeeper and its competitors, which we allow to vary by varying the extent to which demand is contestable. Second, the extent of competition between the gatekeeper's competitors, where we consider the polar cases of a single competitor versus perfect competition.

We assume that consumers are infinitesimal with a total density of one and that all goods are homogeneous, except that a portion of demand is *uncontestable*, with θ of consumers only willing to buy the gatekeeper's good. The remainder of demand is *contestable*, with $1-\theta$ of consumers indifferent between the gatekeeper's and any of the competitors' goods. Consumers are otherwise identical with quasi-linear utility and individual demand q for the good.[5]

The gatekeeper charges consumers a price p_I for its own good, while the competitors charge consumers a price p_F for their good (we suppress the notation for individual competitors for simplicity). The gatekeeper and the competitors produce at constant marginal cost c_I and c_F respectively. The competitors pay an access fee r per good sold using the bottleneck asset. For simplicity the gatekeeper incurs no marginal cost for this use.[6]

Throughout we assume that the gatekeeper sets its access fee and own price first, followed by the competitors' pricing decisions.

The gatekeeper sets p_I and r to maximize

$$\pi_I = \begin{cases} (p_I - c_I)\, q\,(p_I) & p_I < \underline{p}_F \\ \theta\,(p_I - c_I)\, q\,(p_I) + (1-\theta)\, rq \;\; \underline{p}_F & p_I \geq \underline{p}_F \end{cases} \tag{1}$$

where $\underline{p}_F$ signifies the lowest of the competitors prices and, for simplicity, sales are allocated equally to the competitors when they price equal to the

[5] Let utility be $u\,(q,z) = v\,(q) + z$ where v is continuous, twice differentiable and strictly concave, and z is a numeraire good.

[6] Note that this bottleneck model is equivalent to a complementary goods model where goods are either vertically or horizontally related. In the vertical case, the bottleneck asset is a necessary fixed-proportions input in a downstream product. r is then the gatekeeper's wholesale price, p_I its retail price, and p_F the downstream competitors' retail price. In the horizontal case, the bottleneck and the goods are perfect complements in consumption rather than production. The gatekeeper sets prices r and $p_I - r$ for the bottleneck and the good respectively. We can then construe a bundle of the two at a total price p_I. Similarly, the competitors set a price $p_F - r$, and we can construe a bundle at a total price p_F.

gatekeeper.

Each competitor then sets its price p_F to maximize

$$\pi_F = \begin{cases} 0 & min(p_I, \underline{p}_F) < p_F \\ (1-\theta)\left(p_F - r - c_F\right) q\left(p_F\right) & \min(p_I, \underline{p}_F) \geq p_F \end{cases} \tag{2}$$

taking the gatekeeper's price and access fee as given.

Here it helps to define some variables. Let $\bar{p}_F\left(r + c_F\right)$ be the "standalone" competitor price, the price that maximizes a competitor's profits if the prices of the other competitors and the gatekeeper were not binding. Formally,

$$\bar{p}_F\left(r + c_F\right) \equiv \underset{p_F}{\operatorname{argmax}}\left(p_F - r - c_F\right) q\left(p_F\right) \tag{3}$$

Furthermore, let p_I^* and p_F^* be the "integrated monopoly" prices for the gatekeeper good and competitors' good respectively. This is the price that a vertically integrated monopoly that owned the bottleneck asset and a particular good would set (when there are no competing goods). Formally,

$$p_i^* \equiv \underset{p_i}{\operatorname{argmax}}\left(p_i - c_i\right) q\left(p_i\right) \tag{4}$$

for $i \in [I, F]$.

Let Δc be the difference in cost between the gatekeeper and the competitors in producing the good, i.e. $\Delta c \equiv c_I - c_F$. Throughout we will assume that competitors produce at a lower cost than the gatekeeper, which provides an efficiency rational for channelling demand through them.

The competitors' ability to compete is determined by the gatekeeper's pricing, specifically by the margin between the price for the gatekeeper good and its access fee, $p_I - r$. When the gatekeeper charges so low a price for its own good, and so high a access fee, that the margin does not cover the gatekeeper's own cost of providing the good, the pricing is preferential towards the gatekeeper's good and, in line with the terminology used in the antitrust context, we say that the gatekeeper then price squeezes its competitors. In terms of our model, a price squeeze is defined[7] as

$$p_I - r < c_I. \tag{5}$$

Note further, that when the margin is so low that it does not even cover the competitors' cost, c_F, these are effectively foreclosed from the market.

[7]Since there are no fixed costs in this model this definition corresponds to the jurisprudence in the E.U following the "as efficient competitor" principle. A similar definition has been suggested in a horizontal setting. Nalebuff [2005], and in the European Commission Guidance on art 82.

2.1 Single competitor

Consider a setting where the gatekeeper provides market access to a single competitor only. Here, the gatekeeper has an interest in channelling as much sales as possible through that competitor, as it is more efficient, but at the same time the gatekeeper faces a double marginalization problem since the competitor has market power and is inclined to charge a mark-up. The gatekeeper will use its pricing tools to try to control this problem.

2.1.1 Contestable demand

We begin by considering a setting where the competitor's and gatekeeper's goods are fully substitutable for all consumers ($\theta = 0$). With two prices at the gatekeeper's disposal, and only one good that actually sells (the competitor's good), the gatekeeper can effectively take control of the competitor's pricing, eliminate the mark-up and achieve any good price it wants. It does so by squeezing the competitor between the gatekeeper's own price and the access fee, so that it leaves no profits at all for the competitor, setting the access fee to $r = p_I - c_F$. Since $\bar{p_F}(p_I) > p_I$, the gatekeeper's own price now binds the competitor, which is forced to set $p_F = p_I$. Substituting r and p_F in (1), the gatekeeper sets its price p_I to maximize

$$(p_I - c_F)\, q\,(p_I) \tag{6}$$

Having the competitor supply the contestable segment is consequently equivalent to the gatekeeper experiencing a cost reduction in the amount of $\triangle c$. Setting its own price to $p_I = p_F^*$, the gatekeeper pushes the competitor to charge the integrated monopoly price, so that they de facto act as an integrated monopoly.

Thanks to the competitor's lower costs, this pricing policy results both in higher margins and greater quantities than the gatekeeper could achieve by selling the good itself. As there is no trade-off, it will consequently always squeeze in this setting. But how does this preferential conduct affect consumer prices and welfare?

Consider what happens if we impose a policy that prevents price squeeze, i.e we require $p_I - c_I \geq r$. The gatekeeper now can earn no more on a sale of the competitor's good than it can on a sale of its own good. However, the gatekeeper will still not foreclose and rescind market access. It continues to be better to channel all sales through the competitor since, thanks to its lower cost, the competitor will sell at a lower price - thus still generating greater quantities, and in extension profits, than if the gatekeeper sold its own good.[8]

[8] This can be thought of as a special case of Proposition 3 in Whinston [1990], which shows a general absence of foreclosure incentives for complementary good producers.

Since the gatekeeper is prevented from price squeezing, it now obtains lower margins than before however. This means that the trade-off between margins and quantity has tilted in favour of improving margins. The gatekeeper will therefore push the competitor to increase its price above the integrated monopoly price p_F^*, resulting in a price increase and corresponding quantity loss.[9]

Price squeeze consequently has the effect of lowering prices in this setting.

2.1.2 Both contestable and uncontestable demand

We now let a portion of demand be uncontestable ($0 < \theta < 1$). The gatekeeper will then sell its own good in the uncontestable part of the market, while having the competitor serve the contestable part. Here the gatekeeper still faces a double marginalization problem, but the reduction in substitutability in the goods market introduces a cost to the gatekeeper for trying to solve the problem by squeezing prices. Since if the gatekeeper lowers its price below the integrated monopoly price p_I^*, it now has to forgo profits in the uncontestable segment.

Assuming that the cost differential between the gatekeeper and the competitor is not too great however, the gatekeeper nevertheless finds it worthwhile to price squeeze. To see why, let the cost differential be bounded by $\Delta c \leq \bar{\Delta c} \equiv (p_I^* - c_I)/\rho\,(p_I^*)$, where ρ is cost pass-through, a property of the demand curve that we will return to and define precisely later in (10).[10] We can then conclude that

Lemma. The gatekeeper sets its prices so that the price on the own good is binding on the competitor's price, $\bar{p_F}\,(r + c_F) \geq p_I$.

Proof. See the appendix.

The gatekeeper again takes control of the competitor's pricing and then squeezes to the extent of leaving no profits, setting $r = p_I - c_F$. But the gatekeeper now wants to optimize pricing on two goods (its own and the competitor's) instead of only one (the competitor's). Instead of setting the optimal price on each of them, p_I^* and p_F^* respectively, it has to settle for a single price that balances the margins. Substituting r and p_F in (1), the gatekeeper sets a price p_I that maximizes

[9] To see why, consider if the gatekeeper did not push the competitor's price above p_F^*. In order to not squeeze, the gatekeeper would have to lower its access fee just enough to eliminate the squeeze. Since the gatekeeper then makes less on each sale, it could improve its profits by increasing p_I and r one-to-one, still avoiding a squeeze, but pushing the competitor to also increase its price above p_F^*.

[10] An approximate interpretation of the bound to the cost differential, is that even though the competitor has lower costs than the gatekeeper, by Δc, it will still price above at least the gatekeeper's costs, i.e. $p_I^* - \rho(p_I^*) \geq c_I$. It is approximate since pass-through is evaluated only locally.

$$\theta\left(p_I - c_I\right) q\left(p_I\right) + \left(1-\theta\right)\left(p_I - c_F\right) q\left(p_I\right) \tag{7}$$

Again, having the competitor supply the contestable segment is equivalent to the gatekeeper experiencing a cost reduction of $\triangle c$ in that segment. Let $\hat{p}_I$ denote the price the gatekeeper sets, which is inbetween p_F^* and p_I^*.

What are the effects of the price squeeze on consumer prices and welfare? Consider again what happens if we institute a policy that prevents price squeeze, i.e. requiring $p_I - c_I \geq r$, and the gatekeeper therefore once more is bound to earn no more on a sale of the competitor's good than it would on a sale of its own good.

By the same logic as before, as the restrictive policy forces the gatekeeper to earn less on each sale, the gatekeeper will choose to change its pricing so as to push the competitor's price above $\hat{p}_I$, sacrificing quantity in order to achieve a better margin.

Price squeeze consequently results in lower consumer prices also in this setting.

2.2 Perfect competition

We now move to a fully competitive framework with a portion of demand assumed to be uncontestable ($0 < \theta < 1$).[11] As competitors price according to marginal cost, there is no double marginalization problem that needs solving in this setting. We will see that price squeeze still can be attractive however, as the gatekeeper turns its attention to trying to price differentiate between the uncontestable and contestable segments, aiming for optimal pricing in both, with p_I^* and p_F^* respectively.

We begin by noting that since competitors price competitively, with $p_F = r + c_F$, the gatekeeper controls competitor pricing directly through r, without having to squeeze. Substituting the access fee in (1) according to $r = p_F - c_F$, the profit maximization problem then can be reformulated as the gatekeeper directly setting prices p_I and p_F to maximize

$$\theta\left(p_I - c_I\right) q\left(p_I\right) + \left(1-\theta\right)\left(p_F - c_F\right) q\left(p_F\right) \tag{8}$$

Here the gatekeeper is able to achieve the optimal prices in each segment, i.e. the integrated monopoly prices p_I^* and p_F^*.

To simplify notation, we henceforth supress the explicit reference to θ and define $q^1 \equiv \theta q(p_I)$ as uncontestable and $q^2 \equiv \left(1-\theta\right) q(p_F)$ as contestable demand, and let $p^1 \equiv p_I$, $c^1 \equiv c_I$, $p^2 \equiv p_F$ and $c^2 \equiv c_F$.

Whether the gatekeeper will price squeeze is a more subtle question that depends on the shape of the demand curve. To see why, starting from the

[11] In the competitive framework the problem would be trivial if there were no uncontestable demand, so we do not outline that here.

optimal price in the uncontestable segment, p_I^*, the *highest* access fee r the gatekeeper can set without creating a price squeeze is $r = p_I^* - c_I$. This would result in competitors setting the price $p_F = r + c_F = p_I^* - \triangle c$. Whether the gatekeeper wants to price squeeze then depends on whether this competitor price is as high as the one that the gatekeeper wants to implement, i.e. the integrated monopoly price p_F^*. If not, the gatekeeper will want to raise the access fee further, creating a squeeze.

More precisely, differentiate profits in the contestable segment, evaluated at the highest fee, $p_I^* - c_I$, with respect to r. Making use of profit maximization in the uncontestable segment, we obtain:

Proposition 1. It is profitable for the gatekeeper to price squeeze if and only if $\frac{-q^{i\prime}\left(p_I^*\right)}{q^i\left(p_I^*\right)} > \frac{-q^{i\prime}\left(p_I^* - \triangle c\right)}{q^i\left(p_I^* - \triangle c\right)}$.

This condition on the hazard rate of demand implies that the gatekeeper will want to squeeze prices as long as demand is not too convex.

Returning to condition (5), rearranging and substituting for the optimal prices, we can express it differently as that the gatekeeper will want price squeeze if and only if,

$$p_I^* - p_F^* < \triangle c. \tag{9}$$

Thus, the gatekeeper want to price squeeze if the optimal price discrimination between the two segment falls short of the cost difference, i.e., if there is less than full *pass-through* of the cost savings brought about by letting the competitors supply the contestable segment.

Pass-through is here defined as the change in price following a marginal change in marginal cost. Following Bulow and Pfleiderer [1983], pass-through is derived by differentiating the first-order condition of (1) with respect to the relevant cost, expressed as,

$$\rho^i = \frac{q^{i\prime}}{\pi^{i\prime\prime}} \tag{10}$$

This measures the pass-through for a marginal change in costs. The price squeeze condition in (9), which refers to a discrete change in cost, can also be expressed in terms of the arc of pass-through, ρ: $p_I^* - p_F^* = \int_{c_F}^{c_I} \rho\left(v\right) dv < \triangle c$.

The degree of pass-through depends on the curvature of demand, where more convex demand results in higher pass-through. When the arc of pass-through is equal to or greater than 1, as is the case if demand is e.g. exponential or given by a power function, there is no price squeeze.[12]

[12]A useful taxonomy of demand forms is provided in [Weyl, Fabinger (2012) Pass-through and demand forms, (Bagnoli and Bergstrom, and Bulow?)]. For the constant-pass through class, pass-through is less than unity for linear demand (it is one half), unity

Figure 1 shows the optimal difference in price between the two for a given difference in costs, Δc. The profit maximizing price-cost-margin, for a given marginal cost, is simply the vertical distance between demand and marginal revenue. If this distance widens as marginal cost goes down and quantity increases, as in the left panel with linear demand, there is less than full pass-through, and price squeeze. In the right panel, with exponential demand, the entire cost saving is passed on.

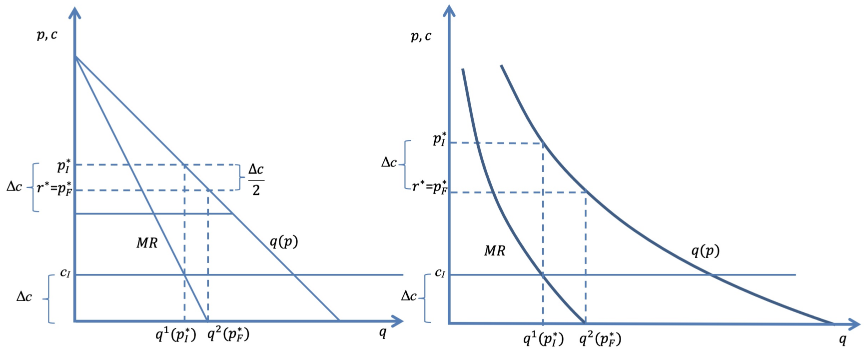

Figure 1: The graphs illustrate pass-through when $c_F = 0$ and demand is linear (left panel) and exponential (right panel) respectively.

2.2.1 Welfare effects

Assuming that the gatekeeper indeed has incentives to squeeze prices, i.e., that demand is not too convex and satisfies Proposition 1. What are the welfare effects of restricting against it, i.e to require $p_I - c_I \geq r$?

The gatekeeper is again bound to earn no more on a sale of the competitor's good than it would on a sale of its own good. Again, it will still want to channel all contestable sales through the competitor, since the competitor has lower costs and can sell at a lower price than the gatekeeper - thus generating greater quantities.

The gatekeeper can eliminate the price squeeze by lowering the access fee below r^* and/or raise its consumer price above p_I^*. These changes have opposite welfare effects. Consumers buying from the competitors benefit

for constant elasticity demand, and greater than unity for constant markup demand [(is latter exponential?) Bulow, show forms]. For statistical distributions, with monotonically increasing pass-through demand, pass-through is less than unity for Normal, Logistic, Type I Extreme Value (Gumbel), Laplace Type III Extreme Value (Reverse Weibull), Weibull with shape alpha > 1 Gamma with shape alpha > 1, and pass-through is price dependent for Type II Extreme Value (Frechet) with shape alpha > 1. For monotonically decreasing pass-through, pass-through is price dependent for AIDS with $b < 0$.

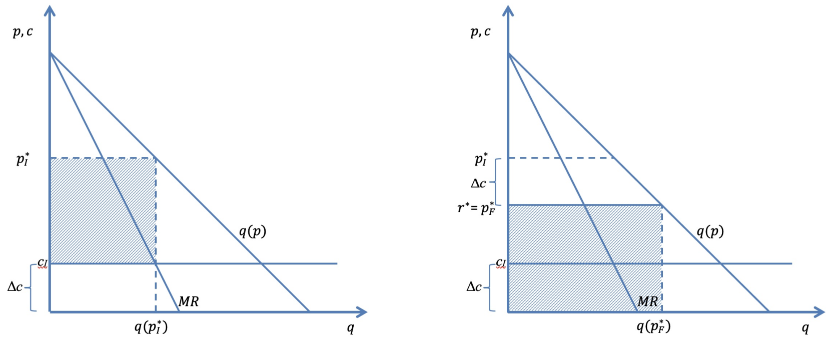

Figure 2: The incumbent's profit (shaded) when servicing the contestable market itself (left panel) is lower than when it sells inputs to downstream competitors at non-squeezed prices (right panel)

from lower prices, while those buying from the gatekeeper are hurt by higher prices.

Preventing the gatekeeper from squeezing prices is akin to restricting the price discrimination between the uncontestable and contestable segmeents to be no more than the cost differential, $p_I - p_F = \triangle c$. Consequently, the welfare analysis below follows the price discrimination analysis of Aguirre et al. [2010].[13]

We proceed to examine the effect of requiring the gatekeeper to maintain a certain price differential $x = p_I - p_F$, where $x \in [0, \triangle c]$, on total sales and welfare.

The effect on total sales of a restriction x on price differentiation is then

$$\frac{\partial(q^1 + q^2)}{\partial x} = q^{1\prime} p^{1\prime} + q^{2\prime} p^{2\prime}, \tag{11}$$

where primes denote first derivatives. If the price differential is a binding restriction for the gatekeeper, it effectively chooses just one price. Thus, its first-order condition is:

$$\pi^{1\prime}(p_F + x) + \pi^{2\prime}(p_F) = 0. \tag{12}$$

From this we can implicitly derive the effect of x on the prices in the respective markets, using the strict concavity of the profit function:

$$p^{2\prime} = \frac{-\pi^{1\prime\prime}}{\pi^{2\prime\prime} + \pi^{1\prime\prime}} < 0, \tag{13}$$

$$p^{1\prime} = p^{2\prime} + 1 = \frac{\pi^{2\prime\prime}}{\pi^{2\prime\prime} + \pi^{1\prime\prime}} > 0. \tag{14}$$

[13] This in turn builds on Schmalensee [1981].

The change in total quantity can now be expressed in terms of pass-through,

$$\frac{\partial(q^1+q^2)}{\partial x} = \frac{-\pi^{2\prime\prime}\pi^{1\prime\prime}}{\pi^{2\prime\prime}+\pi^{1\prime\prime}}\left[\frac{q^{2\prime}}{\pi^{2\prime\prime}} - \frac{q^{1\prime}}{\pi^{1\prime\prime}}\right] = \frac{-\pi^{2\prime\prime}\pi^{1\prime\prime}}{\pi^{2\prime\prime}+\pi^{1\prime\prime}}\left(\rho^2-\rho^1\right). \tag{15}$$

The sign of the quantity change is entirely determined by pass-through, since the first factor is strictly positive. Hence, we can conclude that:

Proposition 2. If pass-through is decreasing (increasing), then total quantity increases (decreases) if price squeeze is reduced.

This is in line with standard results in the price discrimination literature.

We proceed to analyze the welfare effects. Let W be total welfare, which is the sum of welfare in the uncontestable market, W^1, and welfare in the contestable market, W^2. The effect on welfare in market i of varying x, $W^{i\prime} \equiv \partial W^i/\partial x$, is then $W^{i\prime} = \left(p^i - c^i\right) q^{i\prime} p^{i\prime}$. The effect on total welfare is:

$$W' = (p_I - c_I)\, Q^{1\prime} p^{1\prime} + (p_F - c_F)\, q^{2\prime} p^{2\prime}. \tag{16}$$

Using the price responses in (13) and (14), this may be expressed as,

$$W' = \frac{-\pi^{2\prime\prime}\pi^{1\prime\prime}}{\pi^{2\prime\prime}+\pi^{1\prime\prime}}\left[(p_F - c_F)\,\rho^2 - (p_I - c_I)\,\rho^1\right]. \tag{17}$$

Since the first factor is strictly positive, the sign of the welfare change is determined by the second factor, which we denote z. With the margin locked at $p_I = p_F + x$, z may be expressed as follows,

$$z\,(x) = (p_F - c_F)\rho^2 - (p_F + x - c_I)\rho^1. \tag{18}$$

The sign of the welfare effect of reducing, or eliminating, price squeeze consequently depends on demand curvature and pass-through.

2.2.2 Welfare-effects with decreasing or constant pass-through

First, consider demand functions with decreasing pass-through. If we rearrange expression (18), it is easy to see that elimination of price squeeze always increases welfare if demand has decreasing pass-through.

$$z\,(x) = (p_F - c_F)(\rho^2 - \rho^1) + (\triangle c - x)\rho^1 > 0. \tag{19}$$

We proceed to examine demand with constant pass-through. Since price squeeze only occurs when $\rho < 1$, we need not consider iso-elastic or exponential demand. The relevant class of demand is then $q = (a - bp)^{\frac{1}{\delta}}$ where $\delta > 0$ and pass-through is $\rho = \frac{1}{1+\delta}$. For linear demand, $\delta = 1$ and $\rho = 1/2$.

For constant pass-through, $\rho^1 = \rho^2$, and thus the sign of the welfare change is

$$z\,(x) = (\triangle c - x)\rho \geq 0, \tag{20}$$

which is strictly positive as long as the squeeze is not fully eliminated. Thus, we may sum up the effects on welfare as follows:

PROPOSITION 3. Fully eliminating price squeeze increases welfare if pass-through is decreasing or constant.

This result differs from the classic result in the price discrimination literature, where the welfare effect is always negative for linear demand. In that case, price discrimination raises the price in the uncontestable market, and lowers it in the contestable market, thereby shifting quantities to where the marginal consumer has the lowest valuation. Here, consumer valuations are the same across markets, but instead firms differ in terms of cost efficiency. When quantities are shifted to the contestable market, where production is more efficient, they are moved to where the contribution to welfare is the greatest. With non-increasing pass-through it follows that total quantities are non-decreasing, and consequently total welfare must increase.[14]

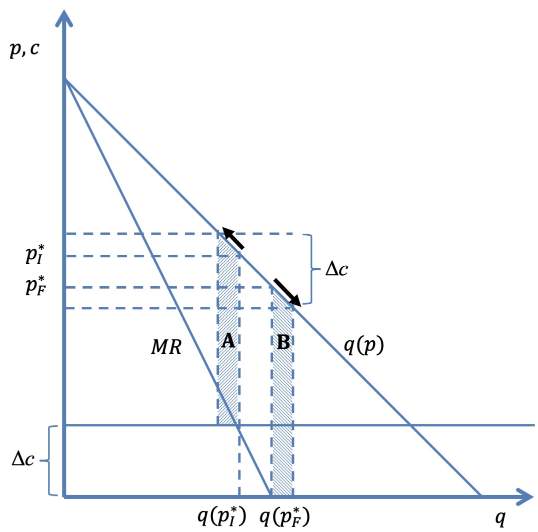

Figure 3: Welfare effects of a ban on price squeeze when demand is linear and equal across markets. Area A is the loss of consumer and producer surplus in the uncontestable market. Area B is the corresponding welfare gain in the contestable market.

Figure 3 illustrates the welfare effects in the case of linear demand, where markets are assumed to be of equal size so the effects on both markets can be shown in the same graph. An increase in x reduces price and increases welfare in the contestable market while doing the opposite in the uncontestable

[14]Another difference concerns the comparisons. The price discrimination literature compares profit maximizing discrimination to uniform pricing. Here, profit maximizing discrimination is compared to prices driven further apart, to reflect the difference in costs.

market. The total welfare effect is positive since total quantity remains constant while demand is shifted to the market with the higher margin.

2.2.3 Welfare-effects with increasing pass-through

For demand with increasing pass-through, reducing price squeeze has two counteracting effects: Quantities shift to the market where the contribution to welfare is the greatest, but aggregate quantity falls (as shown in Proposition 2). Constraints on price squeeze may therefore affect welfare in a positive or negative way, depending on the relative strength of these effects. Below, we examine how welfare is affected by the extent of the constraint, x, and offer two results.

PROPOSITION 4. If pass-through is increasing, it is never optimal to fully eliminate price squeeze.

Proof. The sign of the welfare change at $x = \Delta c$ is $z(\triangle c) = (p_F - c_F)\ \rho^2 - \rho^1$, which is negative for demand with increasing pass-through.

Intuitively, when price squeeze is fully eliminated, there is no difference in the marginal welfare contribution between the two markets, which means that only the negative effect from the reduction in quantity remains.

Next, we identify a threshold demand shape for which any binding constraint on price squeeze reduces welfare, while the marginal effect at the unconstrained equilibrium prices is zero.

PROPOSITION 5. For logit demand $z(p_I^* - p_F^*) = 0$.

Proof. See the appendix.

Thus, for logit demand it is welfare reducing to intervene against price squeeze.

For demand functions with increasing pass-through, where $z(p_I^* - p_F^*) > 0$ and $z(\Delta c) < 0$, a partial constraint on price squeeze would be socially optimal, i.e., unconstrained pricing can be improved upon but full prohibition reduces welfare.

The type of trade-off discussed above is also important in a dynamic perspective. For a competing firm faced with an investment opportunity allowing it to reduce its cost by Δc_F, or for a firm considering to enter the contestable market by virtue of its cost advantage relative to existing firms, Δc_F, the gatekeeper's choice between price discrimination and rent extraction is of critical importance. We will soon examine this and other dynamic effects of price squeeze.

2.3 Non-price self-preferencing

Having focused solely on the gatekeeper's pricing thus far, we briefly consider what incentives there are for the gatekeeper to engage in self-preferencing using non-price means instead. This could for example be conduct such as prominent display of own products on its own digital platform or on the shelves in its stores, favourable ranking algorithms, default options, or non-price terms that otherwise favour the own product, to the detriment of competitors.

A stylized way to capture such behaviour in our static model would be to make the uncontestable share of demand θ endogenous, giving the gatekeeper the option to improve its own sales at the expense of its competitors, without using price.

Introducing θ as a choice variable for the gatekeeper, alongside r and p_I, we immediately see in (1), that as long as $r \geq p_I - c_I$, the gatekeeper will have no incentive to favour its own product by increasing θ. In fact, when the gatekeeper is free to price squeeze, and we have that $r > p_I - c_I$, the gatekeeper would in fact preferably set θ as small as possible. Only when there is a restriction on price squeeze, so that $r = p_I - c_I$, is the gatekeeper at least indifferent regarding θ.

For the gatekeeper to want to increase θ in this static model, we could introduce some efficiency consideration for self-preferencing, for example that increasing θ increases the size of the market, or generates some cost saving.

Our static model consequently does not capture welfare reducing aspects of non-price self-preferencing well.

3 Dynamic effects of price squeeze

How does the prospect of price squeeze affect incentives to undertake cost reducing investments for a gatekeeper and its competitors? How would it affect the incentive for an efficient competitor to enter the market? Alternatively, how does a policy restricting price squeeze affect such incentives? Below, we consider effects on the gatekeeper and its competitors. For simplicity, the competitors are assumed to price competitively.

3.1 The gatekeeper's investments

We examine investments by the gatekeeper both in the bottleneck asset itself, as well as in the production of the gatekeeper's good, but abstract from how such investments might interact. As will be seen, the effect investment of eliminating price squeeze depends on the effects on quantity, and consequently the pass-through properties of demand once more.

3.1.1 Investments in the bottleneck asset

To study the effect of cost reducing investments in the production of the bottleneck asset, we relax the simplifying assumption about zero production costs and allow for a positive constant marginal cost, c_A. Let c_A be a decreasing, convex function of investment, I.

The gatekeeper's profit, is then given by,

$$\Pi_c = (p_I - c_I - c_A(I))\, q^1 + (p_F - c_F - c_A(I))q^2 - I. \tag{21}$$

The gatekeeper chooses investment I, and final prices p_I and p_F, to maximize profit. We assume that c_A is sufficiently low to make this profit non-negative. Now, the increase in gatekeeper's profit from a marginal reduction in c_A simply equals total sales, i.e., $q^1 + q^2$. Consequently, the optimal investment increases in this quantity.

We have already established how intervening against price squeeze affects total sales in Proposition 2. Therefore, the effect of a no squeeze policy follows directly from this result.

Corollary 1. Eliminating price squeeze increases (decreases) the gatekeeper's incentive to reduce c_A if pass-through is decreasing (increasing), provided that the gatekeeper continues to produce the bottleneck asset.

If a constraint on price squeeze leads to increased total output then it also stimulates investments to reduce c_A. This happens if pass-through is decreasing. The opposite holds if pass-through is increasing.

Note however that the gatekeeper's overall profits are reduced by the no squeeze requirement. If overall profits are pushed into the red then of course neither production nor investment will take place. This could be the case if the competitors' cost advantage is large, and the production of A is so costly that rent extraction from competitors is necessary to break even.

3.1.2 Investments in the production of the gatekeeper good

Next, we examine how a binding no price squeeze constraint affects the gatekeeper's incentives to reduce costs in the production of its good. Let c_I be a decreasing, convex function of investment, I. We assume that for all investments in the relevant range the competitors are more efficient, i.e., situations where a prize squeeze constraint may matter).

First, if price squeeze is allowed, the gatekeeper's profit is given by,

$$\Pi_c = (p_I - c_I(I) - c_A)\, q^1 + (p_F - c_F - c_A)q^2 - I. \tag{22}$$

We again assume that there are solutions to the profit-maximization problem resulting in a non-negative profit for the gatekeeper. The marginal revenue from a reduction in c_I then equals the sales in the uncontestable market, q^1.

Second, if price squeeze is eliminated, prices are bound by $p_I - p_F = c_I - c_F$, and the gatekeeper's profit is then,

$$\Pi_c = (p_I - c_I(I) - c_A)\, q^1 + (p_I - c_I(I) - c_A) q^2 - I. \tag{23}$$

In this case, the elimination of price squeeze extends the impact of the gatekeeper's reductions of c_I also to the contestable market, by improving the allowed margin also in this market (the margin the gatekeeper can obtain without inducing a price squeeze). The marginal benefit of a reduction of c_I consequently extends to total sales, $q^1 + q^2$. Whether investment incentives increase with the no squeeze requirement consequently depends on whether total sales without price squeeze, $q^1(p_F + \Delta c) + q^2(p_F)$, are greater than uncontestable sales with a price squeeze, $q^1(p_I^*)$. Clearly, a sufficient (but not necessary) condition, is for total quantity to be non-decreasing with a no price squeeze requirement. In which case, $q^1(p_F + \Delta c) + q^2(p_F) \geq q^1(p_I^*) + q^2(p_F^*)$. Again, the change in total quantity depends on pass-through. Moreover, if the profit-reduction due to the elimination of price squeeze is large enough, then no production or investment will take place for the bottleneck asset, which would render investments for the gatekeeper's good futile as well.

Proposition 6. The elimination of price squeeze increases the gatekeeper's incentive to reduce c_I if pass-through is decreasing (or not too increasing), given that the gatekeeper continues to produce the bottleneck asset.

3.2 Investments by competitors

When analyzing the effects on competitors' investments, let investment and pricing be separated over two periods. In the first period, competitors can make potentially cost reducing investments, which are sunk. In the second period, all firms, including the gatekeeper, compete in prices as before. First we look at a situation where the gatekeeper cannot commit in the first period to how it prices in the second period. This may reflect contractual incompleteness over the time-horizon relevant for the investment. Contractual incompleteness is a matter of degree but is likely to be a feature in many markets, especially in markets subject to technological change or changing demand conditions.

Let N be the number of competitors choosing to make a cost reducing investment I, which we assume is a fixed number. A successful investment reduces marginal cost by δ. As in section 2, this cost reduction is assumed to be small, with $\delta \leq \bar{\delta} \equiv -q^2(p_F*)/q^{2\prime}(p_F*)$. Let the chance of success be independent at λ. competitors that do not invest, or are not successful in their investment, keep their marginal costs at c_F. Now, consider the different possible outcomes.

If no investment is successful, nothing changes and pricing remains as in the previous section. [15]

If more than one competitor succeed, the competitors' prices are competed down to marginal cost, with p_F=$r + c_F - \delta$. If the gatekeeper can squeeze prices, the cost reduction makes the gatekeeper increase its access fee by roughly $(1-\rho)\,\delta$, so that the pass-through of the cost-decrease to competitors' prices is roughly $\rho\delta$. The gatekeeper thus further tightens its squeeze. If the gatekeeper cannot squeeze prices, it raises its access fee and its own price in equal amounts, but less than the price rise just mentioned. In either case, with or without price squeeze, successful competitor investments yield zero return - cost-reductions are either competed away or extracted by the gatekeeper.

The only outcome that can provide a return on the competitors' investment then, is when only one of the competitors succeeds in its investment. This happens with probability $N\lambda\,(1-\lambda)^{N-1}$. In this situation we have a leading competitor, and behavior is the same as in that section. The gatekeeper thus chooses between setting the unconstrained prices r^* and p_I^*, leaving the leading competitor with its rent δ; or, extracting the rent by setting prices $\hat{r} = \hat{p}_I - (c_F - \delta)$.

We know that such price squeeze is profitable if δ is equal or greater to δ^*. In this case, the competitors face a hold-up problem, with the gatekeeper appropriating the entire return on its investments. If, on the other hand, the gatekeeper cannot price squeeze, the leading competitor will price at the other competitors' marginal cost, setting p_F=$r + c_F$.[16]

The competitors' pricing behavior as a function of the access fee is consequently unchanged by the decrease in competitor cost, and the gatekeeper will have no incentive to change its access fee or product price (in a way that respects the price squeeze prohibition). With no price adjustment from the gatekeeper, the succeeding competitor thus obtains a profit of $\delta q^2(p_F)$.

We can now characterize when investment takes place. For at least one competitor to make an investment, i.e. $N = 1$, we need the investment to be profitable in expectation, thus in any circumstance we need $I \leq \lambda\delta q^2(p_F)$. [17]

In addition, when price squeeze is possible, we also have an upper-bound on how great cost differentiation can be, before the hold-up prevents investments, i.e. $\delta \leq \delta^*$. We can summarize our findings in the following corollary.

Corollary 2. When the gatekeeper can squeeze prices, hold-up prevents competitor investments for which $\delta > \delta^*$.

[15] This happens with probability $(1-\lambda)^N$.

[16] As earlier, since δ is small, the firm does not want to sacrifice margin for volume.

[17] With $\lambda\,(1-\lambda)^N\,\delta q^2(p_F) \leq I \leq \lambda\,(1-\theta)^{N-1}\,\delta q^2(p_F)$, N competitors will make the investment.

It follows that a policy that eliminates price squeeze can remove the hold-up problem, which in turn would lower competitors' production costs. Intuitively, hold-up is more likely to be a concern in markets where innovation in good production is more important, relative to pre-existing cost differences, as may be the case in markets with rapid technological development.

To illustrate this, we derive a sufficient, but not necessary, condition for hold-up to be profitable for the gatekeeper. Since $\hat{p}_I$ is the optimal price it follows that $\Pi_\delta(\hat{r}, \hat{p}_I) > \Pi_\delta(p_I^* - c_F + \delta, p_I^*)$. For hold-up to be profitable, $\Pi_\delta(\hat{r}, \hat{p}_I) > \Pi_\delta(r^*, p_I^*)$ it is sufficient that $\Pi_\delta(p_I^* - c_F + \delta, p_I^*) > \Pi_\delta(r^*, p_I^*)$, which, canceling out profits from the uncontestable market, is equivalent to $(p_I^* - c_F + \delta)\, q^2(p_I^*) \geq (p_F^* - c_F)\, q^2(p_F^*)$. A slight rearrangement of terms yields, $(p_I^* - p_F^* + \delta)\, q^2(p_I^*) \geq (p_F^* - c_F)\ \ q^2(p_F^*) - q^2(p_I^*)$. The left hand side captures the benefits in terms of a raised price and appropriation of cost savings in the contestable market, and the right hand side the value of the lost sales. See *Figure 4*. This inequality is more likely to hold if the cost advantage of the competitors' relative to the gatekeeper, Δc, is small and the cost reduction resulting from the investment, δ, is large.

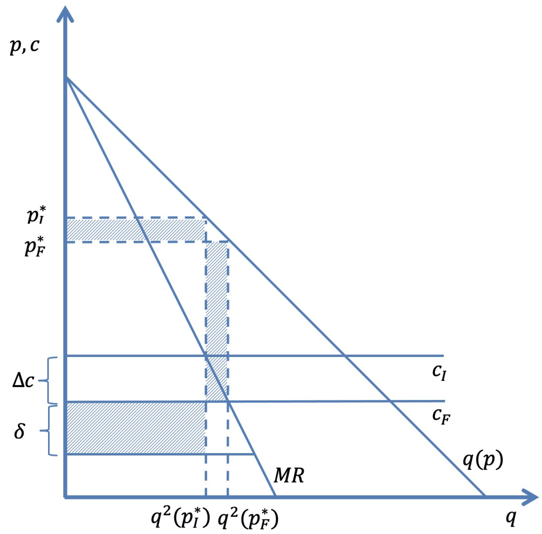

Figure 4: Costs and benefits of extracting efficiency rents by means of uniform pricing when only the price in the uncontestable market changes.

3.2.1 The ability to commit

So far we have analyzed the case where the gatekeeper intrinsically lacks the ability to commit to not squeezing prices. With an ability to commit, would the gatekeeper ever have incentives to do so? This depends on the extent to which the gatekeeper can extract parts of the rent of investments even without a price squeeze, i.e. if expected profits when there is no squeeze (but investments take place) exceed profits from a price squeeze (but there are no investments). Denote profits from prices that do not squeeze when the fringe price according to $p_F = r + c_F - \delta$, as $\Pi_\delta (p - c_I, p) = (p - c_I) q^1 (p) + (p - c_I) q^2 (p - \Delta c - \delta)$, where p is the optimal non-squeeze price given competitor costs $c_F - \delta$. The gatekeeper will then commit voluntarily, only if,

$$(1-\theta)^N \Pi_0 (p - c_I, p) + \quad 1 - (1-\theta)^N - N\theta (1-\theta)^{N-1} \quad \Pi_\delta (p - c_I, p) \\ + N\theta (1-\theta)^{N-1} \Pi_0 (p - c_I, p) > \Pi_0 (r^*, p_I^*) \tag{24}$$

In the absence of voluntary commitment, again, a policy eliminating price-squeeze provides a solution to the hold-up problem also in a world with commitment.

3.2.2 Alternatives to the bottleneck asset and pure foreclosure motives

Finally, even with the ability to commit to, and in the absence of exploitative incentives to price squeeze, the gatekeeper could refrain from committing out of a pure foreclosure motive. So far we have assumed that the gatekeeper's bottleneck asset has been essential for goods production. With such perfect complementarity, true foreclosure motives are absent, as outlined in the so called Chicago critique.

The effects we have looked at until now therefore have had more of an exploitative flavour, which is quite natural given that the gatekeeper voluntarily gives market access to the competitors, and that vertical integration always is an option if foreclosure were a the primary motive.

Nevertheless, there can be pure foreclosure motives behind price squeeze. Assume now that there is a competitively supplied, but inferior, alternative product to the bottleneck asset, available at a price $p_I = c_A > c_U$. If the competitors choose to use the alternative input instead of the gatekeeper's asset, they can price at $p_F = c_A + c_F$. This alternative therefore exerts competitive pressure and $c_A + c_F$ constitutes the upper limit for pricing in the contestable market.

Under these premises, competitor investment that reduces marginal costs now has the additional effect of increasing competitive pressure in the market, so that if several competitors succeed in their investments, the upper limit for pricing in the contestable market becomes $c_A + c_F - \delta$. This reduces the gatekeeper's ability to extract rent from its asset.

By refraining from committing not to price squeeze, the gatekeeper can then prevent these investments from being made, since competitors know they would be held-up and squeezed in case they made the investments. The gatekeeper can eliminate any additional competitive pressure in this way.

A restriction on price squeeze could again eliminate the hold-up option, and enable competitor investments.

4 Discussion and concluding comments

Our analysis has focused on price based self-preferencing, or price squeeze, by a vertically integrated gatekeeper in an unregulated context. As noted in earlier studies, a ban on price squeeze in an imperfectly competitive downstream market risks increase prices and reduce welfare, due to the so called umbrella effect. With more intense competition downstream however, our result suggest that the effects of prohibiting, or restricting, price squeeze may well be positive.

Downstream competition is likely to be more pronounced on many digital platform markets than in markets with regulated access, that was the focus of much of the earlier price squeeze literature. However, the analysis tells us that the nature of these effects is determined by the factual demand conditions on the market at hand. If market demand displays decreasing (or constant) pass-through, which is the case for many commonly used demand functions, the static price and welfare effects of a ban are positive. If pass-through is increasing, the effects are more complex.

Similarly, our analysis showed that dynamic effects of a ban on price squeeze, in terms of the incentives for the gatekeeper to undertake cost reducing investments, also turn on the pass-through properties of market demand. Downstream competitors, in turn, face a potential hold-up problem when considering cost reducing investment on their part, which may be eliminated by a ban on price squeeze. This holds true even in some situations when the gatekeeper has the ability to commit intrinsically, as well as when we introduce pure exclusionary motives for squeezing prices.

We briefly discuss non-price self-preferencing and note that a gatekeeper has little incentive to engage in such practices in the context of our model, even with a ban on price squeeze. Simple extensions of this framework would rather point towards efficiency explanations for non-price self-preferencing. Extending the model to capture richer explanations is a task for future research.

References

Aguirre, I., S. Cowan, and J. Vickers (2010, September). Monopoly price discrimination and demand curvature. *American Economic Review 100*(4), 1601–1615.

Anderson, S. and Özlem Bedre-Defolie (2022). Online trade platforms: Hosting, selling, or both? *International Journal of Industrial Organization 84*, 102861. The 48th Annual Conference of the European Association for Research in Industrial Economics (EARIE) 2021, Norway.

Bouckaert, J. and F. Verboven (2004). Price squeezes in a regulatory environment. *Journal of Regulatory Economics 26*(2), 321–351.

Bulow, J. and P. Pfleiderer (1983). A note on the effect of cost changes on prices. *Journal of Political Economy 91*, 181–185.

Carlton, D. W. (2008). Should "price squeeze" be a recognized form of anticompetitive conduct? *Journal of Competition Law & Economics 4*(2), 271–278.

Choné, P., B. Komly, and V. Meunier (2010). Margin squeeze, entry, and "umbrella effect". mimeo CREST.

Communication from the Commission (2009). Guidance on the Commission's enforcement priorities in applying Article [102 TFEU] to abusive exclusionary conduct by dominant undertakings, OJ C 45/7.

Cowan, S. (2013). Welfare-increasing third-degree price discrimination. Discussion Paper 652, Department of Economics, University of Oxford.

Crémer, J., Y.-A. de Montjoye, and H. Schweitzer (2019). Competition policy for the digital era.

Fabinger, M. and E. G. Weyl (2012). Pass-through and demand forms. Available at SSRN: http://ssrn.com/abstract=2194855 or http://dx.doi.org/10.2139/ssrn.2194855.

Furman, J., D. Coyle, A. Fletcher, D. McAuley, and P. Marsden (2019). Unlocking digital competition: Report of the digital competition expert panel.

Hagiu, A., T.-H. Teh, and J. Wright (2022). Should platforms be allowed to sell on their own marketplaces? *The RAND Journal of Economics 53*(2), 297–327.

Jullien, B., P. Rey, and C. Saavedra (2013). The economics of margin squeeze. IDEI Report October 2013.

Konkurrensverket (2021). Konkurrensen på digitala plattformsmarknader i sverige, Rapport 2021:1.

Konkurrensverket v. TeliaSonera Sverige AB (2011). European Court of Justice, case C-52/09.

Morton, F. S., P. Bouvier, A. Ezrachi, B. Jullien, R. Katz, G. Kimmelman, A. D. Melamed, and J. Morgenstern (2019). Committee for the study of digital platforms - market structure and antitrust subcommittee report.

Motta, M. (2023). Self-preferencing and foreclosure in digital markets: Theories of harm for abuse cases. *International Journal of Industrial Organization 90*, 102974. The 49th Annual Conference of the European Association for Research in Industrial Economics, Vienna, 2022.

Nalebuff, B. (2005). Exclusionary bundling. *The Antitrust Bulletin 50*(3), 321–370.

Pacific Bell Telephone Co. v. linkLine Communications Inc. (2009). 129 S. Ct. 1109.

Padilla, J., J. Perkins, and S. Piccolo (2022). Self-preferencing in markets with vertically integrated gatekeeper platforms*. *The Journal of Industrial Economics 70*(2), 371–395.

Peitz, M. (2022). The prohibition of self-preferencing in the dma.

Petulowa, M. and C. Saavedra (2014). Margin squeeze in a regulatory environment: An application to differentiated product markets. Working Paper. Available at http:// ssrn.com/abstract=2236258.

Salinger, M. A. (2020, November). Self-preferencing. Available at SSRN: https://ssrn.com/abstract=3733688 or http://dx.doi.org/10.2139/ssrn.3733688.

Schmalensee, R. (1981, March). Output and welfare implications of monopolistic third-degree price discrimination. *American Economic Review 71*(1), 242–247.

Sidak, G. J. (2008). Abolishing the price squeeze as a theory of antitrust liability. *Journal of Competition Law & Economics 4*(2), 279–309.

Verizon Communications v. Law Offices of Curtis V. Trinko (2004). LLP, 540 U.S. 398.

Weyl, E. G. and M. Fabinger (2013). Pass-through as an economic tool: Principles of incidence under imperfect competition. *Journal of Political Economy 121*(3), 528–583.

Whinston, M. D. (1990). Tying, forclosure and exclusion. *American Economic Review 80*, 837–859.

5 Appendix

5.1 Imperfect competition

So far we have looked at either a single competitor or competitors that were fully competitive and homogeneous. As will be seen below, market power in the complementary goods market downstream may preclude the gatekeeper from fully extracting efficiency rents from competitors by means of price squeeze, and introduces an incentive for a different pricing strategy which we call a *uniform price squeeze*. It could also reverse the welfare effect of a price squeeze prohibition.

Consider a scenario where one competitor has a cost advantage, Δc_F, compared to the others. The cost differential between the gatekeeper and the competitors, Δc, provides an incentive for price squeeze (as in the competitive case), while the cost differential Δc_F can motivate a uniform price squeeze (as above).

The leading competitor's cost advantage, Δc_F, is assumed to be non-drastic, i.e., its pricing is constrained by the other competitors' marginal cost under price squeeze, $p_F^* = r^* + c_F$. Formally, this entails $\Delta c_F \leq \Delta \bar{c}_F \equiv -Q^2(p_F^*)/Q^{2\prime}(p_F^*)$, where $\Delta \bar{c}_F$ denotes the threshold cost advantage.

If the gatekeeper opts for regular price squeeze, setting p_I^* and r^*, it receives the same profit as in the initial competitive fringe case but leaves the leading competitor with a margin Δc_F on its sales. Alternatively, the gatekeeper can implement a uniform price squeeze vis-a-vis the leading firm by setting $\hat{r} = \hat{p}_I - c_F + \Delta c_F$ and extract its rent. The gatekeeper's profit with price squeeze (PS) and uniform price squeeze (UPS) is,

$$\begin{aligned} \Pi_{PS} &= (p_I^* - c_I)\, Q^1\,(p_I^*) + (p_F^* - c_F)\, Q^2\,(p_F^*)\,, \\ \Pi_{UPS} &= (\hat{p}_I - c_I)\, Q^1\,(\hat{p}_I) + (\hat{p}_I - c_F + \Delta c_F)\, Q^2\,(\hat{p}_I)\,. \end{aligned} \tag{25}$$

Note that Δc_F strictly increases the profitability of uniform price squeeze, but has no effect on the profit from ordinary price squeeze. If uniform pricing is *not* more profitable for the maximum non-drastic cost advantage, $\Delta \bar{c}_F$ then it is clearly not profitable for lower Δc_F. However, if uniform pricing is more profitable for $\Delta \bar{c}_F$ it follows that:

PROPOSITION 7 If $\Pi_{PS} < \Pi_{UPS}$ for $\Delta \bar{c}_F$ there is a unique $\Delta c_F^* \in (0, \Delta \bar{c}_F)$ such that $\Pi_{PS} \geq \Pi_{UPS}$ if $\Delta c_F \leq \Delta c_F^*$ and $\Pi_{PS} < \Pi_{UPS}$ if $\Delta c_F > \Delta c_F^*$.

Proof. First, $\Pi_{PS} \geq \Pi_{UPS}$ for $\Delta c_F = 0$. Second, Π_{UPS} strictly increases in Δc_F, while Π_{PS}, is not affected. The result then follows from continuity.

In general, the relative profitability of the two kinds of price squeeze depends on three factors; the cost advantage of the fringe, Δc, the cost advantage of the leading firm, Δc_F, and the relative size of the non-contestable market, λ. With regular price squeeze the gatekeeper sets gatekeeper prices tailored to its marginal cost on each market, and the price gap between the markets, $p_I^* - p_F^*$, increases in Δc. A uniform price squeeze distorts pricing on the non-contestable market, and more so if the price gap is large. The impact of this distortion depends on the relative size of the non-contestable market, λ. Uniform pricing is only worthwhile if appropriation of the leading competitor's cost advantage, Δc_F, outweighs this distortion.

Below, we provide a simple sufficient condition for when Proposition 7 applies and some implications for the gatekeeper's pricing.

PROPOSITION 8 If $\lambda \Delta c \leq \Delta \bar{c}_F$ then (i) $\Pi_{PS} < \Pi_{UPS}$ at $\Delta \bar{c}_F$, (ii) $\Delta c_F^* < \lambda \Delta c$, and (iii) $\hat{p} > (\leq)\, p_F^*$ if $\lambda \Delta c > (\leq)\, \Delta c_F$.

Proof. In later in the Appendix.

This condition reflects the simple intuition outlined above – if the potential distortion caused by uniform pricing, as measured by $\lambda \Delta c$, falls short of the non-drastic cost advantage threshold $\Delta \bar{c}_F$ for the leading competitor, then then there is a range of Δc_F for which uniform price squeeze is optimal. If this cost advantage is very large and exceeds $\lambda \Delta c$ then the uniform price falls short of p_F^*.

5.1.1 Multiple downstream markets

Differentiation in terms of products or geography could allow firms with different costs to be active downstream. If the gatekeeper cannot price discriminate at the wholesale level, then extracting efficiency rents from the most efficient firms may foreclose others. We examine these effects in a simple extension of the model.

Specifically, we assume that there are two identical contestable downstream markets, denoted 2 and 3, which are completely separate and half the size of the contestable market considered before. Initially, the marginal cost of competitors in both market is c_F. Opportunities for reducing marginal cost, subject to a small fixed investment cost, are then assumed to arise sequentially between market. To highlight the effect of a risk of price squeeze or foreclosure affects investment incentives, the size of the cost reduction, δ_i, is assumed to be subject to choice. First, a competitor in market 2 has the opportunity to reduce its marginal cost, followed by a firm in market 3. (Note that it is not profitable for another firm in the same downstream market to replicate the investment since Bertrand competition would prevent it from recovering even a small investment cost). After these fringe investments firms compete in prices, but the gatekeeper cannot price discriminate between the markets. (For symmetric cost reductions, by one firm in each market, the situation is identical to what we had before).

Suppose $\delta_2 \geq \delta_3$. The gatekeeper can (i) either maintain its prices, (ii) appropriate the cost advantage of the least efficient firm fully and that of the other firm's partially, or (iii) appropriate the most efficient firm's advantage fully and foreclose the less efficient firm. The optimal uniform prices in the two latter cases are denoted $\hat{p}_3$ and $\hat{p}_2$, where the subscript I is dropped.

The gatekeeper's profits in these pricing scenarios, where $\boldsymbol{\delta} = \{\delta_2,\delta_2\}$, are:

$$\begin{aligned}
\Pi_{c_\delta}\left(p_I^*, p_F^*\right) &= \left(p_I^* - c_I\right) Q^1\left(p_I^*\right) + \left(p_F^* - c_F\right) \quad Q^2\left(p_F^*\right) + Q^3\left(p_F^*\right) \quad , \\
\Pi_{c_\delta}\left(\hat{p}_3; \boldsymbol{\delta}\right) &= \left(\hat{p}_3 - c_I\right) Q^1\left(\hat{p}_3\right) + \left(\hat{p}_3 - c_F + \delta_3\right) \quad Q^2\left(\hat{p}_3\right) + Q^3\left(\hat{p}_3\right) \quad , \quad (26) \\
\Pi_{c_\delta}\left(\hat{p}_2; \boldsymbol{\delta}\right) &= \left(\hat{p}_2 - c_I\right) \quad Q^1\left(\hat{p}_2\right) + Q^3\left(\hat{p}_2\right) \quad + \left(\hat{p}_2 - c_F + \delta_2\right) Q^2\left(\hat{p}_2\right).
\end{aligned}$$

The gatekeeper prices to maximize profit, and the above expressions determine the gatekeeper's thresholds for appropriation. As before, cost reductions are only constrained by the risk of appropriation.

Now, suppose firm i in market 2 can reduce its cost first. To avoid appropriation, the cost reduction must neither trigger uniform pricing itself, nor in conjunction with the subsequent cost reduction in market 3. The latter constraint is not binding for firm i, since the second mover will not invest unless it is met. Thus, the relevant constraint for firm i is that $\Pi_{c_\delta}\left(p_I^*, p_F^*\right) \geq \Pi_{c_\delta}\left(\hat{p}_2; 0, \delta_2\right)$. In analogy with the analysis above we can derive the threshold cost reduction for both markets and show the following.

Proposition 9. If $\Pi_{c_\delta}\left(p_I^*, p_F^*\right) < \Pi_{c_\delta} \quad \hat{p}_2; 0, \bar{\delta}$ and the gatekeeper's pricing is unconstrained, $\delta_2^* > \delta^*$ and $\delta_3^* = \delta^*$. This implies that: (i) the feasible aggregate cost reductions with two separate market exceeds that feasible if the markets were combined and (ii) the equilibrium distribution of costs is asymmetric.

Proof. In later in the Appendix.

There are still hold-up effects, reducing the incentive for downstream investment, in the extended model but the scope for cost reductions is increased. The reason being that appropriation becomes less attractive when firms have different costs and the gatekeeper is unable to price discriminate. By the same logic, the risk of appropriation may therefore induce a heterogeneous cost structure in the industry. In the model above, downstream firms receive full return on their investment until the threshold in terms of cost reductions is reached. However, once a threshold cost structure is reached the return on further investments for downstream firms is zero. In this case, only the gatekeeper has an incentive to reduce downstream cost. Again, a ban on price squeeze would eliminate hold-up here.

5.1.2 Other cost advantages

Our discussion of price squeeze and hold up incentives has been cast in terms of cost reducing investments. However, a potential entrant that has a cost advantage relative to competitors would face a very similar problem.[18] Similarly, even if there are no investments, differentiated costs among the fringe can trigger a similar squeeze on the part of the gatekeeper, in order to extract the rent that this differentiation enables.

5.2 Proofs

Proof of the Lemma. Assume, by contradiction, that $p_F < p_I$. This implies interior solutions to both p_F and r. Two first order conditions must be satisfied from (1). First, the condition for p_I, where the interior solution to p_F implies that the second term falls away.

$$q(p_I) + (p_I - c_I)q'(p_I) = 0. \tag{A.1}$$

It follows that the gatekeeper sets the integrated monopoly price, $p_I = p_I^*$.

Second, the condition for r, which takes the competitor's response into account.

$$q(p_F) + rq'(p_F)\rho(p_F) = 0. \tag{A.2}$$

where $\rho(p_F)$ is the competitor's price response to a change in r, i.e. the cost pass-through. Since $\bar{p_F}\,(r + c_F) < p_I^*$, but $\bar{p_F}\,(\Delta c + c_F) = p_I^*$, it follows that $r < \Delta c$. The gatekeeper consequently must benefit from reducing r at $r = \Delta c$, and,

$$q(p_I^*) + \Delta c q'(p_I^*)\rho(p_I^*) < 0. \tag{A.3}$$

Since $q(p_I^*) + (p_I^* - c_I)q'(p_I^*) = 0$, and $q'(p_I^*) < 0$, we can conclude that this contradicts $\Delta c \leq \overline{\Delta c}$.

Proof of Proposition 5. Logit demand is defined by $Q = 1 - F\,(p)$ where $F\,(p) = e^{\frac{p-a}{b}}\left(1 + e^{\frac{p-a}{b}}\right)^{-1}$. It follows that $F' = \frac{1}{b}F\,(1 - F)$. The first order condition for market $i \in \{1{,}2\}$ is $\pi^{i\prime} = Q^{i\prime}(p_j^*) + (p_j^* - c_j)Q^{i\prime\prime} = 0$, where $j = \{I$ if i=1 and F otherwise$\}$. The the margin in market i at the optimal price can then be expressed as $p_j^* - c_j = -\frac{Q^i}{Q^{i\prime}} = \frac{b}{F}$, from which the pass-through can be implicitly derived: $\rho = \frac{1}{1+\frac{d}{dp}\frac{Q}{Q'}} = F$. Evaluating the welfare change (using expression 16) at the price squeeze that the gatekeeper implements in the absence of a ban, $x = p_I^* - p_F^*$, yields

$$z\,(p_I^* - p_F^*) = (p_F^* - c_F)\rho^2 - (p_I^* - c_I)\rho^1 = b - b = 0. \tag{A.4}$$

[18] As mentioned before, Choné et al. [2010] also discuss how price squeeze induced hold up may deter entry of competing downstream firms.

Proof of Proposition 8.
Part (i) follows from $\Pi_{UPS} > \Pi_{PS}$ at $\Delta c_F = \lambda \Delta c$. To see that this is the case, first note that at $\Delta c_F = \lambda \Delta c$ we can write $\Pi_{UPS} = (\hat{p}_I - c_I)\, Q^1(\hat{p}_I) + \Delta c \lambda Q^2(\hat{p}_I) + (\hat{p}_I - c_F)\, Q^2(\hat{p}_I) = (\hat{p}_I - c_F)\, Q^1(\hat{p}_I) + (\hat{p}_I - c_F)\, Q^2(\hat{p}_I)$. This implies that $\hat{p}_I = p_F^*$. Inserting this into the profit expressions reveals that $\Pi_{UPS} > \Pi_{PS}$ if $(p_F^* - c_F)\, Q^1(p_F^*) > (p_I^* - c_I)\, Q^1(p_I^*)$, which clearly must be the case, since a lower marginal cost results in a higher profit.

(ii) Since $\Pi_{UPS} > \Pi_{PS}$ at $\Delta c_F = \lambda \Delta c$ it follows from Proposition 7 that $\Delta c_F^* < \lambda \Delta c$.

(iii) The first order condition for $\hat{p}_I$ is: $Q^1(\hat{p}_I) + (\hat{p}_I - c_I)\, Q^{1\prime}(\hat{p}_I) + Q^2(\hat{p}_I) + (\hat{p}_I - c_F + \Delta c_F)\, Q^{2\prime}(\hat{p}_I) = 0$. Evaluating this profit derivative at $\hat{p}_I = p_F^*$ yields $Q^1(p_F^*) + (p_F^* - c_I)\, Q^{1\prime}(p_F^*) + \Delta c_F Q^{2\prime}(p_F^*)$, using envelope properties on market 2. Rearranging terms slightly we can do the same on market 1, so the derivative can be expressed as $-\Delta c Q^{1\prime}(p_F^*) + \Delta c_F Q^{2\prime}(p_F^*)$. Since $Q^1 = \lambda Q^2$ this derivative is strictly positive if $\Delta c_F < \lambda \Delta c$, implying that $\hat{p}_I > p_F^*$. At equality, the prices are equal, and for $\Delta c_F > \lambda \Delta c$ we have that $\hat{p}_I < p_F^*$.

Proof of Proposition 9. (i) If $\Pi_{c_\delta}(p_I^*, p_F^*) < \Pi_{c_\delta}\left(\hat{p}_2; 0, \bar{\delta}\right)$ appropriation is profitable for some $\delta_2 \in (0, \bar{\delta})$. Since $\Pi_{c_\delta}(\hat{p}_2; 0, \delta_2)$ strictly increases in δ_2 and $\Pi_{c_\delta}(p_I^*, p_F^*) > \Pi_{c_\delta}(\hat{p}_2; 0, 0)$, there exists a unique threshold δ_2^*, such that $\Pi_{c_\delta}(p_I^*, p_F^*) = \Pi_{c_\delta}(\hat{p}_2; 0, \delta_2^*)$. By assumption, the downstream firm in market 2 then chooses $\delta_2 = \delta_2^*$.

The non-appropriation constraint for the second cost reduction, δ_3, is, $\Pi_{c_\delta}(p_I^*, p_F^*) \geq \Pi_{c_\delta}(\hat{p}_3; \delta_3, \delta_2^*)$, which coincides with the constraint in the one-market case, since markets 2 and 3 are identical and half the size of that market. Hence, $\delta_3^* = \delta^*$.

(ii) To show that $\delta_2^* > \delta_3^*$, we note that $\Pi_{c_\delta}(p; \delta) - \Pi_{c_\delta}(p; \delta) = Q^3(p)(\Delta c + \delta) > 0$. Thus, $\Pi_{c_\delta}(\hat{p}_3; \delta_3^*) = \Pi_{c_\delta}(p_I^*, p_F^*) > \Pi_{c_\delta}(p; \delta_3^*)$ for all p, and therefore, $\Pi_{c_\delta}(\hat{p}_2; \delta_2^*) = \Pi_{c_\delta}(p_I^*, p_F^*)$ requires that $\delta_2^* > \delta_3^*$. Thus, the equilibrium cost structure is asymmetric.