

On the Merits of Antitrust Liability in Regulated Industries

by

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Abstract

We examine the merits of imposing antitrust liability on an incumbent supplier of regulated services. Such antitrust liability can limit anticompetitive behavior by the incumbent supplier but also can distort activity in the regulated industry, including the actions of the regulator. We demonstrate how the merits of antitrust liability vary with the regulator's objectives, instruments, and policies, and with prevailing industry conditions.

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1 Introduction

In its *Trinko* Decision, the U. S. Supreme Court (2004) identifies little role for antitrust review in regulated industries where regulators are well equipped to design and enforce industry policy and where antitrust review might distort industry investment.¹ More generally, though, antitrust review might usefully complement (or perhaps even substitute for) regulatory oversight in settings with emerging industry competition and limited regulatory resources (Levy and Spiller, 1996). The purpose of this research is to assess the merits of subjecting an incumbent regulated supplier to antitrust review in settings where regulatory and court oversight are both imperfect.

We develop and analyze a simple formal model of this issue. The model provides several conclusions that are both straightforward and entirely consistent with the views of the Supreme Court. For instance, we find that antitrust liability can be counterproductive when regulatory monitoring is accurate and regulatory enforcement powers are substantial.² We also find that even when it is effective at deterring anticompetitive behavior, the costs of antitrust liability can exceed its benefits. These costs include the losses arising from court error and the potential chilling effects of antitrust liability on industry investment.

Our model also provides more subtle conclusions, including the following five. First, to fully assess the merits of antitrust liability, it is important to anticipate how regulators will respond to its imposition. Even when antitrust liability would enhance welfare under a prevailing regulatory policy, the liability may reduce welfare once the regulator's response to its imposition is accounted for. Second, the regulator's reaction to the imposition of antitrust liability varies with the regulator's goals and instruments. Consequently, these goals and instruments affect the merits of antitrust liability.

¹The Supreme Court (2004, § IV) emphasizes the “particular importance” of “the existence of a regulatory structure designed to deter and remedy anticompetitive harm,” and cites the important oversight role of the U. S. Federal Communications Commission and the New York State Public Service Commission in this regard. See Spulber and Woo (2007), for example, for a useful interpretation and discussion of the *Trinko* Decision.

²Here and throughout the ensuing discussion we will employ the term “antitrust liability” to denote “subjecting the incumbent regulated supplier to court antitrust review.”

Third, the nature of the potential anticompetitive activity in question also can affect the merits of antitrust liability. It matters, for example, whether the activity primarily affects product quality or the relative costs of the regulated supplier and its rivals. Fourth, a variety of industry conditions affect the merits of antitrust liability, including the willingness of consumers to switch suppliers and the intensity of competition among rivals. Fifth (and perhaps most obviously), the merits of antitrust liability can vary with the relevant assessment criterion. Antitrust liability can reduce consumer welfare even as it increases aggregate welfare, for example.

To explain these five conclusions more fully, first consider the importance of anticipating the regulator's reactions to the imposition of antitrust liability. These reactions can take many forms. For example, the regulator may be compelled to increase the price of the incumbent supplier's retail service as antitrust liability increases the supplier's full operating cost, which includes the court-ordered damages the incumbent must pay to a rival. The price increase can harm consumers more than the enhanced antitrust scrutiny benefits consumers. Consequently, a regulator who acts to maximize consumer welfare may limit investment in new industry technologies that facilitate industry competition and thereby expose the incumbent supplier to antitrust liability. This is the case even if the investment would increase aggregate welfare (the sum of consumer welfare and industry profit). The imposition of antitrust liability also can reduce welfare by inducing the regulator to limit her relatively effective monitoring activity. In contrast, antitrust liability can enhance welfare if it induces the regulator to curtail her less accurate and/or more costly monitoring activity.

Prevailing regulatory goals can affect the merits of antitrust liability in several ways. For instance, antitrust liability can provide valued industry oversight that is lacking when the regulator is unduly concerned with the welfare of the regulated supplier. In contrast, antitrust liability can enable a regulator who is primarily concerned with the welfare of industry rivals to promote competition that benefits rivals even though it reduces consumer welfare and/or aggregate welfare.

The regulator's instruments also can affect the merits of antitrust liability. To illustrate, if the fines the regulator can impose on the regulated supplier for anticompetitive activity are limited and/or if the regulator has limited ability to detect such activity accurately, then antitrust liability may be required to constrain anticompetitive activity. Also, if the regulator has limited ability to distribute the costs of new technology investment across all industry consumers (by levying an industry-wide surcharge, for example), then the imposition of antitrust liability (which increases the incumbent supplier's full operating cost) can induce the regulator to discourage investment that facilitates industry competition.

The nature of the anticompetitive activity in question also can influence the merits of antitrust liability. To understand why, suppose the anticompetitive activity serves primarily to reduce the value that consumers derive from the industry service. Antitrust liability that effectively limits such activity can increase both consumer welfare and aggregate welfare. In contrast, if the anticompetitive activity serves primarily to reduce the regulated supplier's fixed cost and to increase the rival's fixed cost of operation, then deterring the activity may have little impact on aggregate welfare. However, the deterrence can reduce consumer welfare by requiring an increase in the price of the regulated product to offset the increase in the regulated supplier's full operating cost.

Many different industry conditions also can affect the impact of antitrust liability. For example, antitrust liability can be particularly valuable in settings where substantial competition among similarly-situated rivals will arise if and only if anticompetitive activity by the incumbent regulated supplier is successfully deterred.

To illustrate why the relevant assessment criterion is important in determining the merits of antitrust liability, observe that antitrust liability enhances aggregate welfare if it deters anticompetitive behavior and thereby reduces industry production costs. At the same time, antitrust liability can diminish consumer welfare if the expected damage the regulated supplier faces due to court error requires a substantial increase in the price the regulated supplier must charge to ensure its financial viability.

Our derivation and discussion of these findings proceeds as follows. Section 2 describes the basic setting on which we focus. Section 3 presents and discusses the formal conclusions that we derive in this setting. Section 4 considers extensions of the basic setting. Section 5 concludes and suggests directions for further research. The Appendix provides the proofs of all formal conclusions.

Before proceeding, we note that the literature provides many useful policy discussions of the benefits and costs of antitrust regulation in the presence of regulatory oversight (e.g., Bourreau and Dogan, 2001; Cave, 2004; Katz, 2004; Rey, 2004; Gérardin and Sidak, 2005; Kahn, 2006; Weiser, 2009). However, the literature offers few rigorous, detailed formal models of the relevant trade-offs. Formal models of related issues focus on different considerations. For instance, Garoupa and Gomez-Pomar (2004) demonstrate that criminal sanctions can usefully accompany regulatory fines when regulatory sanctions are insufficient to deter harmful behavior and when the firm can bribe the regulator not to impose the sanction.³ Ottaviani and Wickelgren (2010, 2011) analyze the optimal timing of regulatory reviews (of mergers, for example). The authors emphasize the better information that is available at later reviews, and abstract from the effects of regulatory goals and instruments that are central to our analysis.⁴ Innes (2004) examines the optimal interplay between *ex ante* and *ex post* regulations that seek to limit the harm from accidents, focusing on the role that *ex ante* investigation can play in reducing enforcement costs.⁵

Tirole (2004) and Weiser (2005), among others, observe that the best policy regarding antitrust review in regulated industries typically entails case-specific economic analysis rather than broad, uniform, rigid rules. Our analysis supports this conclusion, given our finding that a complete assessment of the merits of antitrust review in the presence of regulatory

³We do not consider explicit bribery of the regulator. However, we consider settings in which the regulator seeks primarily to further the interests of the regulated supplier or the rival.

⁴We allow for simultaneous monitoring by a regulator and a court and consider a broad range of relative accuracies of the two monitors.

⁵Innes (2004) reviews the earlier related literature. Our primary analysis abstracts from both regulatory and court monitoring costs in order to focus on alternative determinants of the merits of antitrust liability in the presence of regulatory oversight.

oversight entails many subtleties even in the simplest of economic models. Our analysis also provides a first step in demonstrating formally how some of the key considerations in any case-specific economic analysis are likely to affect the merits of antitrust liability.

2 The Basic Setting

We begin by considering a simple setting in which an incumbent regulated supplier has historically produced with what we will call the *original technology*. The incumbent can produce the essential regulated service at constant marginal cost c_I when it employs this technology. Each of N consumers derives value v_0 from consuming a unit of this service. For simplicity, each consumer is assumed to have an infinitely inelastic demand for one unit of the regulated service, but places no value on (and thus never purchases) additional units of the service.⁶ The original technology does not admit the operation of rival suppliers.

The incumbent supplier can implement a *new technology* that requires incremental investment K . The new technology is socially valuable because it admits the delivery of a service that consumers value more highly than the service produced using the original technology.⁷ Each consumer places value $v(\bar{a})$ on the retail service produced using the new technology if the incumbent supplier undertakes the pro-competitive action \bar{a} . This value declines to $v(\underline{a})$ if the incumbent undertakes the anticompetitive action \underline{a} . Even this lower value exceeds its counterpart under the original technology, i.e., $v(\bar{a}) > v(\underline{a}) > v_0$. Furthermore, the extra consumer value the new technology engenders exceeds its incremental investment cost, i.e., $[v(\underline{a}) - v_0]N > K$.

The new technology admits a rival supplier to serve retail customers at unit cost c_r by accessing the incumbent's network. For simplicity, the incumbent supplier's marginal production cost is assumed to remain at c_I under the new technology. The fixed production costs of both the incumbent and the rival vary with the incumbent's action, $a \in \{\underline{a}, \bar{a}\}$,

⁶For example, a consumer might value highly a telephone line and the accompanying access to the telephone network, but place little value on multiple lines.

⁷For instance, the new technology might admit a high-quality digital telephone service whereas the original technology might only permit a lower-quality analogue service.

under the new technology. The anticompetitive action \underline{a} deliberately disadvantages the rival by, for example, adopting a standard or interface that, in addition to reducing the value that consumers derive from the service, increases the rival's fixed cost of operation and reduces the incumbent's fixed cost. We will denote by Δ_I the financial benefit the incumbent secures under the new technology when it undertakes the anticompetitive action \underline{a} rather than the pro-competitive action \bar{a} .⁸ Δ_r will denote the corresponding financial loss the rival experiences.

The incumbent's choice of technology is observed publicly, but the incumbent's action under the new technology is not. As a component of her industry oversight duties, the regulator monitors the incumbent supplier's activities under the new technology in an attempt to discern the supplier's action. We will denote by $\bar{q}_R \in (\frac{1}{2}, 1)$ the probability that the regulator assesses the incumbent's action (a) correctly when $a = \bar{a}$. $\underline{q}_R \in (\frac{1}{2}, 1)$ will denote the corresponding probability of a correct assessment when $a = \underline{a}$. Thus, the regulator receives an informative ($\underline{q}_R, \bar{q}_R > \frac{1}{2}$) but imperfect ($\underline{q}_R, \bar{q}_R < 1$) indication of the incumbent supplier's action under the new technology. If her investigation indicates that $a = \underline{a}$, the regulator imposes financial penalty F_R on the incumbent supplier. The fraction $f \in [0, 1]$ of this penalty is awarded directly to consumers. The remaining fraction accrues to the government.⁹ For simplicity, we abstract from any costs the regulator might incur in investigating the incumbent supplier's action under the new technology.¹⁰

When the regulated incumbent supplier implements the new technology and the rival sues the incumbent for damages allegedly caused by its anticompetitive action, the court discerns the incumbent's action correctly with probability $\bar{q}_C \in (\frac{1}{2}, 1)$ when $a = \bar{a}$ and with probability $\underline{q}_C \in (\frac{1}{2}, 1)$ when $a = \underline{a}$. Thus, like the regulator, the court obtains an informative but imperfect signal about the incumbent supplier's action. The incumbent is

⁸For simplicity, we assume the two actions, \underline{a} and \bar{a} , are equally costly for the incumbent supplier to undertake, and normalize these costs to 0.

⁹The ensuing analysis is largely unchanged if a portion of F_R is awarded to the rival.

¹⁰Section 4 examines a setting in which regulatory monitoring is costly and the regulator decides whether to undertake the monitoring.

required to pay $m\Delta_r$ to the rival when the court concludes the incumbent has undertaken action \underline{a} . No payment is required when the court concludes $a = \bar{a}$. The parameter $m > 0$ is simply a multiple of the financial damages (Δ_r) the rival suffers when $a = \underline{a}$.¹¹

For simplicity, we abstract from institutional court costs and litigation costs.¹² Consequently, the rival will always sue the incumbent supplier when the latter is subject to antitrust liability. The rival will do so because it stands to gain $m\Delta_r$ from the lawsuit and faces no corresponding costs or potential losses.

Market competition between the incumbent supplier and the rival takes a particularly simple form. A fraction $\lambda \in (0, 1)$ of the N consumers are “mobile” consumers who purchase the product from the supplier that charges the lowest price.¹³ The remaining $[1 - \lambda]N$ consumers are “captive” consumers who always purchase the service from the incumbent supplier.¹⁴ The presence of these captive consumers implies that ongoing price regulation of the incumbent supplier’s service may play a useful role even when the incumbent faces competition from an unregulated rival supplier.

In addition to specifying the maximum price the incumbent can charge for its service, the regulator specifies a transfer payment, $t \leq t_m$, that the rival must pay to the incumbent supplier for each unit of the service the rival delivers to a retail customer. This payment might be viewed as a charge for employing the incumbent’s network to serve retail customers, for example.

The timing in the model is as follows. First, the government announces whether the incumbent regulated supplier will be subject to antitrust liability (i.e., whether the rival has the right to sue the incumbent supplier in court for damages allegedly resulting from

¹¹For example, m is 3 in the case where the penalty for anticompetitive behavior entails treble damages.

¹²Section 4 considers institutional court costs and the concluding section discusses the possibility of nontrivial litigation costs.

¹³Mobile consumers are assumed to purchase the service from the rival if the incumbent and the rival charge the same price for the service.

¹⁴In practice, consumers who have purchased a service exclusively from a regulated incumbent supplier for many years often take a considerable amount of time to realize that they can purchase the service from an alternative supplier. Also, some customers may not have a choice among suppliers if unregulated rivals choose to operate only in certain geographic regions.

the incumbent's anticompetitive action). Second, the regulator sets: (i) the price (p_0) the incumbent supplier can charge for its service if it employs the original technology; and (ii) the price (p) the incumbent can charge for its retail service and the per-unit payment (t) the rival must make to the incumbent if the incumbent implements the new technology. Third, the incumbent decides whether to implement the new technology or continue to operate with the original technology. If the incumbent implements the new technology, it then chooses its action, $a \in \{\underline{a}, \bar{a}\}$. Fourth, if the rival decides to operate, it sets the price it will charge for its service. Fifth, consumers make their purchase decisions. Sixth, if the new technology has been implemented, the regulator monitors the incumbent supplier's action. The court also investigates the incumbent's action during the legal proceeding that the rival initiates if the incumbent is subject to antitrust liability. If the regulator's investigation concludes that $a = \underline{a}$, she imposes fine F_R on the incumbent supplier, distributes the fraction f of this fine to industry consumers, and delivers the remaining fraction to the government. The regulator imposes no fine on the incumbent supplier if her investigation concludes that $a = \bar{a}$. If the court concludes that $a = \underline{a}$, it orders the incumbent to pay $m\Delta_r$ to the rival. The court orders no such payment if it concludes that $a = \bar{a}$.¹⁵

Following the implementation of the new technology, the rival maximizes its profit by matching the price the regulator sets for the incumbent's service. By doing so, the rival secures market share λ and variable profit $\pi_v^r(p, t) \equiv [p - c_r - t]\lambda N$.¹⁶ The incumbent supplier's corresponding variable profit is $\pi_v^I(p, t) \equiv [p - c_I][1 - \lambda]N + t\lambda N$, which includes the payment the rival must make to the incumbent for using its network. We normalize to 0 the rival's fixed operating cost when the incumbent undertakes the pro-competitive action (\bar{a}). Therefore, given retail price p and unit transfer payment t , the rival's operating

¹⁵One can think of the regulatory and court investigations as proceeding simultaneously, so the court finding is not influenced by the regulatory finding and *vice versa*. The concluding section discusses alternative possibilities.

¹⁶See Lemmas A1 and A2 in the Appendix for proofs of these conclusions. Unless otherwise noted, we assume c_r , t_m , and Δ_r are sufficiently small that the rival always finds it profitable to operate in the industry when the new technology is implemented.

profit (not counting expected court awards) is $\pi_v^r(p, t)$ if $a = \bar{a}$ and $\pi_v^r(p, t) - \Delta_r$ if $a = \underline{a}$.

If the incumbent supplier is not subject to antitrust liability, its expected profit under the new technology, given retail price p and unit transfer payment t , is:

$$\bar{\pi}^I(p, t) = \pi_v^I(p, t) - K - [1 - \bar{q}_R] F_R \quad \text{if } a = \bar{a}; \quad \text{and} \quad (1)$$

$$\underline{\pi}^I(p, t) = \pi_v^I(p, t) - K - \underline{q}_R F_R + \Delta_I \quad \text{if } a = \underline{a}. \quad (2)$$

The incumbent's corresponding profit when it is subject to antitrust liability under the new technology is:

$$\bar{\pi}_A^I(p, t) = \bar{\pi}^I(p, t) - [1 - \bar{q}_C] m \Delta_r \quad \text{if } a = \bar{a}; \quad \text{and} \quad (3)$$

$$\underline{\pi}_A^I(p, t) = \underline{\pi}^I(p, t) - \underline{q}_C m \Delta_r \quad \text{if } a = \underline{a}. \quad (4)$$

The incumbent supplier's profit under the original technology is $\pi_0^I = [p_0 - c_I] N$.¹⁷ The incumbent, like the rival, will operate in the industry if and only if it anticipates non-negative profit from doing so.

The regulator acts to maximize expected consumer welfare while ensuring non-negative profit for the incumbent supplier.¹⁸ To do so, the regulator sets the price for the incumbent's retail service to ensure exactly zero expected profit for the incumbent. This price is $p_0 = c_I$ under the original technology. The regulator also implements the highest feasible unit transfer payment (e.g., wholesale access charge) t_m when the new technology is employed.¹⁹ An increase in this payment secures more revenue for the incumbent, which allows the regulator to reduce the retail price for the incumbent's service. This price reduction induces a matching price reduction by the rival and thereby enhances consumer welfare.

Lemma 1 identifies the determinants of the incumbent supplier's behavior under the new technology. The lemma refers to $\underline{q}_R + \bar{q}_R - 1 = \underline{q}_R - (1 - \bar{q}_R)$, which is the increase in the (conditional) probability that the regulator will conclude $a = \underline{a}$ when $a = \underline{a}$ rather than

¹⁷These calculations normalize to 0 the incumbent supplier's fixed cost of production (other than the investment cost K under the new technology).

¹⁸Section 4 considers alternative regulatory objectives.

¹⁹See Lemma A4 in the Appendix for a formal proof of this conclusion.

$a = \bar{a}$. Thus, $\underline{q}_R + \bar{q}_R - 1$ can be viewed as a measure of the accuracy of the regulator's monitoring technology. Similarly, $\underline{q}_C + \bar{q}_C - 1$ can be viewed as a measure of the accuracy of the court's monitoring technology.

Lemma 1. *When it is not subject to antitrust liability, the incumbent will undertake action $a = \bar{a}$ under the new technology if and only if:*²⁰

$$\Delta_I \leq [\underline{q}_R + \bar{q}_R - 1] F_R. \quad (5)$$

When it is subject to antitrust liability, the incumbent will undertake action $a = \bar{a}$ under the new technology if and only if:

$$\Delta_I \leq [\underline{q}_R + \bar{q}_R - 1] F_R + [\underline{q}_C + \bar{q}_C - 1] m \Delta_r. \quad (6)$$

Lemma 1 indicates that in the absence of antitrust liability, the incumbent supplier will undertake the pro-competitive action if and only if the regulatory fine is sufficiently pronounced and the regulatory monitoring technology is sufficiently accurate relative to the financial gain the incumbent secures from the anticompetitive action (Δ_I). Similarly, in the presence of antitrust liability, the incumbent will undertake the pro-competitive action if and only if the regulatory fine and/or court damages are sufficiently pronounced and the regulatory and/or court monitoring technologies are sufficiently accurate relative to Δ_I .

Using the expressions in equations (1) – (4), we can characterize the value of the retail price (p) that ensures zero profit for the incumbent supplier under the new technology.²¹ Given the relevant value of p and the incumbent's action $a \in \{\underline{a}, \bar{a}\}$, consumer welfare is $W(p, a) = [v(a) - p] N + F(a)$, where $F(a)$ denotes the regulatory fines that are expected to be delivered directly to consumers when the incumbent delivers action a . These observations underlie Lemma 2, which characterizes: (i) W_0 , consumer welfare under the original technology; (ii) $W(a)$, expected consumer welfare under the new technology when the incumbent delivers action a and is not subject to antitrust liability; and (iii) $W_A(a)$, the corresponding

²⁰We assume the incumbent will undertake action \bar{a} when it is indifferent between actions \underline{a} and \bar{a} .

²¹See Lemma A3 in the Appendix.

expected consumer welfare when the incumbent is subject to antitrust liability.

Lemma 2. *Expected consumer welfare values are:* $W_0 = [v_0 - c_I] N$,

$$W(\bar{a}) = [v(\bar{a}) - c_I] N + \left[\frac{1}{1 - \lambda} \right] [t_m \lambda N - K - (1 - \bar{q}_R) F_R (1 - [1 - \lambda] f)], \quad (7)$$

$$W(\underline{a}) = [v(\underline{a}) - c_I] N + \left[\frac{1}{1 - \lambda} \right] [t_m \lambda N + \Delta_I - K - \underline{q}_R F_R (1 - [1 - \lambda] f)], \quad (8)$$

$$W_A(\bar{a}) = W(\bar{a}) - \left[\frac{1}{1 - \lambda} \right] [1 - \bar{q}_C] m \Delta_r, \quad \text{and} \quad (9)$$

$$W_A(\underline{a}) = W(\underline{a}) - \left[\frac{1}{1 - \lambda} \right] \underline{q}_C m \Delta_r. \quad (10)$$

Two elements of Lemma 2 warrant emphasis. First, although the incumbent supplier's anticompetitive action (\underline{a}) harms the rival and reduces consumer welfare by reducing $v(\cdot)$, it increases consumer welfare by delivering a financial benefit (Δ_I) to the incumbent. This financial benefit enables the regulator to reduce the incumbent's price without reducing its profit below zero. The maximum feasible such price reduction increases as the fraction of captive customers ($1 - \lambda$) declines.²² This is the case because when the incumbent serves fewer customers, the price charged to each customer can be reduced more substantially without reducing the incumbent's profit as the incumbent's fixed cost of production declines.

Second, abstracting from their potential impact on the incumbent's behavior, court awards and regulatory penalties that are not distributed directly to consumers reduce consumer welfare. Higher expected awards and penalties increase the incumbent's full operating cost and so require the regulator to increase the incumbent's retail price in order to ensure the incumbent's financial viability.

Aggregate welfare is the sum of expected consumer welfare and industry profit. Lemma 3 characterizes aggregate welfare under the original technology (S_0) and under the new technology when the incumbent delivers action a ($S(a)$).

²²Formally, observe from equation (8) that $W(\underline{a})$ increases as Δ_I increases. The rate of increase becomes larger as $1 - \lambda$ declines.

Lemma 3. *Aggregate welfare values are: $S_0 = [v_0 - c_I] N$,*

$$S(\bar{a}) = v(\bar{a})N - N[\lambda c_r + (1 - \lambda)c_I] - K, \text{ and} \quad (11)$$

$$S(\underline{a}) = v(\underline{a})N - N[\lambda c_r + (1 - \lambda)c_I] - K + \Delta_I - \Delta_r. \quad (12)$$

Lemma 3 reflects the fact that: (i) when the rival serves λN customers and the incumbent serves $[1 - \lambda]N$ customers, industry variable production costs are $N[\lambda c_r + (1 - \lambda)c_I]$; and (ii) the incumbent's anticompetitive action increases industry profit by $\Delta_I - \Delta_r$ (which can be either positive or negative) relative to the level achieved when the incumbent undertakes the pro-competitive action.

3 Findings in the Basic Setting

We now examine the welfare implications of subjecting the regulated incumbent supplier to antitrust liability. We will focus on the setting of primary interest where such antitrust liability is required to deter the anticompetitive activity. First, though, we briefly consider two other settings.

A. Settings where Antitrust Liability Does Not Deter \underline{a} .

First consider the setting in which even regulatory and court oversight together will not deter the incumbent supplier from undertaking the anticompetitive action (\underline{a}). In this case, antitrust liability serves only to increase the incumbent's full operating cost under the new technology by requiring the incumbent to make expected damage payments ($\bar{q}_C m \Delta_r$) to the rival. When this cost increase and the corresponding requisite increase in the incumbent's retail price are large relative to the incremental consumer value ($[v(\underline{a}) - v_0]N$) the new technology generates (so the second inequality in expression (13) below holds), the regulator will induce the incumbent to operate with the original technology if the incumbent is subject to antitrust liability. In contrast, if $[v(\underline{a}) - v_0]N$ is moderately large (i.e., if the first inequality in expression (13) below holds), the regulator will induce the incumbent to

implement the new technology in the absence of antitrust liability.²³ In such a setting, the imposition of antitrust liability reduces consumer welfare by deterring investment in the new technology. Because it effectively precludes the rival's operation, antitrust liability also reduces aggregate welfare if the rival is a relatively efficient producer and the anticompetitive activity does not reduce industry profit substantially. These observations are summarized formally in Conclusion 1.

Conclusion 1. *Suppose inequality (6) does not hold and*

$$\begin{aligned} K + \underline{q}_R F_R [1 - (1 - \lambda) f] - \Delta_I &< \{ \lambda t_m + [1 - \lambda] [v(\underline{a}) - v_0] \} N \\ &< K + \underline{q}_R F_R [1 - (1 - \lambda) f] - \Delta_I + \bar{q}_C m \Delta_r. \end{aligned} \quad (13)$$

*Then consumer welfare is higher in the absence of antitrust liability (where the new technology is implemented) than in its presence (where the original technology is employed). Aggregate welfare is also higher in the absence of antitrust liability than in its presence if $c_r \leq c_I$ and $\Delta_I \geq \Delta_r$.*²⁴

B. Settings where Regulatory Monitoring Alone can Deter \underline{a} .

Now consider the setting in which regulatory monitoring alone ensures that the incumbent supplier undertakes the pro-competitive action. If the incremental consumer value generated by the new technology ($[v(\bar{a}) - v_0] N$) is sufficiently pronounced in this setting, the regulator will induce the incumbent to implement the new technology regardless of whether the incumbent faces antitrust liability. Consequently, antitrust liability simply increases the incumbent's full operating cost under the new technology because the court makes Type I errors (i.e., $\bar{q}_C < 1$)²⁵ and so sometimes requires the incumbent to make damage payments

²³The regulator can induce the incumbent supplier to implement the regulator's preferred technology through suitable choice of the price of the incumbent's service and the unit transfer payment from the rival to the incumbent. The regulator can set these instruments to ensure zero profit for the incumbent under the regulator's preferred technology and negative profit under the other technology.

²⁴These conditions are jointly sufficient, not necessary, for aggregate welfare to decline. If $[v(\underline{a}) - v_0] N - K$ is sufficiently large, for example, then antitrust liability can reduce aggregate welfare even if $c_r > c_I$ and $\Delta_r > \Delta_I$.

²⁵A Type I error occurs if the incumbent is deemed to have undertaken the anti-competitive action when, in fact, it undertook the pro-competitive action.

to the rival even when the incumbent has undertaken the pro-competitive action. Consequently, as Conclusion 2 reports, antitrust liability reduces consumer welfare because it necessitates an increase in the price of the incumbent's retail service in order to ensure the incumbent's financial viability.

Conclusion 2. *Suppose inequality (5) holds and*

$$\{ \lambda t_m + [1 - \lambda][v(\bar{a}) - v_0] \} N > K + [1 - \bar{q}_R] F_R [1 - (1 - \lambda) f]. \quad (14)$$

*Then consumer welfare is higher in the absence of antitrust liability than in its presence.*²⁶

C. Settings where Antitrust Liability is Required to Deter \underline{a} .

We now turn to the setting of primary interest where regulation alone cannot deter the anticompetitive action but regulatory oversight and court oversight together will do so. From Lemma 1, this is the case when:

$$[\underline{q}_R + \bar{q}_R - 1] F_R < \Delta_I < [\underline{q}_R + \bar{q}_R - 1] F_R + [\underline{q}_C + \bar{q}_C - 1] m \Delta_r. \quad (15)$$

(i). The Original Technology is Implemented in the Absence of Antitrust Liability.

First consider the case where $v(\underline{a}) - v_0$ is relatively small, so the regulator will induce the incumbent supplier to operate with the original technology in the absence of antitrust liability.²⁷ Conclusion 3 reports that if $v(\bar{a}) - v_0$ is sufficiently large in this case (i.e., if inequality (17) below holds), then the imposition of antitrust liability – which serves to preclude the anticompetitive action – increases both consumer welfare and aggregate welfare.

Conclusion 3. *Suppose inequality (15) holds,*

$$\{ \lambda t_m + [1 - \lambda][v(\underline{a}) - v_0] \} N < K + \underline{q}_R F_R [1 - (1 - \lambda) f] - \Delta_I, \text{ and} \quad (16)$$

$$\{ \lambda t_m + [1 - \lambda][v(\bar{a}) - v_0] \} N > K + [1 - \bar{q}_C] m \Delta_r + [1 - \bar{q}_R] F_R [1 - (1 - \lambda) f]. \quad (17)$$

²⁶If the inequality in expression (14) is reversed, the regulator will induce the incumbent supplier to operate using the original technology both in the presence of antitrust liability and in its absence. Consequently, antitrust liability will not affect consumer welfare or aggregate welfare.

²⁷Formally, suppose inequality (16) below holds.

Then antitrust liability increases consumer welfare. Antitrust liability also increases aggregate welfare if and only if $[v(\bar{a}) - v_0]N - K > \lambda N [c_r - c_I]$.

Conclusion 3 formalizes the intuitive observation that antitrust liability can enhance welfare by encouraging investment in a new, superior technology that delivers increased value to consumers even though it introduces potential anticompetitive concerns.²⁸ As inequality (17) reveals, antitrust liability is particularly likely to increase consumer welfare in this setting when the court is relatively unlikely to commit a Type I error (so $1 - \bar{q}_C$ is small) and when the regulator has substantial ability to distribute the cost of new technology investment across all industry consumers (so t_m is large).

(ii). The New Technology is Implemented in the Absence of Antitrust Liability.

Subjecting the regulated incumbent supplier to antitrust liability also can enhance welfare even when the liability does not alter industry investment decisions. If $[v(\underline{a}) - v_0]N$ is sufficiently pronounced (i.e., if inequality (19) below holds), the regulator will induce the incumbent to implement the new technology even if doing so is certain to induce the anti-competitive action. Antitrust liability can enhance welfare in this setting by inducing the pro-competitive action if the associated increase in consumer value ($[v(\bar{a}) - v(\underline{a})]N$) is large relative to the corresponding increase in the incumbent's full cost (i.e., if inequalities (17) and (18) hold). These observations are summarized formally in Conclusion 4.

Conclusion 4. *Suppose inequalities (15) and (17) hold,*

$$[v(\bar{a}) - v(\underline{a})][1 - \lambda]N > \Delta_I + [1 - \bar{q}_C]m\Delta_r - [\bar{q}_R + \underline{q}_R - 1]F_R[1 - (1 - \lambda)f], \quad (18)$$

$$\text{and } \{\lambda t_m + [1 - \lambda][v(\underline{a}) - v_0]\}N > K + \underline{q}_R F_R[1 - (1 - \lambda)f] - \Delta_I. \quad (19)$$

Then consumer welfare is higher in the presence of antitrust liability (where $a = \bar{a}$) than in its absence (where $a = \underline{a}$). Aggregate welfare is also higher in the presence of antitrust liability than in its absence if and only if $[v(\bar{a}) - v(\underline{a})]N > \Delta_I - \Delta_r$.²⁹

²⁸Of course, if $v(\underline{a}) - v_0$ and $v(\bar{a}) - v_0$ are both sufficiently small, the regulator will induce the incumbent to operate under the original technology both in the presence of antitrust liability and in its absence. The imposition of antitrust liability will not affect consumer welfare or aggregate welfare in this case.

²⁹This inequality states that the increase in consumer value when the anticompetitive action is precluded

Observe that inequality (18) is more likely to hold and so antitrust liability is more likely to increase consumer welfare in this setting when: (i) the cost reduction (Δ_I) the incumbent supplier foregoes when it refrains from the anticompetitive action is small; (ii) the court is relatively unlikely to commit a Type I error, so $1 - \bar{q}_C$ is small; and (iii) the relevant expected regulatory penalty declines substantially when the anticompetitive action is precluded, so $[q_R - (1 - \bar{q}_R)] F_R [1 - (1 - \lambda) f]$ is large. Observe that $q_R - (1 - \bar{q}_R)$ is the reduction in the (conditional) probability that the incumbent supplier incurs a regulatory penalty when it undertakes action \bar{a} rather than action \underline{a} . Also, $1 - (1 - \lambda) f$ is the fraction of the regulatory fine F_R that is not distributed directly to the incumbent's (captive) customers, and so reduces consumer welfare when the regulator increases the incumbent's price to compensate the incumbent for the penalties it expects to incur.

Next consider the setting in which the court monitoring technology is relatively inaccurate and the incremental consumer value secured when the anticompetitive action is precluded ($[v(\bar{a}) - v(\underline{a})] N$) is relatively small (so the direction of inequality (18) is reversed). In such a setting, the imposition of antitrust liability can increase the incumbent's full cost (and thereby necessitate an increase in the price of the incumbent's retail service) by more than the corresponding increase in consumer value. The imposition of antitrust liability will reduce consumer welfare in this case even though it does not affect industry investment, as Conclusion 5 reports.

Conclusion 5. *Suppose inequalities (15) and (17) hold and the direction of inequality (18) is reversed. Then antitrust liability reduces consumer welfare. Antitrust liability increases aggregate welfare (by securing $a = \bar{a}$ rather than $a = \underline{a}$) if and only if $[v(\bar{a}) - v(\underline{a})] N > \Delta_I - \Delta_r$.*

Antitrust liability also can reduce consumer welfare by deterring investment in the new technology if the court makes considerable Type I error and potential damages are pronounced (i.e., if $[1 - \bar{q}_C] m \Delta_r$ is large) and so antitrust liability increases the incumbent's

under the new technology exceeds the corresponding reduction in industry profit.

full operating cost substantially. In this case, if the incremental consumer value secured under the new technology when $a = \underline{a}$ is relatively large but the additional consumer value derived from securing $a = \bar{a}$ is relatively small, the regulator will only induce the incumbent to implement the new technology in the absence of antitrust liability. Conclusion 6 identifies conditions under which antitrust liability deters investment in the new technology in this manner and reduces welfare by doing so.

Conclusion 6. *Suppose inequality (15) holds, and the directions of inequalities (16) and (17) are reversed. Then consumer welfare is higher in the absence of antitrust liability (where the new technology is implemented) than in its presence (where the original technology is employed). Aggregate welfare is also higher in the absence of antitrust liability than in its presence if $c_r \leq c_I$ and $\Delta_I \geq \Delta_r$.*³⁰

In summary, imposing antitrust liability on an incumbent regulated supplier often reduces welfare in the basic setting analyzed here both when court monitoring does not deter the anticompetitive activity (\underline{a}) and when it is not needed to deter \underline{a} . When court monitoring is required to deter \underline{a} , antitrust liability can increase consumer welfare when court monitoring is relatively accurate and the new technology provides substantial consumer value in the absence of anticompetitive activity. However, antitrust liability can reduce consumer welfare when court monitoring entails substantial Type I error or the direct gain in consumer value secured by deterring \underline{a} is limited. Antitrust liability can reduce consumer welfare in part by inducing the regulator to withdraw its support for the implementation of promising new technologies.

4 Additional Findings

The basic setting considered to this point abstracts from industry oversight costs, varied regulatory objectives, and competition among rival suppliers. We now extend the analysis to consider these factors.

³⁰These are jointly sufficient (not necessary) conditions for antitrust liability to reduce aggregate welfare.

A. The Setting with Controllable Regulatory Monitoring Costs.

We first allow for regulatory and court monitoring costs. Let $M_R > 0$ denote the regulator's cost of monitoring the incumbent supplier's action under the new technology and let $M_C > 0$ denote the corresponding court cost. Also let $\mu \in [0, 1]$ denote the fraction of M_R the regulator must finance with industry revenue. In this *setting with costly monitoring*, the regulator can choose whether to incur M_R after the government announces whether the incumbent regulated supplier will be subject to antitrust liability. If the regulator chooses not to incur M_R , she observes no signal about the incumbent's action and imposes no fine on the incumbent.

To illustrate one additional consideration that can arise in this setting, suppose that either regulatory monitoring or court monitoring alone will induce the incumbent supplier to undertake the pro-competitive action (\bar{a}).³¹ Further suppose that consumer welfare is higher under the new technology when $a = \bar{a}$ than under both the original technology and the new technology when $a = \underline{a}$.³² To maximize consumer welfare in this setting, the regulator will incur monitoring cost M_R in the absence of antitrust liability but refrain from monitoring in its presence. Consequently, antitrust liability increases aggregate welfare by substituting for the more costly regulatory monitoring if $M_C < M_R$, but reduces aggregate welfare by crowding out less costly regulatory monitoring if $M_R < M_C$. Antitrust liability also increases consumer welfare in this setting if and only if the costs it imposes on the incumbent supplier are less than the corresponding costs of regulatory monitoring that industry consumers must bear. These observations are stated formally in Conclusion 7.

Conclusion 7. *Suppose* $\Delta_I < \min \left\{ [q_R + \bar{q}_R - 1] F_R, [q_C + \bar{q}_C - 1] m \Delta_r \right\}$,

$$[1 - \lambda][v(\bar{a}) - v(\underline{a})] N > \mu M_R + [1 - \bar{q}_R] F_R [1 - (1 - \lambda) f], \text{ and} \quad (20)$$

$$\begin{aligned} & \{ \lambda t_m + [1 - \lambda][v(\bar{a}) - v_0] \} N \\ & > \max \{ K + [1 - \bar{q}_C] m \Delta_r, K + \mu M_R + [1 - \bar{q}_R] F_R [1 - (1 - \lambda) f] \}. \end{aligned} \quad (21)$$

³¹This will be the case if the inequality in the first line of the statement of Conclusion 7 below holds.

³²This will be the case if inequality (21) below holds.

Then aggregate welfare is higher in the presence of antitrust liability than in its absence in the setting with costly monitoring if and only if $M_C < M_R$. Consumer welfare is higher in the presence of antitrust liability than in its absence in this setting if and only if $M_C + [1 - \bar{q}_C] m \Delta_r < \mu M_R + \lambda [1 - \bar{q}_R] F_R [1 - (1 - \lambda) f]$.³³

B. Settings with Alternative Regulatory Objectives.

We now consider alternative regulatory objectives. To do so most simply, suppose regulatory and court monitoring are costless but the regulator can decide whether to undertake monitoring. Also suppose the regulator cannot raise the price for the incumbent supplier's retail service above p_{0m} under the original technology or above p_m under the new technology.³⁴

(i) The Regulator Acts to Maximize I 's Profit.

First consider the *setting with incumbent favoritism* in which the regulator seeks to maximize the incumbent supplier's profit. The regulator will not monitor the incumbent's action in this setting in order to avoid fines that would reduce the incumbent's profit. Consequently, the incumbent will undertake the anticompetitive action in the absence of antitrust liability. If court monitoring is sufficiently accurate (i.e., if the first inequality in Conclusion 8 below holds), then antitrust liability will induce the incumbent to undertake the pro-competitive action under the new technology. If the associated increase in consumer value ($v(\bar{a}) - v(\underline{a})$) is sufficiently pronounced (so the second inequality in Conclusion 8 holds), antitrust liability will increase both consumer welfare and aggregate welfare by substituting for the discipline the regulator fails to impose when she primarily values incumbent profit. These observations are summarized formally in Conclusion 8.

³³Notice that antitrust liability becomes more likely to increase consumer welfare in this setting as the fraction of regulatory monitoring costs that industry consumers must bear (μ) increases, *ceteris paribus*.

³⁴These maximum prices might reflect either the highest prices that consumers will tolerate or the highest prices consistent with the regulator's charge to protect consumers, for example.

Conclusion 8. Suppose $\Delta_I < [\underline{q}_C + \bar{q}_C - 1] m \Delta_r$, $[v(\bar{a}) - v(\underline{a})] N > \max \{0, \Delta_I - \Delta_r\}$,
and $[p_m(1 - \lambda) - p_{0m}] N > K + [1 - \bar{q}_C] m \Delta_r - \Delta_I - \lambda N [c_I + t_m]$. (22)

Then in the setting with incumbent favoritism, consumer welfare and aggregate welfare are both higher in the presence of antitrust liability than in its absence.³⁵

(ii) The Regulator Acts to Maximize the Rival's Profit.

Now suppose that instead of maximizing the incumbent's profit, the regulator acts to maximize the rival's profit.^{36,37} Further suppose that the rival can only operate profitably under the new technology if the incumbent supplier refrains from the anticompetitive activity (\underline{a}).³⁸ Also suppose that antitrust liability is required to induce the incumbent to refrain from \underline{a} .³⁹ Finally, suppose that $v(\underline{a}) - v_0$ is sufficiently small that consumer welfare is higher under the original technology than under the new technology when $a = \underline{a}$.⁴⁰

In this *setting with rival favoritism*, the regulator will induce the incumbent to operate with the original technology in the absence of antitrust liability. When antitrust liability precludes \underline{a} and thereby enables the rival to operate profitably under the new technology, the regulator will secure the maximum feasible profit for the rival by minimizing the unit transfer payment it must deliver to the incumbent (i.e., by setting $t = 0$) and by setting the highest feasible price (p_m) for the incumbent's service. Antitrust liability reduces consumer welfare in this setting. It also reduces aggregate welfare if the rival's marginal cost exceeds the incumbent's marginal cost sufficiently, as Conclusion 9 reports.

³⁵Inequality (22) ensures that the regulator can secure greater profit for the incumbent supplier under the new technology than under the original technology.

³⁶This objective may be consistent with Ginsburg (2009)'s observation that regulators sometimes promote industry competition even when such competition does not enhance consumer welfare or aggregate welfare.

³⁷Also suppose that when she is indifferent among policies, the regulator will implement the policy that maximizes consumer welfare.

³⁸This will be the case if inequality (23) below holds.

³⁹Recall this is the case if inequality (15) holds.

⁴⁰This will be the case if inequality (24) below holds.

Conclusion 9. *Suppose inequality (15) holds,*

$$[p_m - c_r] \lambda N - \Delta_r < 0 < [p_m - c_r] \lambda N, \quad \text{and} \quad (23)$$

$$\{\lambda t_m + [1 - \lambda][v_0 - v(\underline{a})]\} N + \Delta_I < K + \underline{q}_R F_R [1 - (1 - \lambda)f]. \quad (24)$$

Then antitrust liability reduces consumer welfare in the setting with rival favoritism. Antitrust liability also reduces aggregate welfare in this setting if $[v(\bar{a}) - v_0] N - K < \lambda[c_r - c_I] N$.

C. A Simple Setting with Competition Among Rivals.

The analysis to this point has considered a single rival that finds it most profitable to match the incumbent supplier's price. An alternative extreme would entail competition among multiple homogeneous rivals that drives the price they charge to the level of their unit operating cost. Now consider an intermediate setting – the *setting with rival competition* – in which the price the rival charges (p_r) is a weighted average of the price the incumbent charges (p) and the rival's unit operating cost, i.e., $p_r = \alpha p + [1 - \alpha][c_r + t]$, where $\alpha \in (0, 1)$ is a constant.

Assume that $c_r + t_m < p$ to ensure the rival always finds it profitable to operate in the industry in this setting. Further assume that the conditions in Conclusion 3 prevail, so: (i) antitrust liability is required to preclude \underline{a} ; (ii) $v(\underline{a}) - v_0$ is sufficiently small that the regulator, who seeks to maximize consumer welfare, induces the incumbent to operate under the original technology in the absence of antitrust liability; and (iii) $v(\bar{a}) - v_0$ is sufficiently large that the regulator induces the incumbent to implement the new technology in the presence of antitrust liability. Conclusion 10 reports that the increase in consumer welfare that arises when antitrust liability is imposed in this setting becomes more pronounced as rival competition becomes more intense, i.e., as α declines. The larger gain in consumer welfare stems from the lower price that prevails under the competition the new technology admits.

Conclusion 10. *Suppose inequalities (15), (16), and (17) hold. Then the regulator will induce the incumbent supplier to implement the new technology in the setting with rival competition only in the presence of antitrust liability. The resulting increase in consumer welfare increases as rival competition increases (i.e., as α declines).*

5 Conclusions

We have analyzed the merits of subjecting a regulated incumbent supplier to antitrust review in a simple setting. In doing so, we found substantial support for the standard considerations noted by the U. S. Supreme Court and scholars alike. In particular, the costs of antitrust liability can outweigh its benefits when the courts are imperfect and when diligent, expert regulators have ready access to effective oversight and enforcement instruments. Furthermore, antitrust liability can limit welfare-enhancing investment.

We also identified more subtle considerations that affect both the impact and the merits of antitrust liability. The reactions of regulators to the imposition of antitrust liability are particularly important in this regard. For example, antitrust liability can limit a regulator's (as opposed to the regulated supplier's) support for welfare-enhancing investment. In addition, antitrust liability can induce a regulator to reduce its industry oversight even when this oversight is more effective and/or less costly than the corresponding court oversight.

Regulatory goals also affect the merits of antitrust liability. To illustrate, antitrust liability can substitute for missing regulatory discipline when the regulator is unduly concerned with the welfare of the incumbent supplier. In contrast, antitrust liability can encourage a regulator who is intent on promoting competition to pursue investment that facilitates competition even when the investment reduces welfare.

Prevailing regulatory instruments and policies also influence the impact of antitrust liability. For instance, both the regulator's ability to require all industry consumers to share industry investment costs and the portion of regulatory fines that are distributed to consumers affect the regulator's perceived cost of introducing competition. Consequently, instru-

ments and policies like these can affect the regulator's support for investment that facilitates competition, and can thereby influence the effects of antitrust liability.

The merits of antitrust liability also can vary with the nature of the anticompetitive action in question. If antitrust liability limits actions that substantially reduce consumer value, then the liability can be particularly effective at enhancing both consumer welfare and aggregate welfare. In contrast, if antitrust liability limits activities that primarily raise the rival's fixed cost of operation and reduce the incumbent's fixed cost, then the liability may not increase aggregate welfare much. Antitrust liability can even reduce consumer welfare in this case by forcing the regulator to raise the price the regulated supplier must charge in order to ensure its financial viability.

Prevailing industry conditions also influence the impact of antitrust liability. For example, antitrust liability that limits anticompetitive activity can be particularly effective at enhancing consumer welfare in the presence of intense competition among low-cost rivals.

These conclusions have been illustrated in simple, stylized settings. More general models that admit additional considerations warrant thorough investigation. Alternative effects of anticompetitive actions merit study, for example.⁴¹ Instead of increasing the rival's fixed cost of operation, the incumbent's anticompetitive action might reduce the fraction of mobile consumers, increase the rival's unit production cost, or reduce differentially the value that consumers derive from the rival's product. These changes would modify the details of the findings drawn above, but would not seem to alter the key qualitative conclusions.

For simplicity, we have abstracted from the rival's decision about whether to sue the incumbent supplier. Moderate litigation costs could encourage the rival to sue the incumbent only when it has undertaken an anticompetitive action, and could thereby enhance the efficacy of antitrust liability. However, if the court is prone to substantial Type I error and damages ($m\Delta_r$) are large relative to litigation costs, the rival may sue the incumbent even

⁴¹Different forms and impacts of competition also warrant careful study. For instance, competition might compel the incumbent supplier to reduce its operating cost and/or improve the quality of the product it supplies. Competition might also introduce valued product differentiation and/or increase the number of potential customers, for example.

when the rival knows the incumbent has refrained from anticompetitive activity.⁴²

For simplicity, we have also considered only two distinct actions by the regulated supplier, fixed penalties (F_R and $m\Delta_r$), a binary monitoring decision by the regulator, and either full or no antitrust liability. In a model with a broader array of possible actions and policy choices, antitrust liability might reduce, but not eliminate, both regulatory monitoring and the incumbent supplier's anticompetitive activities.

Additional linkages between regulatory and antitrust policy also merit consideration.⁴³ For instance, the extent of the incumbent's antitrust liability and/or the nature of the court's investigation might vary with the regulator's findings.⁴⁴ Future research might also consider the possibility that antitrust liability can diminish welfare by inducing the rival to divert its effort from ensuring success in the marketplace to securing success in the courtroom.⁴⁵

Formal analysis of these additional considerations seem likely to further support a case-by-case approach to assessing the merits of antitrust liability in regulated industries (e.g., Tirole, 2004; Weiser, 2005).⁴⁶ We have demonstrated how certain industry conditions, types of anticompetitive harm, and regulatory goals, instruments, and policies affect the merits of antitrust liability. Corresponding demonstrations for these additional considerations await further research.

⁴²See McAfee et al. (2008), for example, for a formal analysis of such considerations. Observe that if $m\Delta_r$ is large relative to $v(\bar{a}) - v(\underline{a})$, antitrust liability may result in frequent lawsuits that the incumbent's customers must finance even though consumers are not harmed much by the anticompetitive activity in question.

⁴³Uncertainty about the private benefit the incumbent derives from its anticompetitive behavior might also be analyzed. Such uncertainty can render the regulator unable to consistently eliminate the incumbent's rent and predict the action that the incumbent will undertake.

⁴⁴Schwartzstein and Shleifer (2012) provide a related investigation. See Encinosa and Sappington (1995) and Innes (2004), for example, for related considerations in models with *ex ante* and *ex post* oversight, but no explicit antitrust review.

⁴⁵Alternative regulatory preferences might also be examined. For instance, the regulator might seek to maximize a weighted average of consumer welfare, the incumbent's profit, and the rival's profit. Alternatively, the regulator might value universal service or diversity, for example. See Bourreau and Dogan (2001), Katz (2004), Rey (2004), and Moss (2008) for related discussions.

⁴⁶This conclusion is also consistent with the U.S. Supreme Court (2004, § IV)'s observation that "Antitrust analysis must always be attuned to the particular structure and circumstances of the industry at issue."

Appendix

Lemmas A1 – A4 are employed in the proofs of Lemmas 2 and 3.

Lemma A1. When the incumbent supplier implements the new technology, the incumbent and the rival will charge the same price for their retail services.

Proof. The rival attracts no customers if it charges a price that exceeds the incumbent's price (p^I). The rival can attract all consumers by charging any price that does not exceed p^I . The most profitable such price for the rival is p^I . ■

Lemma A2. The rival serves λN customers under the new technology.

Proof. The conclusion follows from Lemma A1 and the assumption that all mobile consumers purchase from the rival when the two suppliers charge the same price. ■

Let \underline{p} denote the price the incumbent supplier (hereinafter denoted “ I ”) charges, \underline{t} denote the unit transfer payment the rival must deliver to I , and $\underline{\pi}$ denote I 's profit when $a = \underline{a}$ in the absence of antitrust liability. Let \bar{p} , \bar{t} , and $\bar{\pi}$ denote the corresponding measures when $a = \bar{a}$ in the absence of antitrust liability. Also let \underline{p}_A , \underline{t}_A , and $\underline{\pi}_A$ denote the corresponding measures when $a = \underline{a}$ in the presence of antitrust liability. Finally, let \bar{p}_A , \bar{t}_A , and $\bar{\pi}_A$ denote the corresponding measures when $a = \bar{a}$ in the presence of antitrust liability.

Lemma A3. $p_0 = c_I + \frac{\pi_0}{N}$;

$$\bar{p}_A = c_I - \bar{t}_A \left[\frac{\lambda}{1 - \lambda} \right] + \frac{K + \bar{\pi}_A + [1 - \bar{q}_R] F_R + [1 - \bar{q}_C] m \Delta_r}{[1 - \lambda] N}, \quad (25)$$

$$\underline{p}_A = c_I - \underline{t}_A \left[\frac{\lambda}{1 - \lambda} \right] + \frac{K + \underline{\pi}_A + \underline{q}_R F_R + \underline{q}_C m \Delta_r - \Delta_I}{[1 - \lambda] N}, \quad (26)$$

$$\bar{p} = c_I - \bar{t} \left[\frac{\lambda}{1 - \lambda} \right] + \frac{K + \bar{\pi} + [1 - \bar{q}_R] F_R}{[1 - \lambda] N}, \quad \text{and} \quad (27)$$

$$\underline{p} = c_I - \underline{t} \left[\frac{\lambda}{1 - \lambda} \right] + \frac{K + \underline{\pi} + \underline{q}_R F_R - \Delta_I}{[1 - \lambda] N}. \quad (28)$$

Proof. From (4) and Lemma A2, if I delivers \underline{a} in the absence of antitrust liability, it secures profit $\underline{\pi}_A$ if:

$$\begin{aligned} & [\underline{p}_A - c_I][1 - \lambda]N + \underline{t}_A \lambda N - K - \underline{q}_R F_R - \underline{q}_C m \Delta_r + \Delta_I = \underline{\pi}_A \\ \Leftrightarrow & \underline{p}_A = c_I - \underline{t}_A \left[\frac{\lambda}{1 - \lambda} \right] + \frac{K + \underline{\pi}_A + \underline{q}_R F_R + \underline{q}_C m \Delta_r - \Delta_I}{[1 - \lambda]N}. \end{aligned}$$

The derivations of the other prices are analogous, and so are omitted. ■

Lemma A4. $\underline{t} = \bar{t} = \underline{t}_A = \bar{t}_A = t_m$ and $\underline{\pi} = \bar{\pi} = \underline{\pi}_A = \bar{\pi}_A = \pi_0 = 0$.

Proof of Lemma A4 and Lemma 2. From Lemma A1 and the fact that consumer demand is perfectly inelastic, expected consumer welfare is $W(a, p^I) = [v(a) - p^I]N + F$ when I 's price is p^I , I delivers action a , and consumers expect to receive F from regulatory fines imposed on I . Therefore, the conclusions in Lemma 2 follow immediately from Lemma A3 if Lemma A4 holds. To illustrate:

$$\begin{aligned} W_A(\underline{a}) &= [v(\underline{a}) - \underline{p}_A]N + \underline{q}_R f F_R \\ &= v(\underline{a})N + \underline{q}_R f F_R - c_I N + \underline{t}_A N \left[\frac{\lambda}{1 - \lambda} \right] \\ &\quad - \left[\frac{1}{1 - \lambda} \right] \left[K + \underline{\pi}_A + \underline{q}_R F_R + \underline{q}_C m \Delta_r - \Delta_I \right] \\ &= v(\underline{a})N + \underline{t}_A N \left[\frac{\lambda}{1 - \lambda} \right] - c_I N \\ &\quad - \left[\frac{1}{1 - \lambda} \right] \left[K + \underline{\pi}_A + \underline{q}_R F_R (1 - [1 - \lambda]f) + \underline{q}_C m \Delta_r - \Delta_I \right]. \end{aligned} \quad (29)$$

Lemma A4 holds because, as in (29), it is readily verified that expected consumer welfare is increasing in the unit transfer payment (t) that the rival must make to I and decreasing in I 's profit for each action that I might undertake. The regulator has sufficient information to hold I to the minimum feasible profit (0) for each action that I might undertake. The regulator will do so (and implement the maximum feasible unit transfer payment, t_m) in order to maximize consumer welfare. ■

Proof of Lemma 1. Suppose the regulator sets price p and unit transfer payment t under the new technology in the presence of antitrust liability. Then, from (3) and (4), I will prefer $a = \bar{a}$ to $a = \underline{a}$ if and only if:

$$\begin{aligned} \pi_v^I(p, t) - K - [1 - \bar{q}_R] F_R - [1 - \bar{q}_C] m \Delta_r &\geq \pi_v^I(p, t) - K - \underline{q}_R F_R - \underline{q}_C m \Delta_r + \Delta_I \\ \Leftrightarrow \Delta_I &\leq [\underline{q}_R + \bar{q}_R - 1] F_R + [\underline{q}_C + \bar{q}_C - 1] m \Delta_r. \end{aligned}$$

The proof for the setting with no antitrust liability is analogous, and so is omitted. ■

Proof of Lemma 3. From Lemmas A1 – A4, the rival's profit in the absence of antitrust liability when $a = \underline{a}$ and $t = \underline{t}$ is:

$$\begin{aligned} \pi_r(\underline{a}) &= [\underline{p} - c_r - \underline{t}] \lambda N - \Delta_r \\ &= \left[c_I - \underline{t} \left(\frac{\lambda}{1 - \lambda} \right) + \frac{K + \underline{q}_R F_R - \Delta_I}{N(1 - \lambda)} - c_r - \underline{t} \right] \lambda N - \Delta_r \\ &= \left[c_I - c_r - \frac{\underline{t}}{1 - \lambda} \right] \lambda N + \frac{\lambda [K + \underline{q}_R F_R - \Delta_I]}{1 - \lambda} - \Delta_r. \end{aligned} \quad (30)$$

(30) and Lemma 2 imply that aggregate welfare in the absence of antitrust liability when $a = \underline{a}$ is:⁴⁷

$$\begin{aligned} S(\underline{a}) &= [v(\underline{a}) - c_I] N + [1 - f] \underline{q}_R F_R \\ &\quad + \left[\frac{1}{1 - \lambda} \right] \left[t_m \lambda N + \Delta_I - K - \underline{q}_R F_R (1 - [1 - \lambda] f) \right] \\ &\quad + \left[c_I - c_r - \frac{t_m}{1 - \lambda} \right] \lambda N + \frac{\lambda [K + \underline{q}_R F_R - \Delta_I]}{1 - \lambda} - \Delta_r \\ &= v(\underline{a}) N - N [\lambda c_r + (1 - \lambda) c_I] - K + \Delta_I - \Delta_r. \end{aligned}$$

The proofs of all other conclusions in the Lemma are analogous and so are omitted. ■

⁴⁷Notice that aggregate welfare includes the $[1 - f] \underline{q}_R F_R$ generated by regulatory fines that are not distributed directly to consumers.

Lemma A5. $W(\underline{a}) - W_A(\underline{a}) = \left[\frac{1}{1-\lambda} \right] \underline{q}_C m \Delta_r$, $W(\bar{a}) - W_A(\bar{a}) = \left[\frac{1}{1-\lambda} \right] [1 - \bar{q}_C] m \Delta_r$,

$$\begin{aligned} W_A(\underline{a}) - W_0 &= [v(\underline{a}) - v_0]N + t_m N \left[\frac{\lambda}{1-\lambda} \right] \\ &\quad - \left[\frac{1}{1-\lambda} \right] \left[K + \underline{q}_R F_R (1 - [1-\lambda]f) + \bar{q}_C m \Delta_r - \Delta_I \right], \end{aligned}$$

$$\begin{aligned} W_A(\bar{a}) - W_0 &= [v(\bar{a}) - v_0]N + t_m N \left[\frac{\lambda}{1-\lambda} \right] \\ &\quad - \left[\frac{1}{1-\lambda} \right] [K + (1 - \bar{q}_C) m \Delta_r + (1 - \bar{q}_R) F_R (1 - [1-\lambda]f)], \end{aligned}$$

$$\begin{aligned} W(\underline{a}) - W_0 &= [v(\underline{a}) - v_0]N + t_m N \left[\frac{\lambda}{1-\lambda} \right] \\ &\quad - \left[\frac{1}{1-\lambda} \right] \left[K + \underline{q}_R F_R (1 - [1-\lambda]f) - \Delta_I \right], \end{aligned}$$

$$\begin{aligned} W(\bar{a}) - W_0 &= [v(\bar{a}) - v_0]N + t_m N \left[\frac{\lambda}{1-\lambda} \right] \\ &\quad - \left[\frac{1}{1-\lambda} \right] [K + (1 - \bar{q}_R) F_R (1 - [1-\lambda]f)], \text{ and} \end{aligned}$$

$$\begin{aligned} W_A(\bar{a}) - W(\underline{a}) &= [v(\bar{a}) - v(\underline{a})]N \\ &\quad - \left[\frac{1}{1-\lambda} \right] \left[\Delta_I + (1 - \bar{q}_C) m \Delta_r - (\bar{q}_R + \underline{q}_R - 1) F_R (1 - [1-\lambda]f) \right]. \end{aligned}$$

Proof. The proof follows immediately from Lemma 2. ■

Proof of Conclusion 1. Lemma 1 implies that when inequality (6) does not hold, I prefers action \underline{a} to action \bar{a} both in the presence and the absence of antitrust liability.

Lemma A5 implies that $W(\underline{a}) > W_0$ when the first inequality in (13) holds, so the regulator will induce I to implement the new technology in the absence of antitrust liability. Lemma A5 also implies that $W_0 > W_A(\underline{a})$ when the second inequality in (13) holds, so the regulator will induce I to operate under the original technology in the presence of antitrust liability.

Aggregate welfare is higher in the absence of antitrust liability than in its presence in

this setting because, from Lemma 3:

$$S_0 = v_0 N - c_I N < S(\underline{a}) = v(\underline{a}) N - N[\lambda c_r + (1 - \lambda) c_I] - K + \Delta_I - \Delta_r$$

when $c_r \leq c_I$ and $\Delta_I \geq \Delta_r$, since $[v(\underline{a}) - v_0] N > K$, by assumption. ■

Proof of Conclusion 2. Lemma 1 implies that when inequality (5) holds, I will set $a = \bar{a}$ both in the presence and in the absence of antitrust liability.

Lemma A5 implies that $W(\bar{a}) > W_0$ when (14) holds. Therefore, in the absence of antitrust liability, consumer welfare is higher under the new technology than under the original technology. Lemma A5 also implies that $W(\bar{a}) > W_A(\bar{a})$ since $\bar{q}_C < 1$. Therefore, consumer welfare is higher in the absence of antitrust liability than in its presence under the new technology. Since $W(\bar{a}) > \max\{W_A(\bar{a}), W_0\}$, consumer welfare is higher in the absence of antitrust liability than in its presence. ■

Proof of Conclusion 3. Lemma 1 implies that when (15) holds, I prefers to set $a = \bar{a}$ rather than $a = \underline{a}$ in the presence of antitrust liability, and to set $a = \underline{a}$ rather than $a = \bar{a}$ in the absence of antitrust liability.

Lemma A5 implies that $W_0 > W(\underline{a})$ when (16) holds. Therefore, in the absence of antitrust liability, consumer welfare is higher under the original technology than under the new technology. Lemma A5 also implies that $W_A(\bar{a}) > W_0$ when (17) holds. Therefore, in the presence of antitrust liability, consumer welfare is higher under the new technology than under the original technology. Since $W_A(\bar{a}) > W_0 > W(\underline{a})$, consumer welfare is higher in the presence of antitrust liability than in its absence.

From Lemma 3, aggregate welfare is higher in the presence of antitrust liability than in its absence if and only if $S(\bar{a}) - S_0 = [v(\bar{a}) - v_0] N - \lambda N[c_r - c_I] - K > 0$. ■

Proof of Conclusion 4. Lemma 1 implies that when (15) holds, I prefers to set $a = \bar{a}$ rather than $a = \underline{a}$ in the presence of antitrust liability, and to set $a = \underline{a}$ rather than $a = \bar{a}$ in the absence of antitrust liability.

Lemma A5 implies: (i) $W_A(\bar{a}) > W_0$ when (17) holds; and (ii) $W(\underline{a}) > W_0$ when (19) holds. Therefore, consumer welfare is higher under the new technology than under the original technology both in the presence of antitrust liability and in its absence.

Lemma A5 also implies that $W_A(\bar{a}) > W(\underline{a})$ when (18) holds. Therefore, consumer welfare increases under the new technology when antitrust liability is imposed. Consequently, consumer welfare is higher in the presence of antitrust liability than in its absence.

From Lemma 3, aggregate welfare is higher in the presence of antitrust liability than in its absence if and only if $S(\bar{a}) - S(\underline{a}) = [v(\bar{a}) - v(\underline{a})]N - (\Delta_I - \Delta_r) > 0$. ■

Proof of Conclusion 5. Lemma 1 implies that when (15) holds, I prefers to set $a = \bar{a}$ rather than $a = \underline{a}$ in the presence of antitrust liability, and to set $a = \underline{a}$ rather than $a = \bar{a}$ in the absence of antitrust liability.

Lemma A5 implies: (i) $W(\underline{a}) > W_A(\bar{a})$ when the inequality in (18) is reversed; and (ii) $W_A(\bar{a}) > W_0$ when (17) holds. Therefore, the regulator will induce I to implement the new technology in the presence of antitrust liability. Since $W(\underline{a}) > W_A(\bar{a})$, consumer welfare is lower in the presence of antitrust liability than in its absence.

From Lemma 3, aggregate welfare is higher in the presence of antitrust liability than in its absence if and only if $S(\bar{a}) - S(\underline{a}) = [v(\bar{a}) - v(\underline{a})]N - (\Delta_I - \Delta_r) > 0$. ■

Proof of Conclusion 6. Lemma 1 implies that when (15) holds, I prefers action \bar{a} to action \underline{a} in the presence of antitrust liability, and action \underline{a} to action \bar{a} in the absence of antitrust liability.

Lemma A5 implies: (i) $W(\underline{a}) > W_0$ when the direction of the inequality in (17) is reversed; and (ii) $W_0 > W_A(\bar{a})$ when the direction of the inequality in (16) is reversed. Since $W(\underline{a}) > W_A(\bar{a})$, consumer welfare is higher in the absence of antitrust liability (where the regulator induces I to implement the new technology) than in its presence (where the regulator induces I to operate under the original technology).

Aggregate welfare is higher in the absence of antitrust liability than in its presence in this setting because, from Lemma 3:

$$S_0 = v_0 N - c_I N < S(\underline{a}) = v(\underline{a}) N - N[\lambda c_r + (1 - \lambda) c_I] - K + \Delta_I - \Delta_r$$

when $c_r \leq c_I$ and $\Delta_I \geq \Delta_r$, since $[v(\underline{a}) - v_0] N > K$, by assumption. ■

Proof of Conclusion 7. As in Lemma 1, it is apparent that I will set $a = \bar{a}$ rather than $a = \underline{a}$ when the first inequality in the Conclusion holds: (i) in the presence of antitrust liability; and (ii) in the absence of antitrust liability when the regulatory monitoring technology is employed.

Let $W^{nm}(\underline{a})$, $W^R(\bar{a})$, and $W_A^C(\bar{a})$, respectively, denote consumer welfare in this setting: (i) in the absence of antitrust liability when the regulator does not incur monitoring cost M_R ; (ii) in the absence of antitrust liability when the regulator incurs M_R ; and (iii) in the presence of antitrust liability when the regulator does not incur M_R . Following the proof of Lemma 2, it is readily verified that:

$$W^{nm}(\underline{a}) = [v(\underline{a}) - c_I] N + t_m N \left[\frac{\lambda}{1 + \lambda} \right] - \frac{K}{1 + \lambda}, \quad (31)$$

$$W^R(\bar{a}) = [v(\bar{a}) - c_I] N + t_m N \left[\frac{\lambda}{1 + \lambda} \right] - \left[\frac{1}{1 - \lambda} \right] [K + \mu M_R + (1 - \bar{q}_R) F_R (1 - [1 - \lambda] f)], \text{ and} \quad (32)$$

$$W_A^C(\bar{a}) = [v(\bar{a}) - c_I] N + t_m N \left[\frac{\lambda}{1 + \lambda} \right] - \left[\frac{1}{1 - \lambda} \right] [K + M_C + (1 - \bar{q}_C) m \Delta_r]. \quad (33)$$

As in the proof of Lemma 3, these expressions for consumer welfare are readily employed to prove that when action \bar{a} is implemented, aggregate welfare when only the court monitoring technology is employed and when only the regulatory monitoring technology is employed are, respectively:

$$S_C(\bar{a}) = v(\bar{a}) N - N[\lambda c_r + (1 - \lambda) c_I] - K - M_C, \text{ and} \quad (34)$$

$$S_R(\bar{a}) = v(\bar{a}) N - N[\lambda c_r + (1 - \lambda) c_I] - K - M_R. \quad (35)$$

(32) and (33) imply that $W^R(\bar{a}) > W_0 = [v_0 - c_I]N$ and $W_A^C(\bar{a}) > W_0$ when (21) holds. (31) and (32) imply that $W^R(\bar{a}) > W^{nm}(\underline{a})$ when (20) holds. Consequently, (34) and (35) imply that aggregate welfare is higher: (i) in the absence of antitrust liability than in its presence if $M_C > M_R$; and (ii) in the presence of antitrust liability than in its absence if $M_R > M_C$.

The observation regarding consumer welfare follows immediately from (32) and (33). ■

Proof of Conclusion 8. It is apparent that the regulator will always set the maximum feasible price for I 's product and require the rival to deliver the maximum feasible unit transfer payment (t_m) to I . Furthermore, the regulator will never undertake regulatory monitoring because such monitoring reduces I 's profit (by imposing penalties on I and perhaps by inducing I to forego the profit increment Δ_I). Also note that Lemmas 3, A1, and A2 hold in this setting.

In the absence of antitrust liability, the regulator will induce I to implement the new technology because (22) implies:

$$[p_m - c_I][1 - \lambda]N + t_m \lambda N - K + \Delta_I > [p_{0m} - c_I]N.$$

The first inequality in the Conclusion ensures that I will set $a = \underline{a}$ under the new technology in the presence of antitrust liability. The regulator will induce I to implement the new technology in the presence of antitrust liability because (22) ensures:

$$[p_m - c_I][1 - \lambda]N + t_m \lambda N - [1 - \bar{q}_C]m \Delta_r - K > [p_{0m} - c_I]N.$$

The second inequality in the Conclusion implies that consumer welfare is higher in the presence of antitrust liability than in its absence because:

$$[v(\bar{a}) - p_m]N > [v(\underline{a}) - p_m]N \Leftrightarrow v(\bar{a}) - v(\underline{a}) > 0.$$

Aggregate welfare is higher in the presence of antitrust liability than in its absence because, from Lemma 3 and the second inequality in the Conclusion:

$$S(\bar{a}) - S(\underline{a}) = [v(\bar{a}) - v(\underline{a})]N - (\Delta_I - \Delta_r) > 0. \quad \blacksquare$$

Proof of Conclusion 9. Lemma 1 implies that when (15) holds, I prefers action \bar{a} to action \underline{a} in the presence of antitrust liability, and action \underline{a} to action \bar{a} in the absence of antitrust liability.

(23) implies that the rival can operate profitably in the presence of antitrust liability (which induces I to set $a = \bar{a}$). Consequently, the regulator will: (i) instruct I to implement the new technology, which admits competition; (ii) set I 's price at its maximum feasible level (p_m); and (iii) require the rival to make the smallest feasible payment ($t = 0$) to I in order to maximize the rival's profit.

(23) implies that the rival cannot operate profitably in the absence of antitrust liability. Consequently, the regulator will instruct I to operate with the original technology because $W_0 > W(\underline{a})$ from (24) and Lemma A5. Also, since I operates with the original technology in the absence of antitrust liability whereas I implements the new technology (and sets $a = \bar{a}$) in the presence of antitrust liability, Lemma 3 implies that antitrust liability reduces aggregate welfare if $[v(\bar{a}) - v_0]N - K < \lambda[c_r - c_I]N$. ■

Proof of Conclusion 10. As in the proof of Conclusion 3, the regulator will induce I to operate under the original technology in the absence of antitrust liability and to implement the new technology, set $a = \bar{a}$, and charge price \bar{p}_A (as specified in (25)) in the presence of antitrust liability. The rival's price in the presence of antitrust liability will be $\bar{p}_{Ar} = \alpha \bar{p}_A + [1 - \alpha][c_r + \bar{t}_A]$. The corresponding level of consumer welfare is:

$$W_A^{rc}(\bar{a}) = v(\bar{a})N - [\lambda \bar{p}_{Ar} + (1 - \lambda)\bar{p}_A]N + [1 - \bar{q}_R]f F_R. \quad (36)$$

Observe from (25) that \bar{p}_A is not a function of α . Therefore, from (36):

$$\frac{\partial}{\partial \alpha} \{W_A^{rc}(\bar{a}) - W_0\} = -N\lambda \frac{\partial \bar{p}_{Ar}}{\partial \alpha} = -N\lambda [\bar{p}_A - (c_r + \bar{t}_A)] < 0. \quad \blacksquare$$

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