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Effects of Conferring Business Resource on Rivals

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Effects of Conferring Business Resource on Rivals

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By TEJASWI CHANNAGIRI AJIT AND MARK A. JAMISON [†]

We examine how requiring platforms to give rivals resources, such as data, affects innovation. Using simulations in which an initial firm obtains a head start on rivals and uses that head start to build a valuable resource that subsequently gives it a competitive advantage over rivals when competing in the initial technology, we contrast scenarios in which the initial firm is or is not required by a government regulator to provide this resource to rivals. We develop pricing provisions that incentivize the initial firm to voluntarily provide the resource to rivals. We then contrast incentives to create substitutes for the initial technology.

Keywords: platforms; innovation; competition

JEL codes: L13, L15, L51

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Competition regulators and industry regulators have long been interested in issues raised when one firm possesses and uses a resource that would benefit rivals if they had access to that resource. US courts developed what has become known as the essential facilities doctrine under which a monopolist, or at least a firm facing weak competition, can be compelled to allow rivals to use a facility deemed essential for effectively competing with the asset holder. This issue played a central role in the breakup of AT&T in 1984. (Pitofsky, Patterson, and Hooks 2002) Baumol (1983) addressed this issue in the case of railroads seeking to use each other's tracks and developed a pricing mechanism called the parity principle.

Viewing knowledge about online users as an essential resource is growing in acceptance as countries raise competition concerns for companies known as Big Tech, namely Alphabet, Amazon, Apple, Meta, and Microsoft. For example, in announcing the results of its study of Big Tech in 2020, the UK's Competition and Markets Authority (CMA) concluded that rivals are unable to compete with Google (now Alphabet) and Facebook (now Meta) because of their network effects and because, according to CMA's press release, "Each has unmatched access to user data, allowing them to target advertisements to individual consumers and tailor the services they provide." (Competition and Markets Authority 2020) The CMA proposed requiring "Google to open up its click and query data to rival search engines to allow them to improve their algorithms so they can properly compete," and "Facebook to increase its interoperability with competing social media platforms."

We examine the implications of requiring leading information technology companies to share with rivals' valuable knowledge-based capabilities that the leading firms have developed. More specifically, we examine situations where a firm develops a new product and receives revenue based the knowledge it gains as users consume the product. We contrast scenarios in which the initial firm is or is not required by a government regulator to provide this resource to rivals. We

develop pricing provisions that incentivize the initial firm to voluntarily provide the resource to rivals. We then contrast incentives to innovate in these scenarios. We base our analysis on an economic model that is used to perform simulations. Technology adoption follows an s-shaped curve for both the incumbent and the entrant.

The rest of this paper proceeds as follows. The next section describes the model. The following section describes results. The last section is our conclusion.

I. The Model

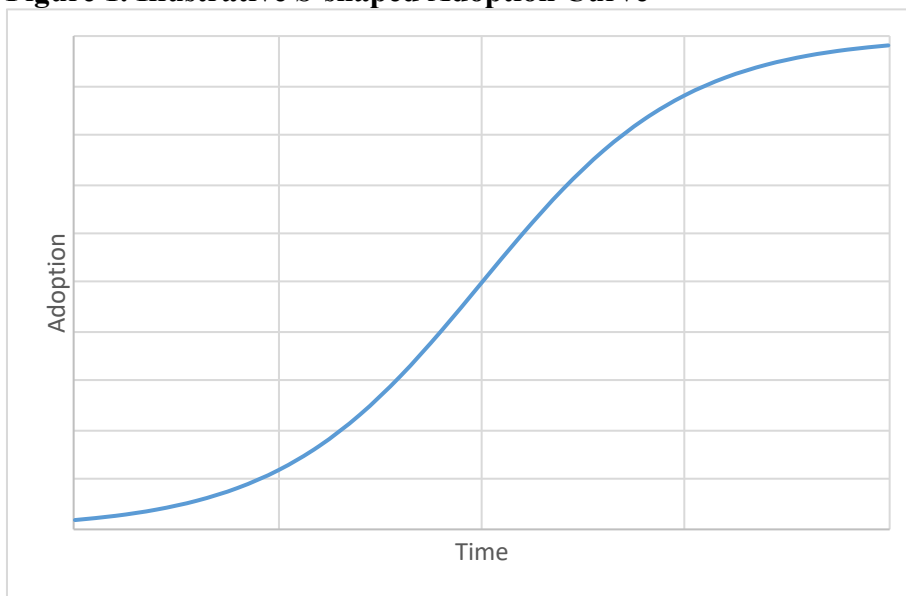
Studies of technology adoption have long concluded that the number of adopters of a new technology forms an S-shaped curve over time in which adoption continually increases as time passes, initially accelerating, giving the curve a convex shape, and then slowing, giving a concave shape. Figure 1 shows an illustrative S-shaped adoption curve.

In our analysis, we develop an S-shaped adoption curve by assuming that for each period the number of adopters that become sufficiently aware of the new product and to adopt follows a bell-shaped curve, meaning that the number of those newly aware rises at first, perhaps as existing adopters talk with potential adopters or as news of the product rises in prominence in traditional media. The number reaches a peak and then declines as the number of people who do not adopt becomes smaller and these potential users are the most difficult to inform and attract. More specifically, we assume a marginal adoption at time $0 \leq t \leq \bar{t}$ is given by $f(t) =$

$\frac{e^{\frac{2t-\bar{t}}{2\beta}}}{\left(1+e^{\frac{2t-\bar{t}}{2\beta}}\right)^2}$, where β is a strictly positive constant. This bell-shaped new-adopter

curve results in an S-shaped cumulative adoption curve $F(t) = \frac{e^{\frac{2t-\bar{t}}{2\beta}}}{1+e^{\frac{2t-\bar{t}}{2\beta}}}$.

Figure 1. Illustrative S-shaped Adoption Curve



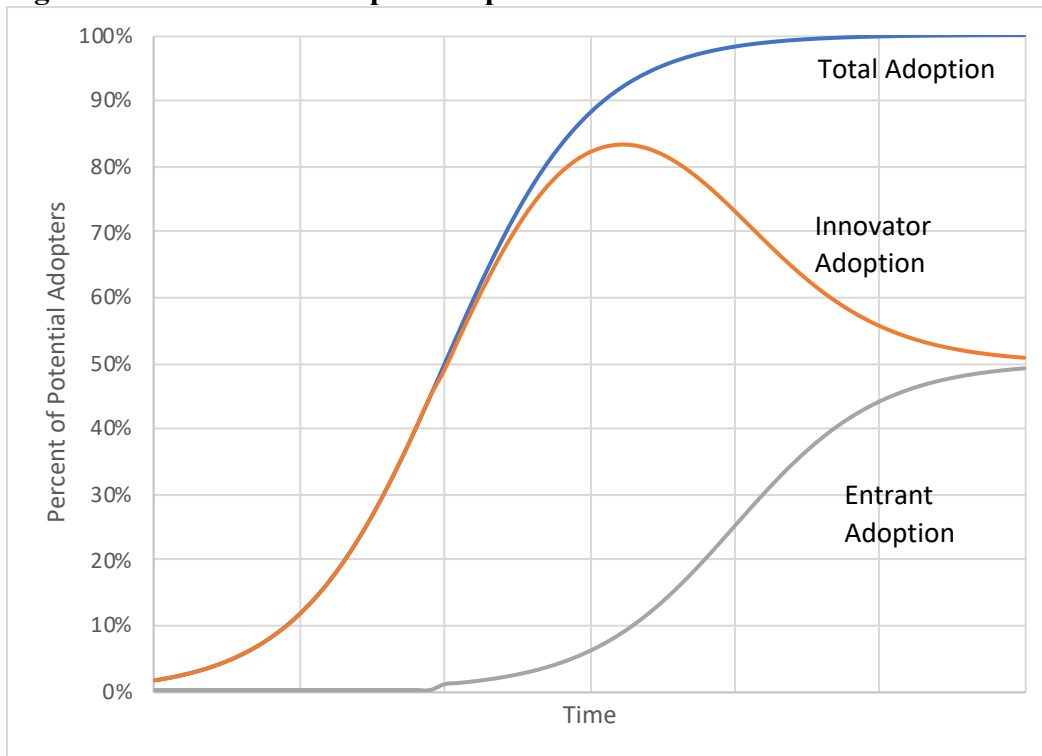
In our analysis, we assume that there is an adoption phase and a saturation phase. The adoption phase is twice as long as the saturation phase, such that $t = \left[0, \frac{2\bar{t}}{3}\right]$ is the adoption phase and $t = \left[\frac{2\bar{t}}{3}, \bar{t}\right]$ is the saturation phase.

In addition to assuming an S-shaped adoption curve, we assume the product is first introduced by an innovator with a duopoly market structure emerging once a second firm, which we call the entrant, enters the market. Consistent with our assumption of an S-shaped technology adoption curve, we assume that adoption of the entrant's product also follows an S-shaped curve. For our analysis, we assume

that the entrant comes into the market half-way through the adoption phase of the product, i.e., at $t = \frac{\bar{t}}{3}$. We further assume that the innovator and the entrant compete as duopolists producing homogeneous products, subject to the adoption curves. This means that adoption for the entrant is half what it was for the innovator given the same amounts of time in the market. Figure 2 illustrates.

In Figure 2, the top curve represents adoption by all users. The next highest curve represents adoption of the innovator's product. This curve coincides with the Total Adoption curve until the entrant enters the market, which occurs at the second vertical grid. The bottom curve is the adoption curve for the entrant. Near the end of our analysis the two firms effectively split the market evenly, which is typical for identical or nearly identical duopolists in homogeneous product markets.

Figure 2. Illustrative S-shaped Adoption Curves for Innovator v. Entrant



Adoption can be viewed at least two ways. It might be that adopters single home, meaning that they choose one provider or the other, or neither. It might also be that adopters can multihome, in which case adoption represents each provider's share of users' time and attention.

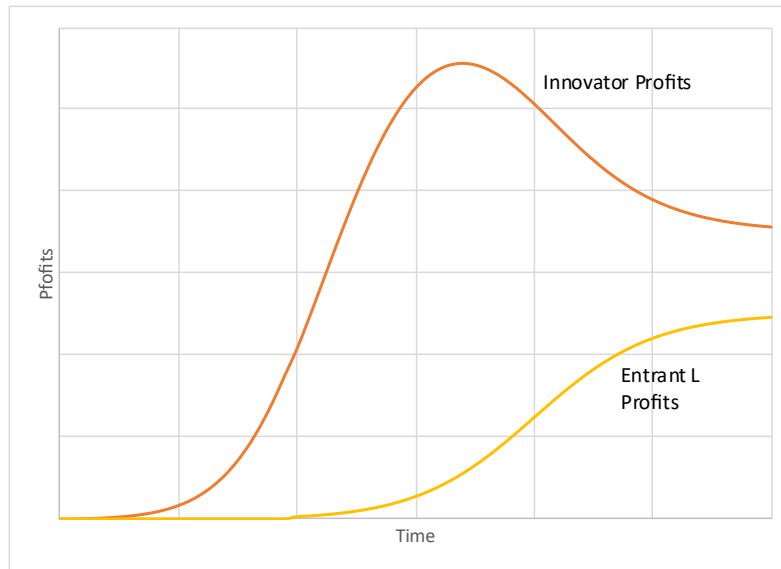
We assume that each firm receives revenue based on products or services directly related to the knowledge it possesses. The revenue might be from advertising, in which case the adoption in Figure 2 represents time and attention, or the revenue might be from selling services based on artificial intelligence. We assume that the innate value of the product or service rises with the number of users (or time and attention) over time, but also decreases with the amount being sold. More specifically, we assume a linear inverse demand function of the form $p_{E,t} \equiv a_j \cdot F(t)^\phi - b \cdot F(t)$ for the entrant's revenue-generating service, where $0 < \phi < 1$ and $0 < b < 1$ are constants and $a_j, j \in \{L, M, H\}$, is a constant such that $0 < a_L < 1$, $a_M = 1$, and $a_H > 1$. $j = L$ when the entrant provides lower valued revenue-generating service than the innovator. This is the base case. $j = H$ or $j = M$ can occur when the innovator shares data with the entrant. $j = M$ provides a revenue-generating service that is equal in value to that of the innovator and $j = H$ is higher valued. The inverse demand function for the innovator's revenue generating service is $p_{I,t} \equiv F(t)^\phi - b \cdot F(t)$. $p_{I,t} > p_{E,t}$ when $j = L$, $p_{I,t} < p_{E,t}$ when $j = H$, and $p_{I,t} = p_{E,t}$ when $j = M$. Revenue is price times the number of adopters for the firm.

II. Analysis and Results

A. Effects of Resource Sharing with Constant Technology

We begin with the no-sharing situation as a useful benchmark. Figure 2 shows the adoption of each firm's product assuming no sharing. Normalizing costs to zero, Figure 3 shows each firm's profits with no sharing.

Figure 3. Base Case Profits Without Resource Sharing



In Figure 3, the entrant's profits remain below those of the innovator even though they have approximately the same number of users towards the end of our study period, as Figure 2 shows. The lower value results from the entrant having a lower price than the innovator for the revenue-generating service.

In our analysis, resource sharing could affect the entrant in either of two ways, or both. One way is by affecting the price the entrant can charge for the revenue-generating service. In our model, the entrant becomes either an H-type or M-type when the innovator shares data. The other way that sharing could affect the entrant

is by enabling it to accelerate adoption. More specifically, we assume a data-enhanced entrant has a marginal adoption at time $0 \leq t \leq \bar{t}$ given by $f_d(t) =$

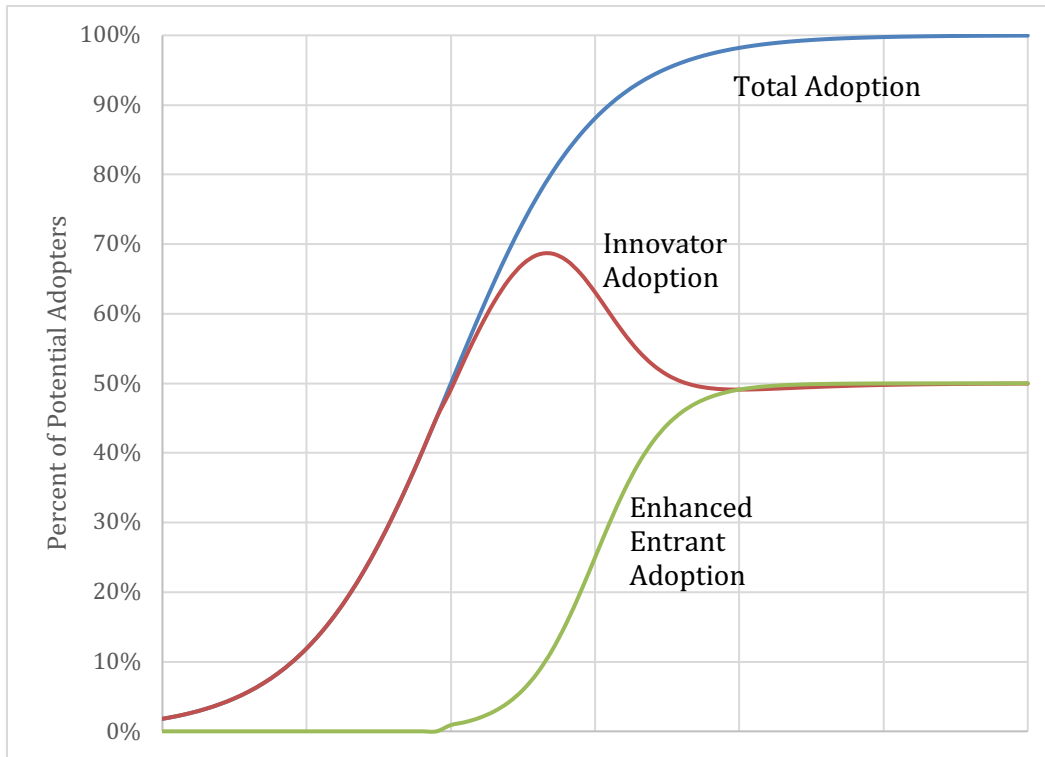
$$\frac{e^{\frac{2t-\bar{t}}{2\beta_d}}}{\left(1+e^{\frac{2t-\bar{t}}{2\beta_d}}\right)^2},$$

where $\beta_d < \beta$ is a strictly positive constant. This bell-shaped new-

adopter curve results in an S-shaped cumulative adoption curve $F_d(t) = \frac{e^{\frac{2t-\bar{t}}{2\beta_d}}}{1+e^{\frac{2t-\bar{t}}{2\beta_d}}}$.

$\beta_d < \beta$ provides the entrant with a faster adoption rate. Figure 4 illustrates the effect of the faster adoption on shares of adopters. With the faster adoption, the entrant achieves a proportion of total adopters that is nearly equal to the innovators by the start of the saturation phase rather than at the end, as Figure 2 shows.

Figure 4. Effects of Accelerated Adoption on Adoption Shares



We now turn our attention to analyzing the effects of data sharing on profits as these direct the incentives of innovators and entrants. Data sharing has no effects on the innovator’s profits if sharing’s only effect is on value of the entrant’s revenue-generating service. This is because this increase in value has no effect on the innovator’s share of adopters and the price it is able to charge for the service that leverages the knowledge the innovator gains from serving them. This might be one of the reasons by Meta, for example, is willing to allow users to export their data to other platforms as the effect on Meta revenue from advertising might be de minimis. However, there are effects on the entrant’s profits, as Figure 5 illustrates.

Figure 5. Profits by Firm Without Accelerated Entrant Adoption

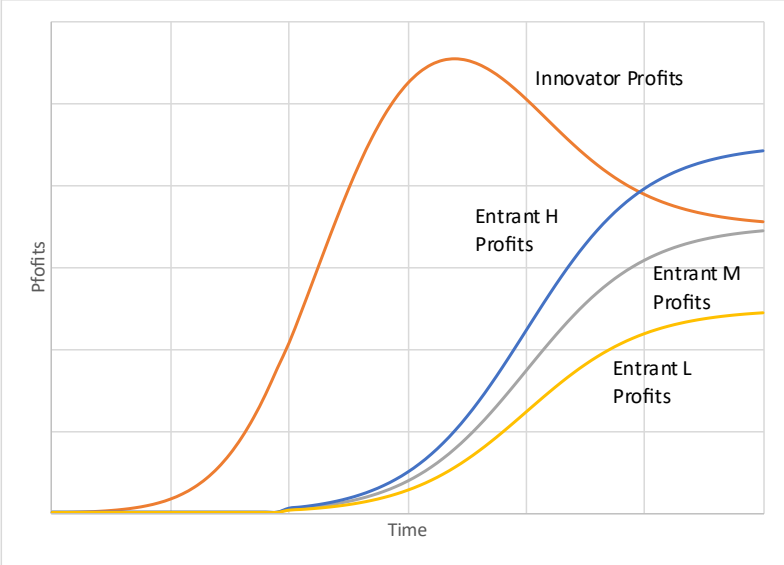


Figure 5 shows a clear profit benefit to the entrant from obtaining data from the innovator, i.e., the profit curve for $j = M$ always lies above the curve for $j = L$, and the curve for $j = H$ always lies above both. These profit enhancements mean that the entrant should be willing to pay the innovator for data even though the innovator might not demand payment. The amount that entrant would be willing to pay would

be the vertical distance between the $j = L$ profit curve and the $j = M$ or $j = H$ curve, depending on which is relevant.

The innovator's indifference goes away in the situation where the data sharing accelerates adoption of the entrant's service. The acceleration causes the innovator to lose adoption share sooner than it would otherwise, as Figure 4 shows. This results in lower innovator profits, as Figure 6 illustrates. In Figure 6, the profit decrease at time t is the vertical distance between the two curves, and the total decrease is the area between the two curves. For the innovator to voluntarily share data, it would need compensation at least as large as these differences.

Figure 6. Effects of Entrant Adoption Acceleration on Innovator Profits

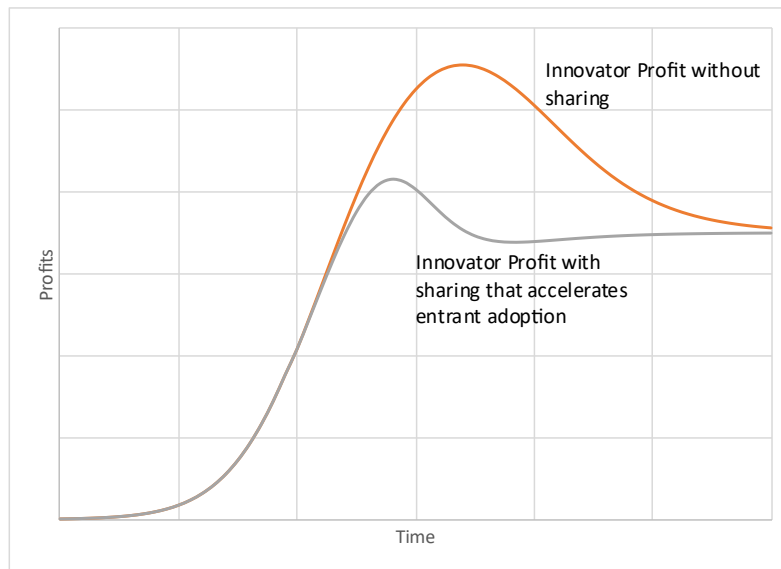
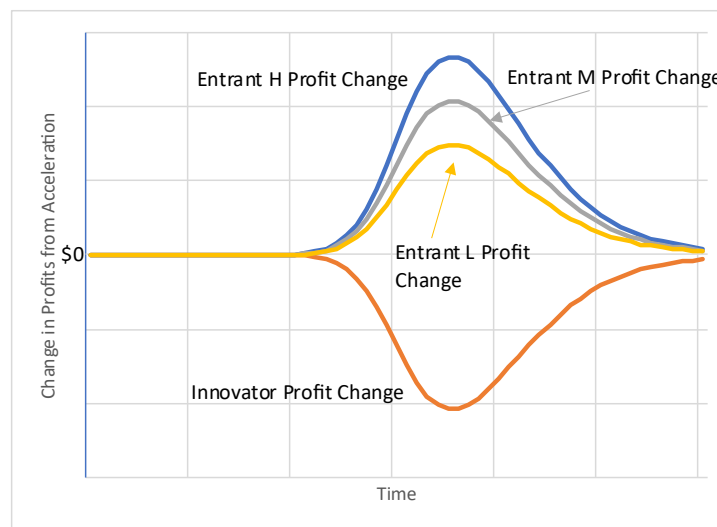


Figure 7 illustrates the entrant's ability to and interest in obtaining data by compensating the innovator's profit losses resulting from acceleration of entrant adoption. The innovator's profit change is illustrated by the curve marked "Innovator Profit Change" and is zero or negative throughout the time period. The amount changes from zero to negative when the entrant enters the market. The three

curves above the zero line represent entrant profit gains, which vary depending on whether j equals L , M , or H . For $j = L$, the entrant's price is below the innovator's price, so the entrant's gains are smaller in each period and in total than are the absolute values of innovator profit declines. This implies that the entrant and the innovator would be unable to reach a compensation agreement for the data sharing, perhaps leading an industry regulator to compel sharing. For $j = M$, the entrant's price is equal to the innovator's price, so the entrant's gains each period and in total are equal to the absolute values of the innovator's profit declines, implying that a compensation agreement is possible, but neither firm is made better off or worse off by the sharing and compensation. Only if $j = H$ is the entrant able to compensate the innovator an amount that makes the innovator and the entrant better off with the trade than without it. The range for the feasible aggregate payments, w , is

$$\int_{\bar{t}/3}^{\bar{t}} p_{E,t} \cdot F_d(t) \cdot dt \geq w \geq \int_{\bar{t}/3}^{\bar{t}} p_{I,t} \cdot [F(t) - F_d(t)] \cdot dt$$

Figure 7. Profit Changes from Acceleration



B. Effects of Resource Sharing on Innovation

We now turn our attention to the effects of sharing on innovation. We assume a new technology becomes available at time t_N , $\frac{\bar{t}}{3} < t_N < \bar{t}$, which occurs between the time that the entrant adopts the initial technology and the end of our analysis period for the initial technology. We analyze each firm's propensity to adopt the new technology and how resource sharing affects these propensities.

We assume that users find the new technology attractive such that, if it is offered, they move their time and attention to the new technology following an s-shaped adoption curve. More specifically, the adoption curve for the new technology is the

function $F_N(t) = \frac{e^{\frac{2t - (\bar{t} + t_N)}{2\beta}}}{1 + e^{\frac{2t - (\bar{t} + t_N)}{2\beta}}}$, which keeps the number of periods from introduction

of the new technology to its saturation and from introduction to the end of the analytical period the same as for the initial technology. We further assume that the greater value of the new technology is also reflected in the demand function for advertising, i.e., $p_{N,t} \equiv a_N \cdot F_N(t)^\phi - b \cdot F(t)$, where $a_N \geq a_H$.

Each firm's propensity to adopt the new technology is positively affected by profits from the new technology (i.e., $p_{N,t} \cdot s_{i,N,t} \cdot F_N(t)$, where $s_{i,N,t}$ is firm i 's share of the adoption of the new technology at time t), negatively affected by any profits from the initial technology that the adopter must give up in order to adopt the new technology (i.e., $p_{i,t} \cdot s_{i,O,t} \cdot F(t)$, where $s_{i,O,t}$ is firm i 's share of the adoption of the initial technology at time t), and negatively affected by adaptation costs. Adaptation costs are an increasing function of each firm's use of the initial technology over time (i.e., $\int_0^t s_{i,O,\hat{t}} \cdot F(\hat{t}) \cdot d\hat{t}$).

We can now make the following observations about each firm's propensity to innovate:

OBSERVATION 1. When data sharing leads to accelerated adoption of the entrant's service using the initial technology, the data sharing decreases the entrant's propensity to adopt the new technology and increases the innovator's propensity.

ANALYSIS 1. Per Figure 7, the acceleration always increases (conversely, decreases) the entrant's (conversely, innovator's) profits from the initial technology, which lowers (conversely, increases) its propensity to adopt the new technology, all other things being equal.

OBSERVATION 2. When data sharing leads to higher values for the entrant's revenue-generating service based on the initial technology, the data sharing decreases the entrant's propensity to adopt the new technology and does not affect the innovator's propensity.

ANALYSIS 2. Per Figure 5, the higher value always increases (conversely, leaves unchanged) the entrant's (conversely, innovator's) profits from the initial technology, which lowers (conversely, leaves unchanged) its propensity to adopt the new technology, all other things being equal.

From Observations 1 and 2, data sharing lowers the entrant's propensity to adopt new technologies. This likely delays the introduction of the new technology when the only effect of the data sharing is to increase the value of the entrant's revenue-generating service from the initial technology (Observation 2) because the entrant's propensity to adopt declines and the innovator's is unaffected. When the effect of data sharing is to accelerate adoption of the entrant's initial service (Observation 1), the effect on adoption of the new technology is ambiguous because the relative

magnitudes of the changes in the entrant's propensity and the innovator's propensity are indeterminate absent specific assumptions regarding parameters, such as prices.

OBSERVATION 3. The effect of data sharing on lowering the entrant's propensity to innovate is greater the closer t_N is to \bar{t} .

ANALYSIS 3. Per Figures 3 and 5, the entrant's profits from the initial technology rise with time. And given that data sharing increases each period's profits (Figures 5 and 7), the entrant's propensity to innovate decreases with time more with data sharing than otherwise, all other things being equal.

III. Conclusion

We examine the effects of data sharing. We demonstrate that there are at least some situations in which mandated sharing can be harmful financially to the innovator, giving it an incentive to hinder efficient sharing. We also demonstrate that there is room for bargaining between the innovator and the entrant in some situations that would create a mutually beneficial exchange. We also demonstrate situations where data sharing decreases entrants' incentives to innovate.

More research is needed. We hope to extend the research to consider situations where the entrant's activities affect overall adoption and situations where data sharing affects the timing of the entrant's entry into the initial market. We also hope to examine the welfare effects of sharing.

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