BIG-TECH MERGERS:
INNOVATION, COMPETITION FOR THE MARKET, AND THE ACQUISITION OF EMERGING COMPETITORS*

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This version:
21 July 2020

Abstract. There is broad concern that merger policy toward Big Tech has been too lenient. Big Tech typically operates in markets characterized by innovation-driven "competition for the market." I show that this fact provides a rationale for heightened scrutiny of incumbents' acquisitions of emerging or potential competitors. I also address the widespread argument that permissive merger policy promotes innovative entry by facilitating entry for buyout. I show that permissive merger policy can also discourage entrant innovation. One way is by diminishing entrants' incentives to invest in marginal product improvements when such improvements reduce the gains from merger. A second way is by facilitating i*ncumbency for buyout,* under which an incumbent makes investments in order to extract rents from an entrant through merger.

Key Words: Antitrust, Big Tech, Digital Markets, Innovation, Merger Policy.

Acknowledgements: I am grateful for helpful comments from Reiko Aoki, Jonathan Baker, Richard Gilbert, Yuka Ohno, Yossi Spiegel, two anonymous referees, and participants of the 2019 Hokkaido Workshop on Intellectual Property and Competition.

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*An earlier version was circulated under the title "Big-Tech Mergers: Schumpeterian Competition, Innovation, and the Treatment of Emerging Competitors."

I. INTRODUCTION

Commentators across the political spectrum have called for new and more forceful approaches to antitrust enforcement with respect to Big Tech—especially Amazon, Facebook, and Google. A wide range of proposals have been put forth, including breaking firms up, subjecting them to pervasive regulation, and being much more wary of mergers between incumbents and either recent or potential entrants.[1] The last concern is driven, in part, by the combination of apparently dominant market positions coupled with large numbers of acquisitions. For example, Amazon is estimated to have accounted for almost 40 percent of all 2019 ecommerce sales in the U.S., and Facebook and Google together account for over 60 percent of U.S. digital ad spending.[2] These companies made hundreds of acquisitions in the previous decade.[3]

To determine if acquisitions by Big Tech are a big problem that justifies heightened or different scrutiny, it is useful to begin by asking: what is special about these firms, beyond their tremendous success? One answer is that all are in industries with very strong increasing returns and positive feedback loops. There are several sources of increasing returns—often present simultaneously. One source is network effects. Another source is the collection and use of big data, which can give rise to economies of scale, scope, and experience. Lastly, the creation of software and intellectual property (including proprietary hardware designs) is typically characterized by large economies of scale, with high fixed costs and very low marginal costs.

The presence of such strong increasing returns can limit the number of viable competitors and even create a tendency to tip toward monopoly. When increasing returns are large relative to product differentiation, competition may be *for* the market rather than *in* the market. Competition for the market whereby firms compete by innovating to attain temporary market dominance is often referred to as Schumpeterian competition.

The need for scale can make entry difficult in the very markets in which entry is critical because competition takes place for the market. In a market in which a large base of users is essential to a firm's ability to offer an attractive value proposition—say because network effects are strong and/or the value of user big data is high—the only

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1 See, e.g., Crémer et al. (2019), Furman et al. (2019), Stigler Committee on Digital Platforms (2019), and Zachary Karabell, "Don't Break Up Big Tech," *Wired,* January 23, 2020, *available at* https://www.wired.com/story/dont-break-up-big-tech/.

2 Matt Day and Spencer Soper, Amazon U.S. Online Market Share Estimate Cut to 38% From 47%, Bloomberg, June 13, 2019, *available at* https://www.bloomberg.com/news/articles/2019-06-13/emarketer-cuts-estimate-of-amazon-s-u-s-online-market-share; Nicole Perrin, "Facebook-Google Duopoly Won't Crack This Year," eMarketer, November 4, 2019, *available at* https://www.emarketer.com/content/facebook-google-duopoly-won-t-crack-this-year.

3 See, e.g., Jon Swartz, "Are Big Tech acquisitions feeding antitrust probes?" MarketWatch, November 4, 2019, *available at* https://www.marketwatch.com/story/are-big-tech-acquisitions-feeding-antitrust-probes-2019-11-04.

economically viable means of entry may be to build up a base of users in an adjacent market and then provide the new service to that base of users—what is sometimes called a two-stage entry strategy.[4] Some commentators believe that Instagram and WhatsApp would have used two-stage entry to become strong competitors to Facebook in social networking if that firm had not acquired them in 2012 and 2014, respectively.[5]

Another strategy, to use alone or in conjunction with two-stage entry, is to offer a product with higher quality than that of the incumbent firm. Most directly, an entrant's quality advantage may outweigh its scale and installed-base disadvantages. There can also be an indirect effect. In markets subject to strong network effects, a firm may gain significant competitive advantage from favorable consumer expectations—when consumers expect that firm to have high sales, their expected value of patronizing that firm rises due to the anticipated network benefits associated with a larger user base. One might expect incumbents generally to have expectations advantages. However, a highly visible innovation might tip expectations in favor of an entrant.[6] If this pattern prevails, then the only way to overcome an incumbent's various scale advantages might be to engage in leapfrog innovation, which would allow an entrant that is small today to generate a positive feedback cycle.

Both two-stage and innovative entry strategies require the entrant to amass complementary resources (e.g., users and intellectual property) to have a chance of overcoming the advantages of incumbency. An entrant also needs a strong growth trajectory that allows it to achieve viable scale. An entrant's need to acquire complementary assets and attain a promising growth trajectory may allow an incumbent to identify potential rivals before they become major actual competitors.

Below, I explore the role of merger policy in a simple model in which competition is for the market and an incumbent can identify—and merge with—an emerging or potential competitor before the entrant becomes the new dominant firm. After Section II briefly reviews related literature, Section III presents the overall analytical framework: a discrete-time, infinite-horizon game in which each period a new potential entry opportunity arises with exogenous probability. Entry requires making a sunk, product-development investment. If entry occurs and the firms do not merge, then

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4 U.S. v. Microsoft is an early example of antitrust action to protect two-stage entry. Microsoft's Window's operating system was alleged to benefit from an "applications barrier to entry." Netscape's browser was seen as a potential first stage in a two-stage strategy to enter the operating systems market; if apps wrote to the browser instead of the operating system, then an entrant operating system that was compatible with the browser would be able to rely on the existing base of apps. See, e.g., Gilbert and Katz (2001).

5 For example, a Facebook co-founder has called allowing these acquisitions the F.T.C.'s "biggest mistake" and has argued that Facebook should be forced to undo them. Chris Hughes, "It's Time to Break Up Facebook," *The New York Times,* May 9, 2019.

6 Farrell and Katz (1998) provide an early analysis of the role of innovation to facilitate entry by shifting consumer expectations in markets with network effects.

the incumbent and entrant compete for the market, and the market is ultimately monopolized as one of the firms is driven to exit.

Section IV argues that incumbents' acquisitions of emerging or potential competitors should be subject to heightened antitrust scrutiny when competition is for the market. Entry is a critically important means of promoting good market performance under Schumpeterian competition but acquisition of a nascent competitor can be an especially effective way to avoid Schumpeterian competition, to the detriment of consumers. This is so for two reasons. First, as just noted, an entrant's need to acquire complementary assets and attain a strong growth may allow an incumbent to identify potential rivals before they become major actual competitors. Second, Marino and Zábojník (2006) have shown that, when competition is *in* the market (i.e., multiple incumbents can be profitable simultaneously), the threat of rapid entry can sometimes serve as a substitute for merger policy by making merger unprofitable absent efficiencies. To see why, suppose that there are two incumbents. In the absence of additional entry, merging to monopoly raises profits by eliminating product-market competition. However, there can an offsetting *share-dilution effect:* when the two firms merge, they may create room for a subsequent firm profitably to enter the market because they weaken their bargaining position—instead of collectively receiving two-thirds of the continuation profits in symmetric bargaining over merger with the entrant, they receive only half. When subsequent entry is rapid, the share-dilution effect renders mergers unprofitable absent efficiencies. By contrast, there is no share-dilution effect when competition is *for* the market: even absent merger, the market is monopolized after a period of competing for dominance following entry. Because it eliminates a period of competition to be the dominant firm, merger is profitable even if ensuing entry is rapid.

Sections V-VIII examine the effects of merger policy on potential entrants' pre-merger innovation incentives. When mergers are banned, entry occurs only when a potential entrant has a sufficiently valuable innovation that it can overcome any incumbency advantages and become the new dominant firm. As Rasmussen (1988) identified, permissive merger policy can facilitate *entry for buyout,* whereby a firm enters the market solely to induce the incumbent to purchase the entrant in order to avoid dissipating product-market profits through competition.[7] Although entry for buyout can represent socially inefficient rent seeking, it is often argued that a benefit of allowing mergers is that they can promote innovative entry by facilitating entry for buyout.[8] Below, I show that allowing mergers can also discourage entrant innovation.

As long as an incumbent's actions conditional on not merging are independent of whether mergers are permitted, the option to merge can only increase an entrant's profits. Hence, in this case, allowing mergers weakly increases the incentives for innovative entry. This finding, however, does not imply that an entrant's incentives to *marginally*

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[7] Entry for buyout can occur even if the entrant could otherwise become dominant—competition to attain that position could prevent the firm from recovering its entry costs.

[8] Cabral (2020) and Motta and Peitz (2020), for example, find that an entrant might bring a potential innovation to market only if the entrant can cash out through merger.

improve its product are everywhere increased by the possibility of merger. Moreover, this finding does not apply if there is a possibility of *incumbency for buyout,* whereby an incumbent invests in strengthening its competitive position solely to induce the entrant to merge on more favorable terms.

Section V demonstrates that permissive merger policy can raise or lower entrants' marginal innovation incentives. If mergers are allowed, an entrant earns its disagreement profit plus a share of the gains from merger. If mergers are banned (and there are no incumbency-for-buyout effects), then the entrant earns just its disagreement profits. Hence, the effect of permissive merger policy on innovation incentives depends on how a change in the entrant's product quality affects the gains from merger. In general, increasing the entrant's product quality can raise or lower the gains from merger. Hence, an entrant's incentives to invest in quality can rise or fall due to lax merger policy.

The analysis to this point relies on reduced-form profit functions. Sections VI and VII present examples in which product-market competition is explicitly modeled. These examples illustrate how permissive merger policy can harm innovation incentives and that the competitive effects of mergers can be complex and highly fact specific. The first example exhibits same-side network effects, such as arise with social networks. The second example considers a market in which a firm must make a new investment each period in order to be an active seller.

Section VIII considers the possibility of incumbency for buyout. I show by example that, by facilitating incumbency for buyout, permissive merger policy can discourage innovative entry.

Section IX discusses some policy implications of this analysis, and a technical appendix examines a benchmark case of *imitative* entry to compete *in* the market, which serves as a benchmark for the text's model of innovative entry to compete for the market.

II. RELATED LITERATURE

Before turning to the analysis, it is useful to put it in context and discuss related literature. The model presented below is not intended to apply to all Big Tech mergers.[9] It is highly unlikely that the Big Tech incumbents considered each of the hundreds of firms they acquired to be a significant potential competitor, and any given incumbent may have a variety of motives underlying different acquisitions. For example, some commentators are concerned that a digital platform can expand into various industries that rely on it and then create artificial advantages for its subsidiaries while harming competition from rivals to those subsidiaries. Variants of this complaint have been made

[9] At the same time, the economic forces modeled here are not limited to the digital platforms associated with Big Tech. For example, the development and sale of pharmaceuticals may have very large economies of scale and—due to the need for clinical trials—it is possible to identify potential entrants. The model presented here could be interpreted as a market with entry by a succession of firms that invent substitute treatments for a specific disease, where an entry opportunity corresponds to successfully innovating around the incumbent's patents.

against Amazon Basics, Google Shopping, and Apple apps sold on its App Store.[10] My focus is on mergers aimed at preventing successful entry into a firm's core market(s), rather than mergers that allow a firm to expand into other markets. The latter type of merger is more appropriately analyzed using models developed in the literature on vertical mergers. Church (2008) surveys the main theories relevant to vertical mergers, and Slade (2020) surveys empirical studies of the effects of vertical mergers.

Big Tech firms often operate multi-sided platforms, which can have strong implications for the welfare effects of a merger. Recent analyses include Anderson and Peitz (2020) and Correia-da-Silva et al. (2019). Foros et al. (2015) and Jullien and Sand-Zantman (2019) offer surveys of the two-sided merger literature. Below, I abstract away from multi-sidedness and focus on the implications of strong increasing returns.

There has been a long and inconclusive debate regarding the general relationship between horizontal mergers and innovation. See, for example, Baker (2007), Jullien and Lefouili (2018), Katz and Shelanski (2007), and Shapiro (2012), and the papers cited therein. This literature tends to be concerned with the effects of merger on the level of *post-merger* innovation. By contrast, I consider situations in which innovation is necessary to launch an entry attempt, and I focus on the effects that the *prospect* of merger has on *premerger* innovation incentives.

Several recent papers also consider this issue.[11] Cabral (2020), Letina et al. (2020), Motta and Peitz (2020), and Hollenbeck (2020) all find that prohibiting mergers can reduce innovation by reducing entry for buyout. The first three papers all examine models in which additional investment increases the probability that an innovation project is successful but does not affect the outcome conditional on success.[12] Hence, the possibility that merger discourages entrant investment in marginal quality improvements does not arise. Hollenbeck (2020) considers a computational oligopoly model in which entrants' investment decisions do affect their marginal product qualities, but for the functional forms that he utilizes, he finds that the prospect of merger never decreases entrants' innovation levels.

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10 See, e.g., Julie Creswell, "How Amazon Steer Shoppers to Its Own Products," *The New York Times,* June 23, 2018; Jack Nica and Keith Collins, "How Apple's Apps Topped Rivals in the App Store It Controls," *The New York Times,* September 9, 2019; Charles Duhigg, "The Case Against Google," *The New York Times Magazine,* February 20, 2018.

11 With the exceptions of Hollenbeck (2020), these papers examine a single merger in isolation, so the share-dilution effect cannot arise. My finding that there is no share-dilution effect when competition is for the market can be viewed as validating their focus on a single merger.

12 More precisely, in the model of Letina et al. (2020) firms can invest in portfolios of projects, where any given project has three possible outcomes: failure, low success, and high success. Because the levels of low and high success are the same for all projects, and investment levels do not affect the relative likelihood of achieving high rather than low success, the marginal quality incentive effects that I examine are absent.

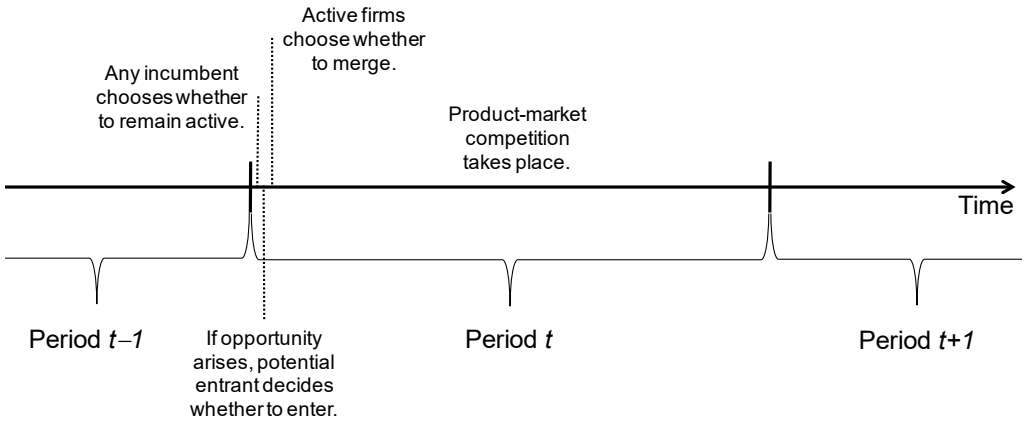
Kamepalli et al. (2020) also examine the effects of merger policy on premerger innovation. They find that permissive merger policy can reduce entrant innovation but for a reason very different than the ones I identify below. Specifically, Kamepalli et al. examine a market subject to network effects in which prospective early adopters shy away from an entrant that they believe will be merged out of existence.

Finally, Bryan and Hovenkamp (2020) examine a model of startup acquisitions by duopoly incumbents in which a startup does not have the ability to enter the market. Although related, the analysis focuses on the effects of exclusive licensing rather than the elimination of a potential Schumpeterian competitor that I examine.

III. THE MODEL

I explore the effects of merger policy by examining Markov perfect equilibria (i.e., subgame perfect equilibria in which players' strategies depend only on the current, payoff-relevant state variables) in the infinite-horizon game illustrated in Figure 1 below. Firms and consumers have a common per-period discount factor, δ. The structure of the game and specific parameter values are common knowledge.

Figure 1: Timing



At the start of each period, any existing incumbent chooses whether to remain active in the market. Then a new potential entry *opportunity* arrives with exogenous probability, $\bar{\rho}$. An opportunity can be thought of as arising due to the discovery of a new generation of product or process technology that is proprietary to the potential entrant. When a new generation arrives, the potential entrant associated with that generation chooses how much to invest in developing the new technology, where greater investment leads to higher quality.

Let $q_k(I)$ denote the quality level obtained for the generation-k technology when the entrant invests I. $q_k(I)$ is assumed to be increasing in k as well as I. To simplify the notation, equate each technological generation with the corresponding period index. That is, generation k refers to the technology that allows entry commencing in period k. This notation implicitly assumes that generations advance over time independently of whether an entry opportunity arises in a particular period and the amounts that entrants have

invested in past generations.[13] Once a given generation of technology has arrived, it does not improve (i.e., for a given k, $q_k(\cdot)$ does not change with the passage of time), and there is only a single entry opportunity any given firm: a firm must either choose to enter when an opportunity arises or otherwise stay out forever.

Conditional on having an entry opportunity and choosing to enter, a generation-l entrant facing an incumbent with product quality q_f chooses investment I to maximize

$$\mathrm{V}_l^E\big(q_f, q_l(I)\big) - I \ ,$$

where $\mathrm{V}_l^E\big(q_f, q_l\big)$ is the expected discounted product-market profits that will be earned by a generation-l entrant with quality q_l facing an incumbent with quality q_f.[14] Assume that that there is a unique optimal investment level conditional on the incumbent's quality, $I_l^E(q_f)$, with associated quality level $q_l^E\big(q_f\big) \equiv q_l(I_l^E(q_f))$. The potential entrant chooses to enter the market if

$$\mathrm{V}_l^E\left(q_f, q_l^E\big(q_f\big)\right) - I_l^E(q_f) \geq 0 \ ,$$

and will stay out of the market otherwise (with $I = 0$). Let $\rho_k^E(q_f)$ denote $\bar{\rho}$ times the conditional probability that entrant with generation-k technology will enter if the opportunity arises and there is a single incumbent having quality q_f.

After the entry decision, any incumbents and the entrant (if there is one) choose whether to merge, which generates a new state of the market. A merger is assumed to take place whenever doing so maximizes the net present value of the merging parties' joint profits. The entry and merger/exit decisions occur sequentially but instantaneously, followed by a production period. The next period repeats this structure.

I consider settings in which, if entry occurs and the incumbent and entrant do not merge, then they compete for the market for one period, after which one of the firms exits the market. The losing firm puts up a fight for one period before exiting because it has a depreciating asset (e.g., consumer brand, installed user base, or plant and equipment) in which the firm stops investing after entry but that has sufficient residual value for the

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[13] This assumption does not drive Proposition 1 below. As will become clear, Proposition 1 depends on the assumption that, conditional on an incumbent's technology, the subsequent evolution of technology and the probabilities of later entry are independent of whether the current monopoly incumbent is the product of a past merger.

[14] There may be additional payoff-relevant state variables (e.g., the size of the incumbent's installed base of users). In such cases, q_f can be interpreted as a vector of state variables. Also note that the value function will generally depend on the merger policy regime.

firm to constrain the winner's pricing for one period.[15] Once the loser has exited the market, it exerts no competitive pressure.[16]

Let $\pi_t^I(q_f, q_l)$ and $\pi_t^E(q_f, q_l)$ denote the per-period profits of the incumbent and entrant, respectively, when they compete for the market in period t with products having qualities q_f and q_l, respectively.[17] One can think of f as standing for "follower" and l standing for "leader" because the entrant relies on the leading technology.[18] After one firm has exited the market, the remaining firm earns $\pi_t^M(q_k)$ per period until the next entry event occurs, where $k \in \{f, l\}$ denotes the winner's technology.

Assume that $\max_I \pi_t^E(q_f, q_l(I)) - I < 0$, so that it is unprofitable to enter the market, lose the competition for the market, and exit. Given this assumption, and because the model is deterministic with respect to product-market competition, entry occurs only if the entrant anticipates either winning the competition for the market or merging.[19]

If entry occurs and the incumbent and entrant merge, then the combined firm earns $\pi_t^T(q_f, q_l)$ in the entry—or "transition"—period given the incumbent's and entrant's product qualities. The transition period reflects lags in redeploying competitive

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15 Section VIII presents an example in which the incumbent may threaten to remain in the market to appropriate a greater share of the gains from merger, but would never remain in the market on the equilibrium path.

16 In this regard, the present model is very different—and often more realistic—than quality-ladder models. In those models, the past generation is assumed to remain a competitive constraint even though the firm makes no sales. See. e.g., Segal and Whinston (2007).

17 The time subscript is necessary to account for situations (e.g., where network effects are present) in which consumers are forward looking and make current consumption decisions based on expectations regarding future market developments.

18 "Quality" can also be interpreted as marginal costs of production, where higher quality corresponds to lower costs. The products may also be horizontally differentiated as long as the differentiation is insufficient to allow to firms to coexist profitably. Moreover, the incumbent may enjoy incumbency advantages that offset it quality disadvantage. For a brief survey of various forms of incumbency advantage, see Biglaiser et al. (2019).

19 A more realistic model would allow for uncertainty regarding the entrant's success in displacing the incumbent. If the entrant and incumbent are symmetrically informed about the entrant's chance of success, then the uncertainty affects the division of rents, but there still are gains from avoiding competition. Hence, Proposition 1 below would still hold as long as the expected gains from merger are larger than any transaction costs of merger and the merger of the current entrant and incumbent does not reduce their joint continuation value when subsequent entry occurs. By contrast, when the firms are asymmetrically informed (e.g., the entrant's costs are private information), bargaining might break down. These issues are best addressed in an explicit, non-cooperative model of bargaining, which is beyond the scope of the present analysis.

assets (e.g., brands, installed bases, or physical plant). The merged firm earns $\pi_t^M(q_k)$ per period in subsequent periods until the next entry event occurs, where $k \in \{f, l\}$ is the technology that the merged firm chooses to adopt going forward. The assumption that the merged firm has to choose one or the other technology is consistent with my focus on effects that arise when mergers do not generate productive efficiencies.

Even absent merger efficiencies, there is private incentive to merge to avoid dissipating profits through competition: both $\pi_t^T(q_f, q_l)$ and $\max_{k\in\{f,l\}} \pi_t^M(q_k)$ are assumed to be larger than $\pi_t^E(q_f, q_l) + \pi_t^l(q_f, q_l)$.

IV. ACQUISITIONS OF EMERGING COMPETITORS: A CASE FOR HEIGHTENED SCRUTINY

As described in the Introduction, to be successful, an entrant needs to amass complementary resources (e.g., users and intellectual property) to overcome any incumbency advantages, and it needs a strong growth trajectory to achieve viable scale. The entrant's need to acquire complementary assets and attain a strong growth may allow an incumbent to identify and acquire a potential rival before it has entered into direct competition with the incumbent, or while the entrant still has a very small share of the market in which the incumbent competes.[20] This possibility challenges the traditional antitrust approach to assessing mergers in the U.S., under which it is difficult to prevail in court when trying to block a merger based solely on the loss of potential future competition.[21] Moreover, the earlier the dominant firm can identify such a rival, the more problematical the outcome is for competition policy—both because the earlier a merger involving a nascent or potential competitor occurs the harder it is to challenge and because such a merger allows the firms more fully to avoid competing.

Although the conditions just described make it particularly difficult for antitrust enforcers to challenge acquisitions, these conditions also make it particularly important that enforcers do so: absent entry and dynamic competition, there will be little competition at all. Moreover—in contrast to when competition is in the market—when competition is for the market, the share-dilution effect does not arise and thus cannot serve as a substitute for antitrust enforcement in limiting inefficient mergers.[22]

The intuition for why the share-dilution effect doesn't limit mergers when competition is for the market is as follows. Suppose that, in the event of merger, the

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[20] By contrast, Cabral (2020) argues that, in digital markets, it is difficult to identify potential rivals and predict market evolution. Also in contrast to Cabral, I assume that the transaction costs of merger (e.g., investment bank fees) are small relative to the expected gains from eliminating competition.

[21] See, e.g., Bush and Massa (2004) and Werden and Limarzi (2010). In addition, the lack of assets or sales may result in a transaction's falling below the thresholds that trigger mandatory notification of antitrust authorities. (See Wollman (2019).)

[22] For analyses of the share-dilution effect when there is competition in the market, see Proposition A.2 in the Appendix below and Marino and Zábojník (2006).

merged entity adopts the entrant's technology. If entry occurs, then after one period, the continuation game looks the same whether or not the entrant and incumbent have merged—either way there will be a single firm, which relies on the entrant's technology. From the perspective of the current incumbent and most recent entrant, the only effect of their merger is to avoid a period of competition to be the dominant firm. If the merged firm would adopt the incumbent's technology, then merger must be even more profitable.

To see this point formally, suppose that mergers are allowed and that the current entrant comes into the market in period l with a quality advantage sufficient for it to win the market if the firms do not merge. Absent merger, the incumbent earns

$$\pi_l^I(q_f, q_l) \tag{1}$$

for one period and then exits the market, while (gross of the entry cost) the entrant earns

$$\pi_l^E(q_f, q_l) + \sum_{j=1}^{\infty}\left\{\left[\left(1-\rho_{l+j}^E(q_l)\right)\pi_{l+j}^M(q_l) + \rho_{l+j}^E(q_l)V_{l+j}^I\left(q_l, q_{l+j}^E(q_l)\right)\right] \times \right.$$
$$\left. \delta^j \prod_{h=0}^{j-1}[1-\rho_{l+h}^E(q_l)]\right\}, \tag{2}$$

where $\rho_l^E(\cdot) \equiv 0$ and $\mathrm{V}_{l+j}^I(q_l, q_{l+j})$ denotes the continuation value that a firm with quality q_l earns as the new incumbent when the next entrant comes into the market in period $l+j$ with quality q_{l+j}. $\pi_l^E(q_f, q_l)$ in expression (2) equals the profits the entrant earns in the entry period. The terms involving $\pi_{l+j}^M(q_l)$ are the discounted profits the current entrant earns in later periods before subsequent entry occurs.

If the current incumbent and entrant merge and adopt the entrant's technology, then they collectively earn

$$\pi_l^T(q_f, q_l) + \sum_{j=1}^{\infty}\left\{\left[\left(1-\rho_{l+j}^E(q_l)\right)\pi_{l+j}^M(q_l) + \rho_{l+j}^E(q_l)V_{l+j}^I\left(q_l, q_{l+j}^E(q_l)\right)\right] \times \right.$$
$$\left. \delta^j \prod_{h=0}^{j-1}[1-\rho_{l+h}^E(q_l)]\right\}. \tag{3}$$

Denote the gains from merger by $G_l(q_f, q_l)$. Comparing the sum of expressions (1) and (2) with expression (3), the only difference is in the first period following entry, when merger allows the firms to avoid competing. Thus, if the merged firm adopts the entrant's technology,

$$G_l(q_f, q_l) = \pi_l^T(q_f, q_l) - \{\pi_l^E(q_f, q_l) + \pi_l^I(q_f, q_l)\} > 0\,. \tag{4}$$

If the merged firm would find it more profitable to retain the incumbent's technology, then $G(q_f, q_l)$ would be larger than the right-hand side of equation (4). A similar argument applies to cases in which the incumbent would prevail absent merger. Hence,

Proposition 1: *When competition is for the market, it is profitable to merge regardless of the rate at which subsequent entrants arrive or firms discount future profits.*

The finding that merger is profitable when competition is for the market is somewhat more general than Proposition 1. The key factors are that: (a) until entry next occurs, the incumbent and current entrant earn greater profits if they are merged than if

they are independent competitors, and (b) their joint continuation value when entry next occurs is not lowered by their merger. The example presented in Section VII below demonstrates that, as long as the incumbent would place no competitive pressure on the subsequent—as opposed to current—entrant, condition (b) is satisfied even if a non-merging incumbent would remain active in the market until the next entry event occurs.

V. MERGER POLICY AND PRODUCT DEVELOPMENT

When entry is profitable only if it leads to merger, the ability to merge must increase investment incentives.[23] Similarly, when entry is profitable only if mergers are prohibited, the ability to merge must decrease investment incentives. To further examine the effects of merger policy on marginal investment incentives, assume in this section that, when entry occurs, it is profitable whether or not the entrant subsequently merges.

Recall that entry is assumed to be profitable absent merger only if the entrant anticipates winning the market. Hence, when mergers are prohibited

$$V_l^I(q_f, q_l) = \pi_l^I(q_f, q_l)\,. \tag{5}$$

Using equation (5), any firm other than the first one to enter the industry earns

$$\begin{aligned} V_l^E(q_f, q_l) &= \pi_l^E(q_f, q_l) + \textstyle\sum_{j=1}^{\infty}\Big\{\Big[\big(1-\rho_{l+j}^E(q_l)\big)\pi_{l+j}^M(q_l) + \rho_{l+j}^E(q_l)V_{l+j}^I\big(q_l, q_{l+j}^E(q_l)\big)\Big] \times \\ &\qquad \delta^j \textstyle\prod_{h=0}^{j-1}[1-\rho_{l+h}^E(q_l)]\Big\} \\ &= \pi_l^E(q_f, q_l) + \textstyle\sum_{j=1}^{\infty}\Big\{\Big[\big(1-\rho_{l+j}^E(q_l)\big)\pi_{l+j}^M(q_l) + \rho_{l+j}^E(q_l)\pi_{l+j}^I\big(q_l, q_{l+j}^E(q_l)\big)\Big] \times \\ &\qquad \delta^j \textstyle\prod_{h=0}^{j-1}[1-\rho_{l+h}^E(q_l)]\Big\}\,. \end{aligned} \tag{6}$$

Next, suppose mergers are allowed and that the incumbent always gets share σ of the gains from merging with the entrant. Then

$$\mathrm{V}_l^I(q_f, q_l) = \pi_l^I(q_f, q_l) + \sigma G_l(q_f, q_l) \tag{7}$$

and

$$\begin{aligned} \mathrm{V}_l^E(q_l, q_f) = \pi_l^E(q_f, q_l) + \textstyle\sum_{j=1}^{\infty}\Big\{\Big[\big(1-\rho_{l+j}^E(q_l)\big)\pi_{l+j}^M(q_l) + \rho_{l+j}^E(q_l)\big[\pi_{l+j}^I\big(q_l, q_{l+j}^E(q_l)\big) + \\ \sigma G_{l+j}\big(q_l, q_{l+j}^E(q_l)\big)\big]\Big] \times \delta^j \textstyle\prod_{h=0}^{j-1}[1-\rho_{l+h}^E(q_l)]\Big\} + (1-\sigma)G_l(q_f, q_l)\,. \end{aligned} \tag{8}$$

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[23] Such entry for buyout occurs when $I_l^E(q_f)$ is greater than expression (2) and less than the sum of expression (2) and the entrant's share of $G_l(q_f, q_l)$.

Comparing the expressions for the entrant's profits—equations (6) and (8)—the difference in the objective function due to a merger is:

$$\Delta_l(q) \equiv (1-\sigma)G_l\left(q_f, q\right) + \sigma \sum_{j=1}^{\infty}\{\rho_{l+j}^{E}(q_l)\, G_{l+j}\left(q, q_{l+j}^{E}(q_l)\right)\delta^j \prod_{h=0}^{j-1}[1-\rho_{l+h}^{E}(q_l)]\}. \quad (9)$$

$\Delta_l(q)$ equals the expected net present value of the sum of the entrant's share of the gains from merger with the incumbent, $(1-\sigma)G_l\left(q_f, q\right)$, and its share of what would have been the gains from merger with a subsequent entrant had it not merged with the original incumbent, $\sigma\, G_{l+j}\left(q, q_{l+j}^{E}(q_l)\right)$. That latter term arises because it is a component of the entrant's disagreement payoff with respect to the initial merger with the incumbent.

The effect of merger on the entrant's investment incentives depends on the derivative of $\Delta_l(q)$, which in turn depends in part on how $G_l\left(q_f, q\right)$ and $G_{l+j}\left(q, q_{l+j}\right)$ vary with q. In general, G_j is non-monotonic in the quality levels. For example, $G_j(q_h, q_k) = 0$ if the quality of the entrant's product quality, q_k, is too low for the entrant to place competitive pressure on an incumbent with quality q_h or is so high that the incumbent does not place competitive pressure on the entrant and the merged firm would not choose to adopt the incumbent's technology.[24] This fact strongly suggests that the effects of merger on marginal innovation incentives are ambiguous. The derivative of $\Delta_l(q)$ also depends on how the entrant's choice of quality affects decisions by later potential entrants with respect to entry probabilities and investments in quality (i.e., terms of the form $\rho_{l+j}^{E}(q_l)$ and $q_{l+j}^{E}(q_l)$). Models that consider a single merger in isolation and only an all-or-nothing innovation project miss these effects.

Given these complexities, it is useful to look at explicit examples of product-market competition in order to identify possibilities and say more about welfare effects.

VI. AN EXAMPLE WITH NETWORK EFFECTS

The first example is of a market subject to network effects in which competing networks are incompatible. In keeping with the assumption that there are no production efficiencies from merger, assume that, even if an incumbent and an entrant merge, the incumbent's existing users cannot be migrated to the entrant's network and the incumbent's existing network cannot be upgraded to the entrant's quality. A merged firm must choose between adopting the entrant's technology and stranding existing users, or retaining the incumbent's network and not using the entrant's technology.

Each consumer lives for two periods, and any given consumer purchases at most one subscription to a network. Each period, a unit mass of consumers enters the market, and each consumer chooses whether to subscribe to a network for two periods. I assume that a consumer cannot choose to wait one period before making a purchase. Hence, at any given time, half of the consumers in the market are choosing a network.

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[24] Bryan and Hovenkamp (2020, pp. 618, 630) note a similar effect with respect to the two incumbents in their model.

A consumer enjoys per-period gross consumption benefits of $q\beta(m) - p$, where q is the chosen network's quality, m is the network's size or "member" base, and $\beta(m)$ is the network benefit function, which is increasing with $\beta(0) = 0$.

When choosing a network, a consumer must forecast the sales of any currently available network in each period of his or her life. Consumers are forward looking and account for the possibility of entry in the second period of their lives. I assume that, if there are two firms actively selling output, consumer expectations "track quality" in that consumers expect the higher-quality network to win all of the sales in any given period (if qualities are equal, consumers expect the incumbent to win). This expectations process is very favorable to innovative entry because any degree of product superiority neutralizes the incumbent's installed base advantage.[25]

A. PRODUCT-MARKET EQUILIBRIUM

Consider the product-market equilibrium when an entrant with quality q_l competes against an incumbent with quality q_f, where $q_l < q_f$. Because expectations track quality, consumers always expect the incumbent to win the future sales. Thus, the entrant can never obtain a user-base advantage over the incumbent (in future periods, at best, the entrant could have an installed base equal to 1 and the incumbent would be projected to win current sales, giving it a projected base of 1 as well). Given that the incumbent is willing to price at least as low as zero to win sales, the entrant can never win sales at a positive price. Hence, entry with $q_l < q_f$ is never profitable.

Next, suppose $q_l > q_f$. In the entry period, the incumbent has an installed base equal to 1—the previous cohort of consumers who are in the second year of their lives. However, because consumer expectations track quality, consumers currently making purchases do not expect the incumbent to make any future sales.[26] The incumbent thus offers a new consumer expected gross consumption benefits equal to $q_f\beta(1)$.

The entrant has no installed base but has a projected base equal to 1 in the entry period due to its superior quality and the consumer expectations process. Consumers also form projections of the entrant's user base in the next period. To simplify the analysis, assume that each subsequent generation of technological opportunity is a sufficient

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[25] There are, of course, other possible assumptions regarding consumer expectations. Farrell and Katz (1998 and 1990) identify several alternatives, including ones in which a network is focal for consumers if it: (a) charges a lower price; or (b) was the dominant network in the previous period. Or an entrant might need a quality that exceeds the incumbent's by a threshold amount before consumers expect other consumers to purchase from it. Under any of these processes, having a higher-quality product weakly facilitates entry and competition generally dissipates profits. For a recent analysis based on focal consumer expectations, see Halaburda and Yehezkel (2019).

[26] As will become evident, any network of an earlier generation that does not currently have an installed base of users neither earns profits nor affects the product-market outcome.

improvement over earlier ones that entry always occurs when an opportunity arises: $\rho_j^E(q_l) = \bar{\rho}$ for all $j \geq l$.[27]

Suppose mergers are prohibited. If there is no entry next period, then the current entrant will have a user base equal to 2. If there is entry next period, then the current entrant is expected to have a future user base equal to 1 because the next entrant will have a superior product. Hence, the current entrant offers a new consumer expected gross consumption benefits equal to $q_l\{\beta(1) + \delta\hat{\beta}\}$, where $\hat{\beta} \equiv \bar{\rho}\beta(1) + (1-\bar{\rho})\beta(2)$.

When mergers are allowed, consumers recognize that they will not be stranded if entry occurs next period but the entrant merges with the incumbent and the merged firm uses the incumbent's technology. Let $\gamma_t(q)$ denote the probability that, conditional on entry in period t and the incumbent's having quality q, the resulting merged firm will use the incumbent's technology. When mergers are permitted, a firm with quality q offers a new consumer expected gross consumption benefits equal to

$$\hat{\beta}_t(q) \equiv \bar{\rho}[1-\gamma_t(q)]\beta(1) + \{1-\bar{\rho}[1-\gamma_t(q)]\}\beta(2) \ .$$

Note that $\hat{\beta}_t(q) \geq \hat{\beta}$, with strict inequality whenever $\gamma_t(q) > 0$. The analysis will restrict attention to equilibria in which consumer expectations are fulfilled.

Now consider consumers' purchase decisions. If mergers are allowed but the *current* entrant and incumbent do *not* merge, then consumers in the entry-period cohort choose the entrant's product if and only if

$$q_l\{\beta(1) + \delta\hat{\beta}_{l+1}(q_l)\} - p_l \geq q_f\beta(1) - p_f \ , \qquad (10)$$

where p_j is the price charged by a network that offers the generation-*j* product. The incumbent would be willing to charge a price below 0 only if it could later charge a positive price. However, if a negative price is needed to win in this period (when the incumbent has an installed base of users), then a negative price would also be needed to win in every subsequent period, when the incumbent would face either the current entrant or a subsequent entrant having an even-higher-quality product. Hence, the incumbent will price as low as 0, but no lower, to win sales. By inequality (10), the entrant can profitably win sales even if $p_f = 0$. Therefore, in equilibrium, the entrant wins all of the sales in the period in which it enters, with

$$p_l = (q_l - q_f)\beta(1) + \delta q_l\hat{\beta}_{l+1}(q_l) \ .$$

Because the two cohorts of users are split across the two networks, the resulting gross consumption benefits are equal to $\{q_l + q_f\}\beta(1)$.

Next consider the periods that follow period l but are prior to the period in which entry next occurs. The previous incumbent (generation *f*) has an installed base of 0 and consumers do not expect the firm to make future sales. Given $\beta(0) = 0$ and its unwillingness to price below zero, the previous incumbent offers consumers no surplus

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[27] Although much stronger than necessary, $q_{k+1}(0) > q_k(I)$ for all k and I is a sufficient condition.

and, thus, places no constraint on the entrant's pricing beyond that already imposed by consumers' option to purchase nothing. When selling in period t, the most recent entrant has expected network benefits in the next period equal to $\hat{\beta}_{t+1}(q_l)$. Consumer cohorts making purchase decisions in these periods thus choose the recent entrant's product if and only if $q_l\{\beta(2) + \delta\hat{\beta}_{t+1}(q_l)\} - p_l \geq 0$, and the entrant makes sales at $p_l = q_l\{\beta(2) + \delta\hat{\beta}_{t+1}(q_l)\}$. Because all users are on the generation-l network, gross consumption benefits are equal to $2q_l\beta(2)$ per period.

If mergers are banned, a similar analysis applies but with terms of the form $\hat{\beta}_t(q_l)$ replaced by $\hat{\beta}$. In summary,

Proposition 2:

(i) Suppose that mergers are permitted, but the current entrant and incumbent do not merge. Then the continuation equilibrium has the following form:

(a) in the entry period, the entrant wins all of the sales at a price of $(q_l - q_f)\beta(1) + \delta q_l\hat{\beta}_{l+1}(q_l)$ *and gross consumption benefits are equal to* $\{q_l + q_f\}\beta(1)$*; and*

(b) in subsequent periods prior to the next entry event, the generation-l *entrant wins all of the sales at a price equal to* $q_l\{\beta(2) + \delta\hat{\beta}_{t+1}(q_l)\}$ *and gross consumption benefits are equal to* $2q_l\beta(2)$ *per period.*

(ii.) If mergers are prohibited, then the same results hold with $\hat{\beta}$ *replacing* $\hat{\beta}_{l+1}(q_l)$.

Now suppose that mergers are permitted and the current entrant and incumbent merge.[28] Recall that the incumbent's existing users cannot enjoy the benefits of the entrant's higher-quality technology.[29] The merged firm must choose whether to: (1) maintain two separate networks for one period and shut down the network based on the older technology at the end of the transition period,[30] or (2) have new cohorts of consumers join the incumbent's network even though the entrant's network could offer higher quality.

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28 Firms either merge immediately or never merge. If the firms waited one period, there would be no gains from merger because the incumbent would be competitively irrelevant.

29 It is readily shown that, if an acquisition allowed the merged firm to utilize the entrant's higher-quality product to serve the incumbent's installed base, then permissive merger policy would increase profits and total surplus but reduce expected consumer surplus given the other assumptions of this example. Merger always increases total surplus here because the rate of entry is independent of merger policy and there is no margin for welfare losses due to inefficient under-consumption triggered by monopoly pricing. Under different assumptions, permissive merger policy could reduce total surplus even if the entrant's quality diffuses to the incumbent's user base under merger.

30 I assume that contractual obligations or reputational concerns deter the firm from immediately shutting down the incumbent network.

Straightforward calculations establish:

Proposition 3: *Suppose mergers are permitted and the current entrant and incumbent merge.*

(i.) If the merged firm operates both networks during the entry (or transition) period and shuts down the network utilizing the older technology at the end of that period, then in the continuation equilibrium:

(a) in the entry period, the merged firm makes sales on the new network at a price of $q_l\{\beta(1) + \delta\hat{\beta}_{l+1}(q_l)\}$ *and gross consumption benefits are* $\{q_l + q_f\}\beta(1)$*; and*

(b) in the subsequent periods prior to the next entry event, the merged firm makes sales on the new network at a price of $q_l\{\beta(2) + \delta\hat{\beta}_{t+1}(q_l)\}$ *and gross consumption benefits are* $2q_l\beta(2)$ *per period.*

(ii.) If the merged firm operates a single network using the older technology, then in the continuation equilibrium the merged firm makes sales at a price of $q_f\{\beta(2) + \delta\hat{\beta}_{t+1}(q_f)\}$ *and gross consumption benefits are* $2q_f\beta(2)$ *in the entry period and all subsequent periods prior to the next entry event.*

Propositions 2 and 3 demonstrates that, in this example, for $q_l > q_f$,

$$\pi_t^I(q_f, q_l) = 0,$$

$$\pi_t^E(q_f, q_l) = (q_l - q_f)\beta(1) + \delta q_l\hat{\beta}_{t+1}(q_l),$$

$\pi_t^T(q_f, q_l) = q_f\{\beta(2) + \delta\hat{\beta}_{t+1}(q_f)\}$ *if the merged firm retains the old technology,*

$\pi_t^T(q_f, q_l) = q_l\{\beta(1) + \delta\hat{\beta}_{t+1}(q_l)\}$ *if the merged firm utilizes the new technology,*

and

$$\pi_t^M(q_k) = q_k\{\beta(2) + \delta\hat{\beta}_{t+1}(q_k)\},$$

which satisfy the reduced-form profit assumptions in Section III above.

The conditions of this example are favorable to entry. When mergers are prohibited, every firm chooses to enter given the opportunity and is an active producer for two periods. Hence, much of the time the industry is subject to product-market competition if $\bar{\rho}$ is near 1. Proposition 1 implies that, by contrast, if mergers are freely allowed, then entry is immediately followed by merger, and there are no periods of product-market competition—the favorable entry conditions alone cannot protect product-market competition.

B. Inefficient Entry and Killer Acquisitions

The favorable entry conditions can, however, promote the introduction of innovative new technologies. Given the assumed nature of consumer expectations, even

a minor innovation can allow the entrant to appropriate a large fraction of the monopoly profits. As a result, there can be socially excessive entry.[31]

One situation in which this arises is when entry occurs and the merged firm uses the older technology: The only effect of entry on total surplus is to reduce it by the amount the entrant invests to develop its product. In some respects, the outcome in which the merged firm operates a single network using the older technology is similar to what is known in the pharmaceutical industry as a "killer acquisition," where an incumbent buys a new drug but never introduces it to the market.[32] By contrast to pharmaceutical markets, however, there can be consumer and efficiency benefits of sticking with the older technology in order avoid the loss of network benefits that arises when users are spit across networks. In fact, firms may fail to stick with the older technology when doing so would be efficient.[33]

Suppose two firms have just merged and are deciding which technology to adopt going forward. The private cost to the merged firm from splitting the current cohorts is equal to the loss in the consumer benefits it is able to appropriate: $q_f\{\beta(2) - \beta(1)\}$. By contrast, the social cost from splitting the cohorts is $2q_f\{\beta(2) - \beta(1)\}$. The difference arises because the firm does not internalize the losses suffered by consumers who are in the second half of their lives during the transition period.

One also needs to account for the effects of the quality choice on profits in future periods. Adoption of the new technology generates gross consumption benefits prior to the next entry event, which the merged firm fully appropriates in expected value: the firm charges $q_l\{\beta(2) + \delta\hat{\beta}_t(q_l)\}$ instead of $q_f\{\beta(2) + \delta\hat{\beta}_t(q_f)\}$. This effect induces no bias.

Adoption of the new technology also improves the merged firm's bargaining position with respect to the next entrant: that entrant's non-merger profits are decreasing in the merged firm's quality. This bargaining effect is a purely private benefit.

The net effect of the first three components is to bias the firms toward adopting the new technology. However, there may be an effect running in the opposite direction: by adopting the new technology, the current firm may generate surplus for the next entrant because, when the current firm merges with that entrant, the new merged firm will have a more attractive option when deciding whether to use the current firm's network.

When δ is sufficiently small, failure to internalize the consumer losses due to stranding dominates, and the current incumbent and entrant are biased toward adopting the new technology. Although allowing mergers may prevent inefficient stranding in this case and others, it is an open question whether, in still other cases, merged firms can be

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31 Of course the possibility of excessive entry is not dependent on the presence network effects. Proposition A.1 in the Appendix finds entry for buyout in a setting in which there are no network effects and an entrant's and incumbent's technologies are identical.

32 Cunningham et al. (2019).

33 Farrell and Saloner (1986) first examined the possibility of inefficient adoption of a new, incompatible network, which they labeled "excess momentum."

biased toward the old technology. And even when it avoids inefficient stranding, a merger harms consumers through the loss of competition in the transition period.

C. MERGER POLICY AND ENTRANT INNOVATION

In addition to showing that killer acquisitions can sometimes be efficient, the network effects example illustrates that the option to merge can raise or lower the entrant's marginal investment incentives. First, suppose that the merged firm adopts the entrant's technology. Then, by Propositions 2 and 3,

$$G_l(q_f, q) = \pi_l^T(q_f, q) - \pi_l^E(q_f, q) = q_f\beta(1) .$$

Similarly, if the *next* merger leads to adoption of the then-new technology,

$$G_{l+j}(q, q_{l+j}) = q\beta(1).$$

Recall that, in this example, $\rho_{l+j}^E(q_l) = \bar{\rho}$ for all $j > 0$. Hence, by equation (9), when merged firms always adopt the newer technology,[34]

$$\Delta_l(q) = (1-\sigma)q_f\beta(1) + \sigma q\bar{\rho}\mu\beta(1)$$

and

$$\Delta_l'(q) = \sigma\bar{\rho}\mu\beta(1) > 0 ,$$

where $\mu \equiv \frac{\delta}{1-\delta+\delta\bar{\rho}}$.

Anticipation of the *initial* merger has no effect on the entrant's *marginal* investment incentives; the gains from that merger arise because consumers do not get the surplus that the incumbent would have offered them as an independent competitor, and this amount does not depend on the entrant's quality. However, for the same reason, an increase in the current entrant's product quality does raise the gains from the merger with the *next* entrant if the current entrant does not merge with the incumbent. The current entrant's anticipation of sharing the increased gains from a future merger raises its product-development incentives. The same argument applies to the first firm to enter the industry because it anticipates merging with a later entrant.

Now, suppose that the *current* merged firm retains the incumbent's technology but again assume that, when the *next* entry event occurs, the resulting merged firm will adopt the technology of *that* entrant. Given the latter assumption, $G_{l+j}(q, q_{l+j}) = \beta(1)q$ and $\hat{\beta}_t(q) = \hat{\beta}$ for all t from the entry period until the next entry event. As in the case just considered, an increase in the entrant's product quality raises the gains from the merger that would take place between the current entrant and the next entrant if the former did not merge, which raises the entrant's disagreement profits. Now, however, the gains to the initial merger, $G_l(q_f, q)$, are decreasing in q. Intuitively, the higher is the

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[34] The profitability of adopting the new technology increases relative to the profitability of adopting the old technology when technological progress is more rapid, δ is larger, and/or $\beta(2) - \beta(1)$ is smaller.

entrant's product quality, the greater the opportunity cost of not using it. Formally, the effects can be broken into three components using Propositions 2 and 3. First, the gains from the initial merger realized during the transition period,

$$g_l^T(q_f, q) \equiv q_f\{\beta(2) + \beta(1) + \delta\hat{\beta}\} - q\{\beta(1) + \delta\hat{\beta}\},$$

are decreasing in the entrant's quality. So too are the merger's effects on the profits earned in each subsequent period prior to the next entry event,

$$g_t^M(q_f, q) \equiv \{q_f - q\}\{\beta(2) + \delta\hat{\beta}\} \ .$$

Third, because the merged firm adopts the incumbent's technology, the gains to the *current* merger arising from effects on the gains to agreement associated with a *subsequent* merger, $g_{l+j}^S(q_f, q) \equiv \beta(1)(q_f - q)$ are decreasing in q.

Using the fact that $\rho_{l+j}^E(q_l) = \bar{\rho}$ for all $j > 0$,

$$\Delta_l(q) = (1-\sigma)\{g^T(q_f, q) + (1-\bar{\rho})\mu g^M(q_f, q) + \bar{\rho}\mu g^S(q_f, q)\} + \sigma\bar{\rho}\mu\beta(1)q \ .$$

Differentiating and collecting terms,

$$\Delta_l'(q) = \{(2\sigma - 1)\bar{\rho}\mu - (1-\sigma)\}\beta(1) - (1-\sigma)\delta\{1 + (1-\bar{\rho})\mu\}\hat{\beta} - (1-\sigma)(1-\bar{\rho})\mu\beta(2) \ . \qquad (11)$$

The right-hand side of (11) is negative for any $\sigma \leq 0.5$ or when $\sigma < 1$ and δ is sufficiently close to 0.[35]

Summarizing this discussion:

Proposition 4: *When product-market competition exhibits network effects, permitting mergers: (a) can increase an entrant's product-development incentives when the merged firm adopts the entrant's technology; and (b) can reduce an entrant's product-development incentives when the merged firm retains the incumbent's technology.*

VII. AN EXAMPLE WITH PER-PERIOD FIXED COSTS

Next, consider a market in which there are no network effects but, at the start of each period, a firm must incur a fixed cost of F in order to be an active producer in that period. An incumbent's investment decision for each period is made before that period's entry opportunity arises. A new entrant sinks its initial per-period investment at the same time that it makes its one-time entry investment, I. For simplicity, assume there are constant marginal costs of production, which are subsumed in the demand function.

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[35] As can be seen from Proposition 3, choosing the incumbent's technology may raise profits in the transition period but it lowers them in subsequent periods. Hence, the set of parameter values for which the merged firm will make that choice gets larger as δ falls.

Suppose there is no horizontal product differentiation and all consumers identically value vertical quality improvements, so that all consumers choose the same product in any period. Let $X = q_i - p_i$ denote the per-period market demand function, where i is the index of the active producer offering the lowest quality-adjusted price, $p_i - q_i$. Any firm not charging the lowest quality-adjusted price makes no sales.

Consider a single incumbent with quality q_f facing an entrant with quality q_l.[36] If $q_l \geq 2q_f$, the entrant's innovation is drastic (i.e., the current incumbent provides no competitive constraint even if it sets its nominal price at 0). In this case, the firms have is no incentive to merge, and the incumbent will make no further investments. Until the next entry event occurs, the current entrant earns profits of

$$\pi^M(q_l) \equiv \tfrac{1}{4} q_l^2 - F \tag{12}$$

per period. If $q_l \in (q_f, 2q_f)$, the entrant's innovation is non-drastic. If the firms do not merge and the next entry event has not yet occurred, then the current entrant earns

$$\pi^C(q_f, q_l) \equiv q_f(q_l - q_f) - F \tag{13}$$

in each period that the incumbent remains active and $\pi^M(q_l)$ per period if the incumbent has dropped out. Whether or not it remains active, the incumbent makes no sales in any period following entry. Assume that $\pi^C(q_f, q_l) > 0$, so that the current entrant would find it profitable to pay the per-period fixed cost even if it anticipated the incumbent's doing so as well.

If there is no possibility of merger, then the incumbent never invests F after entry has occurred and, thus, is a competitive constraint at most during the transition period. But suppose that merger is allowed. If the firms merge, they jointly earn product-market profits $\pi^M(q_l)$ in each period until the next entry event. The gains from merger depend on what the incumbent would do absent merger. In the network-effects example above there is nothing that an incumbent can do to remain competitively relevant after the entry period because consumer's perceived value of its product falls. By contrast, in the present example, an incumbent chooses whether to remain a competitive constraint (i.e., whether to invest F), which raises the possibility that an incumbent might sink F solely to induce the current or later entrants to pay it more to merge. That is, an incumbent might engage in *incumbency for buyout.*

To avoid some of the complications associated with such strategies, assume that the *next* entry event after the current one will entail a drastic innovation relative to the current incumbent (and possibly to the current entrant as well). This assumption implies that the presence of the incumbent as an independent firm would have no effect on the subsequent entrant's incentives, and as an independent firm the current incumbent would have no ability to extract rents from any later entrant. Hence, merging does not give rise

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[36] Technology is assumed to advance sufficiently slowly relative to the discount rate that the net present value of industry profits is finite.

to a share-dilution effect. It follows that the incumbent and current entrant will merge to avoid dissipating rents in one or more periods until the next entry event occurs.

There remains the issue of the acquisition price. The cooperative-game-theoretic approach to bargaining with respect to the merger is problematical because the disagreement payoffs are not obvious when F is sufficiently small relative to $\pi^M(q_l) - \pi^C(q_f, q_l)$. Depending on what the incumbent would do off the equilibrium path absent merger, the gains from merger could range from $\pi^M(q_l) - \pi^C(q_f, q_l)$ (when the incumbent drops out after the initial entry period)[37] to $\frac{\pi^M(q_l) - \pi^C(q_f, q_l) + \delta F}{1 - \delta - \delta\bar{\rho}}$ (when both the incumbent and entrant invest in remaining in the market as long as they have not merged and there has been no subsequent entry in any previous period). But regardless of the acquisition price, the firms have incentives to merge, and a merger reduces consumer and total surplus by eliminating transition-period competition.

The value of the acquisition price can, however, affect an entrant's product-development incentives. Suppose that a firm has an opportunity to enter using the generation-l technology and face an incumbent with product quality q_f. Moreover, suppose that technological opportunities are such that $q_l(I) \in (q_f, 2q_f)$ for all I, and with probability one an entry opportunity will arise in period $l+1$ with $q_{l+1}(I) > 4q_f$ for all I. Under these assumptions, the gains from a merger between the incumbent and the generation-l entrant equal the increase in profits from the elimination of competition in the entry period. After that, a new firm will enter and displace the merged firm with a drastic innovation, which eliminates any incentive for a further merger. Hence, $\Delta_l(q) = (1-\sigma)\{\pi^M(q) - \pi^C(q_f, q)\}$. Differentiation yields $\Delta_l'(q) = \frac{1}{2}(1-\sigma)\{q - 2q_f\}$, which is negative given that $q_l(I) < 2q_f$. Intuitively, the entrant chooses a higher product quality when mergers are banned because the possibility of merger leads the entrant to put weight on the effects of its innovation on monopoly profits, which are less sensitive to the entrant's quality than are the profits the entrant earns when competing with the incumbent.

In summary:

Proposition 5: *When there is undifferentiated Bertrand product-market competition, permitting mergers can reduce an entrant's product-development incentives even when its technology is adopted by the merged firm.*

VIII. INCUMBENCY FOR BUYOUT

As long as an incumbent's actions conditional on not merging are independent of whether mergers are permitted, the option to merge weakly increases an entrant's profits. Hence, in this case, allowing mergers encourages innovative entry, and there can be situations in which entry is profitable only if entry for buyout is feasible. But the finding that the option to merge can only increase an entrant's profits does not apply if there is a

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[37] This case gives rise to payoffs satisfying the assumptions in Section III above.

possibility that the incumbent can engage in conduct to appropriate a larger share of the post-entry profits through merger. As the following example shows, by facilitating *incumbency* for buyout, permissive merger policy can discourage innovative entry.

The structure of this example is the same as the one in the previous section, with three differences.[38] First, $F = 0$, so there is no issue of the incumbent's dropping out in future periods. Second, whenever an entry opportunity arises, it is drastic: $q_l \geq 2q_f$. Third, if entry occurs, an incumbent can make a one-time, sunk investment of Z that allows it partially to imitate or catch up to the entrant, with resulting quality level q_f^Z, where $q_l \in \left(q_f^Z, 2q_f^Z\right)$. The incumbent can imitate only the next entrant to arrive. The choice of investing Z is made after entry but before any merger discussions. There are gains from merger if and only if the incumbent invests Z.

The incumbent has no incentive to invest Z if mergers are prohibited—once entry has occurred, the incumbent makes no sales whether or not it invests Z. But when mergers are allowed, the incumbent may find it profitable to invest Z to induce the entrant to merge and share some of the post-entry profits. Investing Z lowers the current entrant's profitability, but the probability of later entry is unaffected in this example because the current incumbent is irrelevant as a standalone firm and neither the entrant's nor merged firm's costs are affected.[39] Conditional on entry's occurring, the incumbent's investment has no effect on either gross consumption benefits or consumer welfare. For any given stream of entry events, the net present value of industry profits is less when mergers are allowed than when they are banned; the difference is the net present value of the rent-seeking investments in Z. It follows that there must be at least some entry events that are less profitable when mergers are allowed than when they are banned.[40]

Summarizing the discussion of this section,

Proposition 6: *Depending on the specifics of the market, banning mergers may: (a) reduce innovation by preventing entry for buyout, or (b) promote innovation by preventing incumbency for buyout that would otherwise deter entry.*

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38 Permissive merger policy can discourage innovative entry in the example in Section VII if acquisition prices are based on the belief that the incumbent will sink F in future periods if the firms have not yet merged. Intuitively, in the periods after the entry period but before the next entry event, the current entrant has to share $\pi^M(q_l)$ with the incumbent rather earning it all itself. I consider the modified example in the text to avoid the issue of multiple equlibria based on beliefs regarding moves off the equilibrium path.

39 When the incumbent invests Z, this example does not meet Section III's assumption that the entrant's profits after the competitive period and the merged firm's profits after the transition period are equal when the merged firm adopts the entrant's technology. However, because merger does not affect the sum of the incumbent's and entrant's continuation values at the next entry event, Proposition 1 still holds.

40 It is difficult to say more with a non-stationary innovation process.

This example only scratches the surface of actions an incumbent could take to improve its bargaining position. Here, the investment takes place only after entry has occurred. An incumbent might also make pre-entry investments designed to appropriate rents should entry occur. Such investments might also affect the probability that entry occurs at all. An interesting line of future research would examine how the possibility of merger affects an incumbent's pre-entry investments, which can serve both to deter entry and to extract rents should entry occur.

Although the example presented above is very specific, it is sufficient to establish the general point that arguments that permissive merger policy supports innovation are too simple: banning acquisitions can, at least in theory, increase or decrease innovative entry. Moreover, as discussed above, entry incentives can be socially excessive, so that, promoting additional innovation does not necessarily promote greater total surplus.

IX. IMPLICATIONS FOR MERGER POLICY

It is often argued that, under Schumpeterian competition, a firm that appears to be dominant today based on its market share may actually face strong competitive pressures from the threat of being displaced by an innovative entrant with little or no current share.[41] Rather than indicating that dominance is not a concern, the importance of innovative entry as a driver of market performance provides a rationale for paying increased attention to harm to emerging or potential competition when assessing acquisitions by incumbents in such markets: acquisition of a firm that does not yet have a substantial—or even any share—of the incumbent's immediate product market may nonetheless substantially harm future competition. Moreover, competition authorities should be wary of claims that the threat of future entry ensures that merger is profitable only if it generates procompetitive efficiencies. As shown above, due to the absence of a share-dilution effect, successive acquisitions are especially likely to constitute a profitable strategy for avoiding Schumpeterian competition.

It is also often argued that mergers facilitate innovation by allowing entry for buyout. The analysis above, however, demonstrates that the possibility of merger can have positive or negative effects on entrants' innovation incentives. Hence, in some instances, blocking mergers will promote both dynamic and static efficiency, rather than sacrificing the former for the latter.

Several recent reports address competition policy toward large digital platforms. They generally call for heightened scrutiny of acquisitions by dominant firms in markets with strongly increasing returns to scale, innovation, and competition for the market, especially with regard to acquisitions of potential or nascent competitors.[42] The analysis

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41 See, e.g., Evans and Schmalensee (2002), who make this point but do not argue for lax merger policy.

42 See, e.g., Crémer et al. (2019, p. 11 and Chapter 6), Furman et al. (2019, pp. 12, 95-96, and 98-99), and Stigler Committee on Digital Platforms (2019, pp. 16-17, 32-33, and 111-112).

of the present paper broadly supports these proposals.[43] It does not follow, of course, that all mergers in industries with these characteristics should be banned; some mergers generate production efficiencies or promote innovation.

Unfortunately, the competitive and welfare effect of mergers in markets subject to Schumpeterian competition can be very difficult to assess. As the various examples above make clear, the welfare effects of a merger can be highly dependent on detailed features of the market. Although there are many (appropriate) calls to focus on innovation effects and to take a forward-looking view of competitive effects, neither is easy to do.[44] U.S. courts' skepticism toward merger challenges based on alleged harm to potential competition increases the difficulty.[45]

As Werden and Limarzi (2010) have pointed out, the assessment of a proposed merger always requires projecting the likely future competition between the merging parties absent the merger. Indeed, the *U.S. Horizontal Merger Guidelines* describe themselves as applying to "mergers and acquisitions involving actual or potential competitors".[46] The *Guidelines* further state that:

> A merger between an incumbent and a potential entrant can raise significant competitive concerns. The lessening of competition resulting from such a merger is more likely to be substantial, the larger is the market share of the incumbent, the greater is the competitive significance of the potential entrant, and the greater is the competitive threat posed by

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43 It also supports the conclusion that merging parties should not be exempted from notifying antitrust authorities based on having low current sales and/or market share. Furman et al. (2019, pp. 12 and 94-95) and Stigler Committee on Digital Platforms (2019, p.16) express concern with underreporting. The U.S. Federal Trade Commission has recently requested information on past un-notified acquisitions by major tech firms (U.S. Federal Trade Commission, "FTC to Examine Past Acquisitions by Large Tech Firms: Agency Issues 6(b) Orders to Alphabet Inc., Amazon.com, Inc., Apple, Inc., Facebook, Inc. Google, Inc., and Microsoft Corp.," press release, February 11, 2020), and the European Commissioner for Competition has stated that the European Commission is developing means for screening smaller acquisitions by Big Tech (Arjun Kharpal, "EU says it will look closer at smaller acquisitions made by big tech firms after 'shopping spree,'" CNBC, February 18, 2020, *available at* cnbc.com, accessed March 13, 2020).

44 For examples of such proposals and some discussion of the difficulties of implementing them, see, Crémer et al. (2019, Chapters 6.C and 6.E.2), Furman et al. (2019, pp. 12 and 95-96, and 98-99), and Stigler Committee on Digital Platforms (2019, pp. 88-89).

45 For discussions of relevant cases, see, e.g., Bush and Massa (2004) and Werden and Limarzi (2010).

46 U.S. Department of Justice and the Federal Trade Commission, "Horizontal Merger Guidelines," issued August 19, 2010, *available at* https://www.justice.gov/atr/horizontal-merger-guidelines-08192010, p. 1.

this potential entrant relative to others.[47]

However, predicting "the competitive significance of the potential entrant"—both in absolute terms and relative to other potential entrants—can be very difficult. There might be several firms that could be claimed to be potential entrants, which raises the question of whether incumbents and antitrust enforcers can identify particularly promising potential or nascent competitors. Current revenues or market shares may be of little use in determining whether a firm currently having little or no market presence would—in the absence of a merger—grow to be a meaningful competitor. Looking at share growth rates may be more useful in some cases (e.g., when there is evidence that a firm with a small share is growing rapidly and that the growth can be expected to continue).[48] Consumers' views of an emerging competitor's product might also be helpful. When network effects are present, for example, it would be useful to know if the firm benefits from favorable consumer expectations regarding its network size.

One might reasonably expect incumbents to be more able than antitrust enforcers to identify competitive threats. The acquisition price might thus serve as a basis for predicting competition effects.[49] First, a high acquisition price indicates that the acquired firm possesses valuable assets, which tends to indicate that it has stronger prospects of being a meaningful competitor, all else equal. Second, an acquisition price that appears to be high relative to some other measure of the value of the assets (e.g., the value of the increased quality that the acquirer's product would enjoy as a result of the acquisition) may indicate that the acquirer is paying a premium to eliminate future competition.[50] Assessing an acquisition price in this second way is tantamount to applying the *no economic sense test,* which is often used as the standard for evaluating potentially exclusionary conduct: if the merger would be unprofitable but for the elimination or weakening of a rival, then the merger would be blocked.[51] Here, too, network effects can complicate matters. One might argue that any acquisition in which the acquirer does not utilize the acquired assets is anticompetitive; but as noted in Section VI.B, even a killer acquisition can, in some circumstances, promote efficiency by avoiding user stranding.

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47 Id., p. 18.

48 Some might argue that the rapid growth of a recent entrant implies that entry is easy and there thus is no need to be concerned with the acquisition of such a firm. This argument is incorrect. A central barrier to entry may be getting a positive feedback cycle started even though in those (rare) instances when it gets going, growth is rapid. It is precisely because there are rare events where a currently small firm has a chance to become that market leader that one should be concerned with mergers in this setting.

49 See, also, Stigler Committee on Digital Platforms (2019, pp. 88-89).

50 Hemphill and Wu (2020) also recommend looking at the parties' business documents to determine an acquisition's rationale.

51 See, e.g., Werden (2006) for a general discussion of the test, and Katz (2017) for discussion of applying the test to multisided platforms.

It is important to give careful consideration to the appropriate but-for world when assessing a merger. Doing so is necessary to form an accurate prediction of a merger's effects. Moreover, some but-for worlds may generate much clearer comparisons than others and serve as useful bounding cases. For instance, there may be alternative transactions that capture the innovation benefits of entry for buyout without giving rise to the competitive harms, which would indicate that the merger is on balance harmful. When the acquired firm's principal asset is intellectual property, one alternative might be for the potential entrant to grant a non-exclusive license to the incumbent instead of being acquired.[52] That said, in some instances, once the incumbent has licensed the technology, it may be unprofitable for any other firm to use that technology to enter the market.[53] Another alternative might be for a non-incumbent firm to purchase the potential entrant as a going concern.[54] But there can be situations in which entry is unprofitable for any firm if that entry is not followed by merger with the incumbent. In short, considering alternative transaction is valuable but not a panacea.

One response to the difficulties of establishing harm to competition from the acquisition of a potential or emerging competitor is to lower the standard of proof required to block a merger or to place the ultimate burden of persuasion on the merging parties rather than the plaintiff.[55] A critical issue is how one defines the set of mergers to which this alternative regime of burdens or presumptions applies. The present analysis suggests that one factor would be whether the merger is taking place in an industry that has a history of firms becoming "dominant" and then being displaced by a new "dominant" firm or technology. A pattern in which promising "long-shots" are acquired would also be a candidate for increased scrutiny.[56] Although competition-policy enforcement agencies can be flexible and somewhat vague as they exercise investigatory and prosecutorial discretion, the differential treatment of a specific class of mergers by the courts raises much more difficult issues and might require legislation rather than common-law evolution. In order to avoid costly and unproductive legal disputes over which boxes various mergers fall into, any such legislation should seek to define as clearly as possible the underlying economic characteristics of a market that trigger the alternative regime. The definition should also be designed to avoid unintended

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52 Bryan and Hovenkamp (2020) compare the competitive effects of exclusive and non-exclusive licensing, where exclusive licensing is interpreted as an acquisition.

53 This can be seen by considering the example in Section VI, where, without a technological lead, the entrant will fail to become established.

54 Motta and Peitz (2020, Section 2.3) examine this benchmark.

55 The Stigler Committee on Digital Platforms (2019, pp. 16, 98-99, and 111) and Motta and Peitz (2020, pp. 13-44) make recommendations along these lines.

56 Stigler Committee on Digital Platforms (2019, pp. 88-89) makes a similar recommendation, as do Bryan and Hovenkamp (2020, p. 632) in the context of intellectual property licensing.

consequences, such as distorting firms' organizational choices as they attempt to shoehorn themselves into favored categories.

Finally, it should be noted that, although the model analyzed the use of innovation to enter a market directly, two-stage entry has a similar logical structure: in the case of two-stage entry, the complementary asset can be a valuable reputation or an installed base of users (and their transaction data) in another market on which the potential entrant can build. Moreover, other firms' observable reputations or user bases may provide an incumbent a means of identifying potential competitors. Hence, there are similarly powerful arguments for taking potential competition seriously. In addition to the policy approaches described above, one could also consider Brodley's (1977) recommendation that the courts develop the notion of "market proximity" as a means of assessing whether a firm active in one market is likely to enter another, although it would be necessary to develop a set of indicators or metrics that reflect that nature of digital-platform industries. For example, one approach to examine would consider two firms to be in proximate markets if there is a high degree of overlap in their user bases, or at least in the demographics of those bases.

X. APPENDIX: IMITATIVE ENTRY TO COMPETE IN THE MARKET

In this appendix, I examine a benchmark case of imitative entry to compete in the market. An entrant must invest I_0 to become active. This investment allows the entrant to match the product quality and costs of incumbent firms. Active firms are symmetric in terms of profitability: any active firm earns $\pi(n)$ per period when there are n active sellers.[57] Industry profits, $n\pi(n) > 0$, are assumed to be decreasing in *n*.[58] Firms are symmetric with respect to their bargaining ability.

Lemma 1: *Suppose mergers are banned. If* $\frac{\pi(n_0+1)}{1-\delta} < I_0 < \frac{\pi(n_0)}{1-\delta}$, *then the first* n_0 *potential entrants will enter and industry will thereafter be an* n_0*-firm oligopoly.*

Proof: A firm's strategy is mapping from the number of incumbents to an entry probability when its opportunity arises and, if it has entered in the past, whether to exit. If there are $n \geq n_0$ incumbents, no additional entry will occur: there is no way to earn more than $\pi(n_0 + 1)$ per period going forward because no firm has an incentive to drop out given that the flow of profits is positive. Hence, if there are fewer than n_0 incumbents, entry is profitable because the net present value of the entrant's product-market profits will be least $\frac{\pi(n_0)}{1-\delta} > I_0$. **QED**

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[57] If each firm possesses a "brand" that differentiates it from other firms, then to be consistent with the assumption that $\pi(1)$ is independent of the past merger activity that created the current monopolist, a merger must eliminate all but one of the merging parties' brands.

[58] The assumption that $\pi(n) \geq 0$ for all *n* simplifies the analysis by avoiding the need to consider situations in which market participants play a war of attrition.

Now, consider a market that is a natural monopoly in the sense that the first firm to enter could recover its entry investment if there were no further entry, but a second firm to enter could not recover its investment without merging, even if there were no further entry. Under these conditions, the market is always monopolized:

Proposition A.1: *Suppose* $\max\{\frac{\pi(1)}{3(1-\delta)}, \frac{\pi(2)}{1-\delta}\} < I_0 < \frac{\pi(1)}{1-\delta}$ *and all mergers are allowed. Then the first potential entrant enters and:*

i. *when* $\frac{\pi(1)}{2(1-\delta)} < I_0$*, there are no subsequent entry events;*

ii. *when* $\frac{\pi(1)}{2(1-\delta)+\delta\bar{\rho}} < I_0 < \frac{\pi(1)}{2(1-\delta)}$*, entry occurs with probability* $\frac{\pi(1)-2(1-\delta)I_0}{\delta I_0} \in (0, \bar{\rho})$ *in all periods after the initial entry event and any entrant immediately merges with the incumbent; and*

iii. *when* $I_0 < \frac{\pi(1)}{2(1-\delta)+\delta\bar{\rho}}$*, entry occurs whenever the opportunity arises and the entrant immediately merges with the incumbent.*

Proof: The net present value of future industry profits cannot be greater than $\frac{\pi(1)}{1-\delta}$. Hence, as long as the entrant gets no more than ½ of the future profits, entry in the presence of an incumbent is unprofitable when $\frac{\pi(1)}{2(1-\delta)} < I_0$, which establishes Part (i). For the remainder of the proof, assume that $\frac{\pi(1)}{2(1-\delta)} > I_0$. The inequality $\frac{\pi(1)}{3(1-\delta)} < I_0$ implies that $\rho(n) = 0$ for $n \geq 2$, where $\rho(n)$ denotes the probability of entry conditional on the number of incumbents and the existence of an entry opportunity.[59]

Consider a candidate equilibrium in which $\rho(1) = 0$. If a firm deviated and entered, it would then be profitable to merge to monopoly because $\pi(1) > 2\pi(2)$. But given $\frac{\pi(1)}{2(1-\delta)} > I_0$, such entry would be profitable. Hence, $\rho(1)$ cannot equal 0 in equilibrium. If there is a single incumbent and entry occurs but the two firms never merge, then there will be no further entry and each firm will earn continuation profits equal to $\frac{\pi(2)}{1-\delta} < I_0$. Suppose instead that the incumbent immediately merges with the entrant at every entry event, and let $V(1)$ denote the continuation value associated with being a monopolist at the start of a period. With probability $\rho(1)$ entry (followed by merger) will occur in that period, in which case the current monopolist will earn $\frac{1}{2}\{\pi(1) + \delta V(1)\}$. With probability $1 - \rho(1)$ entry will not occur, in which case the current monopolist will earn $\pi(1) + \delta V(1)$. Hence, $V(1) = \left\{1 - \frac{1}{2}\rho(1)\right\}\{\pi(1) + \delta V(1)\}$, or

$$V(1) = \frac{2-\rho(1)}{2(1-\delta)+\delta\rho(1)}\pi(1) .$$

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[59] This inequality also implies that, even if it were feasible, a firm with an entry opportunity would never find it profitable to wait until the next entry event to itself enter.

Thus, if the duopolists merge, the net present value of each firm's profits will be

$$\tfrac{1}{2}\pi(1) + \delta\tfrac{1}{2}V(1) = \frac{\pi(1)}{2(1-\delta)+\delta\rho(1)}\,. \qquad \text{(A.1)}$$

If $\frac{\pi(1)}{2(1-\delta)+\delta\bar{\rho})} > I_0$, then $\rho(1) = \bar{\rho}$: entry followed by merger and then further entry at every opportunity is profitable. Moreover, each merger is profitable because the continuation profits exceed one half of the duopoly profits. This proves Part (iii).

If $\frac{\pi(1)}{2(1-\delta)+\delta\bar{\rho})} < I_0$, then entry followed by merger to monopoly would be unprofitable if entry were to occur whenever the opportunity arose. Instead, entry after that of the first firm occurs with probability $\frac{\pi(1)-2E(1-\delta)}{E\delta}$, so that each potential entrant after the first one is indifferent between actually entering and not. The first firm to enter gets a period of monopoly profits, so it strictly prefers to enter. This proves Part (ii). **QED**

Lemma 1 and Parts (ii) and (iii) of Proposition A.1 establish conditions under which entry occurs only if there is a possibility of merger. However, in this setting, entry benefits consumers only if its leads to increased competition, and here entry is always followed by merger to monopoly. Although a permissive merger policy does not harm consumers—the industry would be monopolized in any event—the policy reduces total surplus by the amount of the entry investments. The policy also harms the initial incumbent, which would earn the full monopoly profits if mergers were banned rather than splitting the profits with a succession of entrants.[60] Strict merger enforcement serves as a commitment device for the incumbent not to accommodate an entrant by merging.

Next, suppose that the market is a natural duopoly in the sense that the second firm to enter could recover its entry investment if it did not merge with the incumbent and there were no further entry, but a third firm to enter could not.

Proposition A.2: *If* $\frac{\pi(1)}{3(1-\delta)} < I_0 < \frac{\pi(2)}{1-\delta}$ *and all mergers are allowed, then:* [61]

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[60] This raises the question of whether an incumbent might (through strategies outside the scope of the present model) deter entry by establishing a reputation for delaying merger by one or more periods after an entry even. However, suppose entry occurs. If the incumbent delays merger to reduce the entrant's profits and discourage future entry, then by symmetry, the incumbent would suffer the same loss in its own profits, rendering delay less profitable than immediate merger.

[61] The condition $\frac{\pi(1)}{3(1-\delta)} < I_0$ implies that, when there are two or more incumbents, it would be unprofitable to enter the industry even if the firms then merged to monopoly and there was no further entry.

i. *when* $\frac{1-\delta}{2(1-\delta)+\delta\bar{\rho}}\pi(1) > \pi(2)$*, entry occurs at every opportunity, and following all entry events after the first one, the entrant and incumbent merge to monopoly; and*

ii. *when* $\frac{1-\delta}{2(1-\delta)+\delta\bar{\rho}}\pi(1) < \pi(2)$*, the first two potential entrants enter, there is no further entry, and the industry thereafter is a duopoly.*

Part (ii) of Proposition A.2 identifies conditions under which entry and the threat of share dilution serve as substitutes for competition policy—there is no incentive to merge absent efficiencies (unless a firm has mistakenly entered above the natural-duopoly threshold).[62] The forces at work are easiest to see when $\bar{\rho} = 1$. If two firms are in the market and choose not to merge, then no further entry occurs and each of the two firms earns one half of the total duopoly profits, with net present value

$$\frac{\pi(2)}{1-\delta} \tag{A.2}$$

gross of the entry cost. If it is profitable for the first two firms to enter and merge, then entry will occur in each period followed by merger to monopoly. A firm receives one half of the industry profits during the period in which it enters and its share of industry profits falls by half with each subsequent entry event because each new entrant splits the industry profits equally with the firm that is the incumbent at the time of entry. Hence, gross of the entry cost, the net present value of entering is

$$\sum_{T=1}^{\infty}\left\{\pi(1)\left(\frac{1}{2}\right)^{T}\delta^{T-1}\right\} = \frac{\pi(1)}{2-\delta}. \tag{A.3}$$

The profitability of merging to monopoly and inviting entry thus depends on the comparison of expressions (A.2) and (A.3).[63]

As is intuitive, the share-dilution effect is stronger when the threat of entry arises more frequently. Let L denote the length of a production period, which is also the

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62 Rasmussen (1988, § IV) examines a model that has a single incumbent and two potential entrants, both of which choose whether to enter the market from the start of the model, rather than arriving sequentially. He finds that, off the equilibrium path, the prospect of suffering from share dilution deters merger between the incumbent and a first entrant, which in his model deters entry overall.

63 The share-dilution effect would arise even if the incumbent had all of the bargaining power. This point is easily seen when $\frac{\pi(1)}{3(1-\delta)} < I_0 < \frac{\pi(2)}{1-\delta}$. Suppose that two firms merge and entry later occurs. The first two firms' joint continuation value at the date of subsequent entry can be no greater than $\frac{\pi(1)-\pi(2)}{1-\delta}$. If the incumbent and entrant do not merge, then entry never occurs, and their joint continuation value as of that period would be $\frac{2\pi(2)}{1-\delta}$, which exceeds the upper bound on the merger continuation value.

minimum time lag between entry events.[64] Letting *r* denote the instantaneous interest rate, $\delta = e^{-rL}$. As the entry lag goes to infinity, δ falls to 0 and $\frac{1-\delta}{2(1-\delta)+\delta\bar{\rho}}$ converges to ½. This fraction also converges to ½ as $\bar{\rho}$ approaches 0. In both cases, $\pi(1) > 2\pi(2)$ implies merger to monopoly is profitable. At the other pole, as *L* falls to 0, δ rises to 1. For any $\bar{\rho} > 0$, if δ is sufficiently close to 1, then it is unprofitable for an incumbent monopolist to acquire the entrant.

Proposition A.2 follows from Lemmas 2 and 3 below.

Lemma 2: *Suppose all mergers are allowed. If* $\frac{\pi(n_0)}{1-\delta} > I_0$ *and the industry has* $n_0 - 1$ *incumbents, then the next available entrant will choose to enter.*

Proof: Suppose there are $n_0 - 1$ incumbents, where $\frac{\pi(n_0)}{1-\delta} > I_0$, the initial entrant enters the market, and the next entry event occurs *T* periods later, where *T* may be infinite. By refusing to merge, the initial entrant can guarantee itself flow profits of at least $\pi(n_0)$ per period for the first *T* periods. Let *U* denote the current value of the subsequent entrant's lifetime profits gross of the entry cost as of *T* periods in the future. By the symmetry assumption, the initial entrant will have a current continuation value of *U* at time *T* as well. Hence, the initial entrant will earn

$$\sum_{t=0}^{T-1} \delta^t \pi(n_0) + \delta^T U = (1 - \delta^T)\frac{\pi(n_0)}{1-\delta} + \delta^T U. \qquad \text{(A4)}$$

By assumption, $\frac{\pi(n_0)}{1-\delta} > I_0$, and the subsequent entry will occur only if $U > I_0$. Hence, equation (A4) implies that the initial entrant would earn positive expected profits by entering. **QED**

Lemma 3: *Suppose all mergers are allowed and* $\frac{\pi(1)}{3(1-\delta)} < I_0 < \frac{\pi(2)}{1-\delta}$. *If there are two firms in the industry at the time the merger decision is made, then they will merge if and only if* $\frac{(1-\delta)}{2(1-\delta)+\delta\bar{\rho}}\pi(1) > \pi(2)$.

Proof: Consider an industry in which there are two active firms at the time merger is being considered.

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[64] Ceteris paribus, per-period profits change as *L* changes. Suppose $\pi(n) = \frac{1-e^{-rL}}{r}\varphi(n)$, where $\varphi(n)$ the instantaneous flow rate of profit. As *L* changes, $\pi(n)$ scales by a multiplicative factor that is independent of *n*. Hence, terms of the form $\frac{\pi(n_1)}{\pi(n_2)}$ in the statement of Proposition A.2 hold independently of the value of *L*. Note too that $\frac{\pi(n)}{1-\delta} = \frac{\varphi(n)}{r}$, so that terms in the statement of the proposition having the form $\frac{\varphi(n)}{\alpha(1-\delta)}$, α a constant, are independent of *L* as well.

- If the duopolists do not merge, then $\frac{\pi(1)}{3(1-\delta)} < I_0$ implies there will be no subsequent entry. Hence, the net present value of each firm's profits will be $\frac{\pi(2)}{1-\delta}$.
- If it profitable for the duopolists to merge, then entry followed by merger will occur at every opportunity. By equation (A.1), the net present value of each of the current duopolist's profits will each will be $\frac{\pi(1)}{2(1-\delta)+\delta\overline{\rho})}$. **QED**

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