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Keywords: acquisition, innovation, merger policy, startup

JEL Classification: G34 L12 L41 O3

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1 Introduction

Regulating acquisitions of small startups by dominant firms has become a global policy issue. In the last decade, tech giants have acquired hundreds of smaller firms (Argentesi et al., 2019; Gautier and Lamesch, 2021), often without facing significant competition authority hurdles. However, increasing concerns over market dominance and the potential stifling of competition have led to heightened scrutiny by competition authorities. For example, in the UK, the Competition and Markets Authority (CMA) blocked Meta's acquisition of Giphy in 2022, the first completed startup acquisition unwound over competition concerns in social media and digital advertising. In the U.S., the Federal Trade Commission (FTC) succeeded in getting Illumina - a dominant provider of next-generation sequencing technology - to divest its acquisition of startup Grail in 2023. In the EU, the Digital Markets Act (DMA) was implemented in 2022, which requires digital gatekeepers to proactively notify the European Commission of all acquisitions. This allows competition authorities to assess their competitive impact in advance, with the aim to, as Commissioner Margrethe Vestager notes,[1]

> *"...use merger enforcement to investigate a problematic acquisition even if it does not meet our usual turnover thresholds. Because prevention is always better than cure..."*

Meanwhile, the policy circle has acknowledged the risks of overly aggressive regulation in dynamic and uncertain sectors, recognizing that excessive intervention could stifle innovation and hinder the growth of startups.

The importance of regulating acquisitions of startups by dominant firms extends beyond policy debates and into academic discussions. Recent literature on such acquisitions highlights three key differences from traditional merger studies (Farrell and Shapiro, 1990; Perry, 1989; Rey and Tirole, 2007). First, it emphasizes the asymmetry between the dominant acquirer and the smaller, innovative startup, which lacks the resources to fully realize its ideas. Second, it focuses on the dynamic nature of markets, especially in sectors like technology and pharmaceuticals, where outcomes are uncertain, and early-stage innovations depend on factors like consumer demand, competition authority approvals, and technological feasibility. Third, unlike traditional merger analysis, which centers on pricing, this literature is concerned with how

[1] `https://ec.europa.eu/commission/presscorner/detail/en/speech_24_3442`

acquisitions impact entry and innovation. While such mergers may not lead to anti-competitive pricing, they can reduce incentives for new startups to innovate or enter the market.

This paper reviews the recent literature on startup acquisitions and their implications for innovation.[2] We classify the literature into two main streams. The first stream investigates whether dominant incumbents have the incentive to develop acquired R&D projects and how changes in ownership influence innovation and overall welfare. The second stream focuses on how startup acquisitions influence pre-acquisition innovation incentives of startups.

The first stream builds on Kenneth Arrow's classic *replacement effect* (Arrow, 1962), which posits that a monopolist derives less incremental profit from innovation than a potential entrant, thereby reducing its incentive to invest in new projects. In the words of Arrow (1962): "the preinvention monopoly power acts as a strong disincentive to further innovation."

Arrow's insight has been central to the competition-innovation debate. In particular, it has gained renewed attention following empirical findings that a significant share of acquisitions in the pharmaceutical industry are aimed at shutting down the acquired startups—a practice known as killer acquisitions (Cunningham et al., 2021). Building on this idea, Motta and Peitz (2021) argued that the competitive harm from these acquisitions stems not only from loss of innovation but also from the elimination of competition, even when the acquirer continues project development. Similarly, Caffarra et al. (2020) contend that a permissive approach to startup acquisitions undermines innovation incentives for both startups and incumbents, as the latter may find it more cost-effective to acquire emerging technologies rather than invest in their own R&D.

The second stream builds on the opposing view to Arrow's replacement effect in the competition-innovation debate, which was established by Schumpeter (1962). Schumpeter argued that market power and monopoly profits are key drivers of innovation, as the prospect of earning substantial profits in the absence of competition provides strong incentives for firms to engage in costly R&D. This perspective underlies the concept of *Entry-For-Buyout* (Rasmusen, 1988): an entrant may strategically innovate to establish itself as a credible market player, compelling the incumbent

[2]We differentiate ourselves from recent work which reviews the broader literature on mergers and innovation (e.g., Lefouili and Madio (2025)) by focusing only on *startup* acquisitions.

to acquire it at a high price. In the context of startup acquisitions, this suggests that permitting acquisitions strengthens startups' incentives to innovate, supporting a more lenient policy stance. The fundamental reason why incumbents are willing to acquire such startups ties back to Schumpeter's insight: monopoly profits can be shared with the entrant, but only if the entrant poses a credible competitive threat—something achievable only through aggressive innovation. A substantial body of research has since explored how merger policies influence pre-acquisition innovation incentives (Norbäck and Persson, 2012; Mason and Weeds, 2013; Phillips and Zhdanov, 2013; Jaunaux et al., 2017; Hollenbeck, 2020; Kamepalli et al., 2021; Bisceglia et al., 2024).

Pre-acquisition innovation is not only about the level of investment or the decision to enter a market but also about the strategic direction of innovation. For instance, an early-stage startup must decide whether to develop a complement to the incumbent's product or to create a direct substitute, and in the latter case, how differentiated it should be. A small but growing body of literature examines this innovation direction problem in the context of startup acquisitions, including Katz (2021), Callander and Matouschek (2022), Kamepalli et al. (2021), Motta and Sheleiga (2021), Dijk et al. (2024a), Dijk et al. (2024b), and Teh et al. (2025). One might expect that the prospect of acquisition would push startups to develop innovations that pose a greater competitive threat to incumbents, following the logic of Entry-For-Buyout. However, the literature presents a more nuanced picture. In particular, whether a startup is more likely to innovate in a way that challenges the incumbent's core market depends on whether doing so increases the combined profit under competition more than it would under monopoly.

Startup acquisitions present new challenges for the design and enforcement of merger policies. Due to the small size of many startups, numerous acquisitions have escaped competition authority scrutiny, as they do not meet the threshold for review, potentially allowing anti-competitive deals to go unchecked. Different jurisdictions have adopted various approaches to address this issue. In the US, antitrust authorities have relied on traditional enforcement tools, challenging Meta's acquisitions of WhatsApp and Instagram in court. In the EU, several large digital platforms have been designated as digital gatekeepers and are thus now required to notify the European Commission of all acquisitions. In Australia, the recent merger reform proposal seeks to replace the voluntary merger notification regime with a mandatory one.

Beyond procedural reforms, the dynamic nature of digital markets and the role of innovation are becoming increasingly central to merger policy design. As highlighted by Gilbert and Katz (2022) and Katz (2021), a key distinction exists between static and dynamic merger policies. While static policies focus only on the immediate welfare effects of an acquisition at the time of review, dynamic policies account for their broader impact on startup entry incentives and the direction of innovation. This shift in perspective has influenced recent policy discussions, including proposals such as the balance of probabilities standard, the balance of harms framework, and shifting the burden of proof, as explored in Cabral (2024).

The remainder of this survey is structured as follows. Section 2 explores post-acquisition innovation. Section 2 extends this framework to incorporate pre-acquisition innovation, beginning with an analysis of Entry-For-Buyout in Section 3.1, followed by a discussion on innovation direction in Section 3.2. Section 4 examines the implications of these insights for the design of merger policies. Section 5 discusses the impact of acquisitions on incumbent innovation. Section 6 reviews extensions in the literature and outlines potential avenues for future research on startup acquisitions.

2 Post-Acquisition Innovation

A key concern surrounding startup acquisitions is how dominant firms handle the acquired R&D projects. Margrethe Vestager highlighted this issue in 2021, stating:

> *"I sympathize with the worry that big businesses could buy up green innovators and kill their new ideas while those companies are still too small for the mergers to have to be notified."*[3]

We begin our discussion by examining firms' post-acquisition innovation incentives. This context raises three critical questions. First, does a dominant acquirer always have weaker incentives for R&D compared to the startup it acquires? Second, why do dominant firms often succeed in acquiring startups, even when those startups have the potential to disrupt them? Finally, do such acquisitions harm consumers or reduce overall efficiency?

These questions were explored in Cunningham et al. (2021), which introduced the influential concept of **Killer Acquisitions**. This phenomenon occurs when domi-

[3] https://www.politico.eu/article/margrethe-vestager-tougher-take-boost-small-companies/

nant incumbents acquire startups specifically to shut down their R&D projects and eliminate future competition. Using pharmaceutical industry data, Cunningham et al. estimated that approximately 6% of acquisitions fall into this category. In this section, we illustrate the core idea of Cunningham et al. (2021), drawing on a model specification closely related to that in Motta and Peitz (2021).

Consider a market consisting of an incumbent firm I and a startup E that may potentially enter. The startup E owns an R&D project. To develop this project into a product that competes with I's product,[4] E must incur an R&D cost k_E, after which the project succeeds with probability $p_E \in [0, 1]$. If the R&D project succeeds, I and E become duopolists, earning profits π_I^D and π_E^D, respectively. If the project fails, I remains a monopolist with profits π_I^m, while E earns zero profit. Note that π_I^m also represents I's profit if E chooses not to incur k_E.

In the absence of acquisitions, E will invest in R&D if and only if the expected return exceeds the cost:

$$p_E \pi_E^D - k_E \geq 0. \tag{1}$$

If I acquires E's project and successfully develops it, its monopoly profit increases to π_I^M, which exceeds its original monopoly profit π_I^m. This increase arises because the new product either enhances quality or expands I's product portfolio. The success probability and development cost for I are p_I and k_I, respectively. I will proceed with development if and only if the expected gain in monopoly profit outweighs the development cost:

$$p_I(\pi_I^M - \pi_I^m) - k_I \geq 0. \tag{2}$$

We can compare E and I's incentives to develop the same R&D project by examining the LHS of (1) and (2). First, consider the special setup used in Motta and Peitz (2021) with $p_I = p_E$ and $k_I = k_E$. In this case, the left-hand side (hereafter LHS) of (1) is greater than the LHS of (2), and thus E has a stronger incentive to incur the innovation cost than I, if and only if

$$\pi_E^D \geq \pi_I^M - \pi_I^m. \tag{3}$$

The inequality in (3) is commonly referred to as the **Arrow Replacement Effect**.

[4] All insights remain valid if E innovates to develop an independent product that has a non-zero probability of becoming a substitute in the future. For a detailed discussion of this variation, see Motta and Peitz (2021).

Kenneth Arrow (1962) argued that this inequality is likely to hold given that the incumbent can still maintain its current monopoly profit without engaging in innovation and thus has a weaker incentive to innovate compared to an entrant who could earn a positive profit only if it innovates. In practice, recent work by Akcigit and Goldschlag (2023) provide partial evidence for the Arrow Replacement Effect. By analyzing the employment history of over 760,000 U.S. inventors with job information, Akcigit and Goldschlag found that inventors hired by large incumbents earn 12.6% more but produce 6–11% fewer inventions compared to if they had been hired by young firms.

Note that even if the Arrow Replacement Effect holds, the LHS of (1) may still be lower than that of (2) if p_E is significantly lower than p_I and/or k_E is substantially higher than k_I. Given the incumbent's superior R&D resources, we expect that $p_E \leq p_I$ and/or $k_E \geq k_I$ often hold. As Crémer et al. (2019) puts it:

> *"..while the start-up may contribute innovative ideas, products and services, the established firm may possess the skills, assets and financial resources needed to further deploy those products and commercialise them.."*

Remark 1 *Suppose the Arrow Replacement Effect holds. A dominant acquirer will continue the acquired project if its resources allow for a higher success rate and lower development cost than the target; otherwise, it may discontinue the project.*

While Cunningham et al. (2021) provides compelling evidence of killer acquisitions in the pharmaceutical industry, the existence of such acquisitions in the tech industry remains a subject of ongoing debate. This issue is particularly relevant given that early policy discussions, as highlighted by Barnett (2024), have heavily relied on Cunningham et al.'s findings, even though many aspects of the pharmaceutical industry do not directly apply to the tech industry. For one, the replacement effect was derived in the context of homogeneous firms engaging in a process innovation. There are many reasons to suspect that such innovations do not apply to recent acquisitions in the tech industry and, as we discuss in Teh and Wang (2025), relaxing these assumptions often leads to the failure of the replacement effect. Empirical evidence of killer acquisitions is also scarce. Gautier and Lamesch (2021) find that GAFAM - Google, Amazon, Facebook, Apple, Microsoft - discontinue a significant proportion of their acquired startups, but they cannot definitively determine whether these acquisitions were intended to "kill" the startups or simply to integrate their products or hire talent. Moreover, many high-profile acquisitions, such as Facebook's purchases of Instagram and WhatsApp, have not led to the products being "killed" in the traditional sense, as both apps continued to develop after the acquisitions. Crandall and Hazlett (2022) further argues that many tech company acquisitions, like Facebook's of Instagram and WhatsApp, are at worst ambiguous or benign, and at best, pro-competitive. Ivaldi et al. (2024) examined eight major GAFAM acquisitions previously scrutinized by the European Commission and found no evidence that these acquisitions led to the elimination of the target's products or reduced competition. Gautier and Maitry (2024) also contends that while many acquisitions by GAFAM may not qualify as killer acquisitions, they still raise competition concerns by potentially stifling innovation and creating barriers to entry for smaller firms.

Next, we explore why incumbents often succeed in reaching acquisition agreements with entrants. When modelling the negotiation process, the literature commonly assumes that bargaining between the two parties is efficient. This implies that an acquisition deal will always be feasible as long as the incumbent's monopoly profit after acquiring the entrant exceeds the combined profits of both firms when operating independently. Suppose E incurs k_E when the negotiation fails. E's expected profit is $p_E\pi_E^D - k_E$ and I's expected profit $p_E\pi_I^D + (1-p_E)\pi_I^m$ as it only earns a duopoly profit π_I^D if E's innovation succeeds. Thus, the joint expected profit when E and I operate independently is

$$p_E(\pi_E^D + \pi_I^D) + (1-p_E)\pi_I^m - k_E \tag{4}$$

If I acquires E and continues to develop the acquired project, its expected profit is

$$p_I\pi_I^M + (1-p_I)\pi_I^m - k_I \tag{5}$$

Its profit is π_I^m if it discontinues the acquired project. In the special case with $p_I = p_E$ and $k_I = k_E$, it can be shown that the monopoly profit after the acquisition in (5) or π_I^m is always greater than the joint independent profits in (4) and thus firms can always reach an acquisition agreement. The key assumption behind this result is:

$$\pi_I^M > \pi_I^D + \pi_E^D, \tag{6}$$

which holds in many commonly used duopoly models.[5] This is the **Preemption Effect** proposed by Gilbert and Newbery (1982). By rewriting (6) as $\pi_I^M - \pi_I^D > \pi_E^D$, the Preemption Effect implies that I's loss from E's entry always exceeds E's gain from entering. Consequently, I can always offer a buyout that prevents E from entering the market.

Notice that, if $p_I < p_E$ and/or $k_I > k_E$, the two parties may not reach an agreement. For example, suppose $p_I < p_E$ but $k_I = k_E$ and that I would develop the acquired project. The two parties cannot reach an agreement if the difference between π_I^M and $\pi_I^D + \pi_E^D$ is sufficiently small while the term $(p_E - p_I)(\pi_I^M - \pi_I^m)$ is sufficiently positive. This is because the acquisition significantly lowers the project's likelihood of success. This suggests that E can be acquired only if its R&D technology is not significantly more advanced than I's, meaning its success rate is not substantially higher.

Remark 2 *Suppose the Preemption Effect holds. An acquisition agreement can be reached only if the target's R&D technology is not too far ahead of the acquirer's.*

Finally, we examine the factors that determine the desirability of acquisitions involving innovative targets, considering both consumer welfare and overall efficiency. Mason and Weeds (2013) identified four key factors, three of which we discuss in this section (the fourth, innovation direction, will be analyzed in Section 3.2). We begin by assessing the impact on consumers under different market outcomes. Throughout this analysis, we assume that E always incurs k_E to develop its R&D project when acquisitions are prohibited. In the absence of entry and innovation, the market remains monopolized by I with its existing product, yielding consumer welfare of CS^m. If E successfully enters and introduces a new product, the market becomes a duopoly, increasing consumer welfare to CS^D. Without an acquisition, expected consumer welfare is given by

$$p_E CS^D + (1 - p_E) CS^m, \tag{7}$$

where E succeeds in R&D with probability p_E. If I acquires E, consumer welfare depends on whether the acquirer continues the project. If I develops the acquired project and succeeds, consumer welfare is CS^M; otherwise, it remains at CS^m. Under

[5] Firms would have no incentive to collude, even if it were legal, if (6) is not met.

an acquisition, expected consumer welfare is

$$p_I CS^M + (1 - p_I)CS^m, \tag{8}$$

provided that I invests in development. If I discontinues the project, consumer welfare remains at CS^m. In the digital field, mergers between established firms and start-ups may frequently bring about substantial synergies and efficiencies

In general, an acquisition improves consumer welfare if and only if (i) I proceeds with developing the acquired project and (ii)

$$(p_I CS^M - p_E CS^D) - (p_I - p_E)CS^m > 0. \tag{9}$$

The first term in (9) can be positive, particularly when acquisition synergies yield greater consumer benefits than the loss of competition (i.e., $CS^M > CS^D$) and/or when p_I is significantly higher than p_E. The second term is non-negative whenever $p_I \geq p_E$. As a result, the effect of acquisitions on consumer welfare is more nuanced than commonly suggested in the literature.

Remark 3 *The impact of startup acquisitions on consumer welfare is generally ambiguous in the presence of acquisition synergies and differences in R&D success rates between the acquirer and the target.*

Beyond competition and synergies, R&D costs play a crucial role in determining the overall welfare impact of an acquisition. Without an acquisition, the expected total surplus—defined as the sum of expected firm profits and expected consumer welfare—is given by

$$p_E(CS^D + \pi_I^D + \pi_E^D) + (1 - p_E)(CS^m + \pi_I^m) - k_E. \tag{10}$$

If I acquires E, the expected total surplus becomes

$$p_I(CS^M + \pi_I^M) + (1 - p_I)(CS^m + \pi_I^m) - k_I \tag{11}$$

if I proceeds with developing the acquired project, and simply $CS^m + \pi_I^m$ if it discontinues the project. Under the assumption $p_I = p_E \equiv p$, the acquisition increases total surplus if and only if

$$p[(CS^D + \pi_I^D + \pi_E^D) - (CS^M + \pi_I^M)] < k_E - k_I. \tag{12}$$

Even if the LHS of (12) is sufficiently large, e.g., because the acquisition fails to generate synergies and/or I chooses not to develop the acquired project, the inequality in (12) can still hold provided the startup's development cost k_E is sufficiently larger than the incumbent's development cost k_I. This is noteworthy because incumbents typically have abundant R&D resources and benefit from significant economies of scope, further widening the gap $k_E - k_I$. Furthermore, startups often face severe financial constraints, such as in Fumagalli et al. (2022) and Motta and Peitz (2021) (captured by setting $k_E = \infty$).

Remark 4 *Because of the startup's high development costs, startup acquisitions can be efficiency-enhancing, even in the absence of synergies or development by the incumbent.*

3 Pre-Acquisition Innovation

This section shifts the focus from post-acquisition innovation to pre-acquisition innovation. The possibility of acquisition introduces an additional channel through which an startup's investment in innovation influences its payoff—namely, via the acquisition price. We distinguish between entry, which examines how the prospect of acquisition affects startups' incentives to enter the incumbent's market, and innovation direction, which explores whether acquisitions steer innovation toward a (potentially) more disruptive path. Section 3.1 analyzes how the expectation of acquisitions influences startups' entry decisions, particularly the Entry-For-Buyout Effect. Section 3.2 investigates its impact on the direction of innovation.

3.1 Entry

One way the prospect of acquisition influences an startup's decision to pursue innovation—and thereby enter the incumbent's market—is through the **Entry-For-Buyout** effect (Rasmusen, 1988). Specifically, the potential to be acquired at a premium provides additional financial incentives for startups to invest in R&D and develop innovative products, even if direct competition with the incumbent might otherwise be less attractive.[6]

Suppose that for startup E to enter the market, it must incur a non-negative R&D cost, denoted by c_E. We introduce this notation to distinguish the pre-acquisition innovation discussed in this section from the post-acquisition innovation in Section 2. The realized value of c_E is privately known to E and is drawn from a distribution $F_E(c_E)$, as perceived by an external observer. Once E has undertaken its innovation activities, the incumbent I has the opportunity to propose an acquisition. For simplicity, we assume that no further innovation occurs after the acquisition.

Rather than using the lower-case letter π to denote profit, as in Section 2, we use the upper-case Π to represent firms' expected profits when only pre-acquisition innovation decisions are considered. Let Π_E^D and Π_I^D denote the expected profits of E and I, respectively, when they operate independently, and let Π_I^M denote I's expected profits when it acquires E. To streamline the discussion, we assume that the two firms always reach an acquisition agreement whenever it is not prohibited. This implies that the increase in joint profit due to the acquisition is non-negative, i.e., $\Pi_I^M - \Pi_E^D - \Pi_I^D \geq 0$.

Following the standard approach in the literature, we assume that post-acquisition profits are determined through Nash bargaining, where we let $\beta \in (0,1)$ and $1-\beta$ represent the bargaining power of E and I, respectively. This means that before accounting for its innovation cost c_E, E's gross profit in the case of acquisition consists of its reservation profit when operating independently, Π_E^D, plus its share of the incremental profit from the acquisition, $\Pi_I^M - \Pi_E^D - \Pi_I^D$. Thus, anticipating the acquisition, E's expected gross profit is

$$\Pi_E^D + \beta(\Pi_I^M - \Pi_E^D - \Pi_I^D).$$

For convenience, define the threshold R&D cost at which E breaks even as

$$\widehat{c}_E(q) \equiv \Pi_E^D + q\beta(\Pi_I^M - \Pi_E^D - \Pi_I^D), \tag{13}$$

[6]Nowadays, a significant number of startup founders are driven less by the goal of building a long-term business and more by the chance to be acquired by a major platform for a lucrative payout—even if that means their venture ultimately ceases to exist. See for example Lemley and McCreary (2021).

where $q \in [0,1]$ represents the probability that the acquisition is approved. We will explore q in greater detail in Section 4, which discusses merger policy. For now, note that $q = 0$ when the acquisition is prohibited and $q = 1$ when it is allowed. Since we assume $\Pi_I^M - \Pi_E^D - \Pi_I^D > 0$, it follows that $\widehat{c}_E(q)$ is strictly increasing in q.

When the acquisition is prohibited, E undertakes the R&D investment if and only if $\widehat{c}_E(0) = \Pi_E^D \geq c_E$. In contrast, if an acquisition is anticipated, E invests in R&D if and only if $\widehat{c}_E(1) = \Pi_E^D + \beta(\Pi_I^M - \Pi_E^D - \Pi_I^D) \geq c_E$. Since $\widehat{c}_E(0) < \widehat{c}_E(1)$, it follows that E is more likely to invest in R&D and enter the market when acquisitions are permitted. This result confirms the Entry-For-Buyout insight.

However, the Entry-For-Buyout effect does not necessarily benefit consumers. To see this, let CS^D denote consumer welfare when firms operate independently, CS^M when I acquires E after E incurs c_E, and CS^m when E does not incur c_E. Naturally, we have $CS^D, CS^M > CS^m$. Without acquisitions, E enters the market if and only if $c_E < \widehat{c}_E(0)$. Thus, from an outsider's perspective, the probability of entry is $F_E(\widehat{c}_E(0))$, leading to an expected consumer welfare of

$$F_E(\widehat{c}_E(0))CS^D + (1 - F_E(\widehat{c}_E(0)))CS^m. \tag{14}$$

Similarly, if E expects to be acquired, expected consumer welfare is

$$F_E(\widehat{c}_E(1))CS^M + (1 - F_E(\widehat{c}_E(1)))CS^m. \tag{15}$$

Taking the difference between these two expressions gives

$$F_E(\widehat{c}_E(0))(CS^M - CS^D) + (F_E(\widehat{c}_E(1)) - F_E(\widehat{c}_E(0)))(CS^M - CS^m). \tag{16}$$

The first term in (16) captures the classic trade-off between increased market power and acquisition synergies. While acquisitions reduce competition, potentially harming consumers, they can also generate efficiency gains that improve consumer welfare. The net effect, $CS^M - CS^D$, is ambiguous, as discussed in Section 2. It is positive if synergies dominate the competition effect ($CS^M > CS^D$) and negative otherwise. The second term in (16) captures the positive effect of Entry-For-Buyout on consumer welfare. By increasing the probability of entry/innovation by $F_E(\widehat{c}_E(1)) - F_E(\widehat{c}_E(0))$, consumers benefit even if the market structure remains a monopoly.

Observe that if $CS^M > CS^D$, i.e., synergies outweigh the competition effect, then (16) is positive, meaning acquisitions benefit consumers. However, if $CS^M < CS^D$, a trade-off arises between the (strong) competition effect and the Entry-For-Buyout effect. Since the second term in (16) is always positive, an acquisition harms consumers only if the competition effect is strong enough to offset both the synergy gains and the increased innovation.

Remark 5 *The prospect of acquisition incentivizes pre-acquisition innovation through Entry-For-Buyout, which can have either a positive or negative impact on consumer welfare. However, for an acquisition to be considered anti-competitive in this context, the resulting reduction in competition must be more severe than in cases where innovation is not a central factor.*

3.2 Innovation Direction

Among the various pre-acquisition innovation choices, some are not merely about whether to incur the cost of entry but rather about the strategic direction the innovation should pursue. For example, startups seeking to enter a market must decide how differentiated their new products should be from those of incumbents—an issue explored by Gilbert and Katz (2022) and Callander and Matouschek (2022). Another crucial decision is whether to innovate for a substitute or a complement to existing products, as discussed in Motta and Sheleiga (2021). Finally, firms with a fixed R&D budget must allocate resources across multiple projects, a challenge examined in Dijk et al. (2024a) and Dijk et al. (2024b). This section studies how acquisitions affect startups' decisions on innovation direction.

To focus on the choice of innovation direction, assume that E always incurs c_E and enters the market. However, at the same time, E needs to determine an innovation direction $x_E \in \{l, h\}$. We assume this decision is binary to facilitate the discussion. The cost of choosing innovation direction x_E is denoted by $d(x_E)$. The innovation direction affects both the I and E's expected gross profits, denoted by $\Pi_I^D(x_E)$ and $\Pi_E^D(x_E)$ respectively in the absence of acquisition, and $\Pi_I^M(x_E)$ when the startup is expected to be acquired by I. Our assumption that E always enters the market and pursues an innovation direction implies $\Pi_E^D(x_E) \geq c_E + d(x_E)$ for $x_E = h, l$.

Define the marginal changes in profits due to shifting from innovation direction l

to h as follows:

$$\Delta_E^D \equiv \Pi_E^D(h) - \Pi_E^D(l), \quad \Delta_I^D \equiv \Pi_I^D(h) - \Pi_I^D(l), \quad \Delta_I^M \equiv \Pi_I^M(h) - \Pi_I^M(l).$$

When acquisitions are prohibited, E selects its innovation direction by comparing $\Pi_E^D(l) - c_E - d(l)$ and $\Pi_E^D(h) - c_E - d(h)$. It prefers h over l if and only if

$$\Pi_E^D(h) - \Pi_E^D(l) - (d(h) - d(l)) = \Delta_E^D - (d(h) - d(l)) \geq 0. \tag{17}$$

When acquisitions are permitted, E chooses its innovation direction to maximize its expected profit:

$$\Pi_E^D(x_E) + \beta(\Pi_I^M(x_E) - (\Pi_I^D(x_E) + \Pi_E^D(x_E))) - c_E - d(x_E).$$

E prefers h over l if and only if

$$(1-\beta)\Delta_E^D + \beta(\Delta_I^M - \Delta_I^D) - (d(h) - d(l)) \geq 0. \tag{18}$$

To assess the effect of acquisitions on innovation direction, we take the difference between the LHSs of (17) and (18). This difference captures how the prospect of acquisition influences the startup's marginal benefit from choosing h over l:

$$(1-\beta)\Delta_E^D + \beta(\Delta_I^M - \Delta_I^D) - \Delta_E^D = \beta(\Delta_I^M - \Delta_I^D - \Delta_E^D). \tag{19}$$

Thus, whether the prospect of acquisition shifts E's innovation direction towards or away from h depends on the sign of (19). If $\Delta_I^M - \Delta_I^D - \Delta_E^D > 0$, meaning that shifting the innovation direction towards h increases post-merger profits (Δ_I^M) more than pre-merger profits ($\Delta_I^D + \Delta_E^D$), then an startup that prefers h over l in the absence of acquisitions—i.e., when (17) holds—will continue to prefer h when acquisitions are allowed, ensuring that (18) also holds. Moreover, if an startup initially prefers l over h without acquisitions, it may switch to h in anticipation of being acquired, provided that $\Delta_I^M - \Delta_I^D - \Delta_E^D > 0$. Conversely, if $\Delta_I^M - \Delta_I^D - \Delta_E^D \leq 0$, an startup that initially prefers l over h in the absence of acquisitions will maintain this preference even when acquisitions are allowed. Moreover, when $\Delta_I^M - \Delta_I^D - \Delta_E^D \leq 0$, the prospect of acquisition may induce the startup's innovation direction to shift from h to l.

For most of our applications (except for the cases involving vertical quality choices when consumers are homogeneous), the innovation direction l can be seen as one that more directly challenges I's market position by generating a less differentiated product. Consequently, compared to h, the direction l is more disruptive to I's market. Based on the expression in (19), we can draw the following conclusion regarding the startup's innovation direction:

Remark 6 *The prospect of being acquired incentivizes the startup to choose a more (resp. less) disruptive innovation direction if the total marginal gain from selecting a less disruptive direction is greater (resp. smaller) in the absence of the acquisition than with it.*

R&D projects can be categorized by comparing the profits of both firms under h and l in monopoly and duopoly settings. Notably, in many cases examined in the literature, acquisitions often have an ambiguous effect on the direction of innovation. Table 1 summarizes the possible scenarios, followed by a detailed discussion of their implications for acquisitions based on existing research.

Innovation Direction	h **and** l	**Profit Ranking**
Horizontal differentiation	High vs low	$\Pi_I^M(h) > \Pi_I^M(l)$ $\Pi_E^D(h) \gtrless \Pi_E^D(l)$ $\Pi_I^D(h) > \Pi_I^D(l)$
Vertical differentiation	High vs low	$\Pi_I^M(h) > \Pi_I^M(l)$ $\Pi_E^D(h) > \Pi_E^D(l)$ $\Pi_I^D(h) < \Pi_I^D(l)$
Substitute or complement	Complement vs substitute	$\Pi_I^M(h) > \Pi_I^M(l)$ $\Pi_E^D(h) \gtrless \Pi_E^D(l)$ $\Pi_I^D(h) > \Pi_I^D(l)$
Substitute or independent	Independent vs substitute	$\Pi_I^M(h) \gtrless \Pi_I^M(l)$ $\Pi_E^D(h) \gtrless \Pi_E^D(l)$ $\Pi_I^D(h) < \Pi_I^D(l)$

Figure 1: Different types of innovation

Horizontal Differentiation. A key determinant of the innovation direction is the degree of **horizontal differentiation** between the products of E and I. In both Gilbert and Katz (2022) and Callander and Matouschek (2022), h and l represent high and low levels of horizontal differentiation, respectively.[7] In such settings, con-

[7]In Callander and Matouschek (2022), the choice of h is also associated with higher expected product quality and higher risk for innovation success.

ditional on acquisition, a more differentiated product portfolio benefits the acquirer by enabling menu pricing, implying $\Pi_I^M(h) > \Pi_I^M(l)$. Second, greater differentiation reduces competition, which benefits the incumbent and so implies $\Pi_I^D(h) > \Pi_I^D(l)$. Meanwhile, whether greater differentiation benefits the startup is ambiguous, and depends on the net of two forces. On one hand, a more differentiated product lessens the intensity of competition, which benefits the startup. On the other hand, a more differentiated product awards an incumbent a local competitive advantage, which makes it more difficult for the startup to conduct limit pricing to shut the incumbent out of the market.

Because $\Pi_I^M(h) > \Pi_I^M(l)$ and $\Pi_I^D(h) > \Pi_I^D(l)$, the sign of (19), and so the impact of acquisitions on the startup's innovation direction, is ambiguous. Gilbert and Katz (2022) argues, however, that the vertical quality differential plays a key role in determining the sign of (19). The idea is that the benefit to the startup from a lessening of competition under a more differentiated product is more important than the local competitive advantage awarded to the incumbent when products are sufficiently homogeneous. Thus, when the startup's product quality is close to the incumbent's, the acquisition induces the startup to pursue a more differentiated product, i.e. move from l to h. The opposite holds when the startup has a much higher vertical quality than the incumbent, where the startup prefers to cover the market, and finds it more difficult to do so under a more differentiated product. Thus, when the startup's product quality is much higher than the incumbent's, the acquisition induces the startup to pursue a less differentiated product, i.e. move from h to l.

Remark 7 *When the innovation direction involves choosing the degree of horizontal differentiation, we expect the acquisition to incentivize the startup to adopt greater (resp. less) horizontal differentiation if the startup's product quality is close to (resp. much higher than) that of the incumbent's.*

Vertical Differentiation. Another type of innovation direction involves selecting the product's **vertical quality** (e.g., Phillips and Zhdanov (2013)). Suppose E's vertical product quality is always higher than I's but is higher under h than under l. Under this interpretation, we expect $\Pi_E^D(h) > \Pi_E^D(l)$ and $\Pi_I^D(h) < \Pi_I^D(l)$, as a higher quality benefits the startup but harms the incumbent in the event of no acquisition. Additionally, in the event of an acquisition, the acquirer's profit should rise with the quality of its product portfolio, implying $\Pi_I^M(h) > \Pi_I^M(l)$.

Once again, we see that in general, the sign of (19), and so the impact of acquisitions on the startup's innovation direction, is ambiguous. However, when products are insufficiently horizontally differentiated, one intuitively expects a monopolist to be able to exploit an increase in product quality by far more than a startup in a duopoly, due to the intensity of competition. Hence, one anticipates for the increase in industry profits in the absence of acquisitions $\Delta_I^D + \Delta_I^E$ from a higher quality to be smaller than the increase in industry profits with acquisitions Δ_I^M. Thus, the acquisition raises the startup's choice of vertical quality.

Remark 8 *When the innovation direction involves choosing the vertical product quality, we expect the acquisition to incentivize the startup to choose a higher quality innovation when products are insufficiently horizontally differentiated, and have an ambiguous effect otherwise.*

Substitutes vs Complements. In some applications, the innovation direction pertains to the degree of rivalry. One possibility is when the startup's decision is whether to develop a **substitute or a complement** to the incumbent's product, as explored in Motta and Sheleiga (2021). Letting l and h denote the choices of developing a substitute and a complement, respectively, we often expect $\Pi_I^D(h) > \Pi_I^D(l)$ and $\Pi_I^M(h) > \Pi_I^M(l)$ as complementarity generally benefits the incumbent. However, the comparison between $\Pi_E^D(h)$ and $\Pi_E^D(l)$ remains ambiguous.

As in the previous cases, we see that in general, the sign of (19), and so the impact of acquisitions on the startup's innovation direction, is ambiguous, and will depend on a range of other factors. One such factor, the incumbent's imitation, is discussed in Motta and Sheleiga (2021).[8] They find that the incumbent tends to copy the startup's innovation direction when the startup chooses a substitute, but not when the startup chooses a complement. Because of this, allowing for acquisitions avoid the loss in industry profits from imitation when the startup chooses a substitute, which raises the gains from acquisition, while having no effect when the startup chooses a complement. For this reason, they find that the acquisition raises the startup's incentive to choose a substitute over a complement.

Remark 9 *When the innovation direction involves choosing between developing a subtitute or complementary product, we expect that the acquisition will raise the*

[8] Imitation strategies are also considered in Gans and Stern (2000) and Gans et al. (2002) in the context of licensing. We also discuss imitation strategies in Section 5.

startup's incentive to choose a substitute over a complement when the incumbent can copy the startup's innovation direction, and have an ambiguous effect otherwise.

Substitute vs Independent. Another possibility is that the decision revolves around whether to develop a **substitute or independent product**, where h and l denote the choices of developing a substitute and an independent product, respectively. In Dijk et al. (2024a), E allocates its R&D budget between a rival project that competes with I's market and a non-rival project that operates independently of I's business, with the probability of success increasing with the allocated budget. Our binary-choice model represents a special case of their framework, where the entire budget must be allocated to either a substitute or an independent product. Teh et al. (2025) also examined E's decision between pursuing an R&D path that leads to a substitute and opting for a more exploratory R&D direction. However, the latter direction carries uncertainty, as it may result in either a substitute or an independent product. In general, developing a substitute increases competition and reduces I's profit, i.e., $\Pi_I^D(h) > \Pi_I^D(l)$. However, the relative comparisons for Π_I^M and Π_E^D depend on the profitability of the independent market compared to the rivalrous market.

The sign of (19) will depend on the comparison of the industry gains from acquisition from developing the rivalrous product over the independent product. As the previous papers show, this will depend critically on the underlying market characteristics for each product. Hence, the impact of acquisitions on the startup's innovation direction is often ambiguous.

Remark 10 *When the innovation direction involves choosing developing a substitute or independent product, we expect that the acquisition will have an ambiguous impact on the startup's innovation direction.*

Note that there may also be other factors driving the direction of startups' innovation in the settings we consider. For example, in a theoretical model with multiple incumbents, Bryan and Hovenkamp (2020) find that startups tend to direct their innovation toward inventions that are more complementary to the products of market leaders rather than laggards. The underlying intuition parallels the Preemption Effect of Gilbert and Newbery (1982): market leaders have stronger incentives to protect their dominant positions, leading them to outbid laggards to acquire startups and preempt competitors from accessing their technology. This dynamic suggests that entry-for-buyout effects may reinforce the dominance of leading incumbents, a trend that Bryan and Hovenkamp argue is ultimately suboptimal for consumers.

Meanwhile, Warg (2023) shows empirically that startups often direct their innovation toward areas with more active exit markets. Intuitively, this is because startups are often financially constrained, and exit opportunities are valuable both for the founder of the startup and (potential) investors. Warg also finds that this effect weakens when capital is more available and competition between venture capitalists increases. Together, these findings suggest that financial constraints amplify the impact of acquisition prospects on a startup's innovation direction.

3.3 The Kill-zone Effect

Dominant incumbents' acquisitions impact not only the acquired startups' entry and innovation but also that of their competitors. The core idea is that incumbents may leverage acquired technologies to enhance their competitive position against startups targeting their core or adjacent markets. This strategy is effective because incumbents possess greater capabilities, such as access to consumer data, network complementarities, and product ecosystems. As a result, other startups may anticipate lower profits when competing with the incumbent, relative to the acquired startup, leading to a reduction in entry.

This phenomenon, known as the **Kill-Zone** effect, has raised significant concerns among policymakers (Motta and Peitz, 2021).[9] For example, in their case against Facebook (now Meta), the Federal Trade Commission claimed that Facebook's acquisition of Instagram and WhatsApp indirectly benefits Facebook by making it more difficult for other firms to gain traction in Facebook's core market through, respectively, photo-sharing and mobile messaging (D.D.C, 2021). Notably, Facebook CEO Mark Zuckerberg acknowledged this strategic aspect in an email to CFO David Ebersman regarding the Instagram acquisition (D.D.C, 2021):

"...It's possible someone beats Instagram by building something that is better to the point that they get network migration, but this is harder as long as Instagram keeps running as a product... Even if some new competitors spring up... if we incorporate the

[9]Here, we focus on how the incumbent creates a kill-zone in a market through startup acquisitions. In addition, incumbents may use other strategies such as imitation and R&D to achieve similar effects. Refer to Section 5 for a discussion of these alternative strategies.

social mechanics [Instagram] were using, those new products won't get much traction since we'll already have their mechanics deployed at scale."

Several empirical studies have documented how entry by a dominant incumbent, through acquiring a (target) startup, may discourage other (non-target) startups from entry. Affeldt and Kesler (2021) examine apps acquired by GAFAM between 2015 and 2019, matching them with a comprehensive database of apps available in the Google Play Store. Their findings indicate that half of the acquired apps are discontinued, while those that persist often undergo strategic changes under their new ownership. More importantly, competing app developers reduce their innovation efforts following a GAFAM acquisition, as evidenced by a 2.8 percentage point decline in the likelihood of updates, and directly competing apps significantly reduce the frequency of feature updates.[10] Additionally, developers reallocate their efforts to updating their other, unaffected apps rather than continuing to invest in apps that directly compete with the acquired one. Affeldt and Kesler also finds that developers are less likely to launch new apps in markets where GAFAM acquisitions have occurred, signaling a broader chilling effect on innovation and market entry.

Across multiple product categories and markets, Koski et al. (2023) document a decline in startup entry and venture capital funding following acquisitions by US-based big tech companies, particularly those in close proximity to the acquirer's core business areas. They argue that big tech firms can leverage consumer data, software, algorithms, and their established reputation to dominate markets they enter through acquisitions, thereby discouraging both new entries and venture capital investments. This finding contrasts with Prado and Bauer (2022), who instead report that big tech startup acquisitions actually increase venture capital activity worldwide, including in the US.[11]

Finally, Eisfeld (2024) finds that acquisitions of software startups by "strategic" acquirers - firms that are also active in the enterprise software market - is often followed by a decrease in entry of new startups. In contrast, she finds that acquisitions by "non-strategic" acquirers do not have the same effect. Eisfeld argues that the main distinction between the two is that strategic acquirers may possess the capabilities and

[10] Relatedly, Wen and Zhu (2019) found that under the threat of entry by Google, developers in the mobile app market generally shifted innovation on affected apps to unaffected and new apps.

[11] One explanation for this discrepancy is that the decline in activity driven by the Kill-zone effect is offset by the entry-for-buyout effect discussed in Section 3.1, which raises the acquisition price and consequently boosts investors' payouts from funding startups.

incentives to preempt entry, e.g., by leveraging the acquired technology. Meanwhile, non-strategic acquirers, which acquire new startups either to vertically integrate new tools or seeking financial returns, do not.

On the theoretical side, Teh et al. (2025) is, to our knowledge, the only paper explicitly analyzing the impact of acquisitions on competing startups. Their model incorporates both pre- and post-acquisition innovation activities. In their model, a non-target startup E_1 must choose its innovation direction $x \in \{l, h\}$ prior to the incumbent's decision of whether to acquire a target startup E_2. After the acquisition, I then decides whether to continue developing the acquired R&D project, while E_2 decides whether to develop its own R&D project. If E_1 chooses l, it directly challenges I's core market. In contrast, choosing h leads to a more uncertain project that only threatens I's business with probability $y \in (0, 1)$; otherwise, it results in an independent product if development is successful.

Teh et al. show that when R&D costs are not excessively high, I's acquisition of E_2 discourages E_1 from choosing l. This occurs because, for moderate R&D costs, I will counter-develop the acquired project whenever E_1 attempts to enter I's market, reducing E_1's expected profit from choosing l compared to a scenario where acquisitions are banned. However, Teh et al. (2025) also highlight that this conclusion may not hold when R&D costs are sufficiently high. In such cases, I has no incentive to develop the acquired project regardless of whether E_1 enters its market. Here, the acquisition aims purely to eliminate E_2. Knowing that I will never counter-develop in response to its entry, E_1 will always choose l, given that I's market remains more profitable than pursuing an independent market.

Relatedly, Denicolo and Polo (2024) show that in a dynamic setting, consecutive acquisitions by an incumbent can create a "kill zone" (referred to as the "entrenchment of monopoly" in their paper) by raising entry barriers for future competitors. The central idea is that by acquiring startups, the incumbent not only consolidates its market dominance but also builds a growing captive consumer base that is discouraged from switching to potential future competitors due to network and/or ecosystem effects. As a result, by aggressively acquiring startups in the short term, the incumbent can effectively prevent new entrants, stifling long-term innovation.

Moreover, the mere prospect of being acquired can reduce a startup's anticipated acquisition price, discouraging the startup from entering the market or investing in ex-ante R&D. This concept forms the essence of the "kill-zone" effect discussed by

Kamepalli et al. (2021), which differs slightly from the previously discussed form of the effect. The key idea is as follows: a startup's consumers can be divided into two groups—"techies," who value early adoption, and "ordinary consumers," who benefit from network effects. When a startup is acquired, it is quickly integrated into the incumbent's business, becoming accessible to all consumers. If consumers anticipate that an acquisition will occur, it discourages techies from adopting the startup's product early, which in turn reduces the number of ordinary consumers who would adopt the product in the event the acquisition does not happen. This, in turn, lowers the startup's acquisition price. Kamepalli et al. also provide empirical evidence of a decline in venture capital investment in startups within the same markets as Facebook and Google following an acquisition.

4 Merger Policy Design

Thus far, we have examined market and innovation outcomes under two extreme policy regimes: a laissez-faire approach, in which acquisitions are always approved, and a strict prohibition regime, in which acquisitions are always blocked. Building on recent literature on merger policy design—particularly in the context of startup innovation—this section explores a more flexible framework that grants competition authorities greater discretion in regulating startup acquisitions. Our analysis focuses on the optimal design of merger policies aimed at maximizing consumer welfare,[12] providing a nuanced approach beyond the binary extremes.

We conceptualize merger policies as a set of ex-ante rules to which the competition authority commits, outlining the conditions for approving future mergers or acquisitions. The economic model of merger policy we consider follows this sequence:

- **Stage 1**: Competition policy is designed and legislated
- **Stage 2**: Startups engage in pre-acquisition innovation
- **Stage 3**: Firms negotiate about the acquisition
- **Stage 4**: If firms reach an agreement, they submit the proposal to the competition authority. The authority then evaluates the acquisition based on the established merger policy

[12] We adopt the consumer welfare standard as it is the prevailing standard in most jurisdictions.

- **Stage 5**: Depending on whether the acquisition is approved, either the incumbent or the startup decides on the post-acquisition innovation.

Throughout this section, we skip Stage 5 as we want to focus on pre-acquisition innovation.

4.1 Static and Dynamic Merger Policies

Gilbert and Katz (2022) made a distinction between **Static and Dynamic Merger Policies**. Under a static merger policy, the competition authority assesses each proposed acquisition solely based on its immediate impact on consumer welfare, and approves it if it increases consumer welfare and rejects it otherwise. In other words, the approval decision depends on consumer welfare measured at Stage 4 of the timeline described above.

In contrast, a dynamic merger policy requires the competition authority to commit to an approval rule that not only considers the direct impact on consumer welfare but also accounts for how the rule influences firms' pre-acquisition innovation incentives. This means that the approval decision is guided by expected consumer welfare computed at Stage 2 of the timeline, and so has the ability to shape firms' innovation and entry behavior in later stages.

A dynamic merger policy is likely to outperform a static one if the competition authority has a precise understanding of the innovation process and how merger policies influence it. To understand this, consider the setting in Section 3.1. Under a static merger policy, the competition authority's approval decision is based on a direct comparison between CS^M and CS^D. If $CS^M \geq CS^D$, the authority approves the acquisition, and expected consumer welfare follows (14). Conversely, if $CS^M < CS^D$, the authority blocks the acquisition, and expected consumer welfare follows (15). Notice, however, that this policy overlooks the Entry-For-Buyout effect - by committing to a more permissive merger policy, a more permissive merger policy can incentivize a greater fraction of startups to bear the R&D costs of entering the market, as the potential acquisition price more than offsets these costs. This indirect increase in entry may benefit consumers, even if the market remains a monopoly, relative to the case when no entry occurs (i.e., $CS^M > CS^m$). Thus, provided that this indirect effect is large enough, the competition authority can increase consumer welfare by committing to approving all acquisitions, even when conditional on entry, each individual acquisition reduces consumer welfare.

The discussion above does not suggest that a *laissez-faire* regime, which approves all acquisitions, is necessarily optimal for maximizing consumer welfare. The optimal policy must strike a balance between two effects: the benefit of incentivizing entry via R&D by startups by increasing the likelihood of approval, and the potential consumer harm from allowing for excessive mergers. If the additional entry incentives generated by a higher approval rate are not substantial enough to outweigh the negative impact of increased consolidation, then an "intermediate" policy—one that approves only a fraction of acquisitions—can better preserve entry incentives while further increasing consumer welfare.

To further illustrate the idea of why an "intermediate" policy can be optimal, suppose that $CS^D > CS^M$ holds, and that the competition authority commits to approving all acquisitions with a probability $q \in [0, 1]$. Recall the definition of $\widehat{c}_E(q)$ in (13). It is the threshold of R&D cost below which startups choose to incur R&D costs to enter the market, given q. The expected consumer welfare is given by

$$F_E(c_E(q))[qCS^D + (1-q)CS^M] + (1 - F_E(c_E(q)))CS^m$$

By differentiating the above with respect to q, we derive the marginal impact of increasing the approval rate on the expected consumer welfare

$$\begin{aligned} &F_E(\widehat{c}_E(q)) \left(CS^M - CS^D\right) \\ &+ f_E(\widehat{c}_E(q))\beta \left(\Pi_I^M - \Pi_I^D - \Pi_E^D\right) \left[qCS^M + (1-q)CS^D - CS^m\right] \end{aligned} \tag{20}$$

The first term in (20) captures the traditional considerations in a static merger policy. It reflects how an increase in the approval rate affects consumer welfare, holdiing fixed the startup's probability of entry, $F_F(\widehat{c}_E(q))$. The sign of this term depends solely on whether consumer welfare under an approved acquisition, CS^M, exceeds that under a blocked acquisition, CS^D. The second term in (20) introduces a novel dynamic consideration. The expression $f_E(\widehat{c}_E(q))\beta \left(\Pi_I^M - \Pi_I^D - \Pi_E^D\right)$ represents the incremental probability of startup entry when the approval rate increases. Given entry occurs, consumer welfare is expected to change by $qCS^M + (1-q)CS^D - CS^m$. Since we assume $CS^M < CS^D$, the first term in (20) is negative, while the second term is positive, highlighting the trade-off between static and dynamic effects.

A *Laissez-faire* regime, where all acquisitions are approved ($q = 1$), is optimal if and only if the second term in (20) consistently outweighs the first, even at the maximum approval rate. Conversely, a total ban on acquisitions ($q = 0$) is optimal if the first term dominates the second, even at the lowest approval rate. Otherwise, an intermediate approval rate $q^* \in (0, 1)$, determined by setting (20) to zero, maximizes consumer welfare. This **Probabilistic Merger Policy** balances the incentives for startup entry with the need to limit competitive harm from acquisitions. Importantly, even when a startup enters, the incumbent only acquires it with some probability, ensuring that some degree of market competition is preserved.

Remark 11 *A probabilistic approval rule, through simultaneously incentivize market entry and preserving a degree of competition, can maximize consumer welfare.*

We now discuss several factors which influence the optimal approval rate. Suppose the optimal approval rate is probabilistic, so (20) is equal to zero under an optimal approval rate. Rearranging terms, we obtain:

$$\frac{CS^D - CS^M}{\beta(\Pi_I^M - \Pi_I^D - \Pi_E^D)} = \Phi(q^*), \tag{21}$$

where $\Phi(q) \equiv \left[qCS^M + (1-q)CS^D - CS^m\right] \times \frac{f_E(c_E(q))}{F_E(c_E(q))}$. The LHS of (21) is independent of q, while under many kinds of distributions F_E, the RHS strictly decreases in q. Thus, the optimal approval rate is generally unique. More importantly, notice that an increase in E's bargaining power β decreases only the LHS, so the optimal approval rate is higher then. Meanwhile, note that a change in the market fundamental, which simultaneously changes both the consumer welfare and firm profit terms, changes both sides of (21). Thus, determining how the optimal approval rule responds to changes in market fundamentals requires further information.

Given the discussion above, a key challenge is how a competition authority can credibly commit to a dynamic (potentially probabilistic) merger policy.

One mechanism is the ex-ante allocation of resources for evaluating startup acquisitions. For instance, a competition authority could publicly announce the experts it will consult, the data it will prioritize, and the staff it will hire at the start of a given period. These commitments shape the probability of gathering sufficient evidence to assess a merger and, consequently, the likelihood of approval. Moreover, such resource allocation decisions are often difficult to reverse due to contractual obligations and employment laws, providing the competition authority with a credible form of commitment.

Another mechanism is the design of merger guidelines. The more detailed and specific these guidelines are in evaluating startup acquisitions, the greater the likelihood that competition authority officials will identify grounds for making decisions on a merger. Since merger guidelines remain in effect for a defined period, they offer an additional layer of commitment power.

A third mechanism is reputation-building over time. By maintaining a consistent stance—such as retaining leadership and ensuring a transparent, predictable approach to evaluating startup acquisitions—a competition authority can foster trust in its merger review process. Here, the approval rate q reflects the average probability with which merging parties expect their proposal to be approved based on the authority's established reputation.

However, these commitment mechanisms become less effective when merger decisions are frequently subject to judicial review. Courts apply existing legal standards to assess individual mergers, and under a consumer welfare standard, this effectively reduces a dynamic merger policy to a static one. This suggests that an administrative system, where competition authorities retain greater control over merger clearances, may be more effective than a court-based system in implementing dynamic merger policies.

4.2 State-contingent Merger Policies

The innovation process is inherently uncertain. Uncertainty can arise in various forms: the cost of R&D may be unclear, consumer demand for a new product may be difficult to predict (Mason and Weeds, 2013; Jaunaux et al., 2017; Bisceglia et al., 2024), or even the relationship between the new product and the incumbent's offering may be ambiguous—whether it will serve as a substitute or a complement is often unknown in early stages (Wickelgren, 2021; Cabral, 2024). For example, when OpenAI first developed ChatGPT, it was uncertain whether the tool would complement or disrupt traditional search engines. Similarly, in the semiconductor industry, firms investing in next-generation chips face uncertainty regarding both technological feasibility and market adoption.

As innovation advances, uncertainty gradually decreases. Firms typically en-counter the highest level of uncertainty when deciding to enter a market. By the time an acquisition proposal is submitted to competition authorities, firms have gathered more information about the market's likely trajectory. However, legislators lack access to this information when designing merger policies. Instead, they acknowledge that both firms and competition authorities will obtain more information as innovation unfolds, ultimately revealing the eventual market outcome—often referred to as the "state." Anticipating this learning process, legislators can commit to a policy that is contingent on the state.

Until now, we have assumed that competition authorities apply a uniform approval rate to all acquisition proposals, treating them equally regardless of the startup's specific R&D outcome. However, if regulators can observe the actual state z upon receiving an acquisition proposal, the approval rate can be made contingent on z.[13] Before firms submit an acquisition proposal, all parties are uncertain about z and only know that it is drawn from a distribution $G(z)$. Since market outcomes depend on z, we can express profit and welfare measures as functions of z: $\Pi_I^M(z)$, $\Pi_I^D(z)$, $\Pi_E^D(z)$, along with consumer surplus measures $CS^M(z)$, $CS^D(z)$, and $CS^m(z)$. We maintain the assumptions that $\Pi_I^M(z)-\Pi_I^D(z)-\Pi_E^D(z) > 0$ and that consumer surplus rankings hold as $CS^D(z) > CS^M(z) > CS^m(z)$.

The competition authority commits to enforcing a state-dependent merger policy, represented by a function $q(z)$, which specifies the probability of approving an acquisition given the realized state z. In practice, state-contingent merger policies can take various forms. Many **threshold-based policies**, for instance, use market performance measures as proxies for market competitiveness and underlying consumer welfare. A common example of such a policy is one based on pre-merger market shares, sales, or firm revenues, which can be used to estimate pre-merger consumer surplus. Under this approach, the state-contingent merger policy $q(z)$ approves all mergers ($q(z) = 1$) if $CS^M(z)$ exceeds a predefined threshold and blocks mergers ($q(z) = 0$) otherwise. In practice, such policies tend to automatically approve mergers between sufficiently small firms. Alternatively, the policy can be based on the changes in market shares, sales, or revenues resulting from acquisitions, which serve as proxies for the change in consumer surplus. Under this approach, the state-contingent

[13]The parameter z does not need to represent the actual state precisely. We only require that all parties gain additional information about the state, or that firms are mandated to report the additional information they receive to the competition authority. Both allow policy to be conditioned on this new information.

merger policy $q(z)$ approves all mergers ($q(z) = 1$) if the consumer surplus change, $CS^M(z) - CS^D(z)$, exceeds a predefined threshold and blocks the merger ($q(z) = 0$) otherwise.

Applying a similar logic to Section 4.1, we find that if the optimal approval rate for a given state z is a probability $q^*(z)$ strictly between 0 and 1, then it satisfies

$$\frac{CS^D(z) - CS^M(z)}{\beta(\Pi_I^M(z) - \Pi_I^D(z) - \Pi_E^D(z))} = \widehat{\Phi}(q^*(z)), \tag{22}$$

where the function $\widehat{\Phi}(\cdot)$ is defined in the appenidx. This result mirrors the main finding of Jaunaux et al. (2017), namely that the fraction on the left-hand side of (22) determines the optimal approval rate for any given state z.

When the merger policy can be conditioned on states, a natural question arises: under what circumstances should the competition authority be more lenient toward acquisitions in one state compared to another? The fraction on the left-hand side of (22) plays a crucial role in answering this question. In fact, Jaunaux et al. (2017) show that, in the absence of heterogeneity in R&D costs (c_E), an acquisition under state z will be approved with a higher probability than an acquisition under state z' if and only if the fraction associated with z is smaller than that associated with z'. This finding suggests that policies favoring mergers with higher values of $CS^M(z) - CS^D(z)$ may be strictly suboptimal, as they overlook firms' incentives captured by the term $\beta(\Pi_I^M(z) - \Pi_I^D(z) - \Pi_E^D(z))$.

This insight is important because such policies are widely studied in the literature (e.g., Besanko and Spulber, 1993; Mason and Weeds, 2013) and commonly implemented in practice. This includes, for instance, the class of threshold-based policies discussed earlier. Given this, the appendix provides sufficient conditions on the underlying primitives under which a monotone merger policy remains optimal.

Remark 12 *Suppose the merger policy can be state-contingent. The approval rate is higher under one state than the other if the profit-adjusted consumer surplus (i.e., the LHS of (22)) under the former is less than that under the latter.*

Other types of threshold rules were analyzed in Cabral (2024), where a startup's product can be either a substitute or a complement to the incumbent's product. While the actual type of E's product is unknown to all parties, it is commonly known that the product is a complement with probability $z \in [0, 1]$, which serves as the state on which the merger policy is contingent. Beyond laissez-faire and full-ban policy regimes, Cabral examined two additional merger approval rules: **Balance of Probabilities** and **Balance of Harms**. Under the balance-of-probabilities rule, an acquisition is approved if and only if the probability that E's product is a complement exceeds 0.5, i.e., $q(z) = 1$ if $z \geq 0.5$ and $q(z) = 0$ otherwise. Under the balance-of-harms rule, the competition authority explicitly considers the expected benefits and harms based on the likelihood that E's product is a complement or a substitute. The authority identifies a threshold $\hat{z}$ such that $CS^M(\hat{z}) = CS^D(\hat{z})$ and approves the acquisition if $z \geq \hat{z}$, blocking it otherwise. That is, $q(z) = 1$ if $z \geq \hat{z}$ and $q(z) = 0$ otherwise. Cabral (2024) calibrated the model under different policy regimes and found that a full acquisition ban is the worst policy choice, while the balance-of-probabilities rule yields outcomes similar to laissez-faire. The balance-of-harms approach performs significantly better, producing results that closely align with the optimal threshold policy.

4.3 Merger Policy and Innovation Direction

The preceding discussion on merger policies assumes that a startup's innovation direction is predetermined. However, if the startup can choose its innovation direction, the competition authority must also consider how changes in merger policy indirectly impact consumer welfare by influencing this choice. Due to this additional effect, the competition authority may find it optimal to commit to approving more mergers to steer startups toward innovation directions that better serve consumers. This may hold even when, in the absence of such effects, the loss of competition from a merger would be so significant that any merger would harm consumers if the innovation direction were fixed.

Consider the setting in Gilbert and Katz (2022) where the innovation direction is to choose the degree of horizontal differentiation and the acquisition does not generate synergies. Consumer welfare is larger without the acquisition than with it regardless of the innovation direction, i.e., $CS^M(x_E) < CS^D(x_E)$ for $x_E \in \{l, h\}$. Under a static policy, the competition authority rejects all acquisition proposals.

The key insight here is that a laissez-faire merger policy that approves all acquisitions can enhance consumer welfare, even though each acquisition individually reduces consumer welfare in the short run. By adopting such a policy, the competition authority may incentivize the startup to shift to an innovation direction that, conditional on the acquisition occurring, leads to strictly higher consumer welfare compared to a scenario where all acquisitions are prohibited. For instance, suppose $\Pi_E^D(h) < \Pi_E^D(l)$, implying that under a static policy, the startup opts for l. However, if $\Pi_E^D(h) - \Pi_E^D(l) + \beta(\Delta_I^M - \Delta_I^D - \Delta_E^D) > 0$, the startup instead chooses h under a laissez-faire approach. In this case, the welfare ranking $CS^M(h) > CS^D(l)$ suggests that consumer welfare under h, even in a monopolized market, exceeds that under l when competition is preserved. Thus, despite all acquisitions reducing consumer welfare when the innovation direction is fixed, a laissez-faire policy that clears all mergers can still lead to an overall improvement in welfare.

It is important to note that the opposite scenario can also hold: banning all acquisitions may benefit consumers even if each acquisition has a positive immediate impact on consumer welfare, depending on the welfare ranking. This highlights the importance of accounting for startups' incentives in choosing their innovation direction and assessing consumer welfare under different counterfactual scenarios.

To maximize expected consumer welfare, it may be optimal to commit to approving some (but not all) mergers to induce the startup to switch to an innovation that, conditional on the merger failing to be approved, raises consumer welfare—provided the latter gain is sufficiently large. We illustrate this with an example adapted from Gilbert and Katz (2022). Suppose that $\Pi_E^D(h) > \Pi_E^D(l)$, so the startup, anticipating the regulator to block all acquisitions under a static policy, will choose h then. Further, assume $\Pi_E^D(h) - \Pi_E^D(l) + \beta(\Delta_I^M - \Delta_I^D - \Delta_E^D) < 0$, so the startup instead chooses l under laissez-faire, and $CS^M(l) < CS^D(h)$, meaning that a laissez-faire policy is strictly dominated by a static policy. Since the startup prefers h over l whenever mergers are banned but the opposite when mergers are approved, it follows that the startup chooses l if the competition authority commits to approving mergers with a probability weakly larger than some threshold $q^* \in (0, 1)$, and h otherwise.

Observe then that if the competition authority commits to approving all mergers with probability q^*, consumer welfare is given by

$$q^* CS^M(l) + (1 - q^*) CS^D(l)$$

Subtracting the above from consumer welfare when mergers are always banned yields

$$q^*(CS^M(l) - CS^D(l)) + (CS^D(l) - CS^D(h))$$

which is strictly positive if the gain conditional on the merger *not* being approved, $CS^D(l) - CS^D(h)$, is sufficiently large.

Beyond influencing the innovation direction of the startup targeted for acquisition, merger policies can also affect the innovation strategies of non-targeted startups. For instance, in the setting analyzed by Teh et al. (2025) (see Section 3.3), where multiple startups exist, a higher probability of merger approval between the incumbent and the targeted startup incentivizes the non-targeted startup to pursue an innovation direction that minimizes competition with the incumbent, ultimately reducing consumer welfare. However, if the non-targeted startup's innovation direction remains fixed at the level chosen under a strict merger prohibition, approving more mergers can enhance consumer welfare. Thus, if the resulting welfare gain is sufficiently large, the competition authority may find it optimal to commit to approving a limited number of mergers, striking a balance between capturing these consumer welfare benefits and avoiding distortions in the innovation incentives of non-targeted startups.

Remark 13 *A probabilistic approval rule, through simultaneously incentivizing a favourable innovation direction and preserving a degree of competition, can maximize consumer welfare.*

5 Incumbent Strategies

Faced with the pressure of startup-driven innovation and potential competition, dominant incumbents adopt various strategies to safeguard their market position. One prevalent approach is investing in in-house R&D to stay ahead of emerging competitors. Indeed, across many industries, leading firms allocate substantial resources to innovation. For example, in 2022, the five largest tech companies—Amazon, Alphabet, Meta, Apple, and Microsoft—were the top five global R&D spenders, investing \$73.21 billion, \$39.50 billion, \$35.34 billion, \$27.65 billion, and \$26.63 billion, respectively.[14] Google's R&D expenditures alone surpassed \$26 billion in 2017, resulting in

[14] Intelligence, fDi. "Top 100 global innovation leaders". www.fdiintelligence.com.

over 6,200 research papers and the release of numerous open datasets and source code Varian (2021). Incumbents also actively compete with startups across various R&D domains to drive the next wave of transformative innovations. In AI supply chains, for instance, major tech firms compete with smaller players in developing foundation models and cloud computing services. Given these dynamics, assessing the impact of acquisitions on innovation requires accounting not only for the effects of acquisitions on startups, but also for how incumbents strategically respond to the prospect of acquiring startups.

Acquisitions influence incumbents' R&D and investment decisions through two primary channels. First, while large tech firms possess the resources to conduct R&D independently, it may be more efficient to acquire a startup with the necessary technology rather than develop it in-house. This often leads to scaled-back internal R&D post-acquisition. For instance, following Facebook/Meta's acquisition of Instagram in 2014, CEO Mark Zuckerberg noted:[15]

> "*Examples of things we could scale back or cancel:...Mobile photos app (since we're acquiring Instagram)*"

This phenomenon, termed **Reverse Killer Acquisitions** (Caffarra et al., 2020), has been a key concern of regulators, particularly the UK's CMA (several examples are discussed in Latham et al. (2020)), and aligns with broader empirical findings comparing pre- and post-acquisition innovation patterns in large firms (Phillips and Zhdanov, 2013; Seru, 2014; Haucap et al., 2019).[16]

Second, acquisitions create an **Incumbency-For-Buyout** effect (**?**Motta and Peitz, 2021), where incumbents strategically (over-)invest in R&D and capacity expansion to strengthen their market position and increase bargaining power in potential acquisitions. These strategies include expanding production capacity (Rasmusen, 1988), investing in quality-improving R&D (Phillips and Zhdanov, 2013; **?**), directing R&D towards rivalrous products (Dijk et al., 2024b; Letina et al., 2024), or even imitating a startup's innovation (Gans and Stern, 2000; Motta and Sheleiga, 2021). Such investments lower the acquisition price and, in some cases, preempt startups from entering the market, reshaping the competitive landscape.

[15] `https://www.ftc.gov/system/files/documents/cases/051_2021.01.21_revised_partially_redacted_complaint.pdf`

[16] Teh et al. (2025) show that in a setting with multiple startups, the incumbent often prefers acquiring a startup over conducting in-house innovation due to the stronger kill-zone effect under the former.

Overall, the acquisition's effect on an incumbent's incentive to pursue R&D and investment is shaped by the interplay between Reverse Killer Acquisition and Incumbency-For-Buyout dynamics. Notably, these forces often have opposite effects on the incumbent's R&D and investment incentive, so the overall effect is ambiguous. Combined with the ambiguous effect of acquisitions on startup R&D discussed in Sections 2 and 3, these highlight the importance of a nuanced merger policy that is carefully tailored to the specific conditions of each market.

The rest of this section explores other key mechanisms through which acquisitions influence an incumbent's R&D and investment decisions. One such mechanism arises from the interaction between the incumbent's and startup's ex-ante R&D strategies. An incumbent's R&D investments—particularly those driven by an Incumbency-For-Buyout motive—can both shape and respond to the startup's innovation strategy. Notably, countervailing incentives are often at play. For instance, in Dijk et al. (2024b), an incumbent anticipating a startup's entry may direct R&D toward more rivalrous projects to deter competition. In response, the startup may focus on less rivalrous projects to avoid direct competition. Similarly, in Letina et al. (2024), firms allocate effort across multiple R&D projects. An incumbent expecting to acquire a startup reduces investment in overlapping projects, relying on acquisitions rather than duplicating efforts to fend off competition. Anticipating this, the startup may increase investment in these same projects, strategically inflating its expected acquisition price.

A second channel through which acquisitions influence R&D incentives is the redirection of resources. As noted by Dijk et al. (2024b), both incumbents and startups often manage multiple R&D projects with limited resources. When resources are not allocated to a particular project—such as in the case of the Reverse-Killer-Acquisition effect—they may instead be redirected to other projects. This suggests that startup acquisitions do not necessarily increase or decrease an incumbent's overall R&D investment but rather shift it across different projects within their portfolio.

A third channel arises in markets with multiple incumbents, where acquisitions can affect an incumbent's R&D incentives through the rival's acquisition decisions. Bourreau and Gautier (2024) analyze this dynamic in a setting with multiple incumbents and a startup. Their model highlights two key forces that shape an incumbent's R&D incentives when a startup remains independent. First, there is an insurance effect: an incumbent will be able to license the startup's technology as a fallback if its own innovation efforts fail but the other incumbent succeeds. Second, there is a competition effect: if one incumbent fails to innovate, it may license the startup's technology, increasing competitive pressure. Both effects reduce an incumbent's incentive to invest in R&D, as they lower the potential returns from successful innovation. However, when acquisitions are permitted, Bourreau and Gautier finds that an incumbent who successfully develops their technology will always bid to acquire the startup. This reduces the competition effect, as the rival incumbent, when unsuccessful, will never be able to license from the startup. It also eliminates the insurance effect, as the incumbent, if it fails, knows that the other incumbent will acquire the startup, preventing it from licensing from the startup. As a result, acquisitions can ultimately strengthen incumbents' incentives to invest in R&D by shielding them from competitive threats and securing access to critical innovations.

A fourth channel through which acquisitions influence R&D incentives is through changing the incumbent's incentive to imitate the startup's R&D. Motta and Sheleiga examine this in an earlier version of their work (Motta and Sheleiga, 2021).[17] In their model, a startup first decides whether to develop a substitute or complementary product, then the incumbent decides whether to copy the startup's R&D. The possibility of copying leads to potential kill-zone effects: the startup switches to choosing a complement as choosing a substitute would imply that it is copied by the incumbent. They find that allowing for the startup to be acquired after the incumbent's copying reduces the range of parameter values for which a kill-zone occurs, which means the startup chooses a substitute for a larger range of values. This is because a substitute raises the gains from acquisition by more than a complement. This, in turn, raises the set of values for which the incumbent copies the startup, which suggests the prospect of acquisitions lead to more R&D imitation.

6 Concluding Remarks

Our analysis has primarily focused on cases where startups and incumbents compete in the same market. However, the underlying logic extends to scenarios where startups operate in adjacent markets but have some probability of entering the incumbent's market. This is particularly relevant given that large tech incumbents frequently

[17]The published version (Motta and Shelegia, 2024) focuses only on the incumbent's imitation incentives without acquisitions.

acquire startups in adjacent rather than directly competing markets, whether independent or complementary (Motta and Peitz, 2021).

Additionally, we have not considered the distinction between technology-driven acquisitions and acquihires, where an incumbent values a startup's talent but not its technology (Coyle and Polsky, 2013). In an acquihire, the startup is often shut down, and its talent is reallocated to other projects. This distinction poses challenges for competition authorities, as it is difficult to differentiate between "killer acquisitions" aimed at eliminating competitors and acquihires motivated solely by talent acquisition. Acquihires also introduce a host of other potential anticompetitive concerns. For example, acquihires can lead to a concentration of monopsony power in the labor market (Bar-Isaac et al., 2024). Furthermore, related to the preemption effect in Gilbert and Newbery (1982), firms may have incentives to engage in inefficient talent-hoarding through acquihires, preempting (potentially more efficient) rivals from accessing key human capital resources (Benkert et al., 2024).

Like most analyses in the literature, our study focused mainly on the optimal design of merger polices which determine the probability that a merger is cleared. An alternative approach involves structural and behavioral remedies, which target changes to market structure or regulate the merged entity's behavior after the merger is cleared. These remedies and their potential effects on welfare and innovation have been analyzed in works like Letina et al. (2024) and Teh et al. (2025). While these remedies can be effective in markets with high uncertainty, they are often difficult to implement in practice due to informational and resource constraints faced by competition authorities.[18] Incorporating these real-world constraints into the study of optimal remedies, and combining them with the optimal design of merger policy, is a promising avenue for future research.

Meanwhile, designing an optimal merger policy is challenging due to significant informational asymmetries between firms and competition authorities. Firms often possess more knowledge about mergers, and ensuring truthful disclosure may require complex screening mechanisms that are difficult to implement. Even when information is obtained, interpreting it to justify interventions remains a hurdle. To address these challenges, there has been growing support for shifting the burden of proof

[18] As remarked by Tommaso Valletti, ex-Chief Competition Economist of the European Commission's Directorate General for Competition in Brussels, "*..we know that these remedies are ineffective and unenforceable*" (`https://www.linkedin.com/posts/tommaso-valletti-95b079b_is-competition-policy-dead-part-i-having-activity-7266059668869844992-8Bdg`).

onto merging parties (Scott-Morton et al., 2019; Furman et al., 2019; Crémer et al., 2019), though such changes could unintentionally dampen R&D incentives for startups and incumbents. A formal analysis of how these regulatory shifts impact ex-ante R&D decisions is warranted.[19] Additionally, many jurisdictions require pre-merger notifications to facilitate regulatory assessment, with mechanisms such as notification thresholds helping authorities evaluate competitive risks. Expanding research on the design and effectiveness of pre-merger reviews (Benitez and Gonzalez, 2009; Choe and Shekhar, 2010), particularly in the context of R&D-intensive industries, remains an important avenue for future work.

An essential challenge in designing optimal merger policy in rapidly evolving industries is how to deal with uncertainty about the innovation and synergies of merging parties while assessing acquisitions effectively. In settings without significant innovation concerns and where competition authorities are knowledgeable about what private information merging parties can have, Nocke and Whinston (2010), Nocke and Whinston (2013), and Loertscher and Marx (2019) provided important insights into merger policy design under asymmetric information between firms and competition authorities. Further research, drawing upon recent theoretical work in mechanism design with adverse selection *and* moral hazard (e.g., see Castro-Pires et al. (2024)), will be needed to extend these frameworks to account for the startup's ex-ante R&D decision. Another approach is to focus on policies which perform well in settings even when regulators face significant uncertainty about what private information merging parties have. In economic theory, the growing literature on robust mechanism design (Bergemann and Morris, 2005) and information design (Bergemann and Morris, 2019) explores such questions in a general setting. To our knowledge, few studies have applied these insights to the study of merger policy. We see as a promising avenue for future research.

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[19] See Cabral (2024) for a discussion of this policy proposal.

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Appendix: Details for Section 4.2

Suppose that $\Pi_I^M(z), \Pi_I^D(z), \Pi_E^D(z), CS^D(z), CS^M(z), CS^m(z)$ are all continuous in z, and $G(z)$ is continuous on its support, which we assume is compact.

Under q, the cutoff type of startup that enters is given by

$$c_E(q) \equiv \int_Z \left(q(z)\beta(\Pi_I^M(z) - \Pi_I^D(z)) + (1 - \beta q(z))\Pi_E^D(z) \right) dG(z)$$

Therefore, consumer welfare under q is given by

$$\int_Z \left(F_E(c_E(q))(q(z)CS^M(z) + (1 - q(z))CS^D(z)) + (1 - F_E(c_E(q)))CS^m(z) \right) G(z)$$

By a standard first-order condition argument, it follows that if q^* is an optimal merger policy, then

1. If $q^*(z) = 0$,

$$\begin{aligned} F_E(c_E(q^*(z)))[CS^M(z) - CS^D(z)] - \beta[\Pi_I^M(z) \\ -\Pi_I^D(z) - \Pi_E^D(z)] f_E(c_E(q^*(z))) \leq 0 \end{aligned} \tag{23}$$

2. If $q^*(z) \in (0, 1)$, then

$$\begin{aligned} F_E(c_E(q^*(z)))[CS^M(z) - CS^D(z)] - \beta[\Pi_I^M(z) \\ -\Pi_I^D(z) - \Pi_E^D(z)] f_E(c_E(q^*(z))) = 0 \end{aligned} \tag{24}$$

3. If $q^*(z) = 1$, then

$$\begin{aligned} F_E(c_E(q^*(z)))[CS^M(z) - CS^D(z)] - \beta[\Pi_I^M(z) \\ -\Pi_I^D(z) - \Pi_E^D(z)] f_E(c_E(q^*(z))) \geq 0 \end{aligned} \tag{25}$$

In particular, letting

$$\widehat{\Phi}(q) = \left(q^*(z)CS^M(z) + (1 - q^*(z))CS^D(z) - CS^m(z) \right) \times \frac{f_E(c_E(q^*))}{F_E(c_E(q^*))}.$$

and rearranging the equation in (24), we obtain (22).

Now, by observing (23)-(25), given states z, z', a sufficient condition for mergers associated to outcome z to be approved more frequently than those associated to z' under an optimal merger policy q^*, i.e., $q^*(z) \geq q^*(z')$, is for

$$CS^M(z) - CS^D(z) > CS^M(z') - CS^D(z') \tag{26}$$

$$CS^D(z) - CS^m(z) > CS^D(z') - CS^m(z') \tag{27}$$

$$\frac{CS^D(z) - CS^M(z)}{\beta(\Pi_I^M(z) - \Pi_I^D(z) - \Pi_E^D(z))} < \frac{CS^D(z') - CS^M(z')}{\beta(\Pi_I^M(z') - \Pi_I^D(z') - \Pi_E^D(z'))} \tag{28}$$

Conditions (26) and (27) imply that state z is better for consumers than z'. Both the marginal increase in consumer welfare from monopoly over duopoly conditional on the startup pursuing R&D, and the marginal increase in consumer welfare in the absence of mergers from the startup pursuing R&D are larger under z than z'. Meanwhile, (28) says that the "efficiency ratio" under z is larger than z'. Thus, raising the approval rate is relatively more efficient at raising the startup's incentive to pursue R&D when the R&D outcome is z than z'.

In particular, if $CS^M(z) - CS^D(z)$, $CS^D(z) - CS^m(z)$ and $\Pi_I^M(z) - \Pi_I^D(z) - \Pi_E^D(z)$ are all strictly increasing in z, then any optimal merger policy must be monotone, i.e., $q^*(z)$ is non-decreasing in z. This holds, for instance, when a higher z reflects a larger merger synergy (higher $CS^M(z) - CS^D(z)$ and $\Pi_I^M(z) - \Pi_I^D(z) - \Pi_E^D(z)$) and higher quality product (higher $CS^D(z) - CS^m(z)$).