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“Mergers and Investments: Where Do We Stand?”

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Mergers and Investments: Where Do We Stand?*

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In this paper, we review recent studies on the impact of mergers on investments. First, we examine how mergers among competing incumbents influence firms' incentives to develop new products and undertake cost-reducing or quality-enhancing investments. Second, we analyze how an incumbent's acquisition of an innovative entrant affects the investment incentives of both parties. Third, we discuss the effects of vertical mergers on the investment decisions of both upstream and downstream firms. Finally, we outline a few directions for future research.

Keywords: Competition, Investments, Innovation, Mergers, Entry.
JEL codes: D43, L13, L40.

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1 Introduction

The long-standing debate on the relationship between competition and investments has recently been revived due to the growing interest of competition authorities in the so-called "non-price effects" of mergers. For example, the European Commission has taken actions in several merger cases based on an adverse impact on R&D investments. Notable examples include the mergers between Medtronic and Covidien (2014), Novartis and GSK (2015), and Pfizer and Hospira (2015) in the pharmaceutical and medical device sector, as well as those between Dow and Dupont (2017), Bayer and Monsanto (2018), and Bayer and BASF (2018) in the agricultural products industry. All of these mergers have been cleared under the condition that remedies that address concerns about innovation incentives are implemented. Similar concerns have been raised over the last few years in the context of digital markets, where incumbents have engaged in a large number of acquisitions of innovative startups.

The impact of mergers on innovation has also been a central issue in the ongoing debate on European competitiveness. For example, in a recent report for the European Commission, Draghi (2024) recommends revising the Commission's merger guidelines to clarify how the impact of mergers on innovation incentives is assessed and to allow for a "innovation defense". According to the report, such a defense could be justified in certain sectors by the need to pool resources in order to compete at the global level.

The literature on the effects of competition on R&D investments draws on two seminal contributions that offer seemingly opposite views. The first perspective, put forward by Schumpeter (1942), posits that market power (and firm size) spur innovation. The logic behind this assertion is that firms with market power have a stronger incentive to innovate because of their greater ability to appropriate innovation rents (owing to low competitive pressure). The second viewpoint, articulated by Arrow (1962), argues that a monopolist has weaker incentives to innovate compared to a firm in a perfectly competitive environment, due to the so-called *replacement effect* (Tirole, 1988). This effect refers to the idea that a monopolist makes profits even if it does not innovate, whereas a firm in a perfectly competitive market makes profits only if it innovates (thus becoming more efficient than its rival). Consequently, a firm operating under perfect competition has more to gain from innovating than a monopolist. As a preamble, it is important to note that the Arrowian and Schumpeterian views do not contradict each other (Shapiro, 2012). The former essentially states that greater competition *before* innovation raises firms' incentives to innovate, whereas the Schumpeterian view contends that greater competition *after* innovation reduces innovation incentives.

Several scholars have investigated the Arrowian and Schumpeterian effects from both

theoretical and empirical perspectives.[1] Most notably, in a seminal contribution, Aghion et al. (2005) build a model that incorporates both types of effects and show that the relationship between competition and innovation is non-monotonic. Specifically, the authors find that the combination of the Arrowian and Schumpeterian effects lead to an *inverted-U relationship* between competition and innovation.

The early literature on competition and investments has primarily relied on two measures of competition intensity: the number of competitors and the degree of substitutability between products. However, neither of these measures captures a key feature of mergers: the ability of merging firms to coordinate their decisions. This led to the emergence of a new literature that examines the specific effects of mergers on investments. This literature consists of two strands corresponding to two distinct policy debates: one focusing on the impact of mergers between incumbents on post-merger investment incentives and the other exploring the effects of an incumbent's acquisition of an innovative entrant on pre- and post-merger investment incentives.

In Section 2, we examine the effects of horizontal mergers among incumbents on the level and direction of R&D investments. We first provide an overview of the main theoretical contributions, distinguishing between three distinct types of investments: investments in new products, cost-reducing investments, and quality-enhancing investments. The literature shows that different types of investments are affected differently by horizontal mergers. To understand why, consider two rival firms competing in both prices and investments. If they invest in cost reduction, a firm's investment affects its rival's profit only indirectly, through the price changes it induces. In contrast, a quality-enhancing investment by one firm also has a direct impact on its rival's profits: even if prices remain unchanged, it negatively affects the rival's demand. As a result, the externalities associated with these two types of investments differ, leading to distinct effects when these effects are internalized through a merger. We complement our theoretical discussion with a review of (some of) the empirical evidence on the effects of horizontal mergers on investments, starting with aggregate studies and then delving into sector-specific studies.

In Section 3, we discuss the impact of acquisitions of innovative entrants by incumbents on the investment incentives of both the acquired and the acquiring parties. The existing literature has shown that incumbents can have incentives to stifle competition by acquiring emerging competitors and halting their innovative projects. This practice, empirically documented in the pharmaceutical and digital industries, has been termed a *killer acquisition* (Cunningham et al., 2021), and is anticompetitive because its sole ob-

[1]For theoretical contributions on the effect of competition intensity on investments, see e.g., Vives (2008); Belleflamme and Vergari (2011); Schmutzler (2013); Chen and Schwartz (2013); Marshall and Parra (2019). For empirical contributions see e.g., Askenazy et al. (2013); Hashmi (2013); Correa and Ornaghi (2014); Hashmi and Biesebroeck (2016); Beneito et al. (2015, 2017); Jeanjean and Houngbonon (2017); Elliott et al. (2024); Guiffard et al. (2023).

jective is to reduce future competition. However, permitting the acquisition of innovative entrants may also have positive effects on competition and innovation. In particular, the prospect of acquisition may offer an innovative entrant incentives to invest in entering the market in a situation where, absent the possibility of acquisition, entry would not be profitable.

In Section 4, we discuss how vertical mergers affect innovation incentives. A central issue in the literature is how vertical integration affects investment behavior through its impact on hold-up. Vertical integration mitigates hold-up issues between the merging parties, thereby enhacing their incentives to invest. However, recent studies also show that vertical integration can also create hold-up problems for the downstream rivals of the merged entity, potentially reducing their investments.

In Section 5, we provide concluding remarks and outline directions for future research. Specifically, we highlight the need for further work on the impact of mergers on non-merging firms, the effects and design of merger remedies addressing innovation concerns, the way intellectual property rights affect the impact of a merger on innovation, and the effects of conglomerate mergers on firms' innovation incentives.

2 Horizontal mergers between incumbents

This section focuses on the effects of horizontal mergers between incumbents on firms' incentives to invest.[2] In what follows, we first present several theoretical contributions on the effects of mergers between incumbents on investments. We then provide an overview of the empirical literature on the impact of horizontal mergers on different measures of investments and innovation. We distinguish between aggregate studies, which investigate effects of mergers across different sectors and industries, and sector-specific studies, which focus on particular sectors.

2.1 Theory

In this section, we distinguish between different types of investments. First, we discuss the effects of horizontal mergers on firms' incentives to invest in new products. Second, we discuss how horizontal mergers affect firms' incentives to lower their marginal cost of production. Third, we provide an overview of the effects that horizontal mergers have on firms' incentives to enhance the quality of existing products. Fourth, we discuss papers that study the impact of mergers on investments using general approaches allowing for

[2] A recent literature analyzes common and cross-ownership and their relationship with innovation efforts (López and Vives, 2019; Nevrekar, 2022; Li et al., 2023; Antón et al., 2024; Shelegia and Spiegel, 2024). Common and cross-ownership can be thought of as "partial mergers". A review of these studies is beyond the scope of this paper.

both cost-reducing and quality-enhancing investments. Fifth, we review recent papers analyzing the effects of mergers on innovation in a dynamic setting. Finally, we discuss papers exploring the effects of horizontal mergers on the diversity and the direction of innovation.

2.1.1 Investments in new products

Federico et al. (2017) study the effects of a merger on product innovation. They consider a market in which several identical research labs compete to discover a new product (e.g., a treatment for a disease). Because the outcome of research is uncertain, the number of successful labs is random, and competition among several products reduces profits. The authors assume that when there are three or more successful products, all profits are eroded. An investor can only expect positive profits if it is the sole successful inventor or if there is only one other successful inventor.

If a merger between two research labs takes place, the authors assume that the two research units remain separate and are coordinated by the merged entity. Under the assumption that the merged entity would continue to invest equally in the two units, they conclude that the merged entity will invest less in R&D than the two independent labs. The mechanism is as follows: unlike competing labs, the merged entity internalizes that if the two labs succeed simultaneously in their innovation, sales would be cannibalized. As a result, the merged entity has lower incentives to invest than two competing labs. The authors also argue that for concentrated industries, the non-merging firms' reactions would not be able to compensate for the reduction in innovation by the merged entity.

This study has been challenged by Denicolò and Polo (2018), who have shown that the central result of Federico et al. (2017) that the innovation efforts of merging firms always decrease after a merger depends on the assumption that the merged entity finds it optimal to maintain two research labs after the merger. However, the merged entity might want to shut down one of the two research units and focus on only one. The logic behind it is the following. Under competition, firms might jointly succeed in innovation, resulting in innovation duplication and cannibalization of sales. Because the merged entity would internalize this externality, it may find it optimal to reduce its R&D effort in one research path and increase it in another. The authors show that whether the merged entity has such an incentive depends on the returns of R&D. Specifically, if the R&D technology involves little decreasing returns at the research unit level, the merged entity will focus all its efforts on one research unit. The authors also find that, in this case, the merger (weakly) increases the probability that an innovation is achieved.

Another extension of the analysis of Federico et al. (2017) is provided by Jullien and Lefouili (2020) who study the effects of a horizontal merger on incentives to introduce new products as a result of R&D investments in a setting with potentially differentiated

products. They consider an industry with two firms and a merger to a monopoly. Each firm owns a research lab and the probability that its research lab is successful in achieving an innovation depends on the amount invested in R&D. The authors show that if the assumption that R&D investments lead to the development of a homogeneous product is relaxed, the merged entity can have a greater incentive to innovate than independent firms. The mechanism is similar to that of Chen and Schwartz (2013) in the sense that the merged entity can benefit from the price coordination of two new products.

2.1.2 Cost-reducing investments

Motta and Tarantino (2021) examine the impact of a horizontal merger on cost-reducing investments. They consider a market where firms produce differentiated products and compete in prices and investments,[3] and abstract away from (involuntary) R&D spillovers and merger-induced R&D synergies.[4] To isolate the effect of the merger on merging firms' incentives to invest, they first focus on the case in which two duopolists merge, thereby giving rise to a multiproduct monopolist. They find that the merger nternalizes pricing externalities and lead to higher prices relative to the case with independent firms. The resulting increase in prices reduces quantities, which in turn lowers the returns from cost-reducing investments, leading to a reduction in investment effort. Therefore, in this setting, the merger has a negative impact on the merging firms' incentive to invest andconsumer surplus.

The authors then turn to the case where two firms in an industry with at least three firms decide to merge. They show that, in this case, the merger reduces competition between merging and non-merging parties, which results in an incentive for non-merging parties to increase their prices. As the prices of non-merging parties increase to a lesser extent than the merging party, this generates higher demand, which increases the return from cost-reducing investments. This leads to opposite effects on merging and non-merging parties' incentives to invest, with the former being negative and the latter being positive. The overall effect of the merger on the industry-wide level of investments is therefore ambiguous in principle. However, the authors find that this effect is negative under some commonly used model specifications.

An assumption that seems to play an important role in the latter finding is the symmetry among firms in terms of production costs. Baranes and Vuong (2021) extend the model of Motta and Tarantino (2021) to the case in which not all firms are symmetric in their costs. Specifically, they consider a market with two symmetric firms willing to

[3] In the main model, they consider a market in which firms make their decisions on prices and investments simultaneously.They also consider an extension in which decisions on prices and investments are made sequentially.

[4] Related to this, Denicolò and Polo (2021) show that the effect of innovation sharing between merging firms on their incentives to innovate may make horizontal mergers pro-competitive.

merge and an outsider firm with a lower cost. They show that if the outsider firm has a sufficiently low cost relative to the merging firms, the increase in its level of investment can more than offset the reduction in investment of the merged entity. This could spur total investments post-merger and, in some cases, result in an increased consumer surplus.

The impact of mergers on cost-reducing investments is also assessed by Mukherjee (2022), who extends the model by Federico et al. (2017) to a setting in which the payoffs when innovation fails are not equal to zero (which implies that the Arrow replacement effect is present). He builds a simple model that leaves aside any involuntary spillovers or R&D synergies and where two competing firms sell horizontally differentiated products. The two sellers can invest in R&D which, with some probability, results in a lower marginal cost of production. As in Federico et al. (2017), the author assumes that the probability of failure in innovation is log-convex in R&D investments, which implies that the merged entity would not shut down one of the two labs after the merger. Comparing the level of investments without and with a merger, Mukherjee concludes that R&D investments can be either higher or lower with a merger. To further explore this finding, the author provides an example with a specific functional form. If R&D investments substantially lower marginal cost and competition is intense, there is a significant *business-stealing effect* for the firm that succeeds in innovation when the firms are independent relative to when they are merged. In this case, the merger reduces R&D investments in process innovation. If either competition intensity is low or the marginal cost before R&D is not too high, the business-stealing effect is weak and, therefore, a merger can stimulate investments. The study also highlights that a merger can result in an increase in expected consumer surplus and total welfare even in the absence of spillovers and synergies.

2.1.3 Quality-enhancing investments

Investments that aim to enhance product quality differ critically from cost-reducing investments. Specifically, they affect rivals only indirectly through the effect they have on final prices. In contrast, quality-enhancing investments also have a direct effect on rivals because a higher-quality product diverts sales from rivals (even if prices remain unchanged). The presence of direct and indirect effects generates more complex interactions between prices and investment decisions than for cost-reducing investments. In what follows, we review studies that deal with quality-enhancing investments and how market consolidation affects them.

Federico et al. (2018) study the effects of horizontal mergers on firms' incentives to invest in quality-enhancing innovation and consumer surplus in a symmetric oligopoly. In their baseline model, they abstract from any efficiency gains or spillovers. This makes the merger anti-competitive in the absence of investments because of the internalization of the usual *pricing externality*. The latter, which the authors call *price coordination*, has

an indirect impact on firms' incentives to invest, which is ambiguous in general. A second channel through which a merger impacts the level of investments is via the internalization of the *innovation externality* exerted by each of the merging parties on the other one. This effect is unambiguously negative.

The authors first present separate analytical analyses of the price coordination channel and the innovation externality channel and then study the interplay between them using numerical simulations. They find that the effect stemming from the internalization of the innovation externality dominates, which leads to a reduction in the innovation incentives of the merging firms. The authors then look at industry-level investment and find that, while the merged entity reduces its incentive to invest in R&D, non-merging parties respond by raising their R&D effort. To identify which effect prevails, the authors rely on numerical simulations and find that the net effect of the merger is negative absent efficiency gains.

Bourreau and Jullien (2018) study the effect of a merger to monopoly on demand-enhancing investments. The study is well suited to understand mergers in the telecommunications market where firms compete in price and coverage (of broadband, for example). Serving territories is costly and, absent a merger, there are circumstances in which one company out of two is the monopolist for that area and circumstances in which there exists competition between the two companies. Moreover, it is also possible that some areas are not covered at all.

The authors show that in the absence of a merger between the two companies prices are inefficiently high if products are sufficiently differentiated. The firm covering both the competitive segment and the monopolistic segment sets an intermediate price that balances the incentive to raise the price on the monopolistic segment of the market and the incentive to lower the price to attract consumers in the duopolistic segment. As prices are strategic complements, also the rival responds by setting a price that is higher than the price that would be set under competition only. Therefore, the impossibility for the firm serving two markets to differentiate prices entails a price externality in the duopoly setting. If the two companies merge, the merged entity coordinates the deployment of the two products. The authors find that a merger raises prices and total coverage but the coverage of the multi-zone market decreases. The effect on consumers depends on the relative magnitude of extended coverage and higher prices. In particular, there exist cases in which the merger becomes desirable for consumers.

2.1.4 General approaches

We now discuss two papers that examine the effects of mergers on innovation within general frameworks that allow for both cost-reducing and quality-enhancing investments.

Bourreau et al. (2024) investigate the effects of a horizontal merger in a setting where (incremental) innovation can be cost-reducing and/or quality-enhancing, and demand

functions take a general form. In their baseline model, they study the impact of a merger between two symmetric duopolists on their incentives to innovate, assuming away any spillovers or efficiency gains in either R&D or production. They show that the overall impact of the merger on innovation is the sum of a *market power effect* and an *externality effect*. The former subsumes two effects driven by the impact of the merger on output. First, when innovation increases margins, a reduction in output has an adverse effect on merging firms' incentives to innovate. This *margin expansion effect* is negative. Second, a change in output may affect the return to investment per unit of output either positively or negatively. The externality effect can also be decomposed into two effects. First, the merged entity accounts for the negative impact of each merging firm's innovation on the other merging firm's demand, which reduces its incentives to innovate (the authors call this the *innovation diversion effect*). Second, the merger has an impact on the merging firms' margins and thereby affects their incentives to innovate when innovation increases their sales. This *demand expansion effect* is positive. An important insight of the paper is that, whenever the externality effect is different from zero, it is negative if and only if the price diversion ratio,[5] which measures the reallocation of output between the merging parties as a consequence of a unilateral increase in the price of one of the two parties, is less than the innovation diversion ratio, its counterpart for innovation.[6]

The authors show that when innovation reduces marginal costs but does not affect demand, the externality effect is zero and the market power effect is negative. Therefore, a merger reduces innovation in this case. By contrast, when innovation affects demand, the externality effect generally differs from zero, and the impact of the merger on innovation can be either positive or negative. This in turn implies that the effect of the merger on consumer surplus is ambiguous in general. However, simulations relying on two classes of demand functions under which a merger can spur innovation suggest that it is unlikely that a merger benefits consumers in the absence of both efficiency gains (in R&D and production) and spillovers.

The authors pay special attention to the case in which mergers are *P-neutral*, meaning that they would not lead to changes in prices if the innovation levels of the merging parties were fixed.[7] This allows investigating a *standalone* innovation theory of harm, that is, a theory of harm in which adverse effects on innovation are not (entirely) driven by adverse effects on prices.[8] It is shown that in the case of P-neutral mergers, the overall impact of the merger on innovation depends solely on the comparison of the price diversion ratio

[5]The price diversion ratio is commonly used by competition authorities, in particular in the Upward Pricing Pressure (UPP) analysis initially proposed by (Farrell and Shapiro, 2010).

[6]The innovation diversion measures the reallocation of output between the merging parties as a consequence of a unilateral increase in the quality of one of the two parties. For a discussion, see Salinger (2019).

[7]Note that efficiency gains in production are necessary for this to happen.

[8]See Denicolò and Polo (2019) for a critical assessment of the innovation theory of harm.

and the innovation diversion ratio. If the former (resp., latter) is greater, a merger raises (resp., reduces) the merging firms' incentives to innovate.

Moraga-González and Motchenkova (2024) consider a (more) general reduced-form model that allows for both deterministic and stochastic innovation. Because the reduced-form approach allows for both cost-reducing and demand-enhancing R&D, their unified framework accommodates many of the existing models in the literature (e.g., Federico et al. 2017; Denicolò and Polo 2018; Jullien and Lefouili 2020; Motta and Tarantino 2021; Mukherjee 2022). The authors identify three channels through which a merger affects merging firms' incentives to invest in R&D: payoff-enhancing price coordination, internalization of a direct negative innovation externality resulting from a higher probability of success, and internalization of an indirect negative externality resulting from business stealing in the product market.

The authors first show that, in the absence of price effects (for example due to price regulation), a merger always leads to a decrease in R&D investment as the only two channels at work are the second and the third.[9] Second, they examine the class of models in which the R&D process is deterministic. In this case, the only active channels are the first and the third (because the probability of success is set to one), resulting in two opposite effects and, therefore, an a priori ambiguous overall effect. The authors provide a condition under which the latter is positive or negative. Third, they study models with stochastic innovation enabling entry (where profits are equal to zero when innovation fails), and provide a necessary and sufficient condition for a merger to have an adverse impact on R&D investment. Finally, they investigate a richer stochastic R&D model in which a firm makes a non-zero profit even it fails to innovate (which means that the Arrow replacement effect is present). In this case, the effects are substantially more complex and the findings make it clear that the nature of the cost function may play a key role in the assessment of the impact of a merger on R&D investment.

2.1.5 Dynamic aspects

In this section, we review three papers that investigate the effects of horizontal mergers on innovation in a dynamic setting. These studies identify novel channels through which mergers affect innovation, thereby improving our understanding of the (long-term) welfare effects of mergers.

Hollenbeck (2020) analyzes industry dynamics allowing for mergers and quality investments, and identifies conditions for which mergers that lead to lower consumer surplus in the short run (because of higher prices) generate a positive long-run effect on innovation. The author finds that this is possible if entry costs are low and technological progress is possible. He shows that when there are mergers, more firms enter the market, and

[9]Note that the authors abstract away from spillovers and efficiency gains in their model.

these entrants invest in new products. If new products are brought to the market, then competition occurs, which in turn fosters more investments, which may have long-term positive effects for consumers. The author also finds that if acquisitions lead to the incorporation of innovation in existing products, then the positive effect of mergers increases as synergies now arise.

Das et al. (2024) consider a dynamic setting in which two competitors have the opportunity to develop innovations by making investments along a research avenue. The research avenue can be either *good* or *bad*; a good research avenue rewards R&D effort with a product innovation at exponentially distributed times, while a bad research avenue never generates innovation. Initially, firms are unaware of the avenue type, but they learn about it over time through observable research activities and innovation successes of both themselves and their rivals.

Das et al. (2024) show that, in this setting, a merger has three effects on innovation. Firstly, due to the substitutability of innovations, a cannibalization effect arises as the second innovation displaces a portion of the gains from the initial innovation. The merged entity internalizes this negative externality resulting from competing innovations. Secondly, there is an appropriability effect because the merged entity faces less post-merger competition from a potential second innovation, thereby increasing incentives to pursue the first innovation. Thirdly, because a successful innovation by one firm provides information about the quality of the research avenue, there is an informational spillover which reduces incentives to invest due to a free-riding problem. However, the merged entity internalizes this effect and intensifies its research efforts, thus accelerating the timing of the first innovation.

The authors identify conditions under which the merged entity finds it optimal to block or not block the second innovation conditional on the first innovation being successful. This decision depends only on whether the second innovation is ultimately profitable given that the research avenue has been proved good due to the first successful innovation. They show that when the cost of research is low enough, a merger always leads to positive effects on innovation since the merged entity never blocks the second innovation, and more resources anticipate the time of the first innovation. However, if the cost of research is neither too small nor too high, the merged entity stops research for the second innovation because it is unprofitable, but devotes more resources to the first innovation.

Marshall and Parra (2023) adopt a dynamic "creative destruction" approach to study the effects of mergers on market structure, expected time between innovations, the industry-wide R&D expenditures, and social welfare. In their setting, at any given moment, there is a technology leader earning monopoly profits and followers making no profit. Innovation dynamics generate entry and exit of firms, and this relates to the value of being a leader. When the value of being leader is very high, many entrants are attracted to the

market, which increases the speed of innovation and, therefore, makes the lifespan of the leader shorter. On the contrary, when the value of being leader is very low, there is little entry, which decreases the speed of innovation and increases the lifespan of a leader.

The authors compare innovation outcomes in the case in which all firms compete and in the case in which there is an unexpected merger that entails R&D synergies, i.e., the merged entity is more effective than the other firms in reaching a breakthrough. This induces more market concentration and exit by some firms. If the merger entails only small efficiency gains, then it has no effect on the speed of innovation but since there is exit of some followers there is less overall R&D expenditure. However, when these efficiency gains are large enough, then the merged entity can achieve an innovation pace that is higher than the pre-merger one. In turn, the merger reduces the waiting time between innovations and induces all inefficient followers to leave the market. Thus, the merged entity and the technological leader remain the sole active players in the market.

The authors finally conclude that mergers with R&D efficiencies are welfare-improving whenever entry into the market is costly and timely. The reason in that in this case mergers that entail R&D synergies either increase the pace of innovation or keep it constant while reducing overall R&D expenditures.

2.1.6 Diversity and direction of innovation

Mergers can affect not only the amount of R&D investments, but also the diversity of R&D projects and the direction of innovation. This issue has emerged, for example, as one of the main reasons why the Department of Justice, supported by the Department of Defense, opposed the proposed merger between Lockheed Martin and Northrop Grumman in 1998 (Letina, 2016).

Letina (2016), Gilbert (2019) and Moraga-González et al. (2022) study how a horizontal merger affects the diversity of R&D projects. The first two papers find that the merger results in a lower variety of developed projects, while the third shows that the merger distorts R&D portfolios in a way that can have either positive or negative effects on consumers.

Specifically, Letina (2016) studies the effect of horizontal mergers on R&D portfolios starting from the following trade-off: on the one hand, higher variety of R&D projects increases the probability that the innovation is discovered; on the other hand, more duplication of R&D projects leads to stronger product competition ex post. In the baseline model, Letina (2016) assumes competition between symmetric firms that choose the subset of research projects to invest in. Innovation is stochastic and drastic, with all projects being ex ante symmetric in the probability to succeed, but with different fixed development costs. When choosing the projects to develop, firms face a trade-off because cheap projects have the same probability of success as costlier ones but attract more competi-

tors. The author identifies the equilibrium R&D portfolio and finds that R&D variety is lower if a merger occurs. To escape competition, a firm can invest in projects that are more expensive, leading to more diversity. As a merger reduces competition, all else equal, it also leads to less variety of funded projects.

Gilbert (2019) extends the framework of Federico et al. (2018) by assuming that firms decide how many R&D projects to undertake.[10] The author shows that the presence of technological spillovers plays a critical role in understanding the overall impact of mergers on the level of investments in R&D and the probability of discovery. First, he shows that absent technological spillovers, the effect of mergers on investments can be either positive or negative, but the overall effect on consumer surplus is negative, as losses from increases in prices outweigh any gain in innovation incentives. Second, if technological spillovers are present and benefit imitators or enable follow-on innovations, then mergers can not only spur more investments in the industry but also have a positive effect on consumers.

Moraga-González et al. (2022) investigate the impact of horizontal mergers on firms' innovation portfolios and consumer welfare. In an environment where firms have a fixed overall R&D budget and invest it in two research projects, the investment of a given firm in a given project has two opposite effects on rival firms. First, it has a negative effect on them because it reduces the probability that they will win the innovation contest for that project. This is the usual *business-stealing externality* . Second, a firm's investment in one project has a positive effect on its rival because it increases the probability that they win the innovation contest for the alternative project. This is a novel effect, that the authors call a *business-giving externality.* A merger between two firms leads to the internalization of these two opposite externalities. The authors establish that when the project that is relatively more profitable is also the more appropriable, a merger raises consumer welfare. The reason for this is that a merger leads to a lower investment in the more profitable project and a higher investment in the alternative project.

2.2 Empirical evidence

Empirical evidence on the impact of mergers on firms' investment incentives has been examined through both aggregate and sector-specific analyses. We review several of these studies, distinguishing between the two approaches.

2.2.1 Aggregate studies

In this section, we present three aggregate studies exploring the effects of mergers on investments.

[10] Each firm has a fixed cost of running the project, but this cost is independent of the number of projects undertaken.

Ornaghi (2009) investigates the effects of mergers on firms' performances and, in particular, on innovation in the pharmaceutical industry. He considers the period 1988-2004 in which 27 mergers occurred. The author finds that, on average, following a merger, the acquiring party reduced its R&D expenditure, the number of new patents (and also new important patents) and R&D intensity (measured as the ratio between R&D expenditure and revenues). This descriptive evidence is then further corroborated by an analysis with a propensity score matching technique for which each acquirer and target is matched with a company that has similar characteristics but is not involved in a merger. He shows that while merging and non-merging firms were following similar patterns before the merger, they differ post-merger with the merging firms reducing innovation inputs (i.e., R&D expenditure) and outputs (e.g., patents).

Szücs (2014) presents an aggregate study of mergers that were notified either to the US Federal Trade Commission or to the European Commission, over the period 1990-2009. The author addresses endogeneity and selection problems by relying on a propensity score matching whereby each merging firm is matched to a non-merging firm with similar characteristics that would have predicted the treatment. Then, using a difference-in-difference approach, the author studies the effects of mergers on different innovation-related variables and finds that the R&D intensity of acquirers drops significantly post-merger.

Stiebale and Szücs (2022) use a dataset on 194 mergers and acquisitions cleared by European Competition authorities over the period 1999-2007 with the purpose to study whether mergers can explain the higher market power in the economy. When it comes to answering this question, it is not a priori clear how mergers impact merging and non-merging companies. For example, an increase in mark-ups, as a measure of market power, can result from either higher prices or lower marginal costs resulting from merger-specific efficiencies. Which of the two explains a potential increase in markups is often impossible to verify in the absence of price and cost information. Non-merging rivals, however, are unlikely to benefit from merger-specific efficiencies that their merging competitors have, and therefore increase in mark-ups is more likely to be explained by an increase in market power. They find that non-merging entities increase their markup by a 2-4% relative to their control group (constructed using a matching procedure) and that their investments and innovation decrease in the medium-run (that is, after 2 years from the merger approval). As they do not investigate whether mergers increase the investment and innovation activity of the merging parties, it is not clear whether these mergers had a negative or positive effect on the total level of investment and innovation.

Cavenaile et al. (2021) build a general equilibrium model where oligopolistic product market competition interacts with step-by-step innovation, exit and entry decisions as well as horizontal mergers. They calibrate the model with actual data from the US

Department of Justice and Federal Trade Commission and conduct a counterfactual experiment where they shut down antitrust enforcement. They find that a resulting welfare loss of 0.49% in consumption-equivalent terms. Moreover, they show that strengthening antitrust enforcement would generate significant welfare gains, with increased innovation and growth rates. However, this policy change raises innovation by superstar firms but decreases R&D activity in small firms due to the negative impact on their option value derived from M&A opportunities.

2.2.2 Sector-specific studies

The relationship between mergers and investments has been studied across various sectors, revealing heterogeneity in their effects on investments. A key advantage of sector-specific studies is their ability to account for technological differences unique to each sector, which are overlooked in aggregate analyses.

Valentini (2012) focuses on the US medical devices and photographic equipment industry, over the period between 1988 and 1996, and finds that mergers had a positive effect on patenting output, but decreased patent impact, originality, and generality. The author argues that one potential explanation for these findings is that mergers generate efficiencies that result in a higher number of patents, but also put pressure on managers to achieve short-term results, which has negative effects on the quality of patents measured by their impact, originality, and generality.

Genakos et al. (2018) collect a large dataset from the telecommunications industry in OECD countries over the period 2002-2014. The authors focus on mobile network operators that obtained a license to use the spectrum.[11] They study the effects of market consolidation in the industry and identify a potential trade-off for consumers: mergers lead to an increase in prices, but also lead to more investments per operator.[12] In particular, the authors find that a hypothetical average 4-to-3 symmetric merger in their data would lead to an increase in customer bills by about 16.3%, and an increase in investment per operator by about 19.3%. They also use their model to predict the effects of actual mergers that occurred during the considered period. For instance, according to the model predictions, the 2013 merger between Orange and 3-Hutchinson in Austria led to a price increase by 6.6% and an increase in investment per operator by 13.3%.

Lin et al. (2020) provide an empirical analysis of a hypothetical merger between T-Mobile and Spring in the US cellphone service market where four big providers (AT&T Mobility, Verizon Wireless, T-Mobile, Spring) operate. Specifically, they simulate the effects of a hypothetical merger in 2016 between the two providers on the deployment of

[11] They discard mobile virtual network operators, who however were not systematically present across OECD countries over the period of interest.

[12] The impact on total investments is, however, not conclusive.

4G-LTE technology by national providers using granular data at the firm-census block level. They find that relative to the baseline setting in which no merger occurs, the potential merger between T-Mobile and Spring reduces total entry into local markets by 23%, leading to an increase in the population that is under-served. They explain this result by the fact that the merger would reduce the number of potential entrants.

Aimene et al. (2021) examine recent mergers in the European mobile market and their impact on consumer surplus when technological progress is involved. The underlying consideration made by the authors is that technical progress, in the mobile operator market, is much higher with data than voice and, therefore, the impact of mergers on prices and consumer surplus can be different between data-intensive and voice-intensive markets. To test this hypothesis, the authors use data from 21 European countries, of which 5 were exposed to mergers in this sector (Austria, Germany, Ireland, Italy and Norway). Some of these mergers occurred in periods in which operators' revenues were voice-driven, whereas others occurred in periods where the revenues were data-driven. They show that mergers tend to decrease the unit prices of data and increase those of voice, and that mergers have a positive (respectively, negative) net effect in those contexts in which data usage (resp. voice usage) grows larger than voice usage (resp. data usage). For example, mergers in Austria and Germany took place when voice usage was predominant and led to a negative effect of the merger on consumer surplus. On the contrary, mergers in Ireland, Italy and Norway took place when data usage was predominant and in this case consumer surplus increased following the mergers. They further find that a market dominated by data (4G, 5G) maximizes its investment at a lower level of competition than a market dominated by voice (2G, 3G).

Haucap et al. (2019) provide a theoretical and empirical analysis of the effects of horizontal mergers on innovation. They consider 65 mergers that occurred in the pharmaceutical industry between 1991 and 2007 and went under scrutiny by the European Commission, and find that, overall, mergers led to less innovation by merging parties relative to non-merging firms. They employ propensity score matching (to identify suitable untreated firms) and run a difference-in-difference approach to estimate the average effect of the merger on patent applications by the merging parties. Consistently with their theoretical predictions, they find that horizontal mergers have, on average, a negative effect on innovative activities three years from the merger and an even stronger effect four years from the merger. Moreover, they show that the negative effects of mergers on innovation are concentrated in markets that, before the merger, feature high innovation intensity (measured by the average value of the patent stock by all firms active in the related product market).

Chen and Gayle (2019) consider the airline industry and argue that horizontal mergers can theoretically give rise to two opposite effects. On the one hand, mergers can give rise

to efficiencies that can result in higher quality, e.g., better coordination of flight schedules. However, mergers soften competition, resulting in a lower incentive to invest in product quality, as consumers now face fewer alternatives to consider. The net effect depends on the relative magnitude of these two forces. They show that if pre-merger competition is weak (i.e., there is little substitutability), post-merger product quality increases, as in this case the coordination benefit resulting from the merger is strong. However, if pre-merger competition is intense (i.e., there is strong substitutability), post-merger product quality decreases, as in this case the coordination benefit stemming from the merger is limited.

These predictions are tested by leveraging the fact that the intensity of competition between airlines is route-dependent, as operators serve multiple markets. The authors study the effects of two important mergers—the Delta/Northwest merger in 2008 and the Continental/United merger in 2010—on product quality, which is measured by the percentage ratio of nonstop flight distance to the product's itinerary flight distance used to get passengers from the origin to the destination.[13] Using data covering the time span 2005-2013 (before and after the merger), Chen and Gayle (2019) find that the two mergers were associated with an increase in routing quality when they were not competing with one another before the merger, but with a decline post-merger in the presence of pre-merger competition.

Another industry that has undergone significant market consolidation is the hard disk drive industry, which is studied by Igami and Uetake (2020) and Bennato et al. (2021). After continuous consolidation, in 2010 this industry featured only five players, Seagate, Western Digital, Toshiba, HGST (owned by Hitachi) and Samsung. In 2011 a wave of mergers began. Two mergers were notified in April 2011: the first involved Western Digital and HGST, and the second involved Seagate and Toshiba. The latter was approved by the European Commission (and US authorities) subject to the divestiture of a business line to Toshiba (qualifying the latter as a third merger).

Igami and Uetake (2020) use a structural model to estimate the effect of mergers, entry, and exit, in the hard disk drive industry during the period 1996-2016. First, they find that the relationship between competition and R&D investments is likely to be increasing, but plateaus as the number of firms grows. Specifically, the incentive to innovate increases drastically when moving from a monopolistic market structure to a duopolistic/triopolistic market. However, starting from the fourth firm, the incentive to invest becomes less sensitive to the increase in the number of firms. The authors also simulate the effects of merger enforcement and adopt as a baseline model the case in which there are a number of firms equal to 3 in the market. This represents a reasonable approximation of the rule of thumb used by the US Federal Trade Commission in its merger control, blocking mergers from 3 to 2 and 2 to 1 firms. Their empirical evidence

[13]For example, the routing quality of a direct flight has a maximum value of 100.

supports this rule of thumb.

Differently, Bennato et al. (2021) use a structural model to identify the effects of (two) mergers (from 5 to 3) that occurred in 2012 in the hard disk drive industry and their impact on product innovation. The authors rely on a matrix completion method to derive suitable counterfactuals for their analysis and consider as controls firms operating in the flash memory technology market. They show the presence of two main effects. First, investments in R&D increased. Second, there was a reduction in the number of patents, which can be explained by a reduction in duplication and defensive patenting. Third, the citation intensity of the patents increased.

Igami et al. (2024) study the relationship between competition and innovation in the liquid crystal display (LCD) industry over the period 2001-2011. They use a structural model to identify the welfare effects of both process and product innovation in this industry. They find that without product innovation, overall welfare would have been 70.6% lower, whereas without process innovation, overall welfare would have been 38.9% lower. They also find heterogeneous effects depending on the segment, with process innovation having stronger effect in the notebook and monitor segments, whereas product innovation, particularly the introduction of larger products, had a stronger impact in the TV segment.

Moreover, the authors simulate the impact of various mergers on welfare and innovation. When simulating seven-to-six mergers, they find that some mergers would have led to substantial increases in incentives to innovate (i.e., 1.3%-5.1%), whereas others would have had limited impacts (i.e., 0.2%-0.8%), depending on the combination of firms involved. They also extend this analysis to simulate other mergers involving all possible combinations of firms. They find that, on average, innovation incentives tend to increase in six-to-five and five-to-four mergers, while all other mergers lead to a decrease in innovation incentives. Furthermore, all mergers result in a reduction in overall welfare.

3 Acquisition of innovative entrants

Startups play a critical role in the generation of new ideas and products. A key aspect of the current debate on mergers and investments is whether large incumbents should be allowed to acquire startups. In this section, we discuss recent papers that study how acquisitions of potential competitors by incumbent firms can affect the incentives to invest of both the acquiring party and the acquired party.[14]

[14] A more recent literature has emerged to analyze the effects of *acquihiring*, that is a firm's acquisitions of startup talent (Benkert et al., 2023; Bar-Isaac et al., 2024). A review of these studies is beyond the scope of this paper.

3.1 Theory

Merger policy can affect firms' decisions to enter a given market. In particular, a more lenient merger policy can make entry more attractive by reducing the competitive pressure faced by an entrant or by increasing the probability that the entrant gets acquired by an incumbent. The latter strategy, known as *entry for buyout* (Rasmusen, 1988), is particularly relevant for startups (Eisfeld, 2024).

Norbäck and Persson (2012) are among the first to study the relationship between merger policy and the incentives of entrants to innovate. They consider a model in which an innovator invests in an R&D project that, if successful, results in a product that would displace rivals' sales (otherwise, the innovator fails, and there is no new product on the market). The first result is that more competition (measured by a higher degree of product substitutability) generates a higher incentive for a buyout exit rather than for entry into the market.

They also consider how the degree of competition impacts the incentives of innovators. First, conditional on the entry of the innovators, more competition reduces their incentives to innovate because the prospect of competing with the incumbent reduces the marginal gains from innovation. Second, conditional on the buyout, more competition has an ambiguous effect and can lead to either more or less innovation activity, depending on the return to innovation. More competition has an effect on the willingness to pay by affecting both the profit obtained under acquisition and the profit obtained under no acquisition. If competition intensifies, there is a negative effect on the profit obtained when there is an acquisition. However, competition also has a negative effect on the profit obtained when there is no acquisition. As the two terms decrease, it is not a priori clear what the effect is on the return to the innovators' investment.

A stricter merger policy, in turn, increases the number of incumbents competing in the market. The authors find that such a policy would increase the incentive of the innovator to sell its innovation relative to the case in which it enters directly the market. As a result, there is more innovation for buyout. Finally, Norbäck and Persson (2012) study how merger policy impacts the innovator's effort. They find that the incentive to innovate for entry decreases the stricter the merger policy, whereas there is a U-shaped relationship between the number of firms and the incentive to innovate if there is innovation for sale. The incentive to innovate increases (resp. decreases) with a stricter merger policy if the number of firms in the market is less than or equal to (resp. larger than) two.

Mason and Weeds (2013) argue that four main effects should be considered when designing an optimal merger policy that accounts for the incentives of firms to enter a market. First, there is an *entry encouragement effect* as a more lenient merger policy creates more incentive for entrants to enter the market. This effect is positive, as it leads to an increase in social surplus (irrespective of whether the merger actually occurs).

Second, there is a *competition effect* as the merger reduces the social surplus when it takes place relative to the case in which the entrant and the incumbent compete. Third, the latter adverse effect can be reduced if there are *merger-specific synergies*. Finally, there is a *sunk cost effect*, as more entry generates higher expected sunk costs. They show that the optimal merger policy amounts to choosing a threshold for the entrant's profit below which a merger is allowed and above which it is blocked. Therefore, their approach provides a theoretical foundation for the failing (or "ailing") firm defense story.

This analysis is extended by Jaunaux et al. (2017) who show that a competition authority may find it optimal to be more lenient toward the acquisition of successful, rather than unsuccessful, entrants. To this end, the authors consider a simple setting in which an entrant decides whether to enter (or not) a market in which post-entry profits are uncertain. The entrant observes the behavior of the antitrust authority that can ex ante commit to its behavior toward merger proposals. The authors show that the competition authority should be lenient in priority in the state of the world where the ratio between the loss in ex post consumer surplus and the gain in the entrant's expected profit induced by the merger is the lowest. Applying this general rule to a setting in which uncertainty is about the entrant's marginal cost of production, they show that there are circumstances in which the competition authority should be more lenient toward the acquisition of unsuccessful entrants, but there are also circumstances under which it should be more lenient toward the acquisition of successful entrants.

Bisceglia et al. (2024) examine the interaction between exit policy and entrants' investments. They consider a market in which an incumbent that has committed to invest competes in quantities with a competitor that has an exit option. In their model, the entrant has to decide whether to undertake an investment before learning of its demand. Once demand is realized, the entrant has the option to exit the market or compete with the incumbent. A possible exit strategy, on which we focus hereafter, is to be acquired by the incumbent.

The authors use this setting to compare two opposite merger policies. Under a strict merger policy (which prohibits acquisitions), the exit value of the entrant is equal to zero, as it cannot be acquired by the incumbent. In this case, the entrant invests to the extent to which the marginal gains from investments, absent an acquisition, are equal to their marginal cost. Under a lenient merger regime (which allows acquisitions), different outcomes are possible depending on whether the entrant has invested or not. If the entrant has not invested, the incumbent has no incentive to acquire the "zombie" entrant. The logic behind this follows from the fact that the "zombie" entrant would at most generate weak benefits from monopolization of the market that would not compensate for the takeover price. If the entrant has invested, the acquisition is more likely to be profitable as the benefits from monopolization and the entrant's higher-quality product

(due to investments) are more likely to be larger than the takeover price. The authors show that if the acquisition is profitable for the incumbent, post-acquisition the incumbent always has an incentive to shut down the acquired firm's product. They also establish that a more lenient regime induces the entrant to increase its investments, and this occurs both in the scenario in which it is acquired by the incumbent and in the case in which it is not acquired by the incumbent. Therefore, a more lenient merger policy can lead to both *innovation-for-buyout* (even if a buyout does not occur) and situations in which the incumbent shuts down the entrant's product post-acquisition.

Cunningham et al. (2021) investigate the concern of competition authorities that startup acquisitions may generate adverse effects on competition and innovation. The authors contend that incumbents' acquisitions of innovative entrants might be motivated by their incentives to preempt future competition. In their model, several incumbents compete in the market by selling a differentiated product and there is an innovative entrant that has a project. If an incumbent chooses to acquire the entrant, it must decide whether to pursue or abandon the acquired project. The latter case, which the authors label as a "killer acquisition", can only occur when there is an overlap between the projects of the acquiring incumbent and the acquired entrant. In this context, the entrant would develop the project absent the acquisition but the incumbent may decide not to develop it post-acquisition.

Some startups may not be actual or potential competitors of incumbents but could still affect competition in the market by representing inputs that allow an incumbent to get a competitive advantage over other incumbents. Bryan and Hovenkamp (2020) consider a model in which an incumbent competes with a less efficient rival. In the market, a new startup is present and provides a promising input technology. The authors identify the inefficiencies that can arise with respect to the diffusion, diversity, and rate of innovation under *laissez-faire*. For instance, the incumbent may have the incentive to buy the startup even if the latter would not directly benefit the incumbent in terms of higher quality. The reason is that an acquisition by the rival could reduce (vertical) product differentiation and therefore make competition more intense.

Motivated by the acquisitions made by Big Tech companies over the last few years, Motta and Peitz (2021) examine the effects of merger policy on innovation incentives in a setting where an incumbent can acquire an innovative entrant (e.g., a startup). In their paper, the entrant has a project (e.g., prototype, blueprint, innovative idea) that requires incurring some fixed development costs and additional resources (e.g., data, expertise) and has an uncertain outcome. Before a project is developed, the incumbent can acquire the startup and then decide on the development of its project. Depending on the fixed development cost and the probability that the innovative idea is successful, several outcomes can emerge.

Specifically, the authors consider two scenarios depending on whether the startup would have the resources or not to develop its project absent the acquisition. If the startup lacks such resources, the decision of the incumbent after the acquisition takes place depends on the relative expected profitability of the project net of the fixed development cost. If the development cost is low, an *efficient upgrade* occurs, and an innovative product that otherwise would not have been developed is ultimately brought to the market. If the development cost is high, the acquisition results in a *dead project*, and in this case, only the incumbent will be active in the market.

If the startup has the resources to develop its project, two additional equilibria can arise depending on the relative expected profitability of the project net of the fixed development cost. If the development cost is low relative to the expected net profitability of the project, the incumbent finds it optimal to develop the project, which results in an *upgrade with suppressed competition*: the start up's innovative product is developed but competition does not take place. If the development cost is high, instead, the incumbent does not develop a project that would have been developed by the entrant, resulting in a *killer acquisition*.

In a similar setting, Fumagalli et al. (2024) focus more on the interplay between acquisitions and the behavior of competition authorities. In their model, a startup has a project that, if developed, allows it to compete against an incumbent. The startup may be either *viable* (i.e., it has the resources to develop the product even if not acquired) or *unviable* (i.e., it cannot develop the project on its own). As in Motta and Peitz (2021), the key trade-off is the following. On the one hand, the acquirer may decide to shelve a project that would have been developed by the startup absent an acquisition. On the other hand, the acquisition may allow the development of a project that would otherwise not be developed due to a lack of resources. A major contribution of this paper is to show that the price paid for an acquisition generates relevant information regarding the anti-competitive potential of such an acquisition. Specifically, the authors show that a competition authority who does not know the type of the startup but observes a low takeover price, learns that the startup is unviable, which implies that its acquisition has a (weakly) positive effect on welfare. However, if the competition authority observes a high price, it does not learn the type of the startup. Despite this, it turns out that the optimal merger policy is to prevent high-price acquisitions (and clear low-price ones). Under such a policy, an incumbent only faces two options: offer a low price (and develop the project) or make no offer. This implies that the merger policy generates a "selection effect" as it encourages acquisitions focusing on unviable startups. This explains why this policy is optimal even though it prohibits high-price takeovers that may be welfare-beneficial.

Katz (2021) adds to the literature by studying merger policy in a context in which competition is for (rather than in) the market and an incumbent can acquire a potential

competitor. He considers a dynamic game in which in each period an incumbent decides whether to remain active in the market, and a potential entrant, which arrives with an exogenous probability, can invest in a new technology. After entry occurs, the incumbent can decide whether to merge with the entrant or compete with it. If competition takes place, in the following period one of the firms exits the market (because there is competition for the market). He shows that mergers always occur if not prohibited and that two cases can arise. In the first case, the merged entity only uses the new technology (of the entrant) and shuts down the old one; in the second case, the merged entity only uses the old technology and shuts down the new technology (of the entrant). In the latter scenario, there is an effect similar to that of a killer acquisition as the new technology is dismissed immediately after acquisition. However, this is not necessarily inefficient. The reason is that absent a merger, the market moves to the new network and technology, whereas with the merger and the use of old technology, consumers stick with the old technology (under some conditions) which may be socially efficient because of network effects.

Gilbert and Katz (2022) study the effects of mergers on the ex ante incentives of the entrant to invest, where the entrant has the possibility to imitate the existing incumbent's product or produce a differentiated product. They examine the entrant's decision and show that it might have the incentive to choose to differentiate itself from the incumbent to soften competition. However, there is also a countervailing force at play if the entrant is also vertically differentiated relative to the incumbent: in this case, it might have an incentive to minimize the differentiation from the incumbent and sell products with a higher price.

The prospect of a merger affects the ex ante incentives of the entrant. If the entrant is differentiated ex ante, post-acquisition the incumbent can sell two horizontally differentiated products and benefit from price coordination. If the entrant is not differentiated from the incumbent, post-acquisition the incumbent benefits from the removal of the competitive pressure, but this implies that the entrant can leverage its bargaining power relative to the incumbent. Gilbert and Katz show that the entrant will choose less (resp. more) differentiation if more differentiation would otherwise generate more (resp. less) profits for independent firms than for a multi-product monopolist

The long- and short-run effects of acquisitions are also studied by Denicolò and Polo (2023) in a Schumpeterian model of repeated innovation and acquisition. In the short run, acquisitions are pro-competitive because the prospect of being acquired increases the entrants' incentives to innovate (the *invention-for-buyout effect*). However, in the long run, acquisitions are anti-competitive because they increase the incumbent's market dominance (the *entrenchement-of-monopoly effect*), which makes future innovators' incentives to innovate lower regardless of whether they are acquired or not.

In light of these results, the authors argue that acquisitions should be assessed con-

sidering their cumulative effects, taking into account the degree of market dominance. In particular, they show that it may be optimal to have a merger policy that is lenient as long as market dominance is low but becomes restrictive if repeated acquisitions makes the dominance of a given incumbent too strong.

The prospect of an acquisition can affect not only the level of innovation but also its direction, an aspect studied by Letina et al. (2024), Dijk et al. (2024a) and Dijk et al. (2024b) study these aspects.

Letina et al. (2024) examine the incumbent's decision on which project to invest in and how much to invest. Ex ante there are multiple projects with heterogeneous investment costs, but ex post only one project succeeds. The authors compare the case in which acquisitions can take place and the case in which they are prohibited. In their model, an incumbent owns a technology and invests in R&D, whereas an entrant can sell an innovative product only after having invested in R&D. In the first investment stage, firms decide how much to invest in different research projects, and this determines the probability that (drastic or non-drastic) innovation occurs. In the second stage, the incumbent decides whether to acquire the entrant (if acquisitions are not prohibited). Finally, the firm holding the patent can decide whether to commercialize the technology, and firms receive their payoffs.

The authors identify conditions for which, absent merger control, the incumbent acquires the entrant and then decides whether to dismiss its product (resulting in a killer acquisition) or commercialize it (resulting in a *genuine* acquisition). Specifically, the incumbent has the incentive to acquire the entrant if the latter has a patent for a non-drastic innovation, and commercialization depends on its value (net of its commercialization cost).

They also consider the effects of an outright prohibition of startup acquisitions and show that this policy has a weakly negative effect on innovation because of the lack of an exit option (i.e. the possibility of being acquired by the incumbent). Moreover, such a prohibition has an effect on the duplication strategies of the entrant and the incumbents. In particular, the authors find that conditional on an entrant investing in a project, the incumbent has a higher incentive to duplicate it under no-acquisition than under a laissez-faire regime, as in this case investments are preemptive. Likewise, the absence of exit reduces the incentive to duplicate projects. The authors conclude that an outright ban on acquisitions may lead to more competition but less innovation.

Dijk et al. (2024a) consider a market in which an innovative startup has to allocate its funding across two different projects. The two projects differ in whether they are rival to the incumbent's product: one project, if successful, will represent a higher quality version of the incumbent's product, whereas the other project is a non-rival project. The entrant finds it optimal to distort its investment decisions toward a rival or non-rival project depending on the post-acquisition rents of the incumbent. If the acquisition rents are

high enough, the startup has an ex ante incentive to put more effort into the rival project and to reduce its effort on the non-rival project. If the acquisition rents are low enough, the startup has an ex ante incentive to distort its effort toward the non-rival project. The authors also investigate whether prohibiting acquisitions increases or decreases consumer surplus and show that both cases can arise.

In a related work, Dijk et al. (2024b) explore the strategic interactions in R&D investment between incumbents and entrants, particularly focusing on the context of startup acquisitions. They study how startup acquisitions may affect not only the portfolio of investments of the target firm but also that of the acquirer. To this end, they consider a market in which an entrant can develop projects in two markets A and B, and the incumbent can develop a project in market A (the *rival* market) as well as a project in a third market C (the *non-rival* market). The entrant moves first, then, upon observing the outcome of the entrant's investments, the incumbent chooses its investment portfolio. If an acquisition takes place, there is a bargaining between the incumbent and the startup.

The authors highlight how the anticipation of acquisitions distorts R&D funding allocation by either increasing or reducing investments in the market where the entrant and the incumbent are potential rivals. For example, they identify conditions under which the entrant, anticipating that the incumbent will cut off R&D funding in the rival market in the prospect of an acquisition, will increase its investments in the same market and reduce investments in the non-rival market.[15] Similarly, there are cases in which the entrant, anticipating an increase in the investments by the incumbent in the rival market in the prospect of an acquisition, will strategically cut off its own investments in that market, moving resources towards the non-rival market. In turn, this change in the direction of innovation can either lead to a higher or lower consumer surplus.

In the context of platforms, Motta and Shelegia (2024) consider the incumbent's threat of copying the entrant's product and compare the ex ante incentives to invest of an entrant in such a case with those that would result from the prospect of an acquisition. When entrants anticipate that incumbents might copy their new product, they may focus on creating complementary products, which incumbents are less likely to copy, even if copying is cost-effective and profitable in the short term. This anticipation shifts R&D efforts toward complementary innovations. This result is more likely to occur than in the prospect of an acquisition because, in the latter case, entrants may develop substitutes for the primary product, hoping to be acquired and benefit from the incumbent's intention to avoid competition.

Callander and Matouschek (2022) examine the effects of acquisitions on the incentives to innovate in an environment where a firm decides about the novelty of innovation, that

[15]The possibility that an incumbent reduces its own R&D investment because of the acquisition of a rival entrant has been called a "reverse killer acquisition" by Caffarra et al. (2020).

is, how different it is from existing technologies. Innovation novelty is measured along a continuum that varies from very incremental to very radical innovations. The authors show that uncertainty in the outcome of their investments induces firms to be more radical in their innovative effort. However, this comes at a cost for the firm as the most radical innovations are also more distant from the taste of consumers. Callander and Matouschek (2022) investigate whether, once accounting for the novelty of innovation, incumbents or entrants are more likely to innovate. They show that an effect that resembles the Arrow replacement effect is presentbecause the incumbent would cannibalize existing revenues if it innovates. This gives the incumbent incentives to move away from existing products to appeal to a broader audience. Unlike the incumbent, the entrant does not suffer from the Arrow's replacement effect, which induces it to produce innovations that resemble existing products (incremental innovations).

The authors examine how the prospect of an acquisition by an incumbent changes the ex ante incentives of an innovative startup. On the one hand, the entrant may have incentives to follow the strategy of the incumbent that, absent the acquisition, would find it optimal to distance itself from the existing product (because of the Arrow's replacement effect). However, the entrant can leverage its entry threat to extract additional surplus from the incumbent if it competes fiercely with a product that is closer to the existing one. The latter effect is shown to be stronger than the former, and therefore there is always an incentive for the entrant to moderate its innovative effort and focus on more incremental innovations.

In the context of Big Tech acquisitions, Cabral (2025) considers a market with a startup, an incumbent, and an agency. The author assumes that the innovation process can lead to failure, the production of a substitute product, or the production of a complement product. The startup chooses how much to innovate only knowing the probability that an innovation, if realized, can be a substitute or a complement. Then, the incumbent and the startup negotiate an acquisition, and finally the competition authority decides whether to allow the merger. The authors considers different enforcement scenarios including one relying on a balance of probabilities for which a merger is blocked if it is more likely to have an anti-competitive effect than a pro-competitive effect, one relying on a balance of harm for which the pro-competitive effect or anti-competitive effect is weighted by the consumer surplus effect, and finally one in which mergers are banned. He shows that the balance of probabilities is too lenient on mergers compared to the balance of harms. However, the latter case is too harsh relative to a policy that takes into account that a startup can lower its research effort if it anticipates that an acquisition will be blocked. The author then calibrates the model using available data from GAFAM and shows that moving from a balance of probabilities to a balance of harms would generate welfare benefits, whereas a complete ban on mergers would result in a welfare loss.

3.2 Empirical evidence

Recent empirical papers have shown that pharmaceutical and Big Tech companies have engaged in many acquisitions of startups and that some of these led to the discontinuation of entrants' products. While it is difficult to identify systematically "killer acquisitions" by Big Tech companies (Gautier and Lamesch, 2021), in the pharmaceutical industry, between 5.3 % ad 7.4% of acquisitions are found to be killer acquisitions by Cunningham et al. (2021).[16]

Using a data set that includes detailed information on more than 16,000 projects in the period 1989-2010, Cunningham et al. (2021) study the effects of acquisitions on the development of the projects of acquired firms. A central aspect of their analysis is the identification of overlapping projects between the acquiring and acquired firms, which suggests potential substitutability and the emergence of the acquired firm as a future competitor of the incumbent. In their empirical analysis, the authors focus on the likelihood of post-acquisition project development by comparing projects with and without overlaps. The key finding is that acquired projects with overlaps in the acquiring firm's portfolio are less likely to be developed post-acquisition. This result is shown to be robust across various model specifications.

In several extensions, the authors shed further light on killer acquisitions. First, they examine how the competitive environment influences the probability that a project is not developed post-acquisition. They find that killer acquisitions are more likely to occur in markets with less product competition. In other words, when there are fewer competitors in a market, acquiring firms have a stronger incentive to eliminate potential threats by acquiring and discontinuing the development of similar projects. Second, they study how the prospect of a patent expiration of the acquiring firm influences the probability of not developing the project of the acquired firm post-acquisition. They show that when the relevant patents of the acquiring firm are close to expiration, killer acquisitions are less likely to occur. Finally, they find that most of the acquisitions that are classified as killer acquisitions are below the threshold that requires a notification to the competition authority, thereby avoiding antitrust scrutiny.

Another empirical study on the effects of acquisitions on market outcomes is provided by Eisfeld (2024), which is different in scope and methodology. She studies the impact of innovative startup acquisitions on a firm's incentives to enter a market. Using a structural model, she shows that in markets in which firms are often acquired, startups are more likely to enter. Moreover, she finds that acquisitions of mature startups by major incumbents are followed by lower entry. Based on counterfactual simulations, she finds that blocking all acquisitions would lead to a decrease in startup entry, which is in the

[16] For a comprehensive discussion, see Affeldt and Kesler (2021a). Other papers on GAFAM acquisitions have focused more on the effects on venture capital funding (e.g., Koski et al. 2020 and Prado 2021).

order of 8-20% in markets in which the profits from competing are low relative to the gains of being acquired. By contrast, she finds that blocking only acquisitions by large, strategic firms would increase entry by more than 4% in the concerned markets.

Fons-Rosen et al. (2022) develop an endogenous growth model to examine the dynamics between incumbents and startups in the context of innovation and acquisitions. Incumbents, which produce a finite number of differentiated products, invest in innovation to boost productivity and outcompete other firms. Startups, on the contrary, focus on innovation to enter the market by displacing incumbents. The authors introduce two key elements: incumbents can invest in a search technology to acquire startups, and startup ideas require additional implementation investments to become marketable products. This framework allows for differentiation between related acquisitions (where a startup's idea is related to an incumbent's existing products) and unrelated acquisitions (where the startup's idea is unrelated to the incumbent's current offerings).

The analysis in Fons-Rosen et al. (2022) sheds light on the effects of a decrease in the frequency of startup acquisitions (because of exogenous shocks) on innovation and growth. First, such a decrease generally lowers the startup rate (i.e., the number of new startups created in a given period). Second, a decrease in startup acquisitions has *a priori* an ambiguous impact on the implementation rate of startup ideas because of two opposite effects. On the one hand, incumbents may have lower implementation costs than startups. On the other hand, an incumbent's benefit from implementing a startup idea is lower than the startup's because of a standard replacement effect. Finally, lower startup acquisitions also affects incumbents' own innovation rates through general equilibrium channels. In particular, a lower frequency of acquisitions attracts fewer startups, which reduces the threat of displacement for incumbents and increases their incentives to innovate.

The authors then construct a dataset that combines information on acquisitions, patents, and accounting data, and use it to examine the effect of acquisitions on the implementation of startup ideas. A partial equilibrium analysis shows that more frequent acquisitions increase the implementation rate of startup ideas. However, when general equilibrium feedback effects are considered, this effect is reversed; the startup rate declines significantly, with only minor compensations from increased incumbent innovation and startup implementation efforts, leading to an overall decrease in the growth rate. The authors find that a ban on startup acquisitions would increase the (aggregate) growth rate by about 0.03 percentage points by year.

Focusing on the mobile app market, Affeldt and Kesler (2021b) investigate how GAFAM competitors, in a given relevant online market, react to GAFAM acquisitions. They measure innovation through app updates and feature updates, where the latter includes changes in app features, while quality is measured by the amount of user data collected. To identify the effect of GAFAM acquisitions, they employ a difference-in-difference ap-

proach, with the treatment group comprising competitors exposed to a GAFAM acquisition, and the control group comprising competitors who have not been exposed to such an acquisition. They find that, following GAFAM acquisitions, competitors tend to reduce their innovative efforts, both in terms of app updates and feature updates.

4 Vertical mergers

So far, we have focused on the effects of *horizontal* mergers on investments. We now turn to the impact of *vertical* mergers on investments—an issue that has recently attracted the attention of competition authorities. For instance, in 2022 the European Commission prohibited Illumina's acquisition of GRAIL, a firm operating in the market for blood-based early cancer detection tests, on the grounds that the merger would stifle innovation.

Vertical integration is generally understood to mitigate hold-up problems resulting from situations in which parties make non-contractible decisions (e.g., investments) before actual transactions occur (see, e.g., Williamson 1975, 1985, Klein et al. 1978, and Grossman and Hart 1986). Hold-up can reduce ex-ante incentives to invest, potentially leading to a lower level of investment than is socially optimal. To see why, suppose that upstream firms negotiate their contracts with a downstream buyer only after having invested. They will tend to invest less than in a situation where contracts are negotiated before investments are made because they anticipate that they will capture a lower portion of the value created by their investments. Vertical integration can solve or mitigate this under-investment problem.

Allain et al. (2016) challenge this view by showing that vertical integration can be a source of, rather than a solution to, hold-up problems. They consider a setting in which two downstream competitors operate in a market with two upstream manufacturers. Before negotiations between downstream and upstream parties take place, downstream competitors make investment decisions. They examine two scenarios: one in which all firms are independent (*vertical separation*) and another in which there is *vertical integration* between one upstream supplier and one downstream retailer. They show that, due to upstream competition, there is no hold-up effect under vertical separation. However, under vertical integration, hold-up problems can arise for two reasons. First, vertical integration can create ex-ante incentives to generate hold-up problems. Specifically, the integrated firm has incentives to commit to capturing or dissipating part of its downstream rival's profits, thereby subjecting the latter to hold-up by the competing supplier, which undermines its incentive to invest. Second, vertical integration can create ex-post hold issues when lowering the quality of support provided by a supplier to a downstream firm benefits the downstream competitor.[17]

[17]Similar results are found in an experiment by Allain et al. (2021), which supports the finding that

Another paper that identifies a negative effect of vertical integration on downstream rival's investments is Loertscher and Riordan (2019). The authors consider the case of a firm exploring the simultaneous use of internal and external sourcing. Vertical integration eliminates double marginalization (*markup avoidance effect*), but induces independent suppliers to reduce their cost-reducing investments (*investment discouragement effect*). The integrated firm, on the other hand, increases its investment effort. When upstream competition is intense leading to thin suppliers' margins, the markup avoidance effect is weak and, therefore, is more likely to be outweighed by the investment discouragement effect.

Liu (2016) examines how vertical integration affects firms' incentives to innovate when innovation is relevant in only one market (upstream or downstream) or in both markets (upstream and downstream).[18] He considers a market with two upstream firms and two downstream firms. Investments in this setting are risky and stochastic, meaning that if an investment is unsuccessful, the associated firm exits the market. Investments occur first upstream and subsequently downstream. After investments become observable, upstream and downstream firms negotiate terms if they remain in the market.

When innovation is relevant only upstream, vertical integration mitigates hold-up problems by improving coordination between parties. This leads to higher investment levels and greater total industry profits under integration compared to separation.[19] When innovation is relevant in both markets, vertical integration influences the level of innovation through an additional channel beyond solving hold-up problems. Specifically, when the downstream competitor also succeeds, integration encourages the integrated party to increase its downstream investments. Furthermore, better coordination and complementarity between investments also foster upstream investments within the integrated firm, as it internalizes the positive impact on downstream profits.

Finally, Chambolle and Guignard (2024) study how vertical integration affects quality innovation in a context where the downstream retailer has buyer power and upstream investments may generate positive unvoluntary technological spillovers for rivals. They develop a model comparing a scenario in which two independent manufacturers invest in innovation and sell to a retailer (*vertical separation)* with one in which one manufacturer integrates with a downstream retailer that also buys input from the independent retailer (*vertical integration).* After investments take place, the upstream and downstream parties negotiate a non-linear tariff, allowing the authors to abstract from efficiency gains typically associated with the elimination of double marginalization. However, another distortion is

vertical integration can exacerbate hold-up concerns and lead to lower investment levels.

[18] Also other studies focus on investments undertaken either upstream (Brocas, 2003; Chen and Sappington, 2010) or downstream (Bolton and Whinston, 1993; Buehler and Schmutzler, 2008). However, in several industries (e.g., pharmaceuticals), investments occur at both levels.

[19] When innovation is relevant only downstream, investments are not affected by vertical integration.

present, taking the form of a classical hold-up problem.

They find that vertical integration removes hold-up problems and increases the bargaining power of the integrated retailer in its negotiations with the independent manufacturer. These two effects boost the innovation incentives of the integrated entity but may either increase or decrease the independent manufacturer's incentives to invest, depending on the level of spillovers: when spillovers are high (which implies in their model that investments are strategic complements), vertical integration encourages the independent manufacturer to invest, whereas with low spillovers (which implies that investments are strategic substitutes), it may reduce its investment.

5 Conclusions and directions for future research

This literature review has focused on three issues: the impact of mergers between competing incumbents on firms' incentives to invest, the impact of acquisitions of potential competitors on the investment incentives of the acquiring and acquired parties, and the impact of vertical integration on the incentives to invest.

Although the theoretical literature does not offer a clear-cut message regarding the overall impact of mergers on firms' investment incentives, it does shed light on the various effects at play, and the factors upon which these effects depend. On the empirical side, evidence on the impact of mergers on investments is mixed, which is unsurprising considering the ambiguous predictions from the theoretical literature. A potentially more interesting insight from the empirical literature is that similar consolidation practices may yield different outcomes across different industries. Related to this, it is worth noting the relative scarcity of empirical studies on mergers and acquisitions in digital markets, despite the significant concerns they raise among policymakers.

Finally, we outline below a few promising directions for future research.

Effects on outsiders. The theoretical literature on the impact of horizontal mergers on investments has primarily focused on the merging parties' investments. While a few studies have provided insights into the effects on non-merging parties' investments, our understanding of these effects remains very limited. A key difference between the impact of a merger on outsiders' prices in settings where the only strategic variable is the price and the impact of a merger on outsiders' investments in a setting where there are two strategic variables (prices and investments) is that even if a merger does not affect the merging parties' incentives to invest, it may affect the non-merging parties incentives to invest through its effect on prices. Such a *direct* effect on non-merging parties is absent in standard models of competition in prices (and only in prices), where any effects on non-merging parties are indirect, in the sense that the best-response function of the latter is not affected by the merger. The existence of such direct effects when investments are

incorporated substantially complicates the analysis.

Remedies. To our knowledge, the effects (and design) of structural and behavioral remedies in the context of innovation have not yet been studied. For instance, a merged entity might be required to share interim results from clinical trials in pharmaceutical research or training data in the context of AI startups. Another potential remedy could involve requiring the merging party to license innovation outputs to non-merging rivals, such as an active pharmaceutical ingredient in the case of medications. A third option might involve the partial divestiture of innovation capabilities, such as transferring a research lab from the merging party to a non-merging competitor. Understanding how these remedies affect the innovation incentives of both merging and non-merging firms would be an essential first step toward designing optimal remedies. Naturally, any analysis of remedies requires a framework capable of examining the merger's effects on both merging and non-merging parties.

Intellectual property. We are not aware of any theoretical study that explores how the strength of intellectual property (IP) rights affects the impact of a merger on investment in innovation. The answer to this question is far from obvious. On the one hand, strong IP rights limit *involuntary* spillovers (such as those resulting from imitation). Since the internalization of such positive spillovers by the merging parties can increase their investment incentives, a reduction in these spillovers makes it more likely that the merger will decrease their incentives to invest. On the other hand, stronger IP rights also expand the potential for *voluntary* spillovers—instances where innovations that would otherwise benefit only one of the merging parties absent a merger would be shared within the merged entity. An increase in these voluntary spillovers raises the marginal benefit of investment in innovation, making it less likely that the merger will reduce the parties' incentives to invest. Understanding the circumstances under which the latter force dominates, or is dominated by, the former, would provide valuable insights.

Conglomerate mergers. Most of the literature on the effects of mergers on investments has focused on horizontal mergers. As discussed in Section 4, a growing body of literature has also examined the impact of vertical mergers on investments. However, to our knowledge, no studies have explored the effects of mergers between firms producing complementary products on investments. Note that models analyzing the effects of horizontal mergers on investments with general demand functions (e.g., Bourreau et al. 2024) can, in principle, be adapted to study the effects of mergers between complementors by assuming that demand functions increase with the prices of other firms.

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