Startup Acquisitions: Acquihires and Talent Hoarding

Jean-Michel Benkert, Igor Letina and Shuo Liu*

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Abstract

We present a model of startup acquisitions, which may give rise to inefficient "talent hoarding." We develop a model with two competing firms that can acquire and integrate (or "acquihire") a startup operating in an orthogonal market. Such an acquihire improves the competitiveness of the acquiring firm. We show that even absent the classical competition effects, acquihires need not be benign but can be the result of oligopolistic behavior, leading to an inefficient allocation of talent. Further, we show that such talent hoarding may reduce consumer surplus and lead to more job volatility for acquihired employees.

Keywords: acquihire, talent hoarding, startup acquisition, competition.

JEL Codes: L41, G34, M13.

*Benkert: Department of Economics, University of Bern. Letina: Department of Economics, University of Bern and CEPR. Liu: Guanghua School of Management, Peking University. Email: jean-michel.benkert@unibe.ch, igor.letina@unibe.ch, shuo.liu@gsm.pku.edu.cn. We are grateful to Florian Ederer, Johannes Johnen, Massimo Motta, Armin Schmutzler and to seminar participants at the Universities of Bayreuth, Copenhagen, and Lausanne as well as at the Joint Humboldt University + University of Toronto Theory Conference in Berlin, the CCER Summer Institute in Beijing and the Swiss IO Day 2023 in Bern for valuable feedback and helpful comments. Shuo Liu acknowledges financial support from the National Natural Science Foundation of China (Grant No. 72192844).

1 Introduction

Historically, competition authorities have been concerned with mergers and acquisitions (M&As) only when they were likely to lead to a reduction in effective competition. Since startups, almost by definition, generally hold small or nonexistent market shares, their acquisitions were rarely challenged.[1] This has recently begun to change, as competition authorities are starting to scrutinize the effects of M&A activity not only on current but also on *potential* (or *nascent*) competition. It is in this context that Cunningham, Ederer, and Ma (2021) have shown that in the pharmaceutical industry, 5.3%–7.4% of all acquisitions are so-called "killer acquisitions," aimed at inhibiting the development of future competition. Against this backdrop, competition authorities believe that there may be a case to carefully scrutinize startup acquisitions.[2]

This increased attention by competition authorities is deemed unnecessary by critics arguing that startup acquisitions are typically benign in terms of their impact on competition – even when they result in the "killing" of the startup's product or service. One common argument to support this view is that such acquisitions are so-called "acquihires."[3] As the name suggests, acquihires are essentially a hiring instrument: the acquiring firm is primarily interested in hiring the startup's employees, not removing a potential competitor from the picture. Consider the case of Drop.io, a startup that enabled easy sharing of files. In 2009, Drop.io was a successful startup, having been named a winner of CNET's Webware 100 and listed among the 50 best websites by Time magazine. After acquiring Drop.io in 2010, Facebook promptly terminated it and announced that its CEO Sam Lessin would join Facebook in a new role.[4] While the startup was "killed," the motivation for doing so is clearly different from the killer acquisitions of Cunningham et al. (2021). Yet, does that necessarily mean that the acquisition was benign?

The goal of our paper is to contribute to this discussion, by presenting a simple yet general framework allowing the study of acquihires. We consider a model in which two symmetric incumbents are competing in one market, while a startup is operating in a completely orthogonal market. This rules out the elimination of potential competitors as the motivation for an acquisition. The incumbents can attempt an acquihire of the startup, that is, acquire it and integrate its employees into their own operations. An acquihire

[1]See, for example, Bryan and Hovenkamp (2020b).

[2]On February 11, 2020, the Federal Trade Commission ordered the five "Big Tech" companies – Alphabet, Amazon, Apple, Meta and Microsoft – to "provide information about prior acquisitions not reported to the antitrust agencies under the Hart-Scott-Rodino Act" (FTC, 2020). The stated goal was to investigate "whether large tech companies are making potentially anticompetitive acquisitions of nascent or potential competitors that [...] do not need to be reported to the antitrust agencies." Similarly, the European Commission issued guidance on Article 22 of the merger regulation to also cover smaller M&A transactions with significant competitive implications (European Commission, 2021).

[3]For an example, see Barnett (2023).

[4]See "Webware 100 winner: Dropio," *CNET*, May 2009, "50 Best Websites 2009 – Drop.io," *Time*, August 2009, and "Facebook Acquires Simple File-sharing Service Drop.io," *Mashable*, October 2010.

leads to an efficiency gain for the acquiring firm, so that profits of the acquirer increase, while those of the competitor decrease following an acquihire. We allow for different degrees of efficiency gains by modeling two distinct levels of match quality between the incumbents and the startup.

We present three main results. First, we show that inefficient acquisitions may occur even if the startup is not a potential competitor to the incumbents. In our context, the inefficiency is manifested through *talent hoarding*: firms engaging in acquihires even when such transactions lead to lower aggregate profits for the startup and the acquirer afterward. Essentially, we find that a low-match firm can increase its expected profits by acquiring the startup before the (potentially high-match) competitor learns of its existence. Such acquihires generate an inefficiency because startup employees would be more productive by either staying with the startup or (if available) moving to the high-match competitor. Our model thus suggests that startup acquisitions need not be benign even when potential competition motives are ruled out.

Our second result examines the effect of acquihires on consumer surplus. Whether or not an acquihire decreases surplus depends on whether the loss of surplus induced by the disappearance of the startup is offset by the efficiency gain resulting from the acquisition. In particular, if high-match acquisitions increase consumer surplus while low-match acquisitions decrease it, competition authorities who cannot identify match qualities may face complex challenges in regulating acquihires. For instance, the welfare effects of banning acquihires may not depend straightforwardly on the ex-ante likelihood of a high-match deal. Prohibiting acquihires tends to decrease consumer welfare when that probability is either very high or very low. In the former case, even though low-match firms have a strong incentive to hoard talent, the potential negative impact rarely materializes. In the latter case, low-match firms *endogenously* choose not to engage in (expensive) talent hoarding, so that all observed acquihires are with high-match firms, and thus welfare-enhancing. It is when the probability of a high-match sits in an intermediate range – such that low-matches remain tempted to hoard talent and they are not rare – that banning acquihires has the largest scope for enhancing expected consumer welfare.

Our final result shows that the labor-market outcomes for acquihired employees may become more volatile due to firms' talent hoarding. To obtain this result, we expand our baseline model by adding a second period. Moreover, in between periods, the economy may fall into a recession and consequently, firms may get hit by potentially correlated adverse shocks. Relative to a benchmark with no motive to hoard talent, we show that talent hoarding always leads to more hiring and may also lead to more layoffs and unemployment for acquihired employees when the adverse shocks are sufficiently likely or sufficiently positively correlated. This finding lends support to the view that talent hoarding was a major contributing factor to the substantial number of layoffs in the tech industry following the increased pressure on the US economy in 2022.[5]

Related literature. Our paper is most closely related to the literature studying the economics of startup acquisitions and in particular the potential effects of a policy restricting such acquisitions by large incumbents. Much of the early literature has examined, in various settings, how the prospect of an acquisition impacts the incentives of startups and incumbents to invest in innovation (e.g., Gans and Stern, 2000; Mason and Weeds, 2013; Norbäck and Persson, 2012; Phillips and Zhdanov, 2013; Rasmusen, 1988). Following Cunningham et al. (2021), who demonstrated that incumbents may acquire startups for anti-competitive reasons, a large literature has since developed studying the effects a more restrictive merger policy would have on innovation and overall welfare (Cabral, 2020; Katz, 2021; Letina, Schmutzler, and Seibel, 2023; Motta and Peitz, 2021). In particular, Ederer and Pellegrino (2023) empirically show that startups increasingly favor acquisitions over IPOs as exit strategies, which in turn appears to have increased the market power of the incumbents, while Cabral (2023) argues that a stricter (but not overly strict) acquisition policy would improve welfare. The literature has analyzed the problem of startup acquisitions from multiple angles. Fumagalli, Motta, and Tarantino (2020) consider the impact of financial constraints. Others examine how acquisitions can steer the direction of innovation, including Bryan and Hovenkamp (2020a), Callander and Matouschek (2022) and Dijk, Moraga-González, and Motchenkova (2021). Several papers consider more dynamic incentives, for example Cabral (2018), Bryan and Hovenkamp (2020a), Hollenbeck (2020) and Denicolo and Polo (2021). The key insight is that if the incumbent pulls too far away from the entrants in the technology space, the pace of innovation will go down. There is also the possibility that the incumbent creates a "kill-zone" which disincentivizes entry, either by acquiring entrants, copying their products, or heavily investing in innovation (Bao and Eeckhout, 2023; Kamepalli, Rajan, and Zingales, 2021; Shelegia and Motta, 2021; Teh, Banerjee, and Wang, 2022). Finally, several papers empirically study acquisitions in the tech sector (Affeldt and Kesler, 2021a,b; Eisfeld, 2022; Gautier and Lamesch, 2021; Gugler, Szücs, and Wohak, 2023; Jin, Leccese, and Wagman, 2023; Prado and Bauer, 2022). Our paper differs from this literature by considering startups that need not present as potential competitors with the incumbents. The main channel through which acquisitions create inefficiencies is thus fundamentally different.

Our paper also relates to the (mostly) empirical literature that directly studies acquihires. Ouimet and Zarutskie (2020), Ng and Stuart (2021) Chen, Gao, and Ma (2021) and Chen, Hshieh, and Zhang (2022) show that acquiring talent is indeed an important motivation for acquisitions. However, acquihired employees leave the acquirer at a higher rate than regularly hired employees, and especially so do more experience employees (Ng

[5]See "Tech's Talent Wars Have Come Back to Bite It," *The New York Times*, November 2022.

and Stuart, 2021) and inventors (Verginer, Parisi, de Jeude, and Riccaboni, 2022). Kim (2020) argues that this is because those who work at a startup have a preference for startups (and not large, bureaucratic companies), while Loh, Khashabi, Claussen, and Kretschmer (2019) argue that the acquisition creates a mismatch between the acquihired employees and firm objectives, causing them to leave at a higher rate. The empirical finding that acquihired employees are more likely to separate than regularly hired employees is consistent with our theoretical result. Finally, there is the question of why firms engage in acquihires instead of directly poaching valuable employees. Coyle and Polsky (2013) argue that this is due to reputational reasons, as the acquirers want to maintain good relationships with VCs that hold stakes in the startup and the startup founders prefer the reputation of a successful "exit" as opposed to simply leaving their company. Selby and Mayer (2013) add that there is a value to acquiring the entire team, as they might work better together, and identifying high-performing individuals might be hard.

More broadly related is Haegele (2022), who finds empirical evidence of talent hoarding *within* firms. In her paper, talent hoarding occurs because managers hoard top-performing workers. We identify strategic motives for firms to hoard workers across firms. The literature on endogenous technological spillovers between firms, where the spillovers are caused by workers changing jobs is also broadly related. The possibility that workers might move to the competitor influences whether multinational enterprises export or produce locally (Fosfuri, Motta, and Rønde, 2001) and how much are firms willing to invest in innovation (Gersbach and Schmutzler, 2003a,b). Also broadly related is the concept of *labor hoarding* from macroeconomics, which refers to the notion that firms tend to employ more workers during economic contractions than would be necessary for the current production needs. The firms do this to avoid incurring hiring and training costs after the contraction ends and the economy recovers (for an overview, see Biddle, 2014). Our model predicts that *talent hoarding* implies more volatile hiring and firing decisions during economic expansions and contractions, which would dampen the observed *labor hoarding* during contractions. Interestingly, this is exactly what Biddle (2014, pp. 209-210) reports has been happening recently, especially during the Great Recession. If the practice of *talent hoarding* has become more common, then our model would provide a potential explanation for this observation.

2 Model

Two symmetric firms $i \in \{1, 2\}$ are competing in a market.[6] There is a second market in which an entrepreneur E's startup is active. In the status quo, the firms' payoffs

[6] In many relevant applications there will instead be a dominant firm in the market. We discuss this extension in Section 5 and formally develop it in the Online Appendix B.2. Moreover, we also consider the effect of more than two firms in the Online Appendix B.3.

are given by Π_F and the entrepreneur's payoff is π_E. Our model does not specify any direct linkage between the two markets (e.g. through consumer demand), as we prefer to consider them as orthogonal to each other. This assumption of orthogonality allows us to rules out conventional competition motives for the firms when acquiring the startup, as will become clear later.

A firm can pursue an "acquihire," whereby it acquires and integrates the startup by making a bid p to the entrepreneur. If successful, the payoff consequences of the transaction depend on the match quality $\theta \in \{H, L\}$ between the acquiring firm and the startup. This match quality is the acquiring firm's private information, and it is drawn i.i.d. for each firm according to $\Pr(\theta = H) = 1 - \Pr(\theta = L) = \lambda \in (0, 1)$. Specifically, if firm i with match θ_i successfully pursues an acquihire at bid p, its payoff is $\bar{\Pi}_F^{\theta_i} - p$, while the other firm's payoff is $\underline{\Pi}_F^{\theta_i}$ and the entrepreneur receives p.

We assume that an acquihire leads to a relative efficiency gain over the competitor as follows.

Assumption 1 *We assume that*

(i) $\bar{\Pi}_F^H > \Pi_F + \pi_E > \bar{\Pi}_F^L$;

(ii) $\Pi_F \geq \underline{\Pi}_F^L > \underline{\Pi}_F^H$.

According to Assumption 1(i), the joint profits of the startup and the acquirer are highest when a high-match firm acquires the startup; second highest when the firm does not acquire the startup, and lowest when a low-match firm acquires the startup. Assumption 1(ii) says that the profits of the non-acquiring firm are highest when its competitor does not pursue an acquihire, followed by when a low-match competitor does an acquihire and lowest when a high-match competitor does so.

From the consumers' point of view, there are three possible outcomes. First, absent an acquihire all three firms are active in their respective markets. In this case, the consumer surplus arising from the competition between the two symmetric firms is CS_F and that from the startup is CS_E. Second, a low-match acquihire results in competition between the two (now asymmetric) firms generating the entire consumer surplus (CS_L). Third, a high-match acquihire also results in a similar competition that generates the entire consumer surplus (CS_H). Whenever an acquihire occurs, the consumer surplus generated by the startup (CS_E) is lost. We make the following assumption.

Assumption 2 *Let* $CS_H \geq CS_L \geq CS_F$.

The assumption captures the idea that as one of the two firms becomes more efficient, it passes off some of that efficiency to consumers.[7]

[7]While it is possible to come up with models where this assumption would not hold, extending our analysis to those cases is straightforward, but would come at the cost of more complex exposition. We opt to simplify and present the most interesting case.

Finally, the timing is as follows. Before the game begins, nature draws the private match types of the firms. In the first stage, firm 1 has the opportunity to attempt an acquihire. The entrepreneur can accept or reject the bid. If the entrepreneur accepts a bid, the game ends. Otherwise, we move to the second stage. In this stage, firm 2 has the opportunity to attempt an acquihire. The entrepreneur can accept or reject the bid, after which the game ends.[8]

Example. Our reduced form model encompasses many standard oligopoly models. With a specific application in mind, one could fix a demand function and derive more precise results. For example, consider a Cournot duopoly with (inverse) demand function $P(q_1, q_2) = a - bq_1 - bq_2$ (where $q_1, q_2 \geq 0$ are quantities chosen by the firms and $a, b > 0$ are parameters) and constant marginal cost of production c. Let a high-match acquihire reduce the marginal cost of production of the acquirer to $c - H > 0$ while a low-match acquihire reduces it to $c - L$, with $H > L$. Assuming that both firms are active after a high-match acquihire (that is, $a - c > H$), it is easy to calculate the profits of the two firms after the various outcomes:

$$\Pi_F = \frac{(a-c)^2}{9b}, \qquad \bar{\Pi}_F^H = \frac{(a-c+2H)^2}{9b}, \qquad \bar{\Pi}_F^L = \frac{(a-c+2L)^2}{9b},$$
$$\underline{\Pi}_F^H = \frac{(a-c-H)^2}{9b}, \qquad \underline{\Pi}_F^L = \frac{(a-c-L)^2}{9b}.$$

It can be shown that Assumption 1(i) is satisfied for an interval of π_E values (which is essentially a free parameter), while 1(ii) is always satisfied. Moreover, standard calculations give us consumer surplus for the three possible outcomes:

$$CS_H = \frac{(2a-2c+H)^2}{18b}, \qquad CS_L = \frac{(2a-2c+L)^2}{18b}, \qquad CS_F = \frac{(2a-2c)^2}{18b}.$$

It is immediate that Assumption 2 is satisfied. □

3 Talent Hoarding

We define talent hoarding as a situation where a firm employs a group of workers even though they could be more efficiently engaged elsewhere. In our model, talent hoarding occurs whenever a low-match firm acquires and integrates the startup because the employees of the startup would generate higher additional profits if the startup remained operational. Moreover, if the firm's competitor turns out to be a high-match with the startup, the foregone efficiency would be even greater.

[8] We show in Online Appendix B.5 that the emergence of incentives to hoard talent does not hinge on the game's timing nor on the fact that the firm gets the full surplus resulting from the acquihire.

Proposition 1 (Talent hoarding) *Under Assumption 1, firm 1's behavior in any PBE is uniquely specified. Namely, if firm 1 is a high-match with the startup, it will do an acquihire; if it is a low-match it will do an acquihire if and only if*

$$\lambda \geq \lambda_A \equiv \frac{\pi_E + \Pi_F - \bar{\Pi}_F^L}{\Pi_F - \underline{\Pi}_F^H}. \tag{1}$$

Proof: Suppose firm 1 has not done an acquihire. It follows from Assumption 1 that firm 2 does an acquihire if and only if it has a high type, irrespective of its belief. Moving to stage 1, firm 1's belief is given by the prior belief. A high-match firm 1 will always want to do an acquihire by Assumption 1. A low-match firm 1, will want to do an acquihire whenever $\bar{\Pi}_F^L - \pi_E \geq \lambda \underline{\Pi}_F^H + (1-\lambda)\Pi_F$ or, equivalently,

$$\lambda > \lambda_A \equiv \frac{\pi_E + \Pi_F - \bar{\Pi}_F^L}{\Pi_F - \underline{\Pi}_F^H}.$$

Note that π_E is firm 1's bid for the startup which leaves the entrepreneur just indifferent between accepting or not. ■

The result in Proposition 1 shows that talent hoarding may occur when (i) we have $\bar{\Pi}_F^L - \underline{\Pi}_F^H > \pi_E$ so that $\lambda_A < 1$, and (ii) the probability of a high match is sufficiently high. The condition $\bar{\Pi}_F^L - \underline{\Pi}_F^H > \pi_E$ guarantees that the gain for a low-match firm from doing an acquihire when facing a high-match competitor is bigger than the cost of an acquihire. However, since a low-match firm makes a negative profit from the acquihire *per se*, it will only proceed when facing a high-match competitor is likely enough.[9] Effectively, a low-match firm 1 is willing to overpay when making the acquihire to prevent the potential emergence of a highly competitive firm 2. While a low-match firm 1 does reap some efficiency gain from the acquihire, it is the threat of a more competitive firm 2 motivating the acquihire. Thus, talent hoarding is more likely if the price of the acquisition π_E is low and the probability of a high-match competitor λ is high.[10]

The discussion so far has focused exclusively on the firms. We now turn to the implications of talent hoarding for consumers. Following an acquihire of the startup, the consumer surplus generated by the startup vanishes. Thus, whether consumers benefit from the acquihire and hence what is the appropriate response of the regulators depends

[9] Note that in classical labor models where firm-employee match value matters (e.g., Jovanovic, 1979), firms only care about their own match value. In our model, because of the oligopolistic competition, the potential match value between the competitor and the worker is driving the results.

[10] A reader may wonder why the low-match firm does not keep the startup operational or how this result might be affected if the startup was *also* valuable because of its technology. We discuss these issues in Section 5 and formally analyze them in the Online Appendices B.1 and B.4. In short, we argue that operating the startup as a subsidiary might be less profitable than integration due to moral hazard issues. We also show that when startups also own valuable technology the firms will have no incentive to hoard technology but will still hoard talent.

on the change in consumer surplus created by the competition between the two firms following the acquihire.

By Assumption 2, acquihires always increase consumer surplus in the two-firm market ($CS_H > CS_L > CS_F$) but lead to the loss of CS_E in the startup market. If CS_E is very low, so that $CS_H > CS_L > CS_F + CS_E$, then both the low-match and high-match acquihires increase consumer surplus and the policymakers should always allow acquisitions. Similarly, if CS_E is very high so that both the low-match and high-match acquihires lower consumer surplus ($CS_F + CS_E > CS_H > CS_L$), then the policymakers should prohibit all acquisitions.

A more subtle case appears if CS_E is intermediate, so that $CS_H > CS_F + CS_E > CS_L$. Now, prohibiting a high-match acquihire would decrease consumer surplus while prohibiting a low-match one would increase it. Hence, a policymaker that cannot distinguish a low-match from a high-match acquihire faces a trade-off. Our next result characterizes the optimal policy in all the cases discussed. Define

$$\lambda_{CS} \equiv \frac{CS_F + CS_E - CS_L}{CS_H - CS_L}. \tag{2}$$

How the values of this cutoff and the one defined in (1) relate to each other will be crucial for the effect of acquihires on consumer surplus.

Proposition 2 (Effect of acquihires on consumer surplus)

(i) If $CS_F + CS_E > CS_H > CS_L$, then all acquisitions reduce consumer surplus.

(ii) If $CS_H > CS_L > CS_F + CS_E$, then all acquisitions increase consumer surplus.

(iii) Suppose that $CS_H > CS_F + CS_E > CS_L$. Acquihires reduce consumer surplus in expectation if and only if $\lambda \in [\lambda_A, \lambda_{CS})$.

PROOF: Cases (i) and (ii) are straightforward. We demonstrate (iii). When $\lambda < \lambda_A$, by Proposition 1 only high-match firms engage in an acquihire. Since $CS_H > CS_F + CS_E$, any acquihire in this case increases consumer surplus. When $\lambda \geq \lambda_A$, both low-match and high-match firm 1 engage in an acquihire and the expected consumer surplus is $\lambda CS_H + (1-\lambda)CS_L$. Since the expected consumer surplus when acquihires are prohibited is $CS_F + CS_E$, acquihires reduce consumer surplus if and only if $\lambda \geq \lambda_A$ and

$$\lambda CS_H + (1-\lambda)CS_L < CS_F + CS_E \iff \lambda < \frac{CS_F + CS_E - CS_L}{CS_H - CS_L} \equiv \lambda_{CS}.$$

Thus, acquihires reduce consumer surplus if and only if $\lambda_A \leq \lambda < \lambda_{CS}$. ■

The intuition for Proposition 2 (iii) is that when $CS_H > CS_F + CS_E > CS_L$, acquihires are harmful only when there is talent hoarding (i.e., both low and high-match firms engage

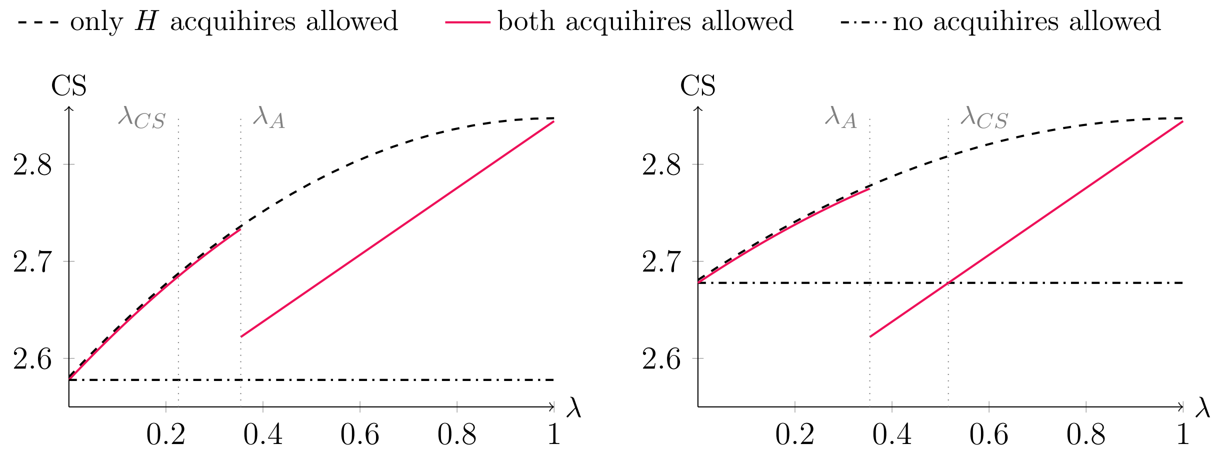

Figure 1: Consumer surplus in the Cournot example when Proposition 2(iii) applies. In the left panel $\lambda_{CS} < \lambda_A$, so that all acquihires increase consumer surplus. In the right panel $\lambda_A < \lambda_{CS}$ so that acquihires decrease consumer surplus if and only if $\lambda \in [\lambda_A, \lambda_{CS}]$.

in an acquihire, requiring $\lambda \geq \lambda_A$) and the probability of a high match is sufficiently low (requiring $\lambda < \lambda_{CS}$). Hence, consumer-surplus destroying acquihires can occur only for intermediate λ, that is when $\lambda \in [\lambda_A, \lambda_{CS})$.

Figure 1 illustrates Proposition 2(iii) using our Cournot example with $\pi_E = 0.9$. The two panels only differ in the level of consumer surplus generated by the startup. We set $CS_E = 0.4$ for the left panel and $CS_E = 0.5$ for the right panel. In both panels, as λ grows from 0 to λ_A, the consumer surplus when acquisitions are allowed increases (the solid line). For these parameters, firms endogenously only engage in high-match acquihires, which benefit consumers. At λ_A, firms start talent hoarding by engaging in low-match acquihires, too, causing a discontinuous drop in consumer surplus visible on both panels. However, on the left panel $\lambda_{CS} < \lambda_A$, which means that the drop at λ_A is not large enough to lower the consumer surplus below the level achieved when acquisitions are prohibited (the dash-dotted line). On the right panel, $\lambda_A < \lambda_{CS}$, so that for all $\lambda \in [\lambda_A, \lambda_{CS})$ the average consumer surplus is lower when acquihires are allowed than when they are not. As λ increases beyond λ_{CS}, high-match acquihires become so likely that the overall consumer surplus is again higher than when acquisitions are prohibited. Thus, when $CS_H > CS_F + CS_E > CS_L$, allowing acquihires only lowers consumer surplus for *intermediate* values of λ. Finally, the dashed line represents the consumer surplus that could be achieved if the regulators could differentiate between the low-match and high-match acquihires. In that case, allowing only high-match acquihires always increases consumer surplus. Of course, if the regulators can only imperfectly detect match types, that would lower the expected consumer surplus below the dashed line.

4 Hiring, Separation and Unemployment

We next discuss the implications of talent hoarding on the hiring of, separation from and unemployment of acquihired employees. To do so, we expand our baseline model from Section 2 by introducing a second period and allowing for economic downturns between the two periods.

The first period of this expanded model is identical to the baseline model in Section 2: the firms' match types are private information and firm 1 has the opportunity to do an acquihire before firm 2. Between the periods, the economy suffers a downturn with probability $\delta \in (0, 1)$. If a downturn materializes – an event that is publicly observable – the firms may be hit by adverse shocks (see details below). In period 2, the entrepreneur has the option of creating a new startup, once more leading to an outside option of π_E for her.[11] If the entrepreneur was employed by a firm in period 1, that firm must decide whether to continue the relationship (at the cost π_E) or lay off the entrepreneur, who might then be hired by the other firm. If no firm did an acquihire in period 1, it is again firm 1 that gets to move first in the second period.

The adverse shocks come with a commonly known joint probability distribution over "downgrades" for firms, though each firm only observes the realization of its own shock. More specifically, firm i is hit by a shock $S_i \in \{D, N\}$, where it is either downgraded from high to low match (if possible) or not affected by the shock. Thus, if a low-match firm is hit by a downgrade, it stays a low-match firm, while a high-match firm turns into a low-match firm. If a firm is not affected by the shock, its match quality stays the same. Let $(S_1, S_2) \in \{D, N\}^2$ be the profile of shocks that hit firms 1 and 2, which follows the distribution given by

$$\Pr(D, D) = r\gamma(1-\gamma) + \gamma^2, \qquad \Pr(D, N) = (1-r)\gamma(1-\gamma),$$
$$\Pr(N, D) = (1-r)\gamma(1-\gamma), \qquad \Pr(N, N) = r\gamma(1-\gamma) + (1-\gamma)^2,$$

where $\gamma \in (0, 1)$ is the probability that a firm will be downgraded and $r \in [0, 1]$ measures the degree of positive correlation between the firms' shocks. In particular, for $r = 0$ the shocks to firms are independent and for $r = 1$ they are perfectly positively correlated.

As we want to make a comparative statement, we need an appropriate benchmark relative to which we can compare the hiring, separation, and unemployment in our model with talent hoarding. To do so, consider the case where $\Pi_F = \underline{\Pi}_F^H = \underline{\Pi}_F^L$ so that an acquihire by firm i does not affect firm j's profits. Thus, there are no incentives to hoard talent in this benchmark model.

Before we state the formal result, let us try to gain a better understanding of what

[11] There is empirical evidence that acquihired employees who leave the acquirer are likely to join a new startup (Kim, 2020, 2022; Ng and Stuart, 2021).

is going on in this two-period game. If the entrepreneur was hired by a high-match firm in period 1 and this firm is not affected by the economic downturn (i.e., remains high-match), the firm will maintain the entrepreneur's employment. Therefore, no separation or unemployment is observed in that case.[12] In contrast, if the entrepreneur was hired by a low-match firm in period 1 or a high-match firm that experienced a downgrade, several distinct period-2 outcomes are possible. Talent-hoarding motives may induce the continued employment of the entrepreneur if the competitor is believed to have a high match value with a high enough probability. Thus, we would not observe any separation or unemployment of the entrepreneur. Otherwise, we may observe a layoff of the entrepreneur, who is subsequently hired by a high-match competitor. Hence, while we observe separation, the entrepreneur does not become unemployed. Finally, the entrepreneur may be laid off and not hired by the competitor, resulting in both separation and unemployment.[13] Note that these distinct period-2 outcomes in turn affect the behavior of low-match firms in period 1, changing the "acquihire threshold." Solving the game fully and deriving the probabilities of hiring in period 1 as well as observing separation and unemployment in period 2, we obtain the following result, the proof of which is relegated to the appendix.

Proposition 3 (Effect on employment outcomes) *The presence of talent-hoarding motives always leads to more hiring than in the benchmark. Additionally, provided that* $\min\left\{\frac{\lambda_A}{\lambda}, \frac{1-\lambda}{\lambda}\right\} > (1-r)(1-\gamma)$*, talent hoarding also leads to more separation and unemployment than in the benchmark.*

The increase in hiring follows immediately, as in the presence of talent hoarding, not only high-match firms but also low-match firms may pursue an acquihire. The increase in separation and unemployment is more subtle. Essentially, when either the correlation between firms' adverse shocks r or the (marginal) probability of suffering a downgrade γ is sufficiently high, talent hoarding raises separation and unemployment. In the case of r being high, this is because firm 1's shock is informative of firm 2's shock due to the correlation, hence allowing firm 1, whenever it draws a negative shock, to forgo the costly talent hoarding in the second period. Similarly, when γ is sufficiently high, firm 1 can be fairly confident that whenever a downturn occurs, the competitor will be downgraded, once more prompting the firm to forgo talent hoarding. Further, when γ or r are sufficiently high, firm 1 is often right in laying off the entrepreneur as firm 2 will indeed have a low match, which in turn leads to unemployment. Finally, all statements in the proposition are strict whenever λ is sufficiently high so that any talent hoarding at all takes place.

[12] In the video game industry, Loh et al. (2019) empirically document that when the skills of the startup employees and the needs of the acquiring firm match well, the startup employees are more likely to stay with the acquirer.

[13] The term "unemployment" captures the state in which the entrepreneur is laid off and then not employed by either firm. Given that the entrepreneur has an outside option of starting their own business, unemployment in the narrower sense of the term does not occur.

5 Discussion and Conclusion

We have presented a simple, yet general, reduced-form model of startup acquisitions. We show that acquihires may not only reflect firms' desire to hire talented employees but may also be rooted in an incentive to engage in inefficient talent hoarding, thus potentially warranting regulators' attention. Further, we show that acquihires may decrease consumer surplus and increase job volatility of acquihired employees, thereby giving further reasons for regulatory scrutiny of such deals.

Our baseline model relies on several simplifying assumptions. As we discuss below, the main results of our analysis hold even if we relax some of those assumptions. Moreover, the extensions of our baseline model reveal several additional insights. The formal analysis and results can be found in the Online Appendix.

People and technology. In the baseline model, we implicitly assume that all the value of the startup is in its employees. Of course, some startups may additionally have valuable technology, that could be of use both to the acquirer and the competitor. We posit that the fundamental difference between people and technology is that technology, once acquired, is the property of the firm and the firm is free to sell it or license it to a third party.[14] We extend the model so that some share of the value of the startup can also be due to its technology. An acquirer can trade the startup's technology (but not the employees) to its competitor. As we show, a low-match acquirer will indeed have an incentive to sell the technology to a high-match competitor, because the price will compensate her for any decrease in market profit due to a more efficient competitor. Thus firms will not have an incentive to hoard technology, while the incentive to hoard talent remains. Interestingly, talent hoarding occurs for a strictly larger set of parameters, as the option to resell technology effectively subsidizes talent hoarding.

Dominant firm. Instead of symmetric firms, the market could be characterized by a dominant firm and a challenger. We show that the incentives to hoard talent also emerge in this asymmetric model. We also show, under reasonable assumptions on the impact of acquisitions on the profits of the dominant firm and the challenger, that the dominant firm is more likely to hoard talent than the challenger.

Multiple firms. Next, we study the markets with more than two firms, which may sequentially attempt to acquihire the startup. Focusing on the Cournot-Oligopoly setting, we show that in the limit, as the number of firms grows large, no talent hoarding takes place. Intuitively, the profit at risk from a competitor's acquihire becomes smaller as the

[14] For a discussion of technology markets, see, e.g., Arora, Fosfuri, and Gambardella (2001) and Gans and Stern (2000).

number of competitors increases, reducing the incentives to engage in costly talent hoarding. However, the effect of the increase in the number of competitors on the incentives to talent hoard is not necessarily monotonic. The reason for the non-monotonicity is that an increase in the number of competitors, in addition to decreasing profit at risk, also increases the probability that a high-match competitor will acquire the startup. Which effect is stronger for a small number of firms is not clear. Indeed, we show in a parametric example that we may observe more talent hoarding when there are three firms than when there are two.

Partial acquisitions. Instead of integrating the startup after acquiring it, the acquirer could allow it to continue operating independently in its own market. Moreover, instead of buying the startup outright, a firm could acquire a partial stake in it. In this context, the key questions are how the startup's profits and control rights are allocated. First, we assume that following an investment the entrepreneur receives a dividend and a wage, while an investor only receives a dividend as their share of the startup's profits. To micro-found these payoffs, we assume that the presence of an outside investor gives rise to an agency problem, which we capture in reduced form, thus allowing for a wide range of agency models while maintaining a simple and (relatively) tractable setup. Second, considering control rights, we are primarily interested in the investor's ability to block and the entrepreneur's ability to push through an acquihire by the investor's competitor. We assume that the entrepreneur can always block an acquihire, as she could sell her shares but refuse to work for the acquiring firm. If the entrepreneur would like to be acquihired and the investor does not want the acquihire to go through, the entrepreneur can (in the spirit of typical shareholder agreements) try to "drag along" the investor and force the transaction. We assume that the investor has a probabilistic chance of blocking this attempt and merely impose that the probability of successfully blocking an acquihire is increasing in the investor's stake in the startup.

We find that an acquihire can be more profitable than buying a startup and letting it operate independently, which implies that the talent hoarding result we identified in the main model also appears in this extension. When blocking rights are sufficiently strong, an investment may constitute a viable and cheaper alternative to an acquihire. Therefore, the possibility of partial ownership may reduce the frequency of acquihires taking place. The flip side, however, is that the frequency of some transactions taking place goes up, as investments are cheaper than acquihires. Notably, the reduction in overall profits is lower in the case of investments than of low-match acquihire. Therefore, the possibility of investments is more likely to lead to inefficient market outcomes, albeit at a lower degree of inefficiency.

We close the paper by noting that our model gives rise to several hypotheses that could be tested empirically. First, our model predicts a positive relationship between talent hoarding and job volatility of acquihired employees. Second, an acquihire by a dominant firm is more likely to be motivated by talent hoarding. Third, increasing market competitiveness can curb talent hoarding but not always monotonically. Fourth, the strength of blocking rights implied by shareholder agreements should have an impact on the relative frequency of acquihires and investments.

A Proof of Proposition 3

The result obtains in three steps. First, we solve the benchmark game without talent hoarding. Second, we solve the game with talent hoarding. Third, we compare the two.

Benchmark. Absent any incentives to hoard talent, only high-match firms do an acquihire. Thus, a layoff only takes place if the economy enters a downturn and the firm that did an acquihire in period 1 is hit by an adverse shock. Further, following a layoff, we observe unemployment only if the competitor was a low-match firm or if it was a high-match firm that got hit by an adverse shock. Finally, hiring takes place in period 1 unless both firms have a low match with the startup. Taken together, the probability of observing a layoff in the second period is

$$l^* = \delta[\lambda + (1-\lambda)\lambda]\gamma = \delta(2\lambda - \lambda^2)\gamma \tag{A.1}$$

and the probability of observing unemployment in the second period is

$$u^* = \delta(2\lambda - \lambda^2 - \lambda^2(1-r)(1-\gamma))\gamma. \tag{A.2}$$

Talent hoarding. First, note that incentives in period 2 coincide with those in period 1 absent an economic downturn, ruling out layoffs and unemployment. In case of a downturn, three cases arise in period 2:

- Suppose firm 1 acquihired in period 1. Then, firm 2 does an acquihire in period 2 iff it has a high match. In period 2 a high-match firm 1 does an acquihire. A low-match firm 1 that received a D shock, believes its competitor has a high match with probability $\lambda(1-r)(1-\gamma)$ and will do an acquihire if this is larger than λ_A. Analogously, a low-match firm 1 that received a N shock will do an acquihire if $\lambda(1-\gamma(1-r)) \geq \lambda_A$.
- Suppose firm 2 acquihired in period 1, so firm 1 is a low-match and will not do an acquihire moving second. Thus, firm 2 does an acquihire iff it has a high match.
- Suppose no acquihire took place in period 1. Then, both firms have a low match and this is commonly known so that no acquihires take place in period 2 either.

Moving to period 1, firm 2 does an acquihire iff it has a high match, knowing that firm 1 has a low match, since a high-match firm 1 would always do an acquihire. For a low-match firm 1, doing nothing yields

$$\lambda\left(\underline{\Pi}_F^H(2-\gamma\delta) + \gamma\delta\Pi_F\right) + (1-\lambda)2\Pi_F = \lambda(2-\gamma\delta)(\underline{\Pi}_F^H - \Pi_F) + 2\Pi_F.$$

The payoff of an acquihire depends on parameters and reads:

- $2(\bar{\Pi}_F^L - \pi_E)$ if $\lambda(1-r)(1-\gamma) > \lambda_A$;
- $(\bar{\Pi}_F^L - \pi_E)(2-\delta\gamma) - \delta\gamma\lambda(1-r)(1-\gamma)(\Pi_F - \underline{\Pi}_F^H) + \delta\gamma\Pi_F$ if $\lambda(1-\gamma(1-r)) > \lambda_A > \lambda(1-r)(1-\gamma)$;
- $(\bar{\Pi}_F^L - \pi_E)(2-\delta) - \delta\lambda(1-\gamma)(\Pi_F - \underline{\Pi}_F^H) + \delta\Pi_F$ if $\lambda_A > \lambda(1-\gamma(1-r))$.

In the first case, a low-match firm will always hoard talent in period 2. In the second case, it will want to hoard talent unless it receives a D shock in an economic downturn. In the third case, it will want to hoard talent as long as the economy does not experience a downturn. Thus, comparing the total payoffs from doing nothing or an acquihire in period 1, the acquihire thresholds for the first period read, respectively,

$$\lambda_A^1 = \lambda_A \cdot \frac{2}{2-\gamma\delta},$$
$$\lambda_A^2 = \lambda_A \cdot \frac{2-\delta\gamma}{2-\delta\gamma-(1-r)(1-\gamma)\delta\gamma},$$
$$\lambda_A^3 = \lambda_A,$$

so that $\lambda_A^1 \geq \lambda_A^2 \geq \lambda_A^3$.

Comparison. To compare hiring, separation, and unemployment, we need to consider three cases.

Case 1: Suppose $\lambda(1-r)(1-\gamma) > \lambda_A$. Then, we have $\lambda \geq \lambda_A^1 = \lambda_A \frac{2}{2-\gamma\delta}$. Hence, in that case, a low-match firm will do an acquihire in both periods so that no layoffs or unemployment are observed, which is less than in the benchmark. Thus, irrespective of whether the economy hits a downturn, the entrepreneur is always employed without separation.

Case 2: Suppose $\lambda(1-\gamma(1-r)) > \lambda_A > \lambda(1-r)(1-\gamma)$. This implies $\lambda > \lambda_A^2$ so firm 1 will always do an acquihire in period 1. In period 2, firm 1 will maintain employment of the entrepreneur unless it receives shock D. Hence, the probability of a layoff will be $\delta\gamma$, which is larger than the benchmark layoff rate l^*. Moreover, the probability of transition to unemployment will be $\delta(\gamma - \lambda P(D,N))$, which is larger than u^* if and only if $\frac{1-\lambda}{\lambda} > (1-r)(1-\gamma)$.

Case 3: Suppose that $\lambda_A > \lambda(1-\gamma(1-r))$. If $\lambda > \lambda_A^3$ then firm 1 will do an acquihire in period 1. Firm 1 will maintain employment in period 2 unless it was hit by a downturn and has a low match. Hence, the probability of observing a layoff is $\delta(\gamma + (1-\lambda)(1-\gamma)) = \delta(1-\lambda(1-\gamma))$, which is larger than l^*. The probability of observing a transition to unemployment is

$$\delta([2\lambda-\lambda^2]\gamma-\lambda^2 P(D,N)+(1-\lambda)^2)$$

which is larger than u^*.

If instead, we have $\lambda<\lambda_A^3$, then we have no talent hoarding in either stage and the equilibrium is identical to the benchmark.

Finally, observe that the condition $\min\left\{\frac{\lambda_A}{\lambda},\frac{1-\lambda}{\lambda}\right\}>(1-r)(1-\gamma)$ implies that we are either in Case 2 or 3. Further, in Case 2, it ensures that we have more unemployment than in the benchmark.

References

Affeldt, P. and R. Kesler (2021a): "Big Tech Acquisitions – Towards Empirical Evidence," *Journal of European Competition Law & Practice*, 12, 471–478.

——— (2021b): "Competitors' Reactions to Big Tech Acquisitions: Evidence from Mobile Apps," DIW Berlin Discussion Paper No. 1987.

Arora, A., A. Fosfuri, and A. Gambardella (2001): "Markets for technology and their implications for corporate strategy," *Industrial and corporate change*, 10, 419–451.

Bao, R. and J. Eeckhout (2023): "Killer Innovation," Mimeo.

Barnett, J. (2023): ""Killer Acquisitions" Reexamined: Economic Hyperbole in the Age of Populist Antitrust," USC CLASS Research Paper No. 23-1.

Biddle, J. E. (2014): "Retrospectives: The cyclical behavior of labor productivity and the emergence of the labor hoarding concept," *Journal of Economic Perspectives*, 28, 197–212.

Bryan, K. A. and E. Hovenkamp (2020a): "Antitrust Limits on Startup Acquisitions," *Review of Industrial Organization*, 56, 615–636.

——— (2020b): "Startup Acquisitions, Error Costs, and Antitrust Policy," *The University of Chicago Law Review*, 87, 331–356.

Cabral, L. (2018): "Standing on the Shoulders of Dwarfs: Dominant Firms and Innovation Incentives," CEPR Discussion Paper No. 13115.

——— (2020): "Merger policy in digital industries," *Information Economics and Policy.*

——— (2023): "Big Tech Acquisitions," Mimeo.

Callander, S. and N. Matouschek (2022): "The Novelty of Innovation: Competition, Disruption, and Antitrust Policy," *Management Science*, 68, 37–51.

Chen, D., H. Gao, and Y. Ma (2021): "Human capital-driven acquisition: evidence from the inevitable disclosure doctrine," *Management Science*, 67, 4643–4664.

Chen, J., S. Hshieh, and F. Zhang (2022): "Hiring High-Skilled Labor through Mergers and Acquisitions," *Available at SSRN 4134426.*

Coyle, J. F. and G. D. Polsky (2013): "Acqui-Hiring," *Duke Law Journal*, 63, 281–346.

Cunningham, C., F. Ederer, and S. Ma (2021): "Killer acquisitions," *Journal of Political Economy*, 129, 649–702.

Denicolo, V. and M. Polo (2021): "Acquisitions, innovation and the entrenchment of monopoly," Available at SSRN 3988255.

Dijk, E., J. L. Moraga-González, and E. Motchenkova (2021): "How do start-up acquisitions affect the direction of innovation?" *CEPR Discussion Paper No. DP16362*.

Ederer, F. and B. Pellegrino (2023): "The Great Start-up Sellout and the Rise of Oligopoly," *AEA Papers and Proceedings*, 113, 274–278.

Eisfeld, L. (2022): "Entry and acquisitions in software markets," Working Paper, Toulouse School of Economics.

European Commission (2021): "Commission Guidance on the application of the referral mechanism set out in Article 22 of the Merger Regulation to certain categories of cases," https://ec.europa.eu/competition/consultations/2021_merger_control/guidance_article_22_referrals.pdf.

Fosfuri, A., M. Motta, and T. Rønde (2001): "Foreign direct investment and spillovers through workers' mobility," *Journal of international economics*, 53, 205–222.

FTC (2020): "FTC to Examine Past Acquisitions by Large Technology Companies," https://www.ftc.gov/news-events/news/press-releases/2020/02/ftc-examine-past-acquisitions-large-technology-companies, last Accessed 26.01.2023.

Fumagalli, C., M. Motta, and E. Tarantino (2020): "Shelving or developing? The acquisition of potential competitors under financial constraints," CEPR Discussion Paper No. DP15113.

Gans, J. S. and S. Stern (2000): "Incumbency and R&D incentives: Licensing the gale of creative destruction," *Journal of Economics & Management Strategy*, 9, 485–511.

Gautier, A. and J. Lamesch (2021): "Mergers in the Digital Economy," *Information Economics and Policy*, 54, 100890.

Gersbach, H. and A. Schmutzler (2003a): "Endogenous spillovers and incentives to innovate," *Economic Theory*, 21, 59–79.

——— (2003b): "Endogenous technological spillovers: causes and consequences," *Journal of Economics & Management Strategy*, 12, 179–205.

Gugler, K., F. Szücs, and U. Wohak (2023): "Start-up Acquisitions, Venture Capital and Innovation: A Comparative Study of Google, Apple, Facebook, Amazon and Microsoft," Tech. rep., Vienna University of Economics and Business, Department of Economics.

Haegele, I. (2022): "Talent hoarding in organizations," Available at arXiv preprint, arXiv:2206.15098.

Hollenbeck, B. (2020): "Horizontal mergers and innovation in concentrated industries," *Quantitative Marketing and Economics*, 18, 1–37.

Jin, G. Z., M. Leccese, and L. Wagman (2023): "How Do Top Acquirers Compare in Technology Mergers? New Evidence from an SP Taxonomy," *International Journal of Industrial Organization*, 89, 102891.

Jovanovic, B. (1979): "Job matching and the theory of turnover," *Journal of political economy*, 87, 972–990.

Kamepalli, S. K., R. G. Rajan, and L. Zingales (2021): "Kill Zone," *Available at SSRN 3555915*.

Katz, M. L. (2021): "Big Tech mergers: Innovation, competition for the market, and the acquisition of emerging competitors," *Information Economics and Policy*, 54, 100883.

Kim, J. D. (2020): "Startup acquisitions as a hiring strategy: Worker choice and turnover," Available at SSRN 3252784.

——— (2022): "Startup acquisitions, relocation, and employee entrepreneurship," *Strategic Management Journal*, 43, 2189–2216.

Letina, I., A. Schmutzler, and R. Seibel (2023): "Killer acquisitions and beyond: policy effects on innovation strategies," University of Zurich, Department of Economics, Working Paper 358.

Loh, J., P. Khashabi, J. Claussen, and T. Kretschmer (2019): "Disruption, specialization and employee exit: Vertical acquisitions in the US Video Game Industry," Available at SSRN 3354763.

Mason, R. and H. Weeds (2013): "Merger policy, entry, and entrepreneurship," *European Economic Review*, 57, 23–38.

Motta, M. and M. Peitz (2021): "Big tech mergers," *Information Economics and Policy*, 54, 100868.

Ng, W. and T. E. Stuart (2021): "Acquired employees versus hired employees: Retained or turned over?" *Strategic Management Journal*, 43, 1025–1045.

Norbäck, P.-J. and L. Persson (2012): "Entrepreneurial innovations, competition and competition policy," *European Economic Review*, 56, 488–506.

Ouimet, P. and R. Zarutskie (2020): "Acquiring labor," *Quarterly Journal of Finance*, 10, 2050011.

Phillips, G. M. and A. Zhdanov (2013): "R&D and the Incentives from Merger and Acquisition Activity," *The Review of Financial Studies*, 26, 34–78.

Prado, T. S. and J. M. Bauer (2022): "Big Tech platform acquisitions of start-ups and venture capital funding for innovation," *Information Economics and Policy*, 59, 100973.

Rasmusen, E. (1988): "Entry for Buyout," *The Journal of Industrial Economics*, 36, 281–299.

Selby, J. and K. J. Mayer (2013): "Startup firm acquisitions as a human resource strategy for innovation: The acqhire phenomenon," Working Paper.

Shelegia, S. and M. Motta (2021): "The "kill zone": Copying, acquisition and start-ups' direction of innovation," CEPR Discussion Paper No. DP16151.

Teh, C., D. Banerjee, and C. Wang (2022): "Acquisition-induced kill zone," Monash University, Department of Economics Discussion Paper No. 2022-24.

Verginer, L., F. Parisi, J. v. L. de Jeude, and M. Riccaboni (2022): "The Impact of Acquisitions on Inventors' Turnover in the Biotechnology Industry," Available at arXiv preprint arXiv:2203.12968.

B Online Appendix: Not for Publication

The online appendix covers the extensions discussed in the conclusion of the paper, as well as the robustness exercises concerning the timing and surplus sharing in the baseline model mentioned in footnote 8.

B.1 People and Technology

Consider a situation where the total value of the startup consists of the people who work for the startup and the technology owned by the startup. The fundamental difference between the employees and the technology, from the acquirer's point of view, is that technology can be sold (or licensed), while the people cannot. In our model, this implies that the acquirer can resell the startup's technology to the competitor, whenever such a sale increases joint profits. Suppose that the share of the value of the startup generated by the technology is $\delta \in [0,1]$, while the share generated by employees is $(1-\delta)$. Moreover, for simplicity, assume that acquiring just the technology (or just the employees) generates δ (or $1-\delta$) of the impact that acquiring the entire startup would have. Just as before, a firm can have a high match value with the startup with probability λ, where we assume for simplicity that the match value of the startup to a firm applies to both the people and the technology identically. The match value of the firm is private information at the beginning of the game. The timing of the game in stage 1 is:

1. Firm 1 observes the match quality with the startup and makes an acquisition of the startup at price p or does nothing.
2. The startup accepts or rejects the bid.
3. If the bid is rejected, the game proceeds to stage 2. If accepted, firm 1 can sell the startup's technology at the price q to firm 2.

Stage 2 is like stage 1 but the roles of firms 1 and 2 are reversed. To accommodate the possibility of selling the startup's technology, we slightly adapt the notation from the main text. Suppose firm 1 with match θ_1 did an acquisition at price p. Absent any sale of the startup's technology, profits read

$$\begin{aligned}\text{Firm 1} &: \Pi_F + \bar{\pi}_F^{\theta_1} - p \\ \text{Firm 2} &: \Pi_F - \underline{\pi}_F^{\theta_1} \\ \text{Startup} &: p,\end{aligned}$$

which coincides with profits in the baseline model (although the notation is different).[15] If the technology part is sold at price q, the profits read

$$\begin{aligned}\text{Firm 1} &: \Pi_F + (1-\delta)\bar{\pi}_F^{\theta_1} - \delta\underline{\pi}_F^{\theta_2} - p + q \\ \text{Firm 2} &: \Pi_F - (1-\delta)\underline{\pi}_F^{\theta_1} + \delta\bar{\pi}_F^{\theta_2} - q \\ \text{Startup} &: p.\end{aligned}$$

Thus, the people who have joined firm 1 from the startup increase firm 1's profits and decrease firm 2's profits, respectively. Conversely, the startup's technology increases firm 2's and decreases firm 1's profits, respectively.

To simplify the model and the exposition, we do not explicitly model the bargaining process between the two firms. Instead, we assume that the two firms meet at the bargaining table, their types are revealed and the resulting surplus from selling the technology is shared equally. The surplus resulting from the sale of the technology is then given by

$$\begin{aligned}&\Pi_F + (1-\delta)\bar{\pi}_F^{\theta_1} - \delta\underline{\pi}_F^{\theta_2} - p + \Pi_F - (1-\delta)\underline{\pi}_F^{\theta_1} + \delta\bar{\pi}_F^{\theta_2} - \left(\Pi_F + \bar{\pi}_F^{\theta_1} - p + \Pi_F - \underline{\pi}_F^{\theta_1}\right) \\ &= \delta\left(\bar{\pi}_F^{\theta_2} + \underline{\pi}_F^{\theta_1} - \bar{\pi}_F^{\theta_1} - \underline{\pi}_F^{\theta_2}\right).\end{aligned}$$

The case we are interested in, is when a low-match firm 1 sells technology to a high-match firm 2. Then, the surplus reads $\delta\left(\bar{\pi}_F^H + \underline{\pi}_F^L - \bar{\pi}_F^L - \underline{\pi}_F^H\right)$. We now make two assumptions on profits. The first corresponds to Assumption 1 in the baseline model in the main text (in this extension's notation). The second ensures that the surplus resulting from a technology sale from a low-match to a high-match firm is positive.

Assumption B1 $\bar{\pi}_F^H > \pi_E > \bar{\pi}_F^L$ *and* $\underline{\pi}_F^H > \underline{\pi}_F^L \geq 0$.

Assumption B2 $\bar{\pi}_F^H + \underline{\pi}_F^L - \bar{\pi}_F^L - \underline{\pi}_F^H > 0$.

Finally, to break ties, we assume that firms of the same match type do not trade the startup's technology. We obtain the following result

Proposition B1 *Under Assumptions B1 and B2, firm 1's behavior in any PBE is uniquely specified. Namely, if firm 1 has a high match, it will make an acquisition and not sell the technology; if it has a low match, it will make an acquisition and sell the startup's technology to a high-match (but not a low-match) firm 2 if and only if*

$$\lambda \geq \lambda_A(\delta) \equiv \frac{\pi_E - \bar{\pi}_F^L}{\underline{\pi}_F^H + \frac{\delta}{2}\left(\bar{\pi}_F^H + \underline{\pi}_F^L - \bar{\pi}_F^L - \underline{\pi}_F^H\right)}$$

and do nothing otherwise.

[15] For instance, the payoff of an acquiring firm with match type θ_1 in the main text is $\bar{\Pi}_F^{\theta_1}$ while it now reads $\Pi_F + \bar{\pi}_F^{\theta_1}$.

PROOF: Suppose firm 1 has not made the acquisition. It follows from Assumption B1 that firm 2 makes the acquisition if and only if it has a high match type, irrespective of its beliefs. Moving to stage 1, firm 1's beliefs are given by the prior belief. Suppose a high-match firm 1 acquired the startup. By Assumption B2 a low-match firm 2 would not buy the technology part of the startup and by our tie-breaking assumption neither would a high-match firm 2. Then, by Assumption B1 a high-match firm acquires the startup and keeps the technology. Suppose a low-match firm 1 acquired the startup. By our tie-breaking assumption, a low-match firm 2 would not buy the startup's technology. However, by Assumption B2, the technology part would be sold to a high-match firm 2. Anticipating this, the threshold for a low-match firm 1 to acquire the startup changes relative to the model in the main text. Formally, doing nothing yields

$$\Pi_F - \lambda \underline{\pi}_F^H,$$

while making an acquisition yields

$$\Pi_F - \pi_E + (1-\lambda)\bar{\pi}_F^L + \lambda(q + (1-\delta)\bar{\pi}_F^L - \delta\underline{\pi}_F^H),$$

where

$$q = \frac{\delta\left(\bar{\pi}_F^H + \underline{\pi}_F^L + \bar{\pi}_F^L + \underline{\pi}_F^H\right)}{2},$$

is the surplus-splitting sale price. Thus, an acquisition takes place whenever

$$\Pi_F - \pi_E + (1-\lambda)\bar{\pi}_F^L + \lambda\left(\frac{\delta\left(\bar{\pi}_F^H + \underline{\pi}_F^L + \bar{\pi}_F^L + \underline{\pi}_F^H\right)}{2} + (1-\delta)\bar{\pi}_F^L - \delta\underline{\pi}_F^H\right) \geq \Pi_F - \lambda\underline{\pi}_F^H,$$

which we can rearrange to the expression in the Proposition. ■

One can verify that for $\delta = 0$ the above condition reduces to the condition (1) in the main text. As δ increases, the threshold $\lambda_A(\delta)$ decreases, i.e., the acquisition happens for a larger set of parameters. Intuitively, as the technology part of the startup can be sold to a high-match firm 2, the expected cost of hoarding the talent falls for the low-match firm 1, leading to more talent hoarding.

B.2 Dominant Firm

Consider a situation where instead of two symmetric firms, the industry is characterized by a dominant firm and a challenger firm. The firms now have different payoffs, which we denote $(\bar{\Pi}_D^H, \bar{\Pi}_D^L, \Pi_D, \underline{\Pi}_D^L, \underline{\Pi}_D^H)$ for the dominant firm and $(\bar{\Pi}_C^H, \bar{\Pi}_C^L, \Pi_C, \underline{\Pi}_C^L, \underline{\Pi}_C^H)$ for the challenger. We maintain Assumption 1 for both firms, that is we assume that both (i)

$\bar{\Pi}_F^H > \Pi_F + \pi_E > \bar{\Pi}_F^L$ and (ii) $\Pi_F \geq \underline{\Pi}_F^L > \underline{\Pi}_F^H$ hold for each $F \in \{D, C\}$. We consider the setting as in Proposition 1, that is firms can either engage in acquihires or do nothing.

Corollary B1 (Acquihires with a dominant firm)

(i) If either the dominant or the challenger firm moves second it engages in an aquihire if and only if it is the high match type.

(ii) If the dominant firm moves first, it engages in an acquihire if it is the high match type or if it is the low match type and the probability that the challenger firm is the high match type is

$$\lambda > \lambda_D \equiv \frac{\pi_E + \Pi_D - \bar{\Pi}_D^L}{\Pi_D - \underline{\Pi}_D^H}. \tag{B.1}$$

(iii) If the challenger firm moves first, it engages in an acquihire if it is the high match type or if it is the low match type and the probability that the dominant firm is the high type is

$$\lambda > \lambda_C \equiv \frac{\pi_E + \Pi_C - \bar{\Pi}_C^L}{\Pi_C - \underline{\Pi}_C^H}. \tag{B.2}$$

The corollary follows directly from Proposition 1. An interesting question is under which conditions would the dominant firm be more prone to talent hoarding than the challenger firm, i.e., when is $\lambda_C > \lambda_D$? The following result gives a set of simple sufficient conditions.

Proposition B2 *If the following two inequalities hold, then $\lambda_C > \lambda_D$:*

$$\Pi_C - \underline{\Pi}_C^H < \Pi_D - \underline{\Pi}_D^H,$$
$$\bar{\Pi}_C^L - \Pi_C < \bar{\Pi}_D^L - \Pi_D.$$

PROOF: From Corollary B1 we have the threshold values

$$\lambda_D \equiv \frac{\pi_E + \Pi_D - \bar{\Pi}_D^L}{\Pi_D - \underline{\Pi}_D^H}, \quad \text{and} \quad \lambda_C \equiv \frac{\pi_E + \Pi_C - \bar{\Pi}_C^L}{\Pi_C - \underline{\Pi}_C^H}.$$

Note that the conditions stated in the proposition imply

$$\lambda_D = \frac{\pi_E + \Pi_D - \bar{\Pi}_D^L}{\Pi_D - \underline{\Pi}_D^H} < \frac{\pi_E + \Pi_D - \bar{\Pi}_D^L}{\Pi_C - \underline{\Pi}_C^H} < \frac{\pi_E + \Pi_C - \bar{\Pi}_C^L}{\Pi_C - \underline{\Pi}_C^H} = \lambda_C,$$

completing the proof. ■

Intuitively, the two inequalities above require that the dominant firm both stands to lose more if a startup is acquired by the challenger (maybe because the dominant firm has a larger market share, so it has more to lose) and stands more to gain by acquihiring the startup itself (a larger market share might be an explanation again, as any improvement could be offered to more consumers more rapidly).

A simple specification that satisfies these inequalities is an "equal proportional gain/loss". Formally, let the profit functions be given by

$$\begin{aligned} \bar{\Pi}_D^H &= H\Pi_D, \quad \bar{\Pi}_D^L = L\Pi_D, \quad \underline{\Pi}_D^L = \ell\Pi_D, \quad \underline{\Pi}_D^H = h\Pi_D, \\ \bar{\Pi}_C^H &= H\Pi_C, \quad \bar{\Pi}_C^L = L\Pi_C, \quad \underline{\Pi}_C^L = \ell\Pi_C, \quad \underline{\Pi}_C^H = h\Pi_C, \end{aligned}$$

where $H > L > 1$ and $1 \leq \ell > h \geq 0$. This implies that an acquihire (either own or by the competitor) has a proportionally equal effect on both the dominant firm and the challenger firm. As long as $\Pi_D > \Pi_C$ (i.e., absent any acquihire, the dominant firm has higher profits than the challenger), straightforward calculations show that the two inequalities of Proposition B2 are satisfied and the dominant firm is more prone to acquihires than the challenger.

B.3 Multiple Firms

Often, more than two firms are competing in a given market. In this extension, we thus allow for $n \geq 2$ firms competing in the same market. As in the baseline, firms may sequentially attempt to do an acquihire of the startup and each firm's match type $\theta \in \{L, H\}$ is an independent draw with identical probability $\Pr(\theta = H) = \lambda$. In the absence of an acquihire, each firm makes profits $\Pi_F(n)$. If firm i with match type θ makes an acquihire profits read $\bar{\Pi}_F^\theta(n)$ for firm i and $\underline{\Pi}_F^\theta(n)$ for firms $j \neq i$.

To make things concrete, we focus on a Cournot oligopoly setting with n firms and the following inverse demand function:

$$P(q_1, ..., q_n) = a - b \cdot \sum_{i=1}^{n} q_i, \tag{B.3}$$

where q_i indicates the quantity choice of firm $i \in \{1, ..., n\}$ and $a, b > 0$. We assume that the demand intercept a is sufficiently large to ensure an interior solution. Let $c > 0$ denote the constant marginal cost when no acquisitions occur. An acquihire by one firm is assumed to reduce its marginal cost to $c - \theta > 0$, where $\theta \in \{H, L\}$ satisfies $H > L \geq 0$.

We first establish that increasing competition eliminates talent hoarding in the limit: as $n \to +\infty$, firms acquire startups if and only if it is efficient to do so.[16] To see this,

[16] As it will become clear, this result does not hinge on the Cournot specification; it holds as long as

take any one of the n firms and suppose that its match value with the startup is θ. It is clear that if $\pi_E < \bar{\Pi}_F^\theta(n) - \Pi_F(n)$, this firm will acquire the startup whenever possible. In contrast, if

$$\pi_E > \bar{\Pi}_F^\theta(n) - \Pi_F(n), \tag{B.4}$$

acquihiring is inefficient. At the same time, a necessary condition for the firm to have incentives to do an acquihire is

$$\bar{\Pi}_F^\theta(n) - \underline{\Pi}_F^H(n) > \pi_E. \tag{B.5}$$

Note that the LHS of (B.5) is the maximum difference in the firm's profits between acquiring and not acquiring the startup. In our Cournot specification, as $n \to +\infty$, both $\Pi_F(n)$ and $\underline{\Pi}_F^H(n)$ converge to zero. Therefore, conditions (B.4) and (B.5) cannot hold simultaneously when n is sufficiently large. This implies that, whenever (B.4) holds, no firm with a match value θ will conduct an acquihire, therefore the talent hoarding problem cannot occur in equilibrium.

Next, we argue that the impact of competition on talent hoarding can be non-monotone. Note that when $n = 2$, talent hoarding arises in equilibrium if and only if

$$\pi_E \leq \lambda \left(\Pi_F(2) - \underline{\Pi}_F^H(2)\right) + \bar{\Pi}_F^L(2) - \Pi_F(2). \tag{B.6}$$

In comparison, suppose that $n = 3$ and firm 1 anticipates that firms 2 and 3 will acquire the startup when their match values are high. Then, firm 1 will be inclined to conduct an acquihire even when it draws a low match value, if the following condition holds:

$$\pi_E \leq (2\lambda - \lambda^2) \left(\Pi_F(3) - \underline{\Pi}_F^H(3)\right) + \bar{\Pi}_F^L(3) - \Pi_F(3). \tag{B.7}$$

Now, consider a parametric example with $\lambda = 0.1$, $a = 10$, $b = 1$, $c = 3$, $H = 2$, $L = 0$, and $\pi_E \in (0.534, 0.54)$. One can show that Assumption 1 holds. In addition, condition (B.6) is violated but condition (B.7) is satisfied. Thus, in the current example, talent hoarding will not occur in equilibrium when there are two firms. However, with three firms, talent hoarding will for sure arise in equilibrium.

B.4 Partial Acquisitions

This section extends the baseline model to incorporate the possibility of partial investments. That is, a firm may acquire a (minority) stake in the startup without integrating it. To do so, we need to specify the payoffs resulting from such partial acquisitions as well

the benchmark profit Π_F converges to zero as the number of firms increases.

as the rights that come with partial ownership.

Formally, the ability to make partial acquisitions means that firms can additionally try to acquire a share $s \in (0, 1]$ of the startup and continue to operate it as a stand-alone entity. In contrast to the model in the main text, we allow for upfront and deferred payments (p, d) as is standard in such transactions. In the main text, doing so would not change anything. In the presence of partial ownership, it allows the acquiring firm to distinguish at least partially between the investor (who only gets a part of the upfront payment) and the entrepreneur (who can also receive deferred payments). If a firm acquires a share s with bid (p, d), its payoff reads $\Pi_F + s\pi_E(s) - p - d$, while the entrepreneur's payoff is $(1 - s)\pi_E(s) + w(s) + p + d$. Here, $\pi_E(s)$ captures the startup's profit net of potential wages paid to the entrepreneur as a function of the size of the external ownership. These profits accrue to the firm and the entrepreneur proportionate to their stake in the startup. Correspondingly, $w(s)$ constitutes the entrepreneur's wage (net of effort costs) for different degrees of outside ownership. In particular, $\pi_E = \pi_E(0) + w(0)$. That is, when the entrepreneur owns the entire startup and thus obtains all of its profit and "pays herself" a net-of-effort wage, her payoff coincides with the initial payoff in the baseline model. The other firm's payoff is unchanged at Π_F. When a firm acquires a stake in the startup it receives a share of profits, while the dilution of ownership gives rise to moral hazard on the entrepreneur's side, which we capture in reduced form, only imposing the following assumption.

Assumption B3 *We assume that $\pi_E(s) + w(s)$ is decreasing in s with $\pi_E(0) + w(0) > \pi_E(1) + b(1)$.*

Assumption B3 captures the moral hazard arising when the entrepreneur no longer fully owns the startup. $\pi_E(s) + w(s)$ being decreasing reflects the reduced effort of the entrepreneur as a result of agency. $\pi_E(0)+w(0) > \pi_E(1)+w(1)$ captures that the first-best value of a startup fully owned by the entrepreneur is strictly higher than the second-best value, when the entrepreneur is actually an employee and has no stake in the startup.

The timing of the game is as follows. In the first stage, firm 1 has the opportunity to make a bid to the entrepreneur to acquire a share $s_1 \in (0, 1]$ of the startup or make an acquihire. If the entrepreneur accepts a bid for an acquihire, the game ends. Otherwise, we move to stage 2, the ownership structure of the startup depending on whether the entrepreneur accepted firm 1's bid. In the second stage, firm 2 can make an acquihire by making a (per-share) bid to the owner(s) of the startup, where we restrict attention to bids (p, d) with $p \geq \pi_E(s_1)$, so that no owner can be expropriated. If the entrepreneur does not accept the bid, the game ends. If the entrepreneur accepts, firm 1 can either also accept or try to block the transaction and succeeds in doing so with probability $q(s_1)$, where q is a weakly increasing function with $q(0) = 0$ and $q(1) = 1$. Nature determines whether a potential blocking attempt succeeds and the game ends.

As a benchmark, we first consider the case where ownership of a stake does not convey any blocking rights.

Proposition B3 *Under Assumptions 1 and B3 and without blocking rights, i.e., $q(s) = 0$ for all $s \in [0,1]$, firm 1's behavior in any PBE is uniquely specified. Namely, if firm 1 draws a high match type, it will make an acquihire; if it draws a low type it will make an acquihire if and only if $\lambda \geq \lambda_A$ and do nothing otherwise.*

PROOF: See the proof of Proposition B4, which contains this as a special case. ■

The result in Proposition B3 shows that partial ownership of the startup is not enough to change firm 1's behavior relative to the setting with only acquihires in Proposition 1. Indeed, since an investment is not profitable in itself and does not prevent a high-match firm 2 from making an acquihire, firm 1 will continue to either do nothing or make an acquihire, depending on the probability of a high-match firm 2 materializing. As the next result shows, it is ownership accompanied by some measure of control over the startup, which makes investments attractive to firm 1.

Proposition B4 *Under Assumptions 1 and B3 and with blocking rights, firm 1's behavior in any PBE is uniquely specified. Namely, if firm 1 draws a high type, it will make an acquihire. If it draws a low type, there is a threshold value for λ below which it does nothing. Above the threshold, it will do an investment and, depending on the model's parameters, there may be an even higher threshold above which it does an acquihire.*

Comparing the thresholds across Propositions 1, B3 and B4, we can observe that the presence of blocking rights on investments increases the parameter space for which some form of talent hoarding occurs. However, the possibility of making investments instead of an acquihire may also have "mitigating" effects relative to a setting with only acquihires, as talent hoarding by means of investments create smaller inefficiencies than by means of acquihires. Put differently, allowing for investments increases the extensive margin of talent hoarding but partially decreases its intensive margin.

PROOF: We solve the game backward.

Stage 2 Observe that firm 2 believes with probability 1 that firm 1 is a low type, as otherwise, an acquihire would have taken place in stage 1. Firm 2 has three actions: doing nothing, making a bid that is accepted by both the entrepreneur and firm 1 and making a bid which is accepted only by the entrepreneur. To understand this, observe that the payoffs of firm 1 and the entrepreneur following a firm-1 investment of size s_1 at price (p_1, d_1) read

$$\text{Firm 1}: \ \Pi_F + s_1\pi_E(s_1) - p_1 - d_1$$
$$\text{Entrepreneur}: \ (1-s_1)\pi_E(s_1) + w(s_1) + p_1 + d_1.$$

Hence, firm 1 would try to block any bid (p_2, d_2) resulting in a lower payoff than the above, while the entrepreneur would not accept any bid yielding a lower payoff than the above. Given these constraints, firm 2 will choose among three options: (i) do nothing and receive payoff Π_F; (ii) make the minimum bid such that both firm 1 and the entrepreneur accept, yielding payoff $\bar{\Pi}_F^\theta - \pi_E(s_1) - w(s_1) - \Pi_F + \underline{\Pi}_F^\theta$ for firm 2; or (iii) make a bid that only the entrepreneur accepts, risking a blocking attempt by firm 1. This third option provides an expected payoff for firm 2 of $q(s_1)\Pi_F + (1-q(s_1))(\bar{\Pi}_F^\theta - \pi_E(s_1) - w(s_1))$.

Let us consider a low-match firm 2 first. Comparing doing nothing with inducing only the entrepreneur to accept, we obtain that the latter move is is better for firm 2 whenever

$$\bar{\Pi}_F^L - \pi_E(s_1) - w(s_1) \geq \Pi_F.$$

It follows from Assumptions 1 and B3 that this condition is not necessarily satisfied. Let $\hat{s}$ be the threshold above which this condition is satisfied. Now let's compare doing nothing with inducing both for $s_1 < \hat{s}$. We obtain that inducing both is better whenever

$$\bar{\Pi}_F^L - \pi_E(s_1) - w(s_1) - \Pi_F + \underline{\Pi}_F^L \geq q(s_1)\Pi_F + (1-q(s_1))(\bar{\Pi}_F^L - \pi_E(s_1) - w(s_1)),$$

which, after rearrangement, can be rewritten as

$$q(s_1)(\bar{\Pi}_F^L - \Pi_F - \pi_E(s_1) - w(s_1)) \geq \Pi_F - \underline{\Pi}_F^L \tag{B.8}$$

Since the right-hand side of (B.8) is positive and the left-hand side of it is negative for $s_1 < \hat{s}$, this condition is never satisfied. Thus, for $s_1 < \hat{s}$ the low type does nothing.

Now let us compare firm 2 inducing only the entrepreneur versus inducing both to accept when $s_1 \geq \hat{s}$. As above, inducing both is better whenever condition (B.8) holds. Since the left-hand side of (B.8) is increasing in s_1, we define $s^L \in [\hat{s}, 1]$ as the threshold above which the condition is satisfied. Overall, a low-match firm 2 will take the following actions: for $s_1 < \hat{s}$, do nothing; for $\hat{s} \leq s_1 \leq s_L$, induces only the entrepreneur to accept; and for $s_1 > s_L$, induce both the entrepreneur and firm 1 to accept the offer.

Next, we turn to the high-match firm 2. Comparing payoffs of doing nothing and inducing only the entrepreneur, it follows from Assumption 1 that the firm will always find the former option inferior. So we only need to compare the payoffs of inducing both versus only the entrepreneur. In particular, inducing both is optimal whenever

$$q(s_1)(\bar{\Pi}_F^H - \Pi_F - \pi_E(s_1) - w(s_1)) \geq \Pi_F - \underline{\Pi}_F^H,$$

which may be satisfied for s_1 above some threshold $s^H \in [0, 1]$. Below this threshold, the high type will induce only the entrepreneur. Note that it is not clear whether s^H or s^L are bigger.

Stage 1 Observe that firm 1's belief about firm 2's type is given by the prior. Firm 1 can acquire different stakes s_1 which in turn may induce different responses from firm 2. Specially, we have learned that a low-match firm 2 may do either nothing (N), induce only the entrepreneur (E), or induce both the entrepreneur and firm 1 to accept a bid (B). As for a high-match firm 2, it may either do E or B. In what follows let (A_1, A_2) denote the action profiles of the low- and high-match firm 2, e.g, (N, B) means firm 2 does nothing when it is a low type, and it induces both to accept when its type is high. Let $\Delta(s_1) \equiv \pi_E(s_1) + w(s_1) - \pi_E(0) - w(0)$. The following are the firm-1 payoffs resulting from an acquisition of s_1 which induces the indicated firm-2 behavior:

$$\begin{aligned}
&(N, E) : \lambda(1 - (q(s_1)))\underline{\Pi}_F^H + (1 - \lambda(1 - q(s_1)))\Pi_F + \Delta(s_1) \\
&(N, B) : \Pi_F + \Delta(s_1) \\
&(E, B) : (1 - (1 - \lambda)(1 - q(s_1)))\Pi_F + (1 - \lambda)(1 - q(s_1))\underline{\Pi}_F^L + \Delta(s_1) \\
&(B, B) : \Pi_F + \Delta(s_1) \\
&(E, E) : q(s_1)\Pi_F + (1 - q(s_1))(\lambda\underline{\Pi}_F^H + (1 - \lambda)\underline{\Pi}_F^L) + \Delta(s_1) \\
&(B, E) : \lambda(1 - (q(s_1)))\underline{\Pi}_F^H + (1 - \lambda(1 - q(s_1)))\Pi_F + \Delta(s_1)
\end{aligned}$$

To illustrate how to calculate these payoffs, consider the case (N, E), where the low-match firm 2 does nothing and the high-match induces only the entrepreneur to accept (while firm 1 would try to block such an acquihire attempt by firm 2). Observe that the lowest bid at which the entrepreneur is willing to sell a stake s_1 to firm 1 is $p_1 + d_1 = \pi_E(0) + w(0) - (1 - s_1)\pi_E(s_1) - w(s_1)$. As we are considering the case (N, E), so that a low-match firm 2 would do nothing, yielding a payoff of

$$\Pi_F + s_1\pi_E(s_1) - (\pi_E(0) + w(0) - (1 - s_1)\pi_E(s_1) - w(s_1)) = \Pi_F + \Delta(s_1). \tag{B.9}$$

A high-match firm 2 would make a bid that firm 1 will try to block, succeeding with probability $q(s_1)$, yielding the following payoff to firm 1

$$q(s_1)\left(\Pi_F + \Delta(s_1)\right) + (1 - q(s_1))\left(\underline{\Pi}_F^H + \Delta(s_1)\right). \tag{B.10}$$

Adding (B.9) and (B.10) up while multiplying them with the probabilities $1-\lambda$ and λ, respectively, we obtain the expression in the above list.[17] Finally, to complete the list, note that an acquihire gives a payoff $\bar{\Pi}_F^L - \pi_E(0) - w(0)$ to firm 1 and doing nothing results in $\lambda\underline{\Pi}_F^H + (1-\lambda)\Pi_F$.

To determine firm 1's equilibrium strategy, we need to further distinguish between three cases three cases based on the values of the thresholds s^H, s^L, and $\hat{s}$. Recall that a low-match firm 2 will do nothing below $\hat{s}$, induce the entrepreneur between $\hat{s}$ and s^L and potentially induce both above s^L, while a high-match firm 2 will induce only the entrepreneur below s^H and may induce both above it.

Case 1: $s^H \leq \hat{s} \leq s^L$. Note that this allows only for four types of firm-2 behavior following an investment. If $s_1 \leq s^H$, then we have (N,E), a low-match firm 2 does nothing and a high-match induces only the entrepreneur ; if $s^H < s_1 \leq \hat{s}$, then we have (N,B), namely a low-match firm 2 does nothing and a high-match induces both; if $\hat{s} < s_1 \leq s^L$, then a low-match firm 2 induces the entrepreneur and a high-match induces both, so we have (E,B); and if $s_1 > s^L$, both types of firm 2 induce both, so we end up with (B,B). Comparing these payoffs, we observe that an acquihire dominates investments inducing (B,B) and (E,B), while an investment inducing (N,B) dominates an acquihire. Thus, the remaining actions are doing nothing, inducing (N,E) or inducing (N,B).

$$\begin{aligned}
(N,E) &: \lambda(1-(q(s_1)))\underline{\Pi}_F^H + (1-\lambda(1-q(s_1)))\Pi_F + \Delta(s_1) \\
(N,B) &: \Pi_F + \Delta(s_1) \\
(N) &: \lambda\underline{\Pi}_F^H + (1-\lambda)\Pi_F,
\end{aligned}$$

where the investment necessary to induce (N,B) is bigger than the one for (N,E) but both are smaller than $\hat{s}$ so that $\Pi_F + \pi_E(s_1) + w(s_1) \geq \bar{\Pi}_F^L$. We note that:

- As $\lambda \to 0$ doing nothing dominates both types of investment
- For $\lambda > \frac{\pi_E(0)+w(0)-\pi_E(s_1)-w(s_1)}{\Pi_F-\underline{\Pi}_F^H}$ inducing (N,B) dominates (N)
- Depending on parameters, (N,E) or (N,B) is the better investment, but for low enough λ inducing (N,E) is always better

In summary, there is a threshold value for λ below which doing nothing is best, then for larger λ inducing (N,E) is better, and for very large λ, depending on parameters, inducing (N,B) may be best.

Case 2: $\hat{s} \leq s^H \leq s^L$. Note that this allows only for four types of firm-2 behavior following an investment: (N,E), (E,E), (E,B) and (B,B). Proceeding as above, we find

[17] Observe that the size of firm 1's investment s_1 is not the same across cases in the above list, as different investment sizes induce the different behaviors of firm 2.

that there is a threshold value for λ below which doing nothing is best, then for larger λ inducing (N, E) is better, and for very large λ, depending on parameters, doing an acquihire may be best.

Case 3: $\hat{s} \leq s^L \leq s^H$. Note that this allows only for four types of firm-2 behavior following an investment: (N, E), (E, E), (B, E) and (B, B). Proceeding as above, we find that there is a threshold value for λ below which doing nothing is best, then for larger λ inducing (N, E) is better, and for very large λ, depending on parameters, doing an acquihire may be best. ■

B.5 Simultaneous Moves

Suppose the two firms move simultaneously and can choose between pursuing an acquihire or doing nothing. To abstract from modeling the bidding process, we assume the following. If firms of the same type both attempt an acquihire, they have an equal chance of succeeding in doing the acquihire. If a low type and a high type firm both attempt an acquihire, the low-match firm succeeds in doing the acquihire with probability $\xi \in [0, 1]$. The price of the acquihire is always π_E. We show that talent hoarding can be sustained as a Bayes-Nash Equilibrium.

Proposition B5 *Suppose* $\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^H > 0$*. Then, for* $\lambda\xi$ *sufficiently high, both types making an acquihire is a BNE, thus showing that talent hoarding can occur.*

Proof: Figure 2 shows the payoffs of the row player in the game in question. We show that both types playing acquihire is a BNE. For a high-match player, the payoffs of the two actions read (conditional on the other playing the equilibrium candidate)

$$
\begin{aligned}
AH &: \frac{\lambda}{2}\left[\bar{\Pi}_F^H - \pi_E + \underline{\Pi}_F^H\right] + (1-\lambda)\left[\xi \underline{\Pi}_F^L + (1-\xi)(\bar{\Pi}_F^H - \pi_E)\right] \\
N &: \lambda \underline{\Pi}_F^H + (1-\lambda)\underline{\Pi}_F^L.
\end{aligned}
$$

If doing an acquihire is better than doing nothing for $\xi = 1$, then it is also better for any other ξ. For the case $\xi = 1$ the condition reads

$$
\bar{\Pi}_F^H - \pi_E - \underline{\Pi}_F^H > 0,
$$

which is satisfied.

For a low-match player, the payoffs of the two actions are (conditional on the other

	AH	N
AH	$\frac{1}{2}(\bar{\Pi}_F^H - \pi_E + \underline{\Pi}_F^H)$	$\bar{\Pi}_F^H - \pi_E$
N	$\underline{\Pi}_F^H$	Π_F

High match facing a high match

	AH	N
AH	$\xi\underline{\Pi}_F^L + (1-\xi)(\bar{\Pi}_F^H - \pi_E)$	$\bar{\Pi}_F^H - \pi_E$
N	$\underline{\Pi}_F^L$	Π_F

High match facing a low match

	AH	N
AH	$\xi(\bar{\Pi}_F^L - \pi_E) + (1-\xi)\underline{\Pi}_F^H$	$\bar{\Pi}_F^L - \pi_E$
N	$\underline{\Pi}_F^H$	Π_F

Low match facing a high match

	AH	N
AH	$\frac{1}{2}(\bar{\Pi}_F^L - \pi_E + \underline{\Pi}_F^L)$	$\bar{\Pi}_F^L - \pi_E$
N	$\underline{\Pi}_F^L$	Π_F

Low match facing a low match

Figure 2: Payoffs of the row-player in the game depending on whether it is a high or a low match and whether it faces a high or a low match competitor.

playing the equilibrium candidate)

$$\begin{aligned} AH &: \lambda\left[\xi(\bar{\Pi}_F^L - \pi_E) + (1-\xi)\underline{\Pi}_F^H\right] + \frac{1-\lambda}{2}\left(\bar{\Pi}_F^L - \pi_E + \underline{\Pi}_F^L\right) \\ N &: \lambda\underline{\Pi}_F^H + (1-\lambda)\underline{\Pi}_F^L. \end{aligned}$$

We obtain that making an acquihire is better than doing nothing whenever

$$\lambda\xi(\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^H) + \frac{1-\lambda}{2}(\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^L) \geq 0. \tag{B.11}$$

It is clear that condition (B.11) is satisfied for any λ and ξ if $\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^L \geq 0$ (which is sufficient for $\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^H \geq 0$). If $\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^L < 0$ but $\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^H > 0$, then condition (B.11) is satisfied provided that the product $\lambda\xi$ is high enough. Since $\bar{\Pi}_F^L - \pi_E - \underline{\Pi}_F^H > 0$ is a necessary condition for $\lambda_A < 1$ and hence for acquihires in the baseline model, this confirms that whenever acquihires are possible in the baseline model, they are also possible in this simultaneous-move model. ■

B.6 Surplus Sharing

We modify our baseline model to allow for arbitrary degrees of surplus sharing between the entrepreneur and the firm when an acquihire takes place. Thus, firms still move sequentially, but in case of an acquihire the entrepreneur receives a share $\gamma \in [0, 1]$ of the surplus. We define surplus here as the difference between the joint payoffs arising from an acquihire and the joint payoffs arising in the case of no acquihire.

Proposition B6 *Talent hoarding can happen if the following condition holds:*

$$\gamma \leq \frac{\bar{\Pi}_F^L - \underline{\Pi}_F^H - \pi_E}{\bar{\Pi}_F^H - \Pi_F - \pi_E}.$$

Proof: We solve the game backward. Consider a high-match firm 2. The surplus resulting from an acquihire is given by $\bar{\Pi}_F^H - \Pi_F - \pi_E > 0$ so that an acquihire takes place and the resulting payoffs for firm 2 and the entrepreneur read $\Pi_F + (1-\gamma)(\bar{\Pi}_F^H - \Pi_F - \pi_E)$ and $\pi_E + \gamma(\bar{\Pi}_F^H - \Pi_F - \pi_E)$, respectively. Consider a low-match firm 2. The surplus then reads $\bar{\Pi}_F^L - \Pi_F - \pi_E < 0$ so that no acquihire takes place.

Moving to period 1, consider a high-match firm 1. The surplus resulting from an acquihire reads

$$\begin{aligned}&\bar{\Pi}_F^H - (\lambda\underline{\Pi}_F^H + (1-\lambda)\Pi_F) - ((1-\lambda)\pi_E + \lambda(\pi_E + \gamma(\bar{\Pi}_F^H - \Pi_F - \pi_E)))\\ &= (\bar{\Pi}_F^H - \Pi_F - \pi_E)(1-\lambda\gamma) + \lambda(\Pi_F - \underline{\Pi}_F^H) \geq 0,\end{aligned}$$

so that an acquihire takes place. Consider a low-match firm 1. The surplus resulting from an acquihire reads

$$(\bar{\Pi}_F^H - \Pi_F - \pi_E)(1-\lambda\gamma) + \lambda(\Pi_F - \underline{\Pi}_F^H) + \bar{\Pi}_F^L - \bar{\Pi}_F^H.$$

This expression is positive (implying that an acquihire is profitable) whenever

$$\lambda \geq \lambda_{A,S} \equiv \frac{\pi_E + \Pi_F - \bar{\Pi}_F^L}{\Pi_F - \underline{\Pi}_F^H - \gamma(\bar{\Pi}_F^H - \Pi_F - \pi_E)},$$

for $\Pi_F - \underline{\Pi}_F^H - \gamma(\bar{\Pi}_F^H - \Pi_F - \pi_E) > 0$. We have $\lambda_{A,S} \leq 1$ whenever the condition stated in the proposition holds. ■