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Release and Catch: Hybrid Organizational Structures in Innovation Markets

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It is well known that large technology firms, especially those based in Silicon Valley, spawn startups founded by departing employees. Based on a unique dataset consisting of 694 technology startup acquisitions executed between 2006 and 2011, we present evidence on a previously unobserved phenomenon: large technology firms sometimes acquire startups founded by their former employees. Those transactions conform to an implicit two-step "release-and-catch" strategy that exploits the high-powered incentives of a small firm's entrepreneurial environment and the scale economies of a large firm's commercialization infrastructure, but at the risk of forfeiting the large firm's R&D and human capital investment. In step one, a firm declines to develop a promising but unproven innovation proposed by an employee, thereby pushing the employee into an entrepreneurial environment that enhances the employee's motivations, shifts risk to outside investors, and generates a "market test" of the innovation's commercial value. In step two, if the startup elicits positive market interest, the parent firm can potentially exploit its informational advantage over other bidders to acquire the startup and recover its original investment through the commercialization process. The model, and the underlying tradeoff between entrepreneurial flexibility, scale economies and knowledge protection, is extended to account for several controlled forms of release-and-catch structures executed by leading technology firms.

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Innovation is not only a technological endeavor. It is also an organizational endeavor. The success or failure of any innovation, starting with idea conception and ending with market release, depends in part on the organizational setting in which it takes place. Complex transactional obstacles must be overcome to move an innovation through the testing, production and distribution stages necessary to reach market.

Existing scholarship identifies two categories of solutions to these transactional challenges. These solutions roughly correspond to the traditional distinction, originally made by Coase (1937), between the market and the firm. First, there is the hierarchical solution represented by the firm. Here the innovator functions as an employee in a large vertically integrated firm that can supply the funds and expertise required to move an idea from conception through market release. Second, there is the entrepreneurial solution represented by the market. Here the innovator functions as an entrepreneur who forms a startup company and must obtain funds, expertise and other inputs from external sources in order to embody the technology in a product or service suitable for market release.

Each solution represents a tradeoff between scale and flexibility. If the innovator operates as an employee of an integrated firm, she enjoys the scale and cost-of-capital advantages of a large-firm environment, but suffers from the poor fit between the incentive structure of a large firm and the administrative flexibility required to support innovation. If the innovator operates as an entrepreneur, she enjoys the strong fit between the incentive structure of a startup and the flexibility required to support innovation, but suffers from the lack of scale and the higher cost of capital that characterize a small firm.

Each solution suits a different stage of the innovation and commercialization process. Flexibility takes priority in the earliest and least capital-intensive phase of technological conception and development. At this phase, the entrepreneurial solution is optimal. Scale takes priority in the later and more capital-intensive phases of testing, production and distribution. At these phases, the hierarchical solution is optimal. Given the temporal association between each institutional model and a corresponding stage of the innovation and commercialization process, technology markets have developed staged transactional models that optimize the point in time at which each of these solutions is used.

Three main models can be observed. First, a vertically integrated firm can create an autonomous division for research and development ("R&D") and support it with funding and, after the innovation is sufficiently developed, with production and distribution services. Second,

a vertically integrated firm can contract with an outside provider that supplies R&D inputs in exchange for production and distribution services. Third, a startup can contract with venture capital investors that provide the funding and expertise required to move an innovation down the development path toward a public offering or sale to a large firm. In all three cases, R&D tends to be conducted in an entrepreneurial (or, in the case of an internal R&D division, a quasi-entrepreneurial) environment, which supplies an optimal setting for innovation, while production and distribution tend to be located in an integrated environment, which supplies an optimal structure for commercialization.

We identify a fourth model that enables integrated technology firms to exploit the advantages of small- and large-firm environments at different stages of the innovation and commercialization process. It consists of a sequence we call "*release and catch*". Suppose an employee has conceived of an idea, believes the idea has positive net value, but cannot credibly validate that belief to the firm. In the first stage (*release*), the employee leaves and forms a startup to pursue her idea because the firm declines to provide the necessary funding. In the second stage (*catch*), if the startup is successful, the firm bids against other interested parties to acquire the startup. In a variant of this model (which we call "controlled" release and catch), the firm initially invests in, or purchases an option to invest in, the employee's startup and commits to invest additional amounts, or exercise the option, subject to indicators of the startup's value.

Whether the firm will make efforts to persuade the employee-innovator to develop her innovation internally depends on two competing considerations. On the one hand, if the innovator leaves, the firm will forfeit its investment in the innovator's human capital. On the other hand, by letting the innovator leave, the firm avoids the risk of project failure and exposes the innovation to a market test that will reveal its commercial value. If the startup is successful and the firm wishes to recapture it, the firm may be able to exploit its informational advantage and technological fit to outbid other interested buyers given the firm's prior relationship with the innovator.

Organization is as follows. In Part I, we provide preliminary evidence of *release and catch* transactions using a sample of acquisitions in the U.S. technology sector. In Part II, we provide an economic rationale for the *release and catch* model. In Part III, we show that the release and catch model requires that firms commit against expropriating startups founded by former employees. In Part IV, we provide qualitative evidence of a controlled form of the release and catch model used by several leading technology firms.

I. Preliminary Evidence: Release and Catch Transactions

It is well known that large technology firms spawn entrepreneurial startups in what is sometimes called the "alumni effect" (Hellman 2007; Bhide 2000; Christensen 1997). Silicon Valley incumbents such as Microsoft, Yahoo, Facebook, Google and Cisco spawn an ever-expanding network of alumni who leave their employer to found their own enterprises (Cassiman and Ueda 2006; Bhide 2000, 1994). Scholars have not previously observed that a nontrivial percentage of those startups are subsequently acquired by the firm at which one or more of the startup's founders were previously employed. That is: if successful, the departing employee sometimes returns to the *alma mater* firm to implement the later stages of the commercialization process. We call this phenomenon the "*release and catch*" model.

a. *Sample and Methodology*

We created a dataset of acquisitions of technology startups by mature technology firms. To do so, we pulled corporate acquisitions included in the SDC Platinum database that were announced between January 1, 2006 through February 28, 2011 in which the Acquiror's Macro Industry is High Technology and the Acquiror made at least ten acquisitions during the sample period.

We identified the founders and leaders of each startup at the time of the deal in two steps. First, we searched for the startup's name on Business Week's Private Company Information and, when available, examined the "Key Executives" section for names of founders or leaders.[1] Second, if the startup was not listed or was listed without naming founders or leaders, we searched for the startup's name together with the word "founder" on Google.com.

Finally, we searched for any prior relationships that the individuals we have identified had with the acquirer. First, we searched for the resume of the individual on LinkedIn.com. Second, if the individual was not listed on LinkedIn.com, we ran an Internet search for his or her resume. Third, if we did not find a resume, we ran an Internet search for the individual's name together with the name of the acquirer. In some cases, we were able to confirm or reject any prior employment or other connection between the acquirer and the target's founders or leaders; in other cases, we could neither confirm nor reject that possibility.

[1] For this purpose, "founder" or "leader" includes any individual who is listed as "founder" or holds a prominent executive or other managerial position.

b. *Findings*

The sample includes 694 startups and 39 acquirers. In 34 of the 694 deals (4.9%), we could confirm that the startup's founders or leaders were former employees of the acquirer (or a predecessor entity). In all other cases, the startup's founders or leaders either (i) had no prior connection with the acquirer or a predecessor entity (although there may have been some other kind of entity-level business relationship between the target and acquiror or predecessor entity) (79 deals or 11%) or (ii) there was no information available to support or reject any such prior employment connection. The highest number of targets bought by an acquirer is 51 (Google), the mean is 17.8 and the standard deviation is 10.8. Based on our data, the acquirers that bought the largest percentage of targets founded or led by former employees were AOL (15% of 26 deals), Cisco (13% of 38 deals), Oracle (12% of 33 deals), and Google (12% of 50 deals).

We obtained funding information on the targets in our sample from the technology database CrunchBase, from the VC and angel investor database ChubbyBrain, from the information industry mergers and acquisitions database MandAsoft, and from the company profile database Manta. Of the 694 targets in our sample, we were able to obtain funding information for 577 targets. Of the 34 targets whose founders or leaders had prior contacts with their acquirer, 8 targets (24%) received funding from a technology firm, 5 targets (15%) received funding from the acquirer (that is, a type of "corporate VC" transaction) and 3 targets (9%) received funding from another technology firm.[2]

The acquirer was in the same geographic region (state) as the startup in about 70% (56%) of parent-alumni acquisitions. In the remaining deals, the acquirer was in the same region (state) as the startup in 35% (26%) of the deals. Targets led or founded by former employees of the acquirer are also significantly more likely to be in the same state as the acquirer at the 1 percent level in a Chi-square test.

Acquirers that make more acquisitions are more likely to buy targets founded or led by former employees. Thus, acquirers in the top quintile by number of acquisitions (Google, IBM,

[2] None of the 34 targets received funding both from the acquirer and from another technology firm. Of the 464 remaining targets for which funding information was available, 73 targets (16%) received funding from a technology firm: 19 targets (4%) received funding from the acquirer and 54 targets (12%) received funding from other technology firms. There was an overlap of 5 targets between the 19 targets that received funding from the acquirer and the 54 targets that received funding from other technology firms.

Microsoft, Cisco, Oracle, EMC, and AOL) bought on average 37.6 targets, 10% of which in the aggregate were led or founded by former employees. By contrast, acquirers in the bottom quintile by number of acquisitions (Adobe, Tyler Technologies, VMware, Iron Mountain, Electronic Arts, The Active Network) bought on average 10 targets, none of which were led or founded by former employees. The Spearman correlation coefficient between the number of acquisitions and the percentage of targets led or founded by former employees is 0.4251 and it is significant at the 1% level. A possible explanation of this finding is that acquirers that buy more targets tend to be larger and thus have more former employees. Another possible explanation is that larger firms experience greater difficulty in retaining employees and therefore have a higher attrition rate and a disproportionately higher number of former employees. These firms benefit more than others from the *release and catch* model.

II. An Economic Rationale for Release and Catch

The *release and catch* model may seem like a curious course of action for a profit-maximizing firm: it involves letting go some of the firm's most innovative employees and risking forfeiture of the intellectual capital that the employee has accumulated at the firm. In this Part, we show that this model is consistent with economic rationality.[3]

A. Innovation as a Contracting Problem

The literature on the economics of innovation generally distinguishes between routine innovations and radical innovations. The former are incremental improvements in an existing technology, often involving cost-saving process innovations. The latter are major deviations from an existing technology, often resulting in significant product innovations. Scholars have widely observed that a large integrated firm faces difficulty undertaking radical innovation. There are several reasons. First, managers may resist innovations that maximize the firm's long-term profits but endanger the value of the manager's human capital (Christensen et al. 2008; National Academy of Engineering 1995). Second, managers who fear the reputational cost of

[3] We are aware of only one other contribution in the innovation context that contemplates that a firm would welcome the departure of employees with promising ideas. Hellman and Perotti (2011) contemplate that a firm's "optimal innovation policy is to empower employees to spin out ideas after establishing that no internal complementers could be found". The authors assume that in that case the firm will not assert any ownership stake in the start-up (because doing so would require an offsetting reduction in employees' compensation (see Nitzan and Pakes (1982), resulting in no net gain). Cassiman and Ueda (2002) mention in passing that a large firm may decline to fund an employee's innovation and then later consider acquiring a start-up founded by the employee, but do not develop the proposition further.

project failure avoid radical innovations, for which the risk of failure is highest and cost and revenue projections cannot readily be quantified (Christensen et al. 2008). Relatedly, managers of corporations subject to scrutiny by the public equity markets, or compensated heavily through stock options, may disfavor R&D projects that increase short-term costs without guaranteeing offsetting long-term revenue (Christensen et al. 2008). Third — and this is the focus of our inquiry — managers have difficulty designing an incentive structure that elicits maximal effort from R&D personnel.

Basic principles of institutional economics teach that a firm hierarchy is ill-suited for replicating the high-powered incentives of the market (Williamson 1975). The problem stems from three sources. First, it is costly for the firm to specify criteria for measuring an employee's R&D efforts, rewarding those efforts and accurately attributing market outcomes to those efforts. Compensating the employee with stock is ineffective unless the employee's contribution is so large that it significantly affects the stock's value, and, even in that case, stock value is an imperfect proxy for employee contribution. As a result, the employee is likely to be under-rewarded for success. Second, the firm cannot commit credibly to the employee-innovator that it will commercialize the innovation diligently, or at all, relative to other projects competing for the firm's resources. Risk-averse managers are likely to resist the most radical innovations that cannot be integrated with the firm's existing technological infrastructure. Third, even if a firm could appropriately measure and compensate innovative efforts by its employees, doing so may be frustrated by internal norms or compensation schedules that discourage large disparities in compensation (Bankman & Gilson 1998; Lerner 2012). Even more tailored pay-for-performance compensation schedules will tend to over-punish failure, and under-reward success, in high-risk innovation projects (Hellman and Thiele 2011; Manso 2011).

For these reasons, a large firm is unlikely to pursue, and provide the necessary support for, the highest-risk and most innovative projects. This proposition is consistent with evidence that large firms tend to allocate R&D resources to low-risk innovation projects that provide marginal improvements to a firm's existing technologies, rather than high-risk innovation projects that may render those technologies obsolete (Bhide 2000; Teece 1996; National Academy of Engineering 1995). Playing it safe, however, can be costly. Xerox's PARC research unit is the paradigmatic example: it originated the mouse pointing device, the local area network and the graphical user interface for computers, but did not make the commercialization efforts required to establish market leadership in these products. As a result, Xerox forfeited billions of dollars in lost opportunities.

All of the variables that disfavor risky innovation projects are reversed in the case of a small startup. The innovator (and now former employee) is fully exposed to the high-powered incentives of the market since she captures the upside in the case of success, usually through an IPO or a sale to another firm, and bears the downside (subject to the bankruptcy limitation) in the case of failure. Given the consolidation of the owner and the innovator, the monitoring and measurement problem that complicates the management of innovation within a large hierarchal firm disappears. For both reasons, the innovator invests more effort, increasing the innovation project's likelihood of success. The innovator has no specific investment in legacy technologies and therefore has little incentive to develop incremental improvements that lower the costs of producing or servicing existing technologies. The startup's only comparative advantage lies in developing technology that replaces or complements existing technology. These propositions are consistent with evidence of smaller firms' superior R&D capacities (Breitzman and Hicks 2008; CHI Research 2003) and proclivity to undertake radical innovation (Acs and Audretsch 1991).

The startup environment motivates not only the founder, but also the startup's employees. In small teams, it is less costly to monitor contributions, to attribute success to these contributions, and to award compensation based on this information. Given the firm's small size, individual employees can influence firm success and can therefore claim an appropriate share of the gains from R&D efforts (Zenger and Lazzarini 2004). Large firms cannot replicate these incentives because it is difficult to identify individual employees' contributions to firm performance (Wiggins 1995). This proposition is consistent with evidence of the lower sensitivity of pay to performance among large-firm as compared to small-firm R&D personnel (Zenger and Lazzarini 2004). Relatedly, large-firm managers describe the difficulty of encouraging creativity and large-firm employees describe the difficulty of being creative (Manso 2011).

Given the foregoing, why does not all innovation take place in startups? Because startups have a critical defect: they lack the scale and the financing capacity to efficiently implement the testing, production, and distribution functions required to bring a new technology to market. Whereas radical innovation is conducted less efficiently as firm size increases, commercialization is conducted more efficiently as firm size increases. This is for two reasons. First, a large firm can spread the fixed costs of a testing, production, and distribution infrastructure over a large pool of products and services. Second, a large firm has a lower cost of capital because it can commit to repayment given its cash reserves, collateralizable assets, and reputational capital and, as an alternative, it can self-finance. By contrast, a startup typically has

nothing to offer outside investors but difficult-to-verify claims about the value of its human capital and intellectual property (Bhide 2000). Hence, Bhide (2000) finds that early-stage startups rely on personal savings and contributions from family, friends and angel investors, who may have access to other indicators of the startup's commercial potential. In certain industries, however, these financing methods are not viable. The capital requirements of the testing and commercialization process in the pharmaceutical industry (approaching or exceeding $1 billion, according to Di Masi et al. 2003) are so high that only the largest firms can access sufficient funding. Without funding, whether accessed through the public equity markets or acquisition by a large firm, the startup cannot reach its target market.

B. Existing Solutions

The advantages and disadvantages of the integrated firm and the startup map onto the innovation and commercialization timeline as shown below.

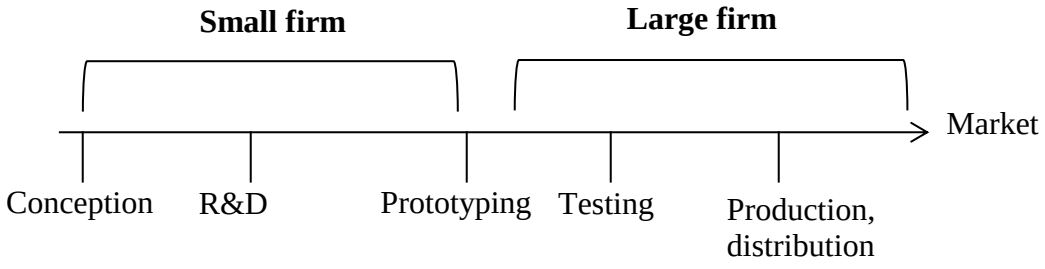

Figure 1. Comparative Firm Advantages in Innovation and Commercialization

This timeline shows how market pressures drive innovators to use small-firm structures in early stages of the innovation process and large-firm structures in later stages. This is roughly what is observed in technology markets. Specifically, four transactional structures are employed to exploit the relative advantages of small-firm environments and large-firm environments at the right time. Each structure represents an increasingly large step away from a vertically integrated model of innovation and commercialization functions and each structure strikes a different balance between the scale advantages of a large firm and the flexibility advantages of a small firm. The different "balance points" are depicted in Figure 2 and are explained in the subsequent discussion.

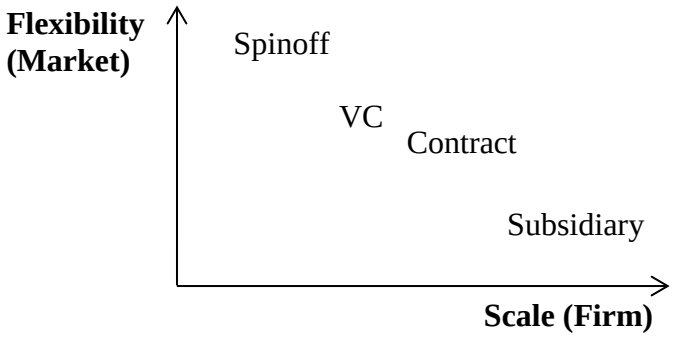

Figure 2. Structural Implementations of the Scale/Flexibility Tradeoff

1. A Subsidiary or a Division: A Lot of Scale, Little Flexibility

In this structure, the firm grants managerial autonomy to a division or a subsidiary dedicated to innovation. This is an attempt to recreate the high-powered incentives of a startup without relinquishing control over employees' human capital and know-how. Hence, this structure would be expected to fully exploit the integrated firm's scale advantages and only partially replicate the flexibility advantages of a small firm.

2. Contract: Trading Flexibility for Scale

In this structure, an R&D-specialist startup contracts with a large integrated firm that has capacities in testing, production and distribution. This structure is typical in the biotechnology industry, where small specialist research firms contract with large integrated pharmaceutical firms, which supply testing, production and distribution services (Pisano et al. 1988). In certain segments of the semiconductor industry, small firms that specialize in designing chips contract with large manufacturing facilities in order to carry out the production function (Hall and Ziedonis 2001). In both markets, contractual agreements exploit the small firm's competency in R&D and the large firm's advantages in testing, production and distribution.

3. Venture Capital: Contracting for Scale

In this structure, a startup firm obtains funding from VC investors to fund delivery of a product to market or movement of a project further along the commercialization timeline. In a variant on this structure, large technology firms operate VC units that invest in promising technologies being developed by start-ups and other small firms. Under either variant of VC

funding, the ultimate objective is a sale of the company to a large firm or an initial public offering that provides the company with funds to mature into an integrated firm. This structure preserves the small size of the startup, thereby exploiting its flexibility advantages, and obtains funding to replicate some of the scale and cost-of-capital advantages of a large firm.

4. Spinoff: A Lot of Flexibility, Little Scale

In this structure, the firm divests itself of any controlling interest in a unit dedicated to innovation, which then operates as an independent start-up entity. This structure replicates both the cultural and ownership characteristics of a startup but, since the unit in which innovation takes place is removed from the firm's organizational umbrella, the unit loses access to the firm's scale and cost-of-capital advantages. The firm also loses control over its previous investment in the employees' human capital and know-how.[4]

C. The Release and Catch Model

Existing solutions to the transactional challenges of innovation management tend to address the problem of maintaining flexibility, while paying less attention to the problem of capturing the efficiency effects of scale (or assume that the innovation can be developed, produced and distributed with low capital investment). This is a nontrivial issue. In capital-intensive technology markets, the information asymmetries that give rise to the imperfections of external financing markets (Stein 1997), which are exacerbated in the innovation context (Lerner 2007), make the absence of scale and cost-of-capital efficiencies a serious obstacle to moving down the innovation and commercialization timeline. Both the academic literature and the trade literature discuss extensively the so-called "valley of death", that is, the failure of many promising startups due to the inability to attract sufficient financing to carry out the commercialization process.

In this Part, we explain how the *release and catch* model addresses the tradeoff between scale and flexibility. To do so, we identify in a stylized form the core features of the *release and catch* model.

[4] The latter characteristic will not always be the case. In variations on this structure that fall under the rubric of corporate VC, the firm retains an ownership interest in the spinoff.

1. Setting

Assume a firm and an innovative employee. The firm has invested in developing the employee's human capital. The employee has no personal wealth. The employee would like to invest her human capital by developing a new technology that she has conceived. The project requires funding to move forward and the employee believes the project has a positive net present value. There is no contract obligating the employee to remain at the firm or to develop the technology as an employee of the firm.[5]

2. The Innovator-Employee's Choice

After conceiving the idea, the employee must elect between two options to finance its development and commercialization.

(i) *Employment Option:* The employee stays in the firm and enters into an innovation and commercialization contract with the firm. The contract allocates to the firm all of the losses and a portion of the gains associated with the project.

(ii) *Entrepreneurial Option:* The employee leaves the firm and seeks capital from outside investors to fund a startup.

This choice presents the following tradeoff. The employment option provides the employee with access to the firm's capital, knowledge, infrastructure, and scale advantages. The firm will bear the costs and enable the project to move forward along the commercialization timeline. But the employment option exposes the employee to three disadvantages: (i) it requires forfeiting a good deal of the upside to the firm in return for being insured against failure; (ii) it requires that the employee operate under the bureaucratic constraints of a large organization; and (iii) it exposes the employee to potential holdup by the firm, which will be in a position to renegotiate the terms of the innovation contract to its advantage once the employee has made a sunk investment in the project.

[5] It may be more realistic to assume that (i) there is a contract or other implicit legal requirement constraining the employees' use of the new technology but (ii) the enforceability of the contract or legal requirement is uncertain. As we discuss later, this describes, at least in some jurisdictions, the practical effect of applicable law.

The entrepreneurial option eliminates exposure to potential holdup by the firm, eliminates the negotiation costs associated with entering into a contract with the firm, and enables the employee to enjoy a portion of the upside and manage the project free from the bureaucratic constraints of the firm. However, the entrepreneurial option raises the cost of capital given the adverse selection and moral hazard that afflict external funding of R&D (Lerner 2007). Moreover, it is not certain that the entrepreneurial option will avoid the pitfalls of the employment option: (i) depending on the terms agreed upon with outside investors, the entrepreneurial option exposes the startup to the risk of failure and requires the employee to forfeit a portion of the upside to outside investors; (ii) the need to seek funding from outside investors reintroduces negotiation and other transaction costs; and (iii) given the costs of contract enforcement and judicial error, the entrepreneurial option exposes the startup to potential holdup by outside investors.

3. The Firm's Choice

After conceiving of the idea, the employee elects whether to offer to develop the project in the firm or to leave and develop the project in a startup.[6] If the employee offers to develop the project in the firm, the firm can respond either by negotiating the terms of project development with the employee or by rejecting the offer. If the employee announces her departure, the firm can respond either by offering terms to the employee for developing the project in the firm or by doing nothing. This decision path is depicted below.

[6] In conversations with participants in the high technology industry, we have sometimes encountered skepticism that an employee would offer the firm an opportunity to fund the project. This skepticism may apply to certain but not other industries. While there is evidence of "involuntary spinoffs" in industries such as the disk drive (Chesbrough 1999) and laser industries (Klepper and Sleeper 2000), there are multiple examples of (i) "tacitly voluntary" spinoffs in which innovator-employees offered valuable technologies to their employers, which refused the offer, erroneously in hindsight (Klepper (2001), Cassiman and Ueda (2006), Garvin (1985)), and (ii) "explicitly voluntary" spinoffs in which the parent corporation declined the offer but purchased an equity stake in the departing employees' startup (Chesbrough 2003, discussing Xerox). Subsequently, we describe formalized internal corporate venture programs that provide a process by which personnel can propose technologies for corporate funding. Second, as Klepper (2001, p.662) notes in a review of empirical studies on spinoffs, it appears that employees "leave firms out of frustration with not being able to get their firms to develop their ideas" and "commonly reveal their discoveries before starting their own firms". We note further that our model applies also to a case in which an employee departs without announcement. So long as the firm learns that the former employee has founded a startup to develop a new technology, the firm can offer sufficient compensation to persuade the former employee to return and develop the technology in house. A firm that fails to offer such compensation implicitly declines to invest in the project.

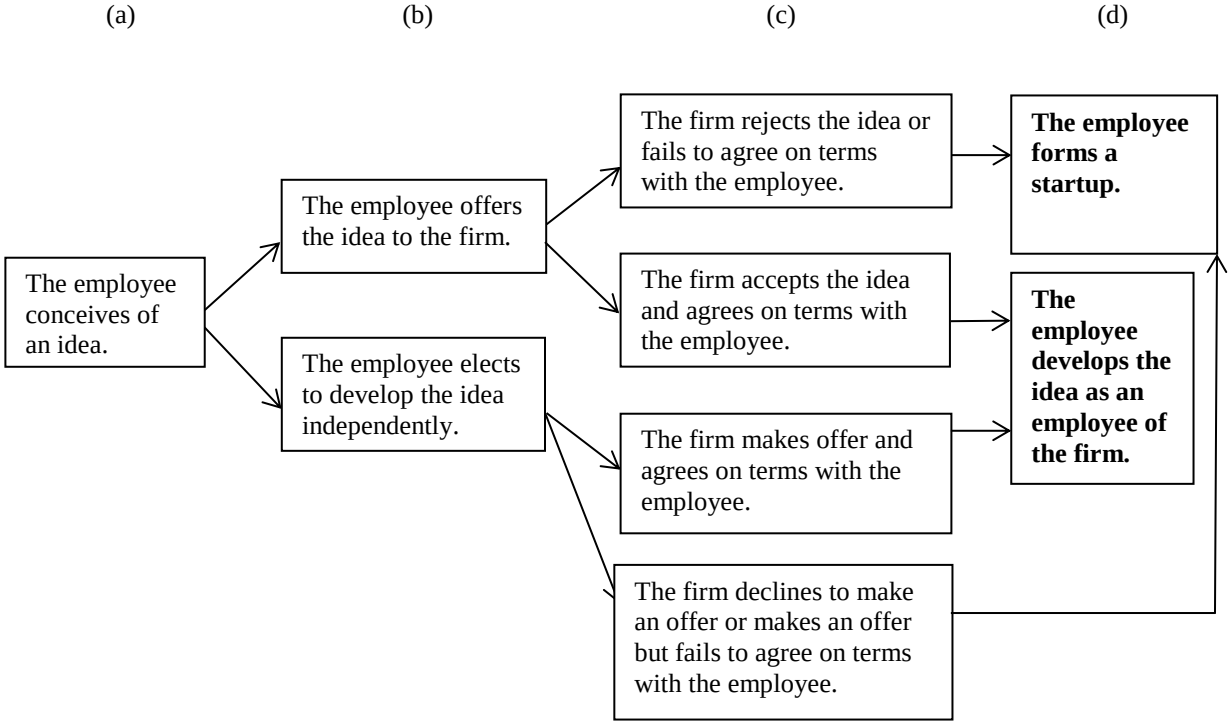

Figure 3. Firm/Employee Decision Path (Part 1)

Suppose the employee elects the employment option at node (b) and offers to negotiate with the firm an innovation and commercialization contract. At node (c), the firm elects whether to accept the employee's offer and provide the compensation and other terms that the employee requires for developing the idea in the firm.[7] Conversely, suppose the employee announces at node (b) that she is electing the entrepreneurial option. At node (c), the firm must decide whether

[7] For this purpose, we assume that a combination of legal, technological or reputational constraints precludes the firm from fully replicating (and expropriating) the employee's idea following disclosure. Specifically, these constraints would exist if: (i) the idea is protected by a patent; (ii) the employee has not disclosed sufficient information to the firm in order to enable it to replicate the idea; or (iii) reputational considerations constrain the firm from expropriating the idea without compensating the innovator. If none of these conditions are satisfied, Arrow's information paradox would apply: the firm would never pay anything for the idea once it had been disclosed and, by anticipation, the employee would never submit the idea for consideration (Arrow 1962). As a result, the innovator would either (i) elect not to develop the idea, or (ii) leave the firm and develop the idea independently. Alternatively, we could assume, as suggested by Anton & Yao (1995), that the firm would still pay a positive value for an unprotected idea in order to prevent either the employee from developing the idea independently or from disclosing the idea to a third-party competitor. In that case, the firm would pay for the ability to secure the difference between monopoly profits (less some portion paid to the employee-innovator) and duopoly profits. Following this framework, an employee is more likely to elect to disclose his or her innovation to the employer in cases where commercialization is executed most efficiently by using the production, distribution or other capacities of the employer.

to offer the employee sufficiently attractive terms in order to persuade her to switch to the employment route and develop the idea in the firm.

For the firm, these choices present the following tradeoff. If the firm induces the employee to stay and develop the idea internally, the firm prevents any knowledge leakage to competitors and captures the entire value of its investment in the employee's human capital. But these benefits come at a price. The firm must bear the costs and the risks associated with the project, and the employee's performance incentives will be reduced in a large firm environment in which the employee is exposed to bureaucratic constraints and holdup risk. If the firm declines to make an offer to retain the employee, it bears none of the costs and risks associated with the project. But this protection also comes at a price: the firm may forfeit its investment in the employee's human capital, as well as any upside on the project.

4. A Hybrid Structure: Release and Catch

a. Ex Post Analysis: Catch?

We can now appreciate the novelty of the "*release and catch*" model. Note that the firm's options at node (c) are reduced to two possible actions: (i) *release*, which corresponds either to an explicit rejection of the employee's offer to develop the idea internally or to an implicit rejection by failing to offer sufficiently attractive terms; and (ii) *catch*, which corresponds either to an explicit acceptance of the employee's offer to develop the idea internally or to an implicit acceptance by offering sufficiently attractive terms. There is a tradeoff between these options. *Release* spares the firm the costs of development and the risks of failure but exposes the firm to the loss of its investment in the employee and any upside on the employee's project. *Catch* spares the firm the loss of its investment in the employee and allows the firm to enjoy any upside on the employee's project, but exposes the firm to the costs of development and risks of failure.

The two options correspond to the standard innovation environments: (i) hierarchical innovation inside a large, internally financed firm (equivalent to *catch*); and (ii) entrepreneurial innovation in a small, externally financed firm (equivalent to *release*). We identify a third option that attenuates the tradeoff between these environments: *release and catch*.

It comprises two steps. Suppose the firm believes the employee is likely to succeed at a certain likelihood. In Step 1, the firm declines to make an offer to retain the employee. The

employee then forms a startup and seeks outside funding. If the project does not yield a commercially viable product, the firm incurs no cost. If the project yields a commercially viable product, the firm can bid for the startup against other potential buyers. To prevail, the firm must offer the employee a premium relative to the amount the firm would have paid had it initially funded the employee's innovation and borne the risk of failure. The premium compensates the employee and her outside investors for bearing this risk.

If the employee forms a startup to develop her idea, we can complete the decision path as follows.

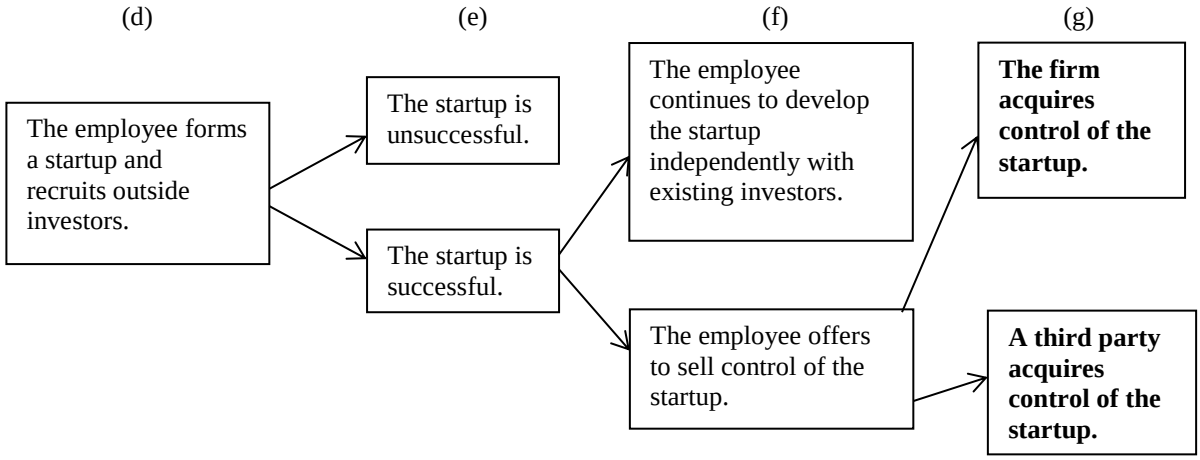

Figure 4. Firm/Employee Decision Path (Part 2)

b. Ex Ante Analysis: Catch or Release and Catch?

The possibility of recapturing the startup after the employee's departure expands the options available to the firm when it decides at node (c) whether to make an offer to retain the employee and develop the project internally. Once the employee indicates that she is leaving or leaves the firm to develop a new technology, the firm elects between *catch* (make an offer) and *release and catch* (let the employee leave, while retaining the option to make an offer once more information is available about the technology's value).

The hybrid structure of *release and catch* has advantages and disadvantages relative to the other two structures. Relative to *catch*, the firm avoids the cost of financing the project and bearing the risk of failure but exposes the firm to the risk of paying a high price for the target or losing to another bidder if the project is a success. Relative to *release*, the hybrid structure

enables the firm to limit knowledge leakage by reacquiring the technology from the employee at the market price.

The firm will select among these options so as to balance between (i) avoiding knowledge leakage and capturing upside value, which favor *catch,* and (ii) protecting against project failure, which favors *release and catch.* The optimal balance will depend largely on the expected costs of development and the expected value of the technology. If the firm assigns a high value to the employee's technology and the expected development costs are not high, knowledge leakage concerns will predominate and recommend *catch*; conversely, if the value of the employee's technology is dubious and the expected development costs are high, downside risk concerns will predominate and recommend *release and catch.*

But there are two important virtues to *release and catch* that may warrant adopting this course of action even in the case of high expected-value technologies. First, the likelihood of project success increases when the employee develops the technology in a startup environment, free from the bureaucratic constraints of an integrated firm. Second, the open bidding to acquire the startup reveals the market value of the employee's technology. Hence, while the firm must compensate the employee for bearing the risk of failure when it acquires the startup after the project is successful, both parties avoid the difficulty of agreeing on a price before the project begins.

Moreover, if the employee's startup is successful, the firm will likely have an advantage over other interested buyers in the bidding process. This is for several reasons. First, the firm is more familiar with the former employee and with the startup's technology, which likely builds on knowledge obtained while working at the firm (Chesbrough 2003). This familiarity is valuable: press coverage reports of some release-and-catch transactions identify the primary motivation as being access to the target's personnel, rather than the target's technology.[8] Second, the former employee's technology may be complementary to the firm's technology—a common theme discussed in press coverage of release-and-catch transactions. This was the case in Google's acquisition of the social search service, Aardvark (founded by a former Google employee), which enhances Google's search capacities (Arrington 2010). Third, the former employee is more

[8] An online industry commentator describes several release-and-catch transactions included in our data sample as "acqui-hires" (a Silicon Valley term describing acquisitions made primarily for the purpose of hiring the target's personnel). See Jay Yarow, Google's Huge Acquisition Spree Continues!, Business Insider, May 23, 2010, http://www.businessinsider.com/googles-acquisitions-2010-3?op=1#!J5IQE.

familiar with the firm and may have more trust in its managers, which can be particularly important if the former employee will continue working on the project after selling it. This too is consistent with online commentary of some release-and-catch transactions.[9] All these informational advantages put the firm in a position to outbid other firms and re-capture its initial investment in the startup's personnel and technology.[10]

III. Credible Commitment Against Legal Expropriation of Alumni Startups

The *release and catch* model confers two advantages on the firm. First, a firm may be better off having an innovative employee leave to develop an idea unsuited to in-house development, which the firm may potentially be able to acquire by exploiting its informational advantage over other bidders. Second, a firm may be better off to the extent that it can recruit the most innovative talent by offering the prospect that the employee will have the subsequent opportunity to leave the firm to develop an innovation in a startup.[11]

To enjoy the advantages of a *release-and-catch* strategy, a firm must credibly represent to actual and potential employees that, in the event an employee leaves the firm and founds a successful startup, the firm will not take legal action to expropriate the startup's innovation. There are multiple legal grounds on which a firm could take such action, exposing an alum to a range of nontrivial costs, including legal fees, monetary damages and loss of the underlying technology and start-up enterprise. The firm might claim that the ex-employee's technology misappropriates the firm's trade secrets, infringes upon a patent or other intellectual property held by the firm, or breaches an invention assignment contract, non-disclosure agreement, non-competition agreement or other contract between the employee and the firm. Even if the employee obtains a patent on its improvement on the firm's knowledge base, the firm could

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[9] This is illustrated by a statement made by a former Google employee, who founded a startup that was then acquired by Google: "I'm thrilled to announce that Google has acquired reMail! . . . Google is where my obsession with email started . . . I'm thrilled to be coming back to a place with so many familiar places" (Gabor Cselle, Feb. 17, 2010, http://blog.gaborcselle.com/2010/02/remail-acquired-by-google.html).

[10] For evidence that corporate VC entities pay a premium relative to other bidders, see Gompers and Lerner (1998). Bankman & Gilson (1998, pp.296-97) similarly observe that an employer has an informational advantage over outside investors with respect to evaluating an employee's idea.

[11] Nitzan and Pakes (1982) show that a firm may tolerate the mobility of its R&D personnel if doing so enables the firm to pay that personnel a lower wage, reflecting the ability of personnel to subsequently extract value using R&D that such personnel develops while employed by the firm.

contest the validity of the patent or, under the "shop right" doctrine, use the patented technology under an implied license.

Without a credible commitment by the employer against taking these legal actions, the firm's employees will rationally decline to leave the firm (or be discouraged to do so) and, by anticipation, will rationally decline to invest effort in developing new ideas that could be converted into the basis for a startup. By anticipation, any *potential* employees of the firm—and, in particular, the most innovative candidates—will choose to take up employment with other firms that are able to make a credible commitment against post-employment expropriation. Both in the short term and the long term, the firm will be deprived of the economic benefits available under a *release-and-catch* strategy. Hence, an employer's self-interest motivates it to commit ex ante against taking legal actions to expropriate value from successful alumni startups ex post.

Credible commitments can be made through three methods: (i) posting a reputational bond that would be forfeited in the event the committing party engaged in expropriation; (ii) posting a monetary bond that would be forfeited in the event the committing party engaged in expropriation; or (iii) posting a legal bond that would result in collectible monetary damages in the event the committing party engaged in expropriation.

Generally speaking, it must be the case that large technology firms often refrain from pursuing misappropriation claims by former employees, for the simple reason that start-up founders often report that they developed ideas to which they had been exposed at a former employer (Bhide 1994).[12] Similarly, there is evidence that spinoffs founded by departing employees account for a disproportionate share of total startup revenues in the semiconductor industry in Silicon Valley (Franco and Filson 2000). The semiconductor industry in particular has a tradition of tolerating employee mobility even among competitors (Braun and MacDonald 1978, p. 135). Other evidence indicates that large firms in Silicon Valley cultivate a reputation for not pursuing former employees who use ideas developed before their departure (Hyde 2003, p. 31). Apparently responding to those reputational pressures, a large technology firm reportedly abandoned a policy of aggressively litigating intellectual property against former employees due to adverse effects on employee recruitment (Gompers & Lerner 1998).

[12] Bhide (1994) reported that 71% of a sample of interviewed founders (of 100 of the 1989 Inc. magazine's 500 fastest growing private companies) stated that they had replicated or modified an idea the founder had encountered through a former employer. It is possible that some percentage of these cases involved a licensing agreement with the former employer.

We are unaware of contractual commitments by technology firms not to pursue a departing employee for founding a startup using ideas developed at the firm. To the contrary: employees of technology firms usually operate under a combination of confidentiality agreements, pre-invention assignment agreements, and noncompetition agreements.[13] Drafting and cognitive constraints probably explain why firms do not waive post-employment legal action against former employees. It may be hard to anticipate or define what would be deemed to be "reasonable" uses of a firm's proprietary information, which the firm would rationally tolerate following a *release and catch* model, and "unreasonable" uses that the firm would not rationally tolerate. Requiring that employees enter into invention assignment and non-competition agreements as a matter of course provides the firm with the *option* to bring legal action against a former employee in the case of "unreasonable" uses of firm information.

So long as an employer maintains the option to pursue legal action against an alumni startup, any employee-inventor is exposed to some threat that the firm will make opportunistic use of these legal instruments. Managerial mistakes or opportunism, or a one-time opportunity to expropriate a particularly valuable follow-on technology, may lead a firm to deviate from a historical policy of self-restraint toward its alumni. Those concerns have some reasonable grounds. There are several recent cases in which major technology companies have sought to enforce noncompete covenants against, or prevent the use of trade secrets by, former employees.[14] Given that fact, firms that seek to pursue a release and catch strategy may have difficulty credibly committing to that strategy, in which case firms will be discouraged from either commencing employment at the firm (due to reduced anticipated post-employment earnings) or departing the firm to develop an innovation and expose it to external market testing.

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[13] Interview with senior director of strategy and business at the international division of a major technology firm, April 30, 2013.

[14] *See, e.g.,* Microsoft v. Miszewski (King Cty., Wash., Superior Court No. 11-2-04589-7 SEA, Feb. 2011) (seeking order to prevent general manager from taking position at SalesForce.com in alleged violation of confidentiality and non-compete agreements); IBM Corp. v. Papermaster , 08 Civ. 9078, 2008 WL 4974508 (S.D.N.Y. Nov. 21, 2008) (seeking order to prevent engineer from taking position at Apple in alleged violation of noncompete agreement and on grounds of inevitable disclosure of trade secrets); Zynga Inc. v. Patmore (Case No. CGC-12-525099 Super. Ct. Cal. 2012) (seeking order to prevent use of proprietary business data by former employee in new position at competitor); Groupon, Inc. v. Hanna et al. (Case No. 11 CH 36731, Cir. Ct. Cook Cnty. Ill., Oct. 2011) (seeking order to prevent use by former employee of proprietary lists and other information in new position at Google); Amazon.com Inc. v. Powers, 34 I.E.R. Cas. (BNA) 1878, 2012 WL 6726538 (W.D. Wash., 2012) (seeking order to prevent executive from taking position at Google in alleged violation of noncompete agreement and severance agreement).

The law may enhance a firm's ability to make a more credible commitment to potential employee-inventors by limiting a firm's ability to take legal action against alumni startups. As a result, the employee is motivated to develop her idea in a startup, investors are motivated to fund it, and the original employer enjoys a market test of commercial value, which would otherwise be unavailable.[15] This rationale may provide some support for three recurrent limitations on firms' ability to pursue departing employees for misappropriation and related claims. First, all state jurisdictions that do enforce non-competes under certain circumstances condition enforceability on a reasonableness test (using the parameters of geography, industry scope, and duration). Second, most state jurisdictions have not adopted the "inevitable disclosure" doctrine under trade secret law, by which a court can prevent a departing employee from working for a competitor in order to preempt use of a firm's trade secret by the employee.[16] Third, jurisdictions typically apply a reasonableness requirement in assessing whether to enforce "trailer clauses" (also known as holdover clauses) in pre-invention assignment agreements that entitle the firm to an ownership interest in an employee's innovations for a certain period after employment has ended. All these limitations have been adopted in some form by California, the home of approximately half of the target firms in our data sample that were acquired by the founder's former employer.[17]

IV. Controlled Release-and-Catch Structures

The competing considerations of flexibility, scale and knowledge forfeiture may lead firms to adopt a variation on the release-and-catch model. In a type of "corporate venture

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[15] Our argument is somewhat related to Gilson (1998), who attributed Silicon Valley's innovative success to the cross-fertilization promoted by California's refusal to enforce noncompetes, which in turn is thought to promote employee mobility. Whereas Gilson's argument rested on a collective action failure (in which no firm would find it individually rational to decline to enter into and enforce a non-compete agreement), our argument rests on the cost of contracting for a tailored non-compete that could only be exercised in "reasonable" circumstances. Limitations on enforcing non-competes discourage the opportunistic use of those instruments. Even in that case, we are not asserting that the refusal to enforce non-compete agreements is necessarily efficient. That would depend on balancing multiple offsetting factors, as analyzed in Barnett and Sichelman (2015).

[16] States in which courts have either affirmatively endorsed or not explicitly rejected the doctrine are: Arkansas; Connecticut (in conjunction with a non-compete); Delaware; Florida; Georgia; Indiana; Iowa; Kansas; Kentucky; Massachusetts; Michigan; Minnesota (in conjunction with a non-compete); New Jersey; New York; North Carolina; Ohio (in conjunction with a non-compete); Pennsylvania; Texas; Utah.

[17] California does not enforce noncompete agreements against individuals, irrespective of reasonableness (*Edwards v. Arthur Andersen LLP*, 189 P.3d 285 (Cal. 2008)), although it does enforce noncompetes in connection with the sale of a business and, under certain circumstances, for purposes of protecting a trade secret. California rejects the inevitable disclosure doctrine and limits the enforceability of trailer clauses by providing that any invention assignment agreement "shall not apply to an invention that the employee developed entirely on his or her own time without using the employer's equipment, supplies, facilities or trade secret information" (Cal. Lab. Code §2870).

capital" ("CVC") transaction, a firm may elect to limit knowledge forfeiture by funding an ex-employee's startup in exchange for equity, governance rights and potentially a right to acquire full ownership under certain conditions. In this Section, we present evidence of two forms of this controlled catch-and-release structure in technology markets. Both variations demonstrate a tradeoff. While a controlled structure provides the firm with greater security against knowledge forfeiture, it weakens the high-powered incentives and informational value of an entrepreneurial environment.

A. *Cisco Spin-Ins*

Cisco, the world leader in network routing hardware, is one of the most frequent users of release-and-catch strategies during the period for which we collected data. This finding is consistent with online commentary that describes the expectations among some engineers that Cisco may acquire an ex-employee's successful start-up.[18] Those expectations appear to rely on several landmark transactions from 1996 through 2013 in which Cisco executed a controlled form of the *release-and-catch* model. In these transactions (sometimes known in Silicon Valley as a "spin-in"), the firm encourages the employee to form a startup and simultaneously invests in the startup through an initial equity investment, an option to purchase equity in the future, or both. The goal: to capture some of the upside of the employee's development efforts and limit knowledge forfeiture without fully exposing the firm to the risk of project failure.

The extent to which this type of transaction limits knowledge forfeiture depends on the size of the firm's equity stake and any purchase options and governance rights it holds in connection with its investment. While the firm secures greater protection against knowledge leakage though its equity position and related governance rights, this comes at a price. First, the firm incurs an up-front cash expense. Second, taking an equity stake in the startup may discourage entrepreneurial activity by the founders (by limiting their potential upside) or deter other investors (by casting doubt on the startup's independence). This may impede the startup's growth and distort a market check of the firm's value. Reducing the sponsor firm's equity stake ameliorates these effects and enables the spin-in entity to simulate more closely the high-powered incentives and pricing efficiency of a market environment.

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[18] A participant in an online forum writes: "I've known folks who left Cisco on the assumption that "The mothership will buy us, and I will get my old seat back". Another writes, referring to spin-in transactions, "I know people . . . that have done the same thing at Cisco several times". Hacker News, at https://news.ycombinator.com/item?id=8348900.

1. *Ardent Communications* (1996)[19]

In 1996, Cisco required a low-cost network access technology that would strengthen its position in the LAN-based data, video and voice delivery market. A group of Cisco employees, together with a third-party entrepreneur, reportedly presented the firm with an unusual proposal. The employees and the entrepreneur proposed that they would found an independent company to build the product required by Cisco and then, if successful, sell the company back to Cisco. Cisco agreed to provide initial funding to an independent entity, known as Ardent Communications, which would be managed by the outside entrepreneur. Cisco took a minority equity stake of 32%, a VC firm purchased an 11% stake, and, as is typical in an entrepreneurial venture, the startup entity issued "cheap founders'" stock to the founders representing a 55% stake. The skewed allocation of equity interests—a departure from typical CVC investments in which the corporate sponsor takes a majority stake—provided the five-member founding team with a powerful economic incentive and increased the likelihood that Cisco would receive the product it sought. To promote employee retention among the start-up's engineering personnel, the options granted to employees vested fully only after a four-year period and would not vest upon a change of control (that is, upon the contemplated acquisition by Cisco). To execute the contemplated "spin-in", the parties implemented a put/call mechanism: (i) Cisco received a call option to purchase the outstanding equity at a predetermined strike price, and (ii) the founders received a put option to obligate Cisco to purchase the outstanding equity at the same strike price. The call option was exercisable 15 months after the initial investment (or, if earlier, the first product shipment) and the put option was exercisable once the entity had achieved a detailed set of product development milestones. At the time Cisco exercised its call option (apparently by mutual agreement prior to the exercise date), Cisco had received the product it sought and the individual founders received shares of Cisco common stock worth more than *100 times* their initial investment.[20] That level of compensation, and the associated high-powered incentive structure, would have caused adverse effects to employee morale if the "startup" had been operated as an internal division.

[19] The information in this sub-section is based on Saloner (2000). Some facts were confirmed by reviewing Cisco Systems, Inc., Form 8-K, filed June 9, 1997. For additional discussion, see Mayer and Kenney (2004).

[20] The exceptional returns were due to the fact that, as noted above, the founders were issued "cheap founders' stock" at a low share price and low implied post-money valuation.

2. *Serial Spin-Ins (2001-13)*

From 2001 through 2013, Cisco made three widely-discussed "spin-in" investments (and, according to its recently-departed CEO, is in the process of completing a fourth spin-in investment (Chambers 2015)). The three completed investments are summarized in the Table below, which includes the Ardent transaction for completeness.

Firm	Technology	Time Elapsed[21]	Initial Funding (est.)	Acquisition Price (est.)	Total Price (est.)[22]
Ardent Communications	Traffic aggregation device for data, voice and video	12 months (6/1996-6/1997)	$7.535M	$156M	$163.5M
Andiamo Systems	Fibre channel SAN switch (storage product)	3 years (4/2001-2/2004)[23]	$184M[24]	$750M[25]	$934M
Nuova Systems	Unified Computing Systems servers	2 years (2006-08)	$70M[26]	$678M[27]	$748M
Insieme Networks	Nexus 9000 (software-defined networking product)	19 months (4/2012-11/2013)	$135M[28]	$855M[29]	$990M

Table I: Cisco's Spin-In Deals (Disclosed)

[21] This refers to time elapsed from the date on which Cisco initially provided funding to the startup, until the date on which Cisco acquired the remaining equity interests in the startup, even if Cisco did not pay the acquisition price in full at that time.

[22] This refers to the sum of the initial funding amounts plus the acquisition price.

[23] Cisco agreed to acquire the remaining equity interests in Andiamo in 2002 (Cisco Press Release 2002); however, the transaction only closed in 2004 (Bort 2014).

[24] This funding was made in two steps. In April 2001, Cisco lent $63 million in Andiamo and committed to lend a total of $84 million. Cisco's total committed lending was in the form of a promissory note convertible into 44% of the target's equity. Cisco also committed to lend Andiamo an additional $100 million prior to closing of the acquisition, at which time Cisco would pay additional compensation to acquire the remainder of outstanding target equity (Cisco Annual Report 2002).

[25] Cisco Annual Report 2004.

[26] Cisco invested $70 million in August 2006 for an 80% stake in Nuova. In April 2007, it agreed to increase its funding commitment and the maximum potential payout to $678M (Cisco Press Release 2008).

[27] This figure represents the maximum acquisition price that could have been paid by Cisco, contingent upon the acquired company meeting certain performance targets (Cisco Annual Report 2012).

[28] Cisco invested $100 million in April 2012 and agreed to fund an additional $35 million, subject to satisfaction of certain conditions (Cisco Press Release 2013, Cisco Annual Report 2012, 2013).

[29] This figure represents the maximum acquisition price that could be paid by Cisco, contingent upon the acquired company meeting certain performance targets (Cisco Annual Report 2014).

The three most recent spin-in investments have the same three components. First, a valuable employee (or group of employees) departed from Cisco to found a startup while Cisco agreed to provide initial funding and certain support services.[30] Second, Cisco had a call option to acquire the remaining equity interest in the startup and the startup's founders had a put option to sell their equity interest back to Cisco, after a certain period and subject to the achievement of certain technology and other milestones.[31] Third, unlike the Ardent transaction, the exercise price of each option is a moving variable determined based on an objective measure (sales revenues during a certain period), subject to a cap (Cisco Press Release 2002; Cisco Annual Report 2002; Cisco 2008; Cisco 2013)).[32] In each case, Cisco exercised the call option and acquired the remaining equity interests held by the startup's employees. Each transaction involved the same group of lead founders (together, in each case, with hundreds of other start-up employees, who appear to have consisted of a mix of ex-Cisco and "outside" employees (Files 2002)).[33]

In this structure, the sponsoring firm avoids knowledge forfeiture risk but must assume the potential obligation to purchase the former employee's startup, provided the startup achieves a certain performance or completion standard, and, in the case of a put option, the startup has no better offer from a third-party bidder.[34] This structure is viable due to the availability of a reliable measure of firm value. When there is no reliable valuation metric available, a sponsoring firm may prefer a "pure" release-and-catch model, in which open bidding is required to reveal the startup's market value.

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[30] In the Andiamo transaction, Cisco provided the startup with office space on its campus and acted as the exclusive manufacturer and distributor of Andiamo products (Cisco Annual Report 2002; Lord et al. 2005).

[31] Both the Andiamo and the Insieme transactions included a put and call option, in which Cisco had a call right and the startup had a put right exercisable under certain conditions (Cisco Annual Reports 2002, 2004, 2012, 2013).

[32] In the case of Andiamo, the ultimate purchase price was determined based on sales of Andiamo products by Cisco during the 3-month period preceding the closing date, multiplied by an agreed-upon multiple and subject to a cap of $2.5 billion (Cisco Press Release 2002, Cisco Form 8-K Aug. 20, 2002, Cisco Annual Report 2002). In the case of Nuova Systems, the ultimate purchase price was determined based on the revenue of Nuova products over three measurement periods (Cisco Press Release 2008, Cisco Annual Report 2012).

[33] The three individuals (all engineers) are: Mario Mazzola, Prem Jain, and Luca Cafiero. Some of the spin-ins involve a fourth individual, Soni Jiandini. In the Andiamo transaction, the CEO Buck Gee was reportedly a former Cisco employee (Lord et al. 2005).

[34] There also appears to be tax advantages to the sponsoring firm, as compared to investing in an entirely external start-up. Cisco reports that it treated the entire amount invested in Andiamo Systems as a R&D expense (Cisco Annual Report 2002), which is deductible for income tax purposes. In the Insieme transaction, Cisco reported that it treated the amount paid to acquire the remaining equity interests in the startup as a compensation expense (Cisco Annual Report 2013).

B. *Internal Corporate VC Structures*

The Cisco model is related to a larger and older family of internal corporate VC ("CVC") models[35] in which a large technology firm provides support to, and then sometimes later acquires, a startup. Two examples have been particularly well-documented and demonstrate how hybrid organizational forms reflect tradeoffs between market discipline, scale economies and protection of knowledge capital.

1. *Lucent New Ventures Group.*[36]

In 1997, Lucent Technologies formed its New Ventures Group ("NVG") to develop innovations conceived by Lucent researchers. NVG solicited internal proposals for technologies that could be potential candidates for development. If NVG accepted a proposal, it assigned the task of developing the innovation to a separate entity that simulated certain characteristics of a startup: (i) the managers received "cheap founders'" stock; and (ii) the NVG staged its investments in the "startup" based on the achievement of technological milestones. If the startup progressed, the NVG invited VC firms to fund the commercialization process. As of March 2001, the NVG had invested in a portfolio of 20 internal startups, of which nine had secured funding from VC firms and four had been re-acquired by Lucent. In principle, any NVG-sponsored entity could be re-acquired by Lucent, provided the internal acquisition was made at fair market value. However, as Chesbrough (2005, p. 211) observes, Lucent made limited use of the re-acquisition option. The reason reflects the tradeoff between exploiting market pricing discipline and protecting the firm's R&D investments. While a re-acquisition option advances the latter objective, it undermines the former objective. Regular re-acquisitions would discourage external bidders from incurring the diligence and negotiation expenditures that generate accurate market valuations. If the sponsoring firm wants to enjoy the high-powered incentives and valuation efficiencies of an entrepreneurial environment, it must be prepared to sell some of its best startups to third parties, including competitors.

2. *Xerox Technology Ventures.*

Xerox's internal CVC initiative, Xerox Technology Ventures ("XTV"), operated from 1988 to 1996. XTV invested in over 12 legally independent entities created to commercialize

[35] Internal corporate venturing is distinguished from "external" CVC transactions, in which the corporation invests in a stand-alone and legally independent startup. For useful overviews of CVC structures, see Chesbrough (2002); Gompers & Lerner (2002).

[36] This discussion is primarily based on Chesbrough (2005, Ch. 7); Chesbrough and Socolof (2000).

technologies developed within Xerox, with a range of anticipated exit outcomes, including IPOs, sale to another company, and re-purchase by Xerox (at a "market" price determined by arm's length bargaining) (Gompers and Lerner 1998; Lerner 1998).[37] The entities were formed in response to proposals submitted by Xerox employees—typically, researchers who had been unable to secure managerial approval to fund development of an idea (Lerner 1998). Compared to Lucent's NVG initiative, XTV's portfolio companies had greater independence and more closely simulated an independent startup (Chesbrough and Socolof 2000)—although not the complete independence envisioned by the pure release-and-catch structure. To achieve that objective, Xerox limited ties between the parent, XTV and the XTV startups: (i) Xerox and the XTV managers entered into agreements akin to the limited partnership agreement in a traditional VC investment; (ii) each startup was set up as an independent legal entity with its own board and officers; (iii) startup management received shares (and options) in the startup and waived any legal right to return to Xerox; and (iv) services provided by Xerox to the startup were negotiated on an arm's-length basis (Lerner 1998). At the same time, Xerox provided the startups with the scale economies and brand capital of an established incumbent, allowing the startups to use its procurement relationships, manufacturing facilities, and brand (Lerner 1998).

Pursuant to the agreement between Xerox and XTV, Xerox enjoyed a right of first refusal in connection with any disposition of a XTV portfolio company and a right to purchase XTV's interest in any XTV portfolio company at a price equal to "fair market value" plus a 5% premium (Lerner 1998). Xerox exercised this right on only one occasion (Lerner 1998). Additionally, Xerox sought to reduce its ultimate ownership stake in each portfolio startup below 50%, for the express purpose of attracting follow-on investments by VC funds (Lerner 1998; Gompers and Lerner 1998).[38] As in the case of Lucent's internal CVC initiative, Xerox's self-restraint most likely reflected an effort to avoid inhibiting valuation and bidding efforts by potential third-party acquirors. Discouraging outside bidders reduces the startup management's incentives and limits the opportunity to secure a reliable market test of the startup's value. This concern is not merely theoretical. In a study of XTV ventures and other Xerox spinoffs during roughly the same period, Chesbrough (2003) reports that Xerox spinoffs that had fewer outside directors, were managed by a Xerox-appointed CEO and sold through Xerox's sale force had lower growth rates, as compared to Xerox spinoffs without those characteristics.

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[37] Xerox executed multiple other spinoffs before, during and after this period outside the framework of the XTV program. For complete details, see Chesbrough (2003).

[38] More detailed data shows that Xerox's initial equity stake in the XTV spinoffs ranged from 30% to 90% (Chesbrough 2003); however, this does not reflect subsequent reductions in that stake once equity interests were sold to outside investors.

Conclusion

It is common to observe that technology markets are populated by a steady stream of startups founded by former employees of large incumbents. But it has not been observed that these startups are sometimes sold back to the founders' former employer. We provide preliminary evidence for this phenomenon and account for it as a mechanism by which the market reveals the value of an employee's proposed innovation, enabling the employer to shift the risk of failure to the startup and other investors and the task of valuation to the market. This *release and catch* model is risky: competitors may outbid the original employer and capture its investment in the innovator's human capital and associated knowledge assets. But keeping innovative employees in-house is risky too: it requires the firm to choose between funding the project with little reliable information or abandoning the project altogether. Additionally, we observe that technology firms sometimes use controlled forms of release-and-catch structures that limit forfeiture risk, at the price of bearing some development risk and weakening the high-powered incentives and valuation efficiencies of an entrepreneurial environment.

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