Equity Investment As A Tool for Open Innovation In The Pharmaceutical Industry

Jinpian Diao
John Felitti

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Project Supervisor: Prof. Claudia Zeisberger

INTRODUCTION:

The pharmaceutical industry is struggling with the challenge of building and maintaining a promising drug pipeline, and the pressure is rising as patents expire on existing products and the traditional R&D operational model fails to develop a plentiful next generation of products. A key challenge is the shift in innovation from familiar chemistry to novel biotechnology. In biotechnology, both empirical experience and academic research indicate that the knowledge intensity places the locus of innovation in the network of learning rather than within any single firm.[1] As a result, to access knowledge established pharmaceutical companies across the globe are increasingly engaging in Open Innovation, i.e., collaborating with other companies and research institutions to identify and generate lead molecules.

As pharmaceutical companies look for new ways to tap into innovative sources outside their organizational boundaries to access new ideas, technologies, and even talents, they are increasingly turning to Corporate Venture Capital (CVC). The generally accepted definition of CVC is direct minority equity investment made by established companies in privately-held entrepreneurial ventures. CVC relationships are inherently exploratory as they extend organizational boundary and seek to identify, and pursue external innovations via new ventures. CVC is often considered an important source of knowledge for corporate investors. However, as a relatively new phenomenon, there is not a clear view on the value that the equity investment brings to the Open Innovation collaboration.

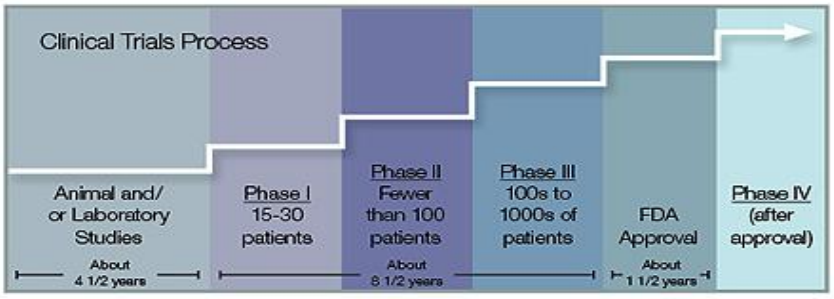
CHALLENGES OF THE PHARMACEUTICAL INDUSTRY

The investment required in research & development (R&D) is very significant in the pharmaceutical industry. Discovery and development of a new drug now takes well over a decade, and the time and cost required has been increasing as regulatory requirements increase.[2]

The innovation cycle for a pharmaceutical product consists of an initial research stage identifying potential drug candidates, and then evaluating them in vitro and in animal subjects. The research stage is followed by a pre-clinical development stage including animal pharmacology and toxicology, in which it is determined whether the investigational drug has pharmacological activity and whether it is acceptably safe to test the investigational drug on human subjects.[3] This is followed by a clinical development stage, in which the drug

candidate is tested on human subjects. As described by clinicaltrials.gov, the clinical development stage is broken into several phases:

- *Phase 1: identify the drug's most frequent and serious adverse events to determine whether the product is safe in humans; Phase I frequently provides additional data on clinical effect and metabolism.*
- *Phase 2: Studies that gather preliminary data on effectiveness (whether the drug works in people who have a certain disease or condition). For example, participants receiving the drug may be compared with similar participants receiving a different treatment, usually an inactive substance (called a placebo) or a different drug. Safety continues to be evaluated, and short-term adverse events are studied.*
- *Phase 3: Studies that gather more information about safety and effectiveness by studying different populations and different dosages and by using the drug in combination with other drugs.*
- *Phase 4: Studies occurring after FDA has approved a drug for marketing.*[4]



(graphic: The University of Texas MD Anderson Cancer Center[5])

While the true average cost of internally developing a drug (closed innovation) through marketing authorization is the subject of much debate (e.g., $802 million estimated by Joseph DiMasi[6] or $500 million to $2,000 million estimated by Adams and Brantner,[7] or $2,558 million estimated by Tufts University[8]), it is clear that the number is high. As a result, major pharma reinvest in the range of 15 to 25 percent of revenues back into R&D,[9] an amount that has ballooned from around 8% in the 1980s due to increased regulatory burdens and more costly technologies.[10] New drug approvals have not kept pace with the increased R&D spending.[11] As existing high-revenue drugs go off-patent and lose their markets to cheap generics, pharmaceutical firms have not been developing enough successor drugs to maintain their past level of sales, resulting in a drop known as the "patent cliff."[12] Given the size and

strategic nature of the investment in R&D, an improvement in its rate of return will have major implications for the firms concerned.

OPEN INNOVATION IN THE PHARMACEUTICAL INDUSTRY

Open Innovation Generally

The historical focus of corporate R&D has been on developing proprietary resources within the firm, an approach that has the advantages of clear ownership and control of the resulting technology as well as relatively easy management with all functions reporting to the same leadership. However, as described above for the pharmaceutical industry, the productivity of the internal R&D no longer appears to be meeting business objectives. In addition, as research shifts from small-molecule drugs made synthetically (chemistry) to large-molecule drugs derived from living organisms (biologics), established pharmaceutical firms do not have the internal skill sets required.[13]

A response of many industries to the perceived failings of their internal R&D organizations in terms of efficiency and effectiveness has been to shift the emphasis of their efforts from internal R&D to ideas and technologies developed outside of their corporate structures. Until relatively recently, R&D was not a favored field for intra-firm collaboration because of its strategic nature[14] did not make it an obvious subject for sharing, but R&D collaboration has gone from being a rarity in the 1970s to a frequently seen phenomenon by the 1990s. This recent emphasis on looking outside the firm has been come to be known as "Open Innovation", a term first applied by Henry Chesbrough in 2003.[15] Open Innovation recognizes that more knowledge exists outside the internal R&D organization than within it, and that this knowledge can be tapped through cooperation with other organizations such as suppliers, competitors and customers.

Attempting to internalize this knowledge (by building it or acquiring it) is neither feasible given the breadth of technology needing to be covered, nor economical given the cost of maintaining such extensive R&D resources internally. And even if scope and cost were not at issue, there is also the question of whether a large established corporation is too ponderous to innovate internally on the timelines required by the business environment. As summarized by Yoann Jaffré, head of BNP-Paribas' accelerator L'Atelier, "Open Innovation means having the humility to recognize that we are no longer capable of producing internally all of the innovation that we need."[16]

The first companies to experiment seriously with Open Innovation were in "platform based" information technology, where the firm's technology gains in value by being built on by others, e.g., application programming interfaces or telecom operator networks. The approach is now found across all industries, whether or not they benefit from a similar scalar economy. For example in France, major corporations holding themselves out as having adopted an Open Innovation model include Valéo, Renault, Groupe Seb, ST-Microelectronics, Schneider Electric, Altstom, JC Decaux (industry); Total, GDF-Suez (energy); Sanofi (healthcare); BNP-Parisbas, Crédit Agricole, Société Générale (banks); EY, Deloitte (consulting), Publicis, Ogilvy, BETC, Wunderman, TBWA (advertising); Canal+, Express-Roularta, M6, TF1, France Télévisions (media); and SNCF, La Poste, RATP (public sector).[17]

Open Innovation as Understood in the Pharma space

Open Innovation in the pharma space typically focuses on allowing the major pharmaceutical firms to avoid the risk of the earlier stages of drug discovery. Because the research and pre-clinical development stages are where there is the greatest diversity of technologies and the highest rate of failure, by partnering in drug candidates only once their potential has been validated, pharmaceutical companies can focus on a smaller number of candidates and eliminate the need to internally develop the knowledge and skills related to the candidates that were not selected for partnering. Financial analysis has revealed both that approximately 40% of the pharmaceutical industry's R&D spend occurs in the steps up through phase I of clinical development, and that even an investigational drug making it as far as Phase I only has less than 1 chance in 10 of ultimately becoming an approved medication. Based on historical data, the probability of marketing approval for a compound entering phase II increases to 15-20%, and to approximately 50% for compounds entering phase III, with about an 80% approval rate for drug applications filed after completion of phase III. These attrition rates for internally developed investigational compounds have not noticeably improved over time, despite investments in technologies meant to improve early screening and weeding out of weak candidates.[i] Therefore, since the earliest, high-attrition phases cannot be made more efficient internally through technology, the major pharmaceutical firms now seek to bypass them by partnering-in assets already in a later phase.

[i] Baum also hypothesized that part of the problem is that, even if the screening technology improves, the internal teams do not have the incentive to fire themselves by terminating an internal project with a low probability of success. Baum (2010), page 7-9.

The innovator firms are structurally suited to collaboration with the major pharmaceutical firms, as the innovators are generally smaller entities specialized in research but not in development, regulatory affairs or marketing. These innovator firms do not have currently marketed products generating cash to pay for their research. Furthermore, debt financing is difficult to obtain because there is no collateral that can be given in projects that will leave few tangible assets of value if they fail.[18]

A recent study by Deloitte identifies four models of Open Innovation in the pharmaceutical industry: (1) pure outsourcing of activities that are non-core or non-mastered; (2) licensing, which allows for control over the assets, at least within a defined scope; (3) collaboration (co-development, joint ventures and other non-sequential cooperation); and (4) open source, (shared access to data and governance across a large network of collaborators linked by similar objectives and agreed protocols). Pure outsourcing has become standard for some activities in the pharmaceutical industry, notably the phenomenon of contract research organizations or CROs. Licensing and collaboration have grown to be extremely important, even if they are still less pervasive than in other industries like electronics.[19] In practice, open sourcing remains marginal in the pharmaceutical industry[ii] because of intellectual property and liability issues as well as the need to have a clearly responsible party in the regulatory process for product development and approval.[20] It remains to be seen whether with time the industry learns to master open sourcing, but in any event for the time being Open Innovation in the industry is principally focused on outsourcing, licensing and collaboration.

Open Innovation is of course more than simply optimizing the cost of what a pharma company could have done internally by using low-cost providers and by increasing the approval rates of projects previously handled internally. It also allows the pharmaceutical majors to access inventions that they would not have been able to construct internally at all. As described above, Open Innovation allows access to a scope of technologies that would be impractical or even impossible to internalize. Compounding the problem, it has also been hypothesized that internal research has failed to deliver in part because the current industry practice of concentrating resources in a small number of centers of excellence has inadvertently reduced diversity and originality.[21] Open Innovation allows industry to side

[ii] In practice open source in pharma is used to solve specific technical questions, not to source lead molecules. For an example, see http://www.innocentive.com/.

step this self-inflicted wound, by accessing sources distant from the centers of excellence. Another important way in which Open Innovation allows results that could not be obtained internally is that Open Innovation allows the major pharmas to access the talent of persons who would never accept to work for a large bureaucratic structure and who demand financial incentive structures that would never be made available to an employee via salary but which are possible through their equity in the innovator.[22] Partnering with, rather than acquiring, the innovator also avoids the damaging exodus of qualified personnel frequently seen after a human-capital intensive business changes hands.[23]

The use of Open Innovation appears to be meeting its objective of increasing R&D effectiveness in terms of the numerical success rate of drug candidates. Based on Deloitte's study of 818 drug candidates brought into clinical development, the success rate of candidates sourced through Open Innovation (licensing or collaboration) was approximately 3 times higher than candidates originating with the registrant.[24]

Investment of Equity

R&D collaboration between firms is typically viewed as a pooling of competencies through a contract-based arrangement (such as licensing, joint development, etc) or a pooling of resources through joint ownership and control of a special purpose structure (a joint venture).[25] According to Hagedoorn, there has been a secular trend away from joint ventures towards non-equity contractual forms of R&D partnerships. He posits that this shift reflects "increased complexity of scientific and technological development, higher uncertainty surrounding R&D, increasing costs of R&D projects, and shortened innovation cycles that favor collaboration."[26] Under these conditions, the weaker ties of contractual arrangements are more attractive than locking up assets in a joint venture. This dynamic favoring "contracts" over "equity" is believed to be particularly strong in high tech industries including pharmaceuticals, because of the importance of flexibility in fast moving technological areas.[27]

Nevertheless, it is clear that in practice equity has found its way back into Open Innovation through the custom of the established firm taking minority equity positions in smaller firms. For the purposes of the analysis in this paper, by equity participation, we mean a non-controlling minority investment by the major pharmaceutical firm (the focal firm) in the innovator (the investee), and not a joint venture structure or a change of control operation.

By focusing on Open Innovation, we are by design not considering a minority stake as an alternative to a full acquisition, because we are taking as a given that the focal firm has already determined that access to a technology or product and not internalization of all of the investee's resources is its current goal.

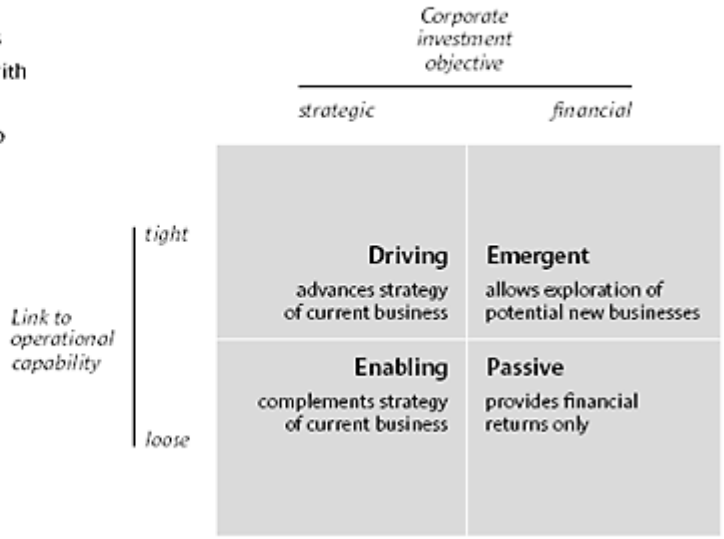
CORPORATE VENTURE CAPITAL

One of the most visible faces of equity investment in the area of Open Innovation has been through corporate venture capital (CVC). In 2014, CVC is estimated to have represented more than a third of the cash invested in U.S. early-stage biotech up from less than a fifth in 2011-2012,[28] and Silicon Valley Bank analysis sees the trend as an outsourcing phenomenon correlated to a reduction in internal R&D spend.[29] To look at this from another perspective, Atlas Ventures calculates that from 2000-2005 only about 5% of its portfolio companies had a CVC investor, but that in the 2006-2008 period this proportion had grown to one third, and then reached more than two thirds after 2009.[30]

As Chesbrough has written,[31] the objective of a CVC can be either financial or strategic. The financial objective is to generate a return through an increase in the value of the equity investment. From the perspective the financial objective, CVC is a means to make money from the focal firm's scientific and industry knowhow by placing winning bets on other firms rather than by directly developing and marketing products. Pursuit of CVC's financial objective implicitly assumes that the corporate has valuable industry insights, knowledge, and network that give it an edge over a purely financial investor such as a traditional Venture Capital (VC). Moreover, as a financial investor, CVC may also benefit from its ability to work with a longer time horizon than traditional VC. Unlike the traditional VC, CVC is not solely financial. The strategic objective in the pharma space is frequently to better understand emerging technologies without internalizing them (insight) and to get a toehold in an interesting company to ward off competitors and have a leg up in a later M&A (access). The operational relationship between the CVC and the investee can be close (for example, with access to facilities or knowhow) or distant with no links. These two pairs of choices has led Chesbrough to classify CVC investments into 4 categories: Driving, Emergent, Enabling and Passive (see below, excerpted from article).

Mapping Your Corporate VC Investments

Combining an assessment of your company's corporate objective – strategic or financial – with an analysis of the degree of linkage – tight or loose – between your operation and a start-up receiving your funding reveals the four types and purposes of corporate VC investments.



We have reviewed the websites of 16 of the largest CVCs and their pharmaceutical parent-firms[32] to see how the CVC present themselves as serving their parent company. 10 align themselves strongly with "strategic" objectives, sometimes portrayed as "driving," sometimes as "enabling" and sometimes not clearly specified. About half of these also espouse "financial" objectives.[iii] Another four depict themselves as pursuing solely "financial objectives" and three of these only "passive" objectives.[iv] The remaining two CVCs (Merck and Mitsubishi) speak only of what they bring to the investee, and not what their own objectives are. Although individually some CVCs clearly have a precise vision of their role, no clear overall pattern emerges.

The level of coordination of the CVC with the parent company was also observed, both in terms of the information on the web sites and in terms of the presence of hyperlinks from the CVC's pages to the parent company's website and from the parent company's home page to the CVC's website. The three espousing purely passive financial goals unsurprisingly have no links between the CVC and corporate websites. Of the remainder, another four (Astellas, Lilly, Novartis and Sanofi) have no links either to or from the CVC pages and appear to be entirely unconnected, despite their ostensible claims to be part of their parent company's integrated approach to innovation. Four other parent companies (AbbVie, Amgen, J&J and

[iii] "Unlike traditional venture capital firms, AbbVie Biotech Ventures characterizes an investment's success by its potential to significantly increase AbbVie's strategic growth, and not solely by its financial return."

[iv] Roche Venture Fund assures that its "focus is purely financial" and SROne goes so far as to promise a "strict firewall" with GSK.

Takeda) appear to be highly integrated with shared materials and contact points. The remainder fall somewhere in between. To the degree that these indicia of integration are significant, they point to very divergent degrees of internal coordination between traditional R&D and business development, on one hand, and CVC activities on the other.

Some in traditional VC have criticized the "strategic" objectives as not being a satisfying explanation of what CVC achieves for the corporate, because focal firms are perfectly capable of setting up an insightful scouting organization without making CVC investments and there is little evidence of CVC activity generating deals for the focal firm.[33] Furthermore, while it may be true that CVC activity helps the ecosystem, the investor does not capture this value because the focal firms in pharma do not own a proprietary platform on which the ecosystem is based. This criticism, if true, suggests that only Chesbrough's Emergent and Passive categories (financial objectives) would be a rational basis for CVC investments.

CO-EXISTENCE WITH TRADITIONAL VENTURE CAPITAL

CVC is generally complementary to traditional VC, and as described above, the two frequently co-exist on the same projects. Traditional VC is also active in the pharma space, providing a consistent investment in early-stage private biotech of around $3 billion annually over the 2011 to 2014 period.[34]

One difference between CVC and traditional VC is that the traditional VC's sole objective is to earn an attractive rate of return for its investors over an agreed investment horizon, resulting in traditional VC making more concentrated bets and being more-hands on with its portfolio companies.[35] As indicated above, a CVC investment can be successful independent of its financial return if the CVC has strategic objectives. While for traditional VC an "exit" is the end goal, for CVC cashing out is not just financial; it ends whatever relationship the equity created and may be a sign of the underlying technology's reduced strategic interest. Takeda, one of the CVCs espousing only strategic objectives, describes the differing drivers of value between it and its VC partners: "Our primary focus is on medium to longer term returns in the form of product and technology successes for our portfolio companies and capital gains for the financial institutions we work with."[36]

CVC can benefit from the discipline of its VC co-investors, who are less sentimental about strategic interests and can impose financial discipline on the question of when to stop putting fresh money into a losing investment.[37] And from its perspective, traditional VC is likely to view corporate co-investment as a positive because through any alliance or licensing portion of their involvement the corporates provide additional funding which does not dilute the existing VC positions.[38] Moreover the CVC co-investor can bring the investee credibility through brand association and a network portfolio that the traditional VC cannot offer.[39]

General Analysis: POSSIBLE ROLES OF EQUITY IN AN OPEN INNOVATION RELATIONSHIP

What logically does an equity stake bring to the table?

Firms have the ability to structure their Open Innovation projects in a number of ways, and one can therefore ask why the inclusion of an equity component has been considered desirable. To consider what equity brings, let us first consider what the typical Open Innovation deal looks like without an equity component. We will then consider what the recourse to an equity component brings to the table.[v]

The base case: without equity

Without equity, Open Innovation typically consists of the in-licensing of one or more investigational drugs. A variant of the simple in-license is a research alliance in which the innovator commits to a research program of an agreed design with an objective of proposing multiple investigational candidates, and the focal firm has the right to obtain a license ("opt in") to the fruit of the innovator's research program.

Structure: Milestones are paid for the right to develop the compound into a marketed product (typically with an upfront payment upon signing the contract, with success payments contingent on the compound making it through phase II, phase III and marketing approval) and royalties are paid on sales once it is marketed. In a research alliance, the foregoing mechanisms are applied to each opt-in product, with the addition of an upfront or periodic payment designed to fund the innovator's research.

[v] Note that this analysis of equity as a structural choice within a license or R&D alliance does not provide insight into the specific phenomenon of equity-only investment by pharma CVC, whereby stakes not accompanied by licenses/options are taken in promising research firms. Purely financial investments may be a rational use of corporate knowledge, but they are not Open Innovation.

Roles: The respective roles of the innovator and the focal firm are generally sequential and the need for cooperation is limited: the innovator delivers a promising compound and the focal firm handles all further development and marketing. There is only very rarely joint research or joint development. Marketing responsibilities are sometimes shared, for example if the innovator reserves exclusive or joint rights to certain geographies, in which case regulatory and commercial issues will require some coordination because one party's actions can impact the other party. A research alliance is not purely sequential and does require coordination, because both parties generally closely monitor the research program. Each opt-in compound, however, is sequential, as would be the case in a single product in-licensing deal.

Risks and rewards:
The risk of R&D prior to signing the deal is by definition on the innovator; if the candidate disappoints, then no deal will be signed and the focal firm has paid nothing. In a research alliance, the risk of the ongoing research has been transferred in large part to the focal firm, but even in the case of a failure to deliver, the recourse to a third party innovator ensures that the focal firm has no R&D staff or structure to redeploy or liquidate.

The risk of failing to develop a validated candidate into an approved product under the license is principally a risk for the focal firm, the size of which is essentially determined by the internal cost of the development process and any upfronts or milestones already paid out to the innovator. If the product is not ultimately approved, these are lost. The development risk for the innovator is largely an opportunity cost (*e.g.*, could a different partner have developed this with more diligence or more talent?) and the downside is greatly reduced by the upfront payment and potentially development milestones that are due even if the product is ultimately never commercialized.

When the product is commercialized, the royalty mechanism ensures that the risk of poor performance affects both parties. The sharing mechanism reduces the take for the licensor compared to an equivalent internally developed product, and is the tradeoff for the cost and risk advantages in the development phase.

Overall, financial analysis has identified an important bias in the perception of risk and rewards between focal firm on the one hand and innovator on the other hand: both parties seem to prefer that the bulk of the value transfer come from royalty payments. For the focal firm, this approach is risk averse, as there is less likelihood of paying much for a product that is not commercially successful than if it had to pay for the rights up front. For the innovator, this approach is taking a bet on big win, which may be either the reflection of an inherently optimistic outlook or the reflection of a weaker negotiating position. One indirect consequence is that the risk-adjusted investment for the focal firm is less than if it simply paid for the rights up front.[40]

The case under consideration: taking an equity stake

When the focal firm takes a minority equity stake in the innovator (the investee), the relationship is impacted in a number of ways.

Information Flow.

Equity can be a means to obtain information concerning the investee. The investee firm has a duty to provide information on its activities and finances to its shareholders. For a firm listed on a stock market, this information is publicly available, but for a privately held firm it is necessary to be a shareholder. Note that a larger holding does not give a right to additional information as a shareholder (even one share will do), but it may justify requesting one or more seats on the investee's board of directors, which will vastly increase the information available to representatives of the focal firm regarding the investee's strategy, operations, finances and relationship with other companies. This comes with a number of caveats: the director has a fiduciary duty to the investee and an obligation to keep the board materials confidential including vis-à-vis the focal firm. Where board actions of the investee concern the focal firm, the director will generally be recused and not receive the board materials. Also note that while equity can be a means to obtain information, a contractual right to information combined with a board observer (as opposed to a director) can achieve the same objectives without investing equity and without violating fiduciary duties.[vi] Even with an equity investment, the most common cause of failure of the minority equity alliance is the focal firm's failure to invest the time to create and maintain human bridges.[41]

[vi] A side question is the absorptive capacity of the focal firm to benefit from the information flow, and whether the director is the best conduit.

Control Over Decisions.

The literature seems to uniformly take as an unquestioned article of faith that minority equity ownership leads to greater control and oversight over the investee, and almost certainly overestimates the degree to which a minority equity holding can be a means to exert influence over decisions taken by the investee.

To the extent major decisions such as a corporate merger require shareholder approval, holding shares in investee gives the focal firm a seat at the table, albeit only commensurate with to its percentage shareholding. The ability of a minority equity stake to influence decision making in practice will be a function of the investee's capital structure: if it is pluralistic, the focal firm may align with several other like-minded investors to cause or to block a decision, if there is a concentrated control block then the minority position will not be particularly influential.

To the extent that the focal firm can use its investment to justify a board seat, its influence over decisions taken by the investee increases significantly. Far more issues are presented for board consideration than for a shareholder vote, and the forum lends itself better to an informed debate than a shareholder assembly meaning that even with a minority stake there is more opportunity to weigh on the decision-making outcomes. As described above under "information flow", to the extent that the focal firm is interested in the board action, the director is likely to find herself recused. The question remains whether the focal firm's objectives could not also be largely achieved with a board observer seat.

Strengthen Quality of Relationship.

Holding equity can enhance the quality of the relationship with the investee in at least two ways.

First is by better aligning the partners' financial interests. The alliance is naturally characterized by divergent incentives: the focal firm would like to appropriate the innovator's technology and the innovator would like to maintain independence; the innovator is dependent on the project succeeding quickly while the focal firm is less pressed and potentially ambivalent about investing in the technology.[42] An alliance's success can be hampered by uncertainty about the other partner's intentions to act opportunistically in the

alliance rather than pursue the agreed common interest, which discourages either partner from committing fully to the shared endeavor.[43] Through its equity investment in the innovator, the focal firm will bear part of the cost of its own opportunistic behavior and be discouraged from such behavior.

Second, the equity participation creates another point of contact between the two firms, increasing the channels of communication. The communication is even more strongly enhanced by the focal firm naming a director, the board being a source of more regular contacts on a broader range of subjects than the shareholders assembly. Nevertheless, even the board level relationship is generally an inadequate substitute for the managerial level contacts that could be achieved contractually without the equity.[44]

Financial engineering

The minority equity stake is a means for the focal firm to capture incrementally more of the value of the product under development. In the non-equity base case, the focal firm earns money from the product once approved, minus milestones and royalties paid to the innovator. An equity stake allows the focal firm to recapture indirectly its percentage share of the milestones and royalties paid to the investee, to participate in profits from sales in any territories that the investee has not licensed to the focal firm, as well as to benefit from any positive spillover effects for the investee (for example, if knowhow built through the collaboration has helped the investee to develop other projects).

Certain of these aspects could be handled contractually, such as reducing the focal firm's royalty rate in exchange for a larger lump-sum contractual payment or for a grant to the focal firm a royalty on the investee's own sales. Because they are hard to predict, define and value, the spillover effects are hard to capture contractually but can be captured through equity. Additionally, equity has specific characteristics that may make it preferable to an equivalent contract payment even from a purely financial perspective.

For the focal firm, a contract payment is an expense in the year it becomes a non-contingent obligation, and reduces the net profit reported in its accounts. An equity stake, on the other hand, is capitalized as an investment and not as an expense, meaning that it does not reduce the focal firm's net profit and allows published R&D expenditures to appear smaller. Unlike a contract payment, which is a pure sunk cost, for the equivalent amount invested in

equity, the focal firm will own an asset. As a bonus, equity is not specific to the project but rather gives the focal firm an interest in all of the investee's activities, which partially hedges the risk and provides a residual value, even if the Open Innovation project with the focal firm turns out to be a failure.

Note that there is frequently a limit to how much equity will be used, because of distortions created by accounting rules. The accounting effects will generally discourage the focal firm from taking a stake in excess of 20% of the investee's equity, as this is the level under both IFRS and US GAAP at which the accounting method typically switches from mark-to-market to the equity method.[vii]

For the investee, too, an equity investment may also have several benefits compared to an equivalent contract payment in the base case. Unlike a contract payment, which is often to fund specific research activities, the equity investment provides unrestricted general-purpose funds that the investee can apply to other research projects or to general overhead. The tax treatment is theoretically more favorable, but because the typical investee is loss making, this is not a major consideration. Additionally, granting value to the focal firm through equity allows a certain type of double counting: the incremental benefit to the focal firm is virtual, and remains in the investee's net profit and can be reinvested by the investee. When the focal firm monetizes its investment by way of sale, this does not diminish the assets or the income of the investee.[viii]

Preemption

The minority stake in the innovator taken by the focal firm can be a manner of marking territory, and may dissuade competitors of the focal firm from attempting to take over the innovator to obtain its technology and know-how.[45] Query whether the same objective could not be achieved contractually with a change of control provision rather than equity. The focal

[vii] This percentage may be lower if the focal firm has a director on the investee's board or if the R&D contract effectively gives it substantial influence over the investee, encouraging an equity stake of 10% or less if avoiding the equity method of accounting is important to the focal firm. Because the investee is typically a loss-making organization for the foreseeable future, the equity method would require the focal firm to record a loss each year. Marking to market is generally the preferred method to account for holdings in most investees, because to the extent that investees are generally not publicly traded, short of potentially needing to write off the investment at some point far in the future, the focal firm's results are not exposed to quarterly volatility.

[viii] Of course granting the equity dilutes the stakes of the other investors, who will need to view the transaction as generating sufficient value to justify the dilution.

firm's minority investment may also dissuade rivals from creating technology-sourcing relationships with the innovator, which gives a sort of soft exclusivity[46] but also constrains the financial value of the minority stake.

Downsides of Equity

Equity in a small-cap company is generally illiquid and difficult to monetize even in the easiest case where the investee's shares are publicly traded. If equity is being considered as an alternative to a contract payment, which will never be returned to the focal firm in any event, this issue of illiquidity is not prejudicial compared to the base case without equity.

A more pernicious downside of equity is that is not just a past expenditure that can be treated as a sunk cost. If the focal firm abandons the Open Innovation project, the equity must generally be written down, which provides a financial disincentive to prune losing bets from the portfolio. Even without this accounting effect, being a part owner of the project encourages continued investment in failures, particularly if focal firm employees are serving as board members of the investee.

Literature Review: WHAT DOES THEORY PREDICT?

What does Theory of Network Advantage expect?

The choice of whether or not to invest equity in an Open Innovation project can be considered under the Network Advantage framework.[47] The first-degree perspective of complementarity and compatibility is not decisive, as the complementary resource brought by the focal firm (financing) is the same under either case. To the extent that the equity investment permits a board membership, the constant exposure to investee's management may theoretically help develop compatibility but this is very speculative and exposure could be achieved by other means if it were a priority. The second-degree perspective would suggest that an equity investment is not well adapted. The appropriate portfolio model is hub-and-spoke, reflecting the sequential roles (investee discovers, focal firm develops) and the need to place a large number of small bets capable of being cut off and abandoned at low cost. This is typical of industries with dynamic technologies, as opposed to technologies that advance incrementally. The equity investment raises the costs of cutting off spokes that are not viable, and is inconsistent with the model. The third-degree perspective suggests that the

equity investment may have some signaling value to the investee[ix],[48] but does not provide a rationale for the focal firm to prefer equity. On the whole, the Network Advantage framework does not support the focal firm holding an equity stake in its Open Innovation partner.

What does Theory of Risk Management expect?

Das and Teng evaluated choices made in structuring alliances based on the risks of the alliance as perceived by each party. For Das and Teng, there are two basic risks in an alliance that partners use to evaluate the structure: (1) the risk that one or more partners do not pursue the agreed alliance goals diligently (relational risk), and (2) even if the partners cooperate well, there is the general business risk that they do not achieve the objectives of the alliance (performance risk). The project typically exits to reduce performance risk, but the existence of the project introduces relational risk. The total risk in the alliance is the sum of these two risks.

Alliances centered on R&D topics are by definition characterized by high performance risk. And this risk is considered higher in fields with fast changing technical characteristics, such as the life sciences, than in fields less exposed to rapid technological shifts like automotives or metallurgy.

Das and Teng conclude that "partner firms that perceive a high relational risk and low performance risk in a prospective alliance will prefer a minority equity alliance," and that the choice of whether or not to add an equity component to a bilateral contract-based alliance will depend on whether the risk needing to be controlled is relational or performance. This is because the control and influence given by equity allows better monitoring of relational risk, but do not allow the flexibility to quickly drop all relations if performance risk materializes. Because the authors consider that R&D intensive industries like pharmaceuticals are the typical example of high performance-risk alliances, the use of minority equity positions in the structuring of in-licensing and R&D alliance projects is counter intuitive and merits a closer look.

[ix] Through association with a high-status partner. It is noted that the market value of listed biotechs with one or more pharma equity partners is on average 25% higher than those without.

To the extent that the project exists to reduce performance risk for the focal firm, then taking equity in the partner to whom the risk has been shifted could mechanically shift part of the risk back to the focal firm. However, this is not the case where the roles are sequential because the biggest risk facing the innovator is that it turns up no innovation worth partnering in the first place. But by the time the alliance is entered into, we already know the answer to this question. The execution risk in the earlier phases has successfully been pushed to the ecosystem, irrespective of whether or not an equity interest is later taken in the winners. From this perspective, the usual argument against equity seems not to apply. The equity participation does however shift some of the risk of the focal firm's own failure to perform back onto the focal firm. In the non-equity base case, the silver lining of such a failure for the focal firm is that at least the corresponding milestone need not be paid. If one owns 20% of the milestone recipient however, the focal firm also owns part of the disappointment of not getting the milestone.

Note that these calculations are different for a research alliance, where the innovator must still perform after the contract is signed, exposing the focal firm to the relational and performance risks tied to the innovator. If the innovator's research does not lead to candidates into which the focal firm wishes to opt in, then--in addition to the loss of any contract payments that would have occurred in the non-equity base case--the value of the focal firm's minority equity share will decline proportionately to the loss in expected value. From the Risk Management perspective, then, the presence of relationship risks make the argument for equity in a research alliance stronger than in an in-licensing of identified products.

What does Theory of Transaction Cost Economics (TCE) analysis expect?

Transaction cost economics (TCE) analysis anticipates that the focal firm will choose whatever alliance structure (including the decision to invest equity or not) that minimizes the sum of transaction and production costs for the alliance. Transaction costs are costs associated with the structuring and the governance of the alliance, while the production costs are the costs tied to organizing internal resources to participate in and profit from the alliance. Transaction cost analysis suggests that non-controlling equity stakes are efficient when transaction costs would militate for internalization (uncertainty over specifying and monitoring via a contract), but there are other barriers to an acquisition.[49] This analysis focuses on an equity participation giving co-control (a joint venture) and does not appear to

be oriented to the assessment of a minority stake giving influence but not control.[x] TCE looks at equity as a solution to the moral hazard that exists in the relationship: when a partner holds equity, it is less likely to behave opportunistically.[50] This mechanism should still hold in an attenuated form for minority equity participations, where there is a long-term commitment and a financial penalty to the focal firm if the investee performs poorly. Parkh observes that the alliance is formed when both parties assess that cooperation leads to a positive outcome for each, but recognizes that after the contract is signed, one party may have a better outcome by behaving opportunistically, for which he suggests an equity investment should provide a check.[51] There may be a fundamental truth to this, and the existence of an equity stake may lead to an optimized collective outcome, but it does not answer the question of why the focal firm would choose to take a minority stake where it is essentially paying to limit its own opportunism.[52] Even if game theory suggests that the investee should prefer the minority equity alliance structure,[xi] it is not clear that the investee has the ability to force its preferences on the focal firm.

What does Theory of Resource Management expect?

Das and Teng have attempted to further generalize the transaction cost analysis into a broader resource analysis: Alliances are vehicles for the integration of the resources of more than one firm, and resource management seeks to determine how to maximize the value of the integrated resources as opposed to simply minimizing their transaction and production costs.[53] As described below, however, their work is not ultimately very helpful in guiding a focal firm faced with the question of whether to structure an alliance with an equity component.

Resource management analysis predicts that an alliance structure will be preferred to an acquisition when not all of the target company's assets are of interest to the focal firm.[54] This however does not fully answer the question of whether the alliance should contain an equity component as resource management analysis focuses on a joint venture or purely contractual

[x] TCE focuses on the difference between "market" solutions through contract and "hierarchical" solutions through ownership control. E.g., Oxley, J. E. (1997). "Appropriability Hazards and Governance in Strategic Alliances: A Transaction Cost Approach." Journal of Law, Economics and Organization 13(2): 387-409. But a minority equity stake as described herein provides little real control and it is not clear how much owning a minority stake would really change the Open Innovation project's position on the market-hierarchy continuum.

[xi] Keep in mind that outside of this game theory exercise, the investee may in fact prefer to avoid an equity investment to preserve autonomy and avoid dilution of existing holders.

structure where only rights to the interesting assets are included. A minority equity investment poses the same structural problem as an acquisition: the focal firm is paying for resources other than the target resources. In fact it is worse, because even if it is less costly than acquiring 100% of the resources, the cost of the minority equity alliance does not provide any benefits because it confers no control over the assets.

Resource management analysis in a dyadic model looks at the resources (property based or knowledge based) brought by each partner and constructs a matrix of 4 categories of alliance. The theory hypothesizes that a partner contributing knowledge (here the innovator) will be interested in granting a minority equity stake to a partner bringing property-based resources, because this will incentivize the property-bearing partner to not behave opportunistically vis-à-vis the knowledge based resources. This model, however, does not address the question of when the investing firm would find it beneficial to take a minority position, because for the same configuration it predicts that the firm bringing property rights would prefer a joint ventures structure as the ideal way to appropriate the other's knowledge.[55] The model therefore does not lead us to a Nash equilibrium in the game of optimizing the two parties' structural preferences. And as in TCE, we are left wondering why the focal firm is paying to limit its own opportunism, although resource management analysis does suggest a possible answer: to maximize the value of the integrated resources, the structure should capture for the focal firm the spillover effects in the innovator of the focal firm's investment in the project.

What does Theory of Real Options (RO) predict?

Real Option theory sees the alliance as an option contract under which the focal firm pays the innovator for the right, but not the obligation to use or acquire the innovator's assets in the future.[56] Proceeding through the optionality provided by the alliance contract as opposed to building or buying allows the focal firm and the innovator to progressively learn more about both the project value and the partner's intentions and capacity before additional investments are sunk.[57] It has been observed that Real Option theory is an appealing framework for alliance agreements, because of the optionality inherent in the contractual structure of the milestone payments and license opt-ins.[58]

RO-based models generally do not explicitly incorporate minority equity positions.[59] There are some suggestions in the literature that the minority equity stake could be considered to be an option to buy out the innovator firm,[60] but this is not very convincing. It is our view that

the minority stake is not an option to acquire the remainder, as (contrary to what is often stated in the literature[61]) it gives the focal firm no special rights to acquire the rest, just a "head start" the value of which is generally limited.[xii] The high cost of the equity stake compared to the low probability of its "exercise"[62] and the marginal value it provides upon exercise suggest that the focal firm must be paying for something other than an option.

What we can see, in any event, is that contrary to TCE, Real Option theory suggests that uncertainty typical of biotech R&D should lead to less hierarchical forms of investment, because it is more costly to abandon hierarchical investments. To the extent that a minority equity interest can be considered hierarchical in nature,[xiii] then Real Option theory does not militate in favor of a minority equity position,

Under RO, sunk costs such as the original upfront payments and other outlays should not affect the option value to the focal firm or its interest in exercising, which should be entirely based on an assessment of project value and probabilities. However, the equity stake creates a future cost to the focal firm if it does not exercise the option: the value of its equity in the innovator will suffer as a result, typically with an immediate effect on the focal firm's reported profit for the period because of either marking the investment to market or writing it down. Because RO is based on the option to defer or abandon investment in the face of uncertainty, even without needing to determine whether a minority equity investment is in fact hierarchical, we can see that making a significant irreversible investment in equity is not consistent with the RO approach.

DISCUSSION OF WHAT IS SEEN IN PRACTICE VS THEORY/CONCLUSION

The theoretical literature on alliance design does not directly address the advisability of minority investments. When we apply the principles to minority investments, they suggest inconsistent--but generally unfavorable--recommendations. For example, "Transaction Cost Economics (TCE)" and Risk Management is not averse to holding minority equity when there is perceived partner risk while "Real Option (RO)" theory and Network theory disfavor

[xii] In a non-competitive bid, an existing position does mechanically reduce the amount of overall premium required to be paid out to acquire control compared to a bidder holding no shares, but this is simply another way of saying that the minority shares might see their value go up which is a financial perspective and not an option perspective. Only in a rare competitive bid would the existing minority stake give the focal firm a special advantage or "right" as the focal firm would have an easier time getting over the hurdle.

[xiii] The hierarchical nature of a minority position is weak, given that it generally confers no control.

holding minority equity in the same circumstances because they each seek more flexibility to exit when faced with risks. Resource Management indicates that the focal firm should want a joint venture rather than a minority position, although in practice we observe that joint ventures in this field remain exceptional. It is also possible that the decision to take equity is principally financial engineering, and these theoretical frameworks which focus on alliance incentives and governance do not in fact provide relevant insights. To make sense of which, if any, of these theoretical frameworks is relevant to the question of when to take a minority equity position, it would be useful to look at the preferences for alliance structures displayed by firms in practice.

We should note that the decision to use equity as a tool in Open Innovation has not been adopted uniformly. For example, in the French telecoms sector, the most established operators Orange, SFR and Bouygues Télécom have each set up incubators accompanied by a venture capital fund, while the principal disruptive player Free has not felt the need to play the role of start up investor.[63] A famous case bucking the trend in the biotech field is Biogen Idec. In 2012, after 8 years of operation and investments into several successful biotech start-ups, Biogen Idec shut down its venture investment and start-up incubator efforts.[64] The management of Biogen Idec argued that they could access new ideas and technology through the research and personal connections of internal staff as all top Biogen executives are intimately connected to the scientific and VC communities. Moreover, they saw that the equity investment does not necessarily bring advantages during deal negotiation. Even among large pharmaceutical companies with established CVC functions like Eli Lilly, there appears constant debates of the added value of corporate venture investments beyond the core R&D and business development activities.[65]

Anecdotal Evidence

To begin to evaluate how practice compares to what theory would suggest, we start by looking anecdotally at one focal firm, Sanofi. Of Sanofi's pipeline of drugs and vaccines in clinical development (phases I to III), 49% are the fruit of external innovation.[xiv] We note that the proportion is progressively higher in the later phases, potentially reflecting a better success rate for externally-sourced projects. In Phase III, this concerns 8 out of 12

[xiv] Only targeted acquisitions were deemed "Open Innovation". The percentage would be over 80% if research in progress acquired through the Genzyme and Aventis acquisitions were included in this calculation. Calculations are based on pipeline disclosed in Sanofi's half year 2015 financial report; partnering verified on http://www.biocentury.com.

candidates; in Phase II this concerns 5 out of 12 candidates; in Phase I this concerns 6 out of 15 candidates. Of the 8 externally-innovated phase III candidates, rights to 2 were sourced through targeted M&A, rights to 2 were sourced through non-equity licensing, and rights to 4 were sourced through equity research alliances. Of the 5 externally-innovated phase II candidates, rights to 2 were sourced through non-equity in-licensing and rights to 3 were sourced through equity research alliances. Of the 6 externally-innovated phase I candidates, 4 were sourced through non-equity in-licensing and 2 were sourced through equity research alliances.

Sanofi has minority investments in 3 companies that have contributed products in clinical development: Regeneron (23% of capital), Alnylam (12% of capital), MyoKardia (15% of capital). All three are multi-product R&D alliances during which the investees are to propose a series of pre-phase I candidates to Sanofi, who may chose to opt-in to a license for development and marketing. Regeneron and Alnylam have maintained the right to market or co-market the products in a certain territories, and Sanofi's voting rights in these two companies have been essentially contracted out of existence. None of these 3 companies had projects in clinical development with Sanofi when the investment was made. Sanofi has additional minority investments in 8 other publicly traded innovator firms who have not (yet) contributed a product to Sanofi's clinical development pipeline, only half of which are still in active collaborations. Sanofi also has 2 CVC structures with an endowment of $100 million to invest in non public companies. In the last year, Sanofi divested 3 holdings in publicly traded companies that were acquired as part of failed alliances. There have been no sales of shares in successful innovators identified in the last decade, other than the passive sales of Millenium and Transkaryotic Therapies shares as part of their changes of control.

What can be seen anecdotally in Sanofi is that the minority equity investments are not made when the tie between the focal firm and the innovator involves a single, identifiable product. Consistent with Risk Management Theory, they are made when the innovator has a technological approach (or platform), which is meant to contribute multiple candidates for clinical development in the future. Consistent with the financial engineering approach and Resource Management Theory, the minority equity investment allows Sanofi to benefit from the spillover effects that the upfront and the later investment in Sanofi opt-in candidates will have for the innovator firm's non-Sanofi projects. It also allows Sanofi to capture the benefit

of sales of the licensed product not made by Sanofi under the license. Nothing has been observed anecdotally in support of or in contradiction with RO and TCE Theory.

Survey Work:

Anecdotal evidence is useful, but by definition limited to the specific cases observed, and it is difficult to deduce universal principles. Research into the practices of a large number of pharmaceutical companies would permit to draw broader conclusions. In addition to a statistical analysis of structures actually implemented, a survey would also allow us to obtain an indication of the firms' preferences and reasoning regarding the adoption of certain structural choices. This is important because equity's capacity in theory to achieve certain objectives in an alliance can in specific implementation be either undone or replaced by contract clauses in the alliance agreement.[66] For example, in the Regeneron and Alnylam examples, above, severe restrictions on voting rights removes much of the "control" and "relationship" value of the equity, and leaves it with principally a financial function. The presence and meaning of such a contractual adjustment to the theoretical role of equity would not be captured in a pure statistical exercise looking at percentage of ownership, and would require subjective explanation by the actors, with the motives of the focal firm and the innovator likely being quite different.

A limited amount of existing survey work has been identified in the realm of alliance structure in the pharmaceutical industry, but we have found none relevant to the questions posed in this paper. Carolina Billitteri and her co-authors investigated the Italian environment.[67] However, although some of the work referred to in their literature review raised the issue of minority equity investment (distinct from Joint Ventures and M&A), their hypotheses were constructed around the classic hierarchical-market dichotomy and the survey they conducted modeled equity in the three-way variable: license vs. non-equity R&D alliance vs. JV/M&A. This simplification may reflect the scarcity of data points in Italy, but side steps what is the central question of the present paper. An additional industry survey has been conducted in Taiwan.[68] That survey specifically sought to identify the motivations for initiating minority equity alliances, however its usefulness to our present inquiry is limited by its survey cohort (only 20 respondents almost none of which had actually engaged in a minority equity alliance), the design of the questions, and the rather similar scoring given by participants to each of the listed motivations.

A Proposed Industry Survey

The literature on alliance structure resolves neither the question of when it actually makes sense for the focal firm to take a minority equity stake in its biotech partners, nor the question of when it makes sense for the innovator firm to issue equity to the focal firm. Moreover, it has been observed in the literature that there is little information on how decision makers actually incorporate the different possible frameworks of analysis in real life.[69] While different theoretical frameworks and what we have anecdotally observed in practice do not lead to consistent conclusions, our review of these elements has at least allowed us to formulate a number of hypotheses that would be interesting to test by way of a survey of industry participants.

A survey of course does not substitute for theory or rational analysis. A survey serves to identify what firms are doing, and what is their stated motivation for doing it. It has been hypothesized, for example, that one possible explanation for individual firm behavior is that, in the absence of an intrinsic motivation, alliances are entered into (and by extension, equity positions taken) because it has become fashionable or common to do so.[70] Alternatively, the firm could have an intrinsic motivation that is not fully rational, such as the common perception that taking a 10-20% stake in the innovator provides an "option" to acquire the remainder later. In both of these cases, the survey will describe the practice, but not justify it.

Hypothesis 1: The focal firm and the innovator firm do not use the same criteria to determine whether a minority equity participation should be part of the alliance structure (Divergence).

> Discussion: Although it generally recognizes the divergent interests of the focal firm and the innovator for entering into the alliance in general,[71] the literature we have reviewed has not adequately addressed how this divergence flows through to the negotiated decision to use equity stakes in the alliance structure. While our primary concern is with the appropriate equity strategy for the focal firm, we must recognize that the ability to implement this strategy is dependent on the innovator firm's perception of what its own appropriate strategy is. Certain frameworks such as Real Options (to the extent that it addresses minority equity interests at all) address the perspective of the focal firm, and do not try to determine under what conditions the innovator firm (and equally importantly, its other shareholders) would grant this "option". To the extent that they address minority equity stakes, the other frameworks

such as Resource Management or TCE tend to regard the divergent interests as creating a risk for the "success" of the alliance, thereby taking the hypothetical alliance perspective and failing to ask whether one or the other partner could not actually be best served by a sub-optimal alliance and push for a different self-serving result in the negotiations.

Hypothesis 2: For the focal firm, including a minority equity stake as part of the structure is an efficient means of obtaining an overall financial rate of return under accounting rules for a given overall project investment budget (Financial Engineering).

Discussion: We have seen that a number of theoretical frameworks suggest that from the focal firm's perspective, the use of equity is either indifferent to or even inimical to achievement of its Open Innovation goals. By deduction, this leaves the financial engineering perspective as the sole strong explanatory force. This is consistent with the discussion of CVC, above, which suggested that equity satisfied financial and not strategic objectives.

Hypothesis 3: For the focal firm, the minority equity stake is a means of capturing positive spillover effects of the alliance for the innovator (Externalities).

Discussion: As an extension of Resource Management theory, this economic perspective recognizes that the focal firm's willingness to finance is conditioned on its ability to benefit from the return on investment. We would expect this to be stronger in a research alliance (where the focal firm is sponsoring the development within the innovator of a technology or platform) than in a collaboration licensing a specific product.

Hypothesis 4: The minority equity stake is not perceived as providing the focal firm significant control or information rights (Control).

Discussion: This hypothesis tests a number of positions taken in our analysis, and the focal-firm and innovator perspectives may differ.

Hypothesis 5: The minority equity position dissuades competitors of the focal firm from partnering with the innovator (Preemption).

Discussion: If competitors are reluctant to rely on a partner whose loyalty may be with its major shareholders, the focal firm may see the investment in equity as a means of ensuring exclusivity to the innovator's knowhow.

Hypothesis 6: for the innovator, the minority equity stake is a means of ensuring the focal firm's alignment and commitment to the alliance (Risk Management).

Discussion: This hypothesis implicitly assumes that the equity stake is not a source of opportunism for the focal firm through control of the innovator, and is therefore linked to Hypothesis 4.

Hypothesis 7: for the innovator, the minority equity stake signals credibility to third parties (Network).

Discussion: As discussed in the analysis, the signaling effect is believed to be valuable to the innovator firm, and may compensate for the "loss" of equity.

Survey Questions

In order to test the foregoing hypotheses, we have developed a survey questionnaire (*see Annex*). The questionnaire has three versions depending on the survey respondent: focal firm, innovator firm, and traditional VC. Each version has a shared core section, allowing us to test Hypothesis 1. Additional questions specific to the role of each party are then found in the different versions. For each focal firm, the objective is to administer the survey to an executive from the main-line business (business development or R&D depending on the organization) and to the head of the focal firm's CVC unit. This is because we suspect that within the same focal firm, the objectives and framework of analysis differ between these two parts of the organization. The survey of traditional VCs, among other benefits, allows us to get the perspective of investors in the innovator firm on when they see it as being acceptable for their holdings to be diluted.

Conclusion

The different available theoretical frameworks do not provide a clear indication of when it makes sense for an alliance structure to include an equity component. We propose that a survey could help clarify the answer to this question, through the testing of a series of hypotheses. If the postulated hypotheses are validated, we would anticipate the following narrative to emerge: The equity stake is an economic modality of the alliance, and not a functional design. The decision to enter into an alliance and invest in the related research project(s) is a strategic decision taken independently of, and prior to, any decision to take a minority equity interest. From the focal firm's perspective, the decision to allocate part of the deal value to a minority equity position and the size of the position are primarily driven by financial and accounting concerns, including the ability to capture externalities. A territory-marking effect may also be a perceived side benefit. From the innovator firm perspective, the acceptability of issuing equity will be primarily a reflection of the positive network effect and a desire to reduce incentives for focal-firm opportunism.

ANNEX:

Survey Questionnaire

Question\Target	Head of Pharma Mainline Business	Head of Pharma Corporate Venture Group	Independent Venture Capital	Head of Biotech Innovator / Venture
Hypothesis 1, 2, and 3				
When you are looking to partner a platform technology or a particular asset, when would you consider a minority equity stake to be a desirable part of the alliance structure?	×	×	×	×
Out of all the partner deals that center on a technology platform, in how many deals do you demand to have the minority equity position < 25%, 25 – 50%, 50 – 75%, > 75%	×	×		×
Out of all the partner deals that center on a single asset development, in how many deals do you demand to have the minority equity position? < 25%, 25 – 50%, 50 – 75%, > 75%	×	×		×
Are you equally likely to use equity in the structure of a single-product licensing arrangement and a technology platform based multi-product research project?	×	×		×
Do you have your hurdle rate to achieve for the equity investment in an innovator firm?	×	×		

What are your criteria for participating in an additional investment round in an innovator firm in which you already hold an equity interest?	×	×		
Assuming your collaboration is fruitful, is your objective to continue to hold shares in the innovator firm indefinitely or to realize a profit through a sale?	×	×		
How would you measure the performance of an investment in non-financial dimensions	×	×		
Do you see equity used in alliance structures for strategic reasons or for financial reasons?	×	×	×	×
HYPOTHESIS 4 AND 6				
In your experience, is a 10% shareholding typically sufficient to allow the investing firm to change decisions of the innovator firm?	×	×	×	×
When minority equity investment is involved, do you also demand a) a board director seat or b) a board observer seat or c) none	×	×		
When a large corporate takes on a minority equity position in your firm, do you demand to have contract terms to prevent a corporate employee to take a) a board observer seat or b) a board observer seat or c) neither				×
Would you form research alliance on its technology platform with an	×	×		

innovator firm if this firm has another corporate as minority equity stakeholder?				
Would you make single asset licensing deals with an innovator firm if this firm has another corporate as minority equity stakeholder?	×			
ALL HYPOTHESIS				
In negotiations between established pharma and innovator, what are the typical arguments heard supporting the proposals to include an equity component in the deal structure?	×	×	×	×
In negotiations between established pharma and innovator, what are the typical arguments heard against the proposals to include an equity component in the deal structure?	×	×	×	×
In negotiations, is the equity stake typically put on the table by the investing firm or by the innovator?	×	×	×	×
Do you prefer financial sponsorship by the large corporate partner in an alliance to be (a) via minority equity investment or (b) milestone payments via contracts?	×	×	×	×
In your experience, is communication generally better between partners tied by equity, or the same as when there is no equity?	×	×	×	×
Do you consider the money from independent VC and corporate pharma the same or different?				×

From your perspective, is there any difference between CVC and independent VC investment?		×	×	
How would you characterize the relationship between large pharma and innovator firms when minority equity investment is involved?	×	×	×	×
If an established firm takes a certain percentage of equity in a collaboration partner, does it later generally buy additional shares to counteract dilution of its position if the innovator raises more capital?	×	×	×	×
What are the benefits to the collaboration when the established firm owns a minority stake in the innovator?	×	×	×	×
Is the established firm more committed to collaboration if it owns some equity in the innovator firm?	×	×	×	×
Is the established firm more likely to seek equity if it is interested in acquiring the innovator if the collaboration is successful?	×	×	×	×
CORPORATE VENTURE FUND MANAGEMENT				
Does your division have a committed evergreen funding? Or does the fund need to be reviewed and approved every year?		×		
Does your division make investment decisions alone or do you need approval from senior management including CEO, R&D heads, and/or other functions? How would you		×		

characterize the relationship between the CVC unit and the core R&D operation of the parent company?				
Which stage of innovation do you focus on? Early-stage, late-stage, or both? Is there an investment cap? What is the typical investment amount?		×	×	
Do you co-invest with other CVCs and/or IVCs?		×	×	
What scheme do you use to compensate your investment team staff? How do you compete with IVC for talented investors?		×		

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