Negotiating for the Market*

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In a dynamic environment where underlying competition is ‘for the market,’ this paper examines what happens when entrants and incumbents can negotiate for the market. For instance, this might arise when an entrant innovator can choose to license to or be acquired by an incumbent firm; i.e., engage in cooperative commercialization. It is demonstrated that, depending upon firms’ dynamic capabilities, there may or may not be gains to trade between incumbents and entrants in a cumulative innovation environment; that is, entrants may not be adequately compensated for losses in future innovative potential. This stands in contrast to static analyses that overwhelmingly identify positive gains to trade from such cooperation. Journal of Economic Literature Classification Number: O31.

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One of the most important insights in strategy is that factors that diminishing competition \textit{in} a market (e.g., patent protection), can themselves increase the degree of competition \textit{for} the market. Of course, it is well-known that this trade-off depends on whether those policies themselves generate inter-temporal persistence of present market power (Scotchmer, 2004). For instance, broad patents can raise barriers to innovative entry and so allow current incumbents to persist. Critically, even where such persistence is not enabled by policy, competition for a market is not a given when incumbents and entrants can reach agreements that subvert that outcome (Salant, 1983; Gans and Stern, 2003). That is, when they can \textit{negotiate} for the market.

From a strict economics perspective, there is a presumption that, if given the opportunity, incumbents and entrants would negotiate rather than compete for the market. Not only would this minimize any competition that might arise between them, it would also save on any costs faced by the entrant in engaging in production (Teece, 1987).\footnote{Teece (1987) emphasized that cooperation was mutually beneficial for incumbents and start-ups as it avoided the duplication of critical complementary assets that would be required when start-ups chose to enter product markets. Gans and Stern (2000) built on this and explored the way in which licensing might avoid the dissipation of monopoly rents but also how intellectual property protection might facilitate such cooperative commercialization by removing expropriation risk that might otherwise cause start-ups to avoid direct negotiations with incumbents (see also Anton and Yao, 1994; Arora, 1995).} That said, negotiation breakdown or avoidance could arise from the weakness of property rights, information asymmetry impeding efficient bargaining or high search costs for cooperative partners (Gans and Stern, 2003). When this arises, competition for the market would be observed.

Empirically, the main economic drivers have been shown to influence the cooperation versus competition decision in commercialization. Specifically, the importance of complementary assets and the strength of intellectual property protection – were borne out in empirical investigations by Gans, Hsu and Stern (2002) and Arora and Ceccagnoli (2005). Hsu
(2006) also considered the importance of intermediaries in markets for ideas as facilitators of cooperation across industries. However, Arora and Gambardella (2009) in their review of the growing empirical literature demonstrate that, while practiced often, there are many industries where licensing or other forms of cooperative commercialization is not favored over more competitive paths. While, in some instances, such choices may be plausibly related to difficulties associated with coming to a cooperative agreement (Gans, Hsu and Stern, 2008), to date, there has been little progress in understanding patterns of competitive commercialization in the face of what appears to be a compelling economic rationale against its existence.

Interestingly, specific examples of debates regarding the choice between cooperation and competition in commercialization do not emphasize transaction costs or informational problems as driving competition. Instead, there is a strong theme that there are dynamic motivations driving firm commercialization choice. Consider the decision by EMI to commercialize its CT scanner rather than to license it to incumbents in the industry. At the time, EMI had not been a medical device maker and so could be considered an entrant. Its leadership emphasized a desire to enter and establish a dominant market position. Their reasoning was as follows (Bartlett, 1983):

Powell claimed that the expertise developed by Hounsfield and his team, couple with protection from patents, would give EMI three or four years, and maybe many more, to establish a solid market position. He argued that investments should be made quickly and boldly to maximize the market share of the EMI scanner before competitors entered. Other options, such as licensing, would impede the development of the scanner. If the licensees were the major X-ray equipment suppliers, they might not promote the scanner aggressively since it would cannibalize their sales of X-ray equipment and consumables. Smaller companies would lack EMI’s sense of commitment and urgency. Besides, licensing would not provide EMI with the major strategic diversification it was seeking. It would be, in Powell’s words, “selling our birthright.” (p.7)

This argument reflected a belief that EMI’s capabilities built up during its innovative phase would be an advantage in continued innovation and production and that selling out early would
lead to reduced profits. In the end, despite the CT scanner being wildly successful, EMI failed to profit from that success with much of its investors being squandered.

A similar debate raged inside Nucleon, a pharmaceutical products start-up over whether to license the manufacture of its first innovative product (Pisano, 1994):

The licensing option had the chief benefit of generating cash immediately; it also spared Nucleon from making large capital investments in clinical development and manufacturing, and allowed the company to concentrate all of its financial and human resources on R&D. Of course, if the product turned out to be successful, Nucleon would receive far lower revenues than if it had made all of these investments itself. Some Nucleon employees viewed this option as “mortgaging away” the company’s future.

In this argument, licensing is seen as a way to build upon current innovative capabilities rather than have them diverted if the start-up were to invest to commercialize the product themselves.

In contrast, it was concerns over a loss of focus post-acquisition, that the founders of Ecton – a medical device start-up, to favor competition (Cape, 1999):

With such a clear focus and few distractions, the Ecton development team had met most of their project milestones on schedule, at significantly lower cost than they had planned, based upon their past experience. The Ecton founders worried that if their company were absorbed into a larger organization after acquisition, their development efforts for next-generation products would get mired … in complexity … Perhaps, they reasoned, their efforts would be more successful in the long run if they remained independent until they had refined a development process … that might survive acquisition and integration.

Ecton were acquired shortly after by Hewlett Packard.

Finally, Palm Computing faced a strong internal debate in 1997 over whether it should license its Palm OS operating system that powered its very successful handheld device (Casadesus-Masanell, Boudreau and Mitchell, 2010). The leadership at Palm saw opportunities to build a platform in a more open manner through licensing. Specifically, they saw that some competence and incentives for improving the operating system lay outside of Palm. But there was a strong challenge to this view:
Dubinsky and Hawkins believed licensing the Palm OS right away would only stifle Palm’s attempts to be the market leader. Furthermore, by having more entrants manufacturing Palm OS devices, Palm’s income would be reduced, thereby stripping away opportunities to invest in future technologies. As far as Dubinsky was concerned, the timing of licensing the platform was crucial. She stated, “Licensing will come later. Today it certainly won’t add value. What will add value today is investing in product development, getting the next generation and the next generation out, advancing the category, and building intellectual property.” (p.9)

Note that the concern is about forgoing a future opportunity to become or sustain market leadership that would arise because of Palm’s experience to date. The entire counter-argument lay on a dynamic component and what today’s investments might generate in terms of future opportunities. Eventually, in 2010, Palm was purchased by Hewlett Packard.

While some of these firms ultimately did take a cooperative path, the landscape is littered with those who, despite being targeted, chose competition ultimately to lead the market. They include Apple, Google, Genzyme, Intuit, Facebook and many more. These examples indicate that we need to look beyond static drivers of commercialization choice and to build a theory that incorporates dynamic factors. In particular, neglected in static analyses are concerns expressed in these examples say, by an entrant, that, by negotiating for a market with an incumbent, they would be forgoing an option to become the incumbent and build up any resulting advantages themselves. This is especially the case when their capabilities to develop new generations of the technology are argued to be related to their accumulated innovative expertise. Indeed, the participants in the examples appear to suggest that this future cost may be so great that a start-up firm should consider avoiding licensing and cooperation altogether. This gap motivates the development of the model in this paper.

To an economist, such possibilities are generally seen as being another factor in the price of cooperation: namely, an entrant would have to be compensated for any reduction in its ability to innovate in the future. However, even recognizing this, it may be that the gains to
trade between established firms and entrants are low or negative when the impact of future innovative competition is taken into account. Therefore, to properly take these considerations into account requires a dynamic model.

This paper constructs a model designed to capture the key elements associated with this issue. First, the market that firms may be competing or negotiating for is the development of the next generation of a product. Second, if that next generation product is developed by an entrant, rather than the incumbent supplier of the previous generation, the patent associated with that increment can be sold and transferred to the incumbent. Third, the experience associated with innovating and producing the current product generation endows firms with capabilities to innovate and develop the next product generation; specifically, being selected as the innovation leader for that next generation. These capabilities, however, are assumed, initially at least, to be non-transferable between firms. As will be shown, this adds a future or dynamic consequence to current negotiations for the market.

To achieve a model that captures these elements, I amend the tractable framework of Segal and Whinston (2007) – hereafter SW – used by them to explore entrant innovation in the context of competitive interactions with an incumbent firm. They only considered competition and the effect of incumbent antitrust practices on rates of innovation. In addition, they assumed that the same firms would persist in the industry through successive waves of innovation; something I relax here by adding in elements of the leadership model of O’Donoghue, Scotchmer and Thisse (1998).

Specifically, the model set-up here considers an environment where, at any given point

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2 SW did remark upon the possibility of licensing but did not explore it. Other work on cumulative innovation similarly does not endogenize the commercialization choices of start-ups (see, for example, the survey by Scotchmer, 2004).
in time, there are (effectively) at most two firms in the industry – an incumbent and an entrant.³ As in SW, an entrant today may become an incumbent tomorrow and vice versa. Unlike SW, I also allow incumbents to assume an innovation leadership role. When an entrant innovates, if there is no cooperation (i.e., licensing or acquisition), it displaces the incumbent for the next generation of innovation. If there is cooperation, the incumbent is not displaced and preserves its role.

In this model, innovations displace completely and immediately the economic value of previous generation products.⁴ In this respect, the underlying structure of the game is one that is termed Schumpeterian, greenfield or winner-take-all competition (Gans and Stern, 2003). When there is competition for the market, the outcome will be characterized by successive monopolies each displacing the predecessor through innovation. When there is negotiation, there are still successive monopolies but the same firm may persist for longer. As will be noted below, this competitive structure is of interest because it is often claimed that in such markets, where static product market competition does not arise, there is a presumption that less antitrust intervention is desirable.

To this end, a key set of parameters in the model considers the dynamic capabilities of the firms. SW assumed that, should an incumbent be displaced, then it, with certainty, becomes the entrant for the next generation. This can be interpreted as a strong form of dynamic R&D capabilities whereby a current incumbent has a significant advantage as an innovator towards the next product generation in that it preempts others from contesting the innovation market.

Here I relax this assumption by allowing that incumbent capability to range from non-

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³ In actuality, the model explicitly allows for many firms and this is critical to the analysis and conclusions. However, through simplifying assumptions I derive a situation where consideration is required of only two firms at any given stage of the dynamic game.

⁴ SW allow for a period of temporary competition between an entrant innovator and an incumbent. This possibility is explored in Section 5 below.
existent (the incumbent cannot engage in future innovation at all) to strong as assumed by SW. In addition, because my model considers licensing whereby the incumbent is not displaced, I also consider entrant dynamic capabilities. That is, should an entrant license its innovation, there is some probability that it will preempt others in becoming an innovation leader. If this probability is high, the entrant is said to have strong dynamic capabilities. However, a case that will be of interest is where this probability is low and cooperation results in low prospective returns for the entrant from future innovation. It is this possibility that permits the dynamic analysis of notions that licensing or acquisition may involve entrants ‘selling their birthright’ to future innovative rents. In essence, I explore the impact of the commercialization decision on the structure of competition in innovation markets in the future. This complements previous analyses based on static product market impacts alone (Gans and Stern, 2000).

Allowing for innovators to return to the pool of potential future innovators reflects reality. Specifically, there are many instances where future innovative potential rests with those who have innovated in the present. For instance, Niklas Zennstrom and Janus Friis founded the peer-to-peer file sharing network, KaZaA, which was acquired by Sharman, before moving onto found the peer-to-peer IP telephony network, Skype, which itself was acquired by eBay. They have now moved into IP television with a new venture, Joost. In each case, they have leveraged skills to become a lead innovator in the next generation of peer and fast transfer Internet technologies. Similarly, Biz Stone created the successful web log platform, Blogger, which he sold to Google and then went on to co-found Twitter, built on the same intuition about the value of social networking.

In other cases, the leverage of dynamic capabilities has led to direct competition for the initial venture. Steve Jobs founded Apple in the 1970s but left in 1986 following disagreements
on firm direction to found NeXT and Pixar. Ten years later NeXT was acquired by Apple with its operating system to become the core of the highly successful OSX. Pixar was acquired by Disney in 2006. Similarly, Walt Disney, having been rebuffed and seen his animation ideas expropriated by several studios, went on to found his own company and dominate the entire industry (Gabler, 2006). In contrast to Jobs (whose technologies and skills was acquired), Disney was to use his dynamic capabilities to take on established firms in the product market and himself become the market leader.

With this framework I find that some important and subtle, dynamic effects that significantly qualify the intuition of static models of innovation. First, the returns to licensing are driven by the value of incumbent technological leadership. That value is itself endogenous in a dynamic environment and it is demonstrated that it can be sometimes lower under licensing than under competition.

A key finding here is that the gains from trade from licensing may not always be positive. In a situation where the dynamic capabilities are very asymmetric, licensing means that some future innovative rents might be jointly forgone by the current incumbent and entrant. In contrast, competition means that such rents (even if they are lower) are captured by current firms – as the entrant becomes the incumbent and the incumbent becomes the next entrant. Thus, depending upon the relative dynamic capabilities, both firms may find this mutually preferable to cooperative commercialization. This captures some of the motivating informal intuition that dynamic capabilities may favor continued competition but also highlights some subtleties in how such capabilities generate this outcome.

The paper proceeds as follows: in Sections 1 the basic model is introduced and Section 2 then presents the baseline results regarding negotiating for the market. The model characterizes
the gains from trade from licensing and/or acquisition purely in terms of dynamic factors. It is demonstrated that these modes have distinct dynamic differences; in particular, acquisition may lead to a loss of future innovative rents in favor of potential future entrants. Section 3 then considers a number of extensions including static product market competition and an endogenous rate of innovation. Section 4 then turns to consider alternative contracting possibilities that may impact on observed commercialization choices. A final section concludes.

1. Model Set-Up

In this section, I describe the basic set-up of the model. It is designed to capture the key elements of a choice between competition and cooperation that focuses on the dynamic elements of that decision. The model is similar to a ‘quality ladder’ model of innovation in that innovation is directed at producing the next generation of a product that dominates the market; in effect, the new product replaces the old in a “winner-take-all” manner. This captures the notion that innovating is equivalent to achieving market leadership.

Firms and Innovations

The model involves discrete time and an infinite horizon with the common discount rate for all participants of $\delta \in [0,1]$. Innovations occur sequentially with each innovation being a new product that yields valuable quality advantages over the previous generation. To keep with the assumption of Schumpeterian competition, it is assumed that there is a single producer ($I$) of that new product can extract a constant flow of monopoly rents, $\Pi$, until such time as it is
displaced by a new innovation.\textsuperscript{5} This might arise if the innovator has a patent right that, while long-lived, can, because of other consumer choices for related products or workarounds, lead to only a certain level of profit even if the patent rights to one or more generations are controlled by the same entity.\textsuperscript{6} This assumption allows us to focus purely on dynamic characteristics.

\textit{Dynamic Capabilities}

A novel feature of the model here is that the set of innovating firms can change from generation to generation. Specifically, I allow both for the possibility that, following a successful innovation, a firm is present in the market during the development of the next generation and the possibility that they are not. As noted earlier, for most models of patent races and innovation, displaced incumbents exit the industry while, for SW, a displaced incumbent merely forgoes technological leadership; taking on the role of the entrant.

Here I nest both of these possibilities. For each product generation, it is assumed that there is only one firm – the \textit{innovation leader} – conducting R&D in the market. Following O'Donoghue, Scotchmer and Thisse (1998), the innovation leader for a product generation is randomly drawn from a pool of firms (infinite in number) and including the current incumbent that could potentially innovate.\textsuperscript{7} This structure amounts to assuming that the ‘know-how’ of how to progress towards the next product innovation is acquired by a single firm who can then

\textsuperscript{5} The term ‘monopoly rents’ does not necessarily mean that the incumbent is unconstrained in its pricing over the product. It is just that it commands 100 percent of the market although the price it charges might be constrained by product generations past. $\Pi$ represents those potentially constrained profits.

\textsuperscript{6} SW make a similar assumption that once a new product innovation is generated, the previous innovation is placed in the public domain. In Section 3, I relax these assumptions and consider what happens if negotiation leads to the control of two generations of patent rights and price accordingly.

\textsuperscript{7} Notice that this is a clear departure from the assumption of SW that only two firms in the industry are potential innovators over the entire course of time.
exploit it by engaging in research towards that next generation product.\textsuperscript{8} However, there are distinct reasons why different types of firms might have a greater chance of being selected from that pool; that is, an advantage in future innovative competition. Those differences rest on what I term here as “dynamic capabilities.”

Of course, the concept of a dynamic capability is one that is relatively fluid within the strategy literature. A firm’s capabilities are usually defined in terms of their ability to deliver products of a certain quality and at a certain cost. This ability then defines the position within a competitive marketplace. Dynamic capabilities are a step beyond this and refer to a firm’s ability to transition in a changing environment. For instance, Teece, Pisano and Shuen (1997) “define dynamic capabilities as the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.” (p.516)\textsuperscript{9} Moreover, such capabilities are generally considered difficult to contract over and to transfer across firm boundaries.

Here I focus on a specific type of dynamic capability: capabilities that are derived from experience in an activity that improve the chances of a firm becoming a technology leader. Experience-based capabilities are identified by Eisenhardt and Martin (2000) as being most salient and relevant in industries where technological change is rapid. This is precisely the type of industry being studied here. Thus, learning by doing can give firms advantages. However, Eisenhardt and Martin (2000) emphasize that such advantages are not long-lived and must be sustained by continual experiential activities.

\textsuperscript{8} As Erkal and Scotchmer (2009) observe, this set-up captures the notion that good ideas are somewhat scarce as opposed to an assumption made by many economists that they are abundant and the resources to develop them are scarce.

\textsuperscript{9} Those capabilities may come externally – through entry. Alternatively, they might be developed internally by those who are currently innovating towards the next product generation. In this respect, a firm is said to have a dynamic capability if they are able to successfully engage in development of the product generations beyond that being developed today.
To capture this, I identify two activities of relevance – innovation and production. Experience in each of these for the current product generation is assumed to give firms undertaking them an advantage in becoming the innovation leader in the next generation. Recall that the innovation leader is formally selected from a large pool of firms with those without experience having an infinitesimal probability of being selected. This is not the case for active participants in the industry.

For a previous incumbent \( (I) \) who is not an innovation leader, knowledge and experience of the industry may afford them with an advantage due to superior knowledge of the market and customers. This is a capability that arises as a result of being a producer. To capture this, I assume that following successful past innovation in the industry, with probability \( \sigma_p \in [0,1] \), the incumbent becomes the innovation leader for the next generation (the subscript \( p \) here standing for innovative capabilities generated by virtue of being a producer). This might be as an incumbent or entrant depending upon whether cooperative commercialization occurs or not. Otherwise, they (effectively) exit the industry and another firm takes on the role of the entrant.\(^{10}\)

For an entrant \( (E) \) who pursues cooperative commercialization, their future innovative advantage may arise because of their knowledge of the innovative process for this line of products. To capture this, I assume that an entrant who innovates, with probability \( \sigma_i \in [0,1] \) (the subscript \( i \) here standing for innovative capabilities generated by virtue of being an innovator), becomes the innovation leader (again as an incumbent or entrant as the case may be). Otherwise, they exit and are, potentially, replaced by a new entrant. As noted earlier, this provides a means of parameterizing and modeling an innovator’s ‘birthright’ to future innovative rents. It captures its advantage in generating future innovations.

\(^{10}\) This the impact to leveraging production experience (and as will be seen innovator experience) lasts only to the next generation and depreciates completely beyond that.
Finally, the previous incumbent might also be an innovation leader. In this case, they combine the knowledge from production and innovation and this translates into a probability, $\sigma_{ip} \in [0,1]$ that they will continue as the innovation leader for the next generation (the subscript $ip$ here standing for capabilities generated by virtue of being both a producer and an innovator). This probability can also arise if an innovating entrant and a non-innovating incumbent were to integrate through an acquisition (rather than licensing).

It is reasonable to assume that $\sigma_{ip} \geq \max\{\sigma_p, \sigma_i\}$ as any resources that allow the firm to combine experiences in a manner that reduces dynamic capabilities can surely be disposed of freely to ensure that the dynamic capability is at least as strong as it would be based on being a separate producer or innovator. This assumption of free disposal is maintained throughout the paper.

In summary, experience in production or innovation or both can give firms an advantage in becoming the next innovation leader. As will be demonstrated below, a choice of cooperative commercialization guides which firms are likely to gain experience and hence, which firm is likely to become the next innovation leader.

**Commercialization Choices**

When a new product is generated by an entrant, the patent holder, $E$, faces a choice. It can enter into production of the product generation (competition) or it can negotiate with the current incumbent (cooperation).\(^\text{11}\) Following this, in the next period, uncertainty is resolved as to whether the firm that does not hold patent production rights is selected amongst the pool of firms to become the next entrant.

If $E$ chooses a competitive path, $I$ loses its monopoly profits while $E$ assumes its role and

\(^{11}\) This is a common presumption in innovative industries; see Teece (1987).
earns $\Pi$ in each period it remains the incumbent. The previous incumbent then becomes one in
the pool of firms from which the next entrant will be selected. $E$ also has a chance of becoming
the innovation leader but in the incumbent role.

Alternatively, if $E$ chooses a *cooperative* path, it negotiates to sell $I$ an exclusive license
to its innovation.\(^{12}\) I assume that such negotiations take the Nash bargaining form where the
incumbent and entrant both have equal bargaining power.\(^{13}\) If a licensing deal is successfully
negotiated, $E$ receives a once-off payment, $\tau$, while $I$ preserves its monopoly position. In this
situation, it is $E$ who returns to the pool of firms as a potential future entrant while $I$ has a
chance of becoming the innovation leader as an incumbent.

### 2. Negotiation Outcomes

We are now in a position to consider what happens when firms have the opportunity to
negotiate over the terms of a cooperative agreement should an entrant innovate. These
negotiations take place in the shadow of potential competition which here involves the entrant
innovator displacing the incumbent and taking its position for that product generation. As will
be demonstrated, relative to cooperation, this shifts which firm earns the monopoly rents from
that innovation as well as who acquires a capability based on production in the future.

**Licensing**

The first case to consider is where an entrant innovator negotiates to grant an exclusive

\(^{12}\) It is implicitly assumed that if $E$ were to engage in non-exclusive licensing, then the resulting on-going
competition between two firms in product markets would be so intense as to make entry non-credible. Of course,
licensing terms can be utilized to soften such competition. In this case, however, the profit impacts of an exclusive
and non-exclusive license would be the same.

\(^{13}\) In a non-cooperative bargaining model, Gans and Stern (2000) show that this outcome is the upper bound on the
entrant’s bargaining power when IP protection is potentially weak and the incumbent can invest in ‘work around’
technologies.
license to the incumbent. In that contract, the incumbent maintains its role as a producer for that product generation while the entrant returns to the pool to become a potential innovator towards the next product generation.

In each period, the following stage game is played:

1. **Selection**: The innovation leader for the next product generation is selected from the pool of potential innovators.

2. **Production**: The firm that holds the production rights to the current product generation sells the product, earns rents of $\Pi$ and acquires a production-based capability.

3. **Innovation**: A new product generation is developed by the innovation leader who acquires an innovation-based capability.

4. **Negotiations**: If the innovation leader selected is the incumbent, the stage game ends. If the innovation leader selected is an entrant, the entrant negotiates with the incumbent over a license agreement including a lump-sum payment to the entrant of $\tau$. Should that an agreement be reached, the incumbent continues in that role to the next period while the entrant returns to the pool of potential innovators in that next period. If an agreement is not reached, the entrant displaces the incumbent in the next period while the incumbent becomes part of the pool of potential innovators in that next period.

This game is repeated each period with new product innovation resulting in a new round starting with production by the incumbent (i.e., patent rights holder) in that period.

Using this structure, the payoffs of each firm can be derived contingent on the outcomes of stage 1 (the selection of the innovation leader), above. The goal is to understand whether the
incumbent or entrant will reach a licensing agreement in stage 4. As with all negotiations, this involves identifying the gains from trade from such an agreement; that is, the increment to joint surplus that results from cooperation as opposed to competition.

If the innovation leader selected is the current incumbent, then only the incumbent earns a positive payoff as the previous entrant (if any) returns to the infinite pool of potential innovations and so has an effectively zero probability of being selected as an innovation leader in the next round. This generates a payoff to the incumbent of:

$$V_I = \Pi + \sigma_p \delta V_I + (1 - \sigma_p) \delta v_I$$

Here, the incumbent’s payoff ($V_I$) is the sum of the monopoly rents it earns in stage 1 ($\Pi$) plus its expected return from being an innovation leader entering the next period ($\sigma_p \delta V_I + (1 - \sigma_p) \delta v_I$); that is, with probability $\sigma_p$, the incumbent will become the innovation leader again while with probability $1 - \sigma_p$, it will be a non-innovating incumbent in the next period and earn $v_I$ (which will be derived below).

If the innovation leader is an entrant and they reach a licensing agreement with the incumbent, then that entrant earns a payoff of $v_E$ while the incumbent earns a payoff of $v_I$ as follows:

$$v_E = \tau + \sigma_p \delta v_E$$

$$v_I = \Pi - \tau + \delta \sigma_p V_I + \delta (1 - \sigma_p) v_I$$

($v_E$) is made up of the license fee the entrant receives as well as its expected payoff in the next period where it has some probability $-\sigma_p$ of becoming an entrant innovation leader for the next product generation. ($v_I$) is made up of the license payment to the entrant in return of which the incumbent continues as the incumbent in the next period earning the monopoly rent of $\Pi$ as well
as a possibility (with probability $\sigma_p$) of becoming an incumbent innovation leader in the next generation.

Note, however, that if the innovation leader is an entrant and they do not reach a licensing agreement with the incumbent, their payoffs become:

$$v_E = \delta \sigma_l V_I + \delta (1-\sigma) v_I$$  \hspace{1cm} (vE)’

$$v_I = \Pi + \delta \sigma_p v_E$$  \hspace{1cm} (vl)’

(vE)’ says that an entrant who is an innovation leader, innovates and then earns monopoly rents ($\Pi$) and has a probability $\sigma_I$ of becoming an innovation leader in the next period as an incumbent (earning $V_I$) or, alternatively, being the incumbent in that period ($v_I$). (vl)’ says that an incumbent from the previous generation has some probability ($\sigma_p$) of converting that incumbency into innovation leadership as an entrant in the next period (earning $v_E$). Note, from (vl)’, that, in the competition case, $v_I < v_E$ as $\sigma_p \delta < 1$. This is intuitive as these payoffs are contingent upon an entrant being selected as the innovation leader who then can earn the full value of incumbency whereas the incumbent, at the time these payoffs have been evaluated, has been displaced although still has some prospects of leveraging its production-based capability to become a future innovation leader.

There will be gains to trade through licensing, and hence, agreement, if the sum of (vE) and (vl) exceed (vE)’ plus (vl)’. That is,

$$\underbrace{\Pi - \tau + \delta \sigma_p V_I + \delta (1-\sigma_p) v_I + \tau + \delta \sigma_I v_E}_\text{Joint Payoff from Cooperation} \geq \underbrace{\Pi + \delta \sigma_p v_E + \delta \sigma_I V_I + \delta (1-\sigma) v_I}_\text{Joint Payoff from Competition}$$

$$\Rightarrow (\sigma_p - \sigma_I) (V_I - v_E - v_I) \geq 0$$  \hspace{1cm} (1)

where it is assumed that if firms are indifferent between licensing or not, they choose to license. In a static sense, a license negotiation merely transfers the monopoly profits for the next
generation from the entrant to the incumbent. Hence, there are no gains from trade on this basis alone. However, here there is also a dynamic component to the joint surplus from licensing. Specifically, it defines the role of each firm in producing the new product generation and potentially innovating towards the next product generation. If a license agreement is reached, the current incumbent produces the new product whereas no agreement will allow the entrant innovator to do so. As there is only one incumbency rent from this, however, it is not a gain from licensing per se as one or the other firm captures those profits.

However, when the incumbent and entrant have different probabilities of becoming the innovation leader for the next generation, the roles they take impact on the expected profits they earn between them in the future. If they license, the expected joint profits from innovation are \( \sigma_e (V_i - v_e) + \sigma_i v_e \) whereas if they do not, these expected joint profits become \( \sigma_e (V_i - v_e) + \sigma_i v_i \). Thus, whether this future profit component drives licensing depends upon whether \( V_i - v_i > v_e \) (that is, whether joint returns are maximized with an incumbent innovator \( V_i' \) than with an entrant innovator \( (v_e + v_i) \)) and \( \sigma_i < \sigma_e \) (the incumbent’s probability of becoming the innovation leader is greater than the entrant’s). It is easy to see that there are four possibilities in which two have a positive and two have a negative gain from trade. As licensing agreements assign roles, the parties will have incentives to license to assign roles that maximize expected future joint profits.

The following proposition utilizes (1) to solve for the equilibrium of the dynamic game. Following SW, the solution concept of Markov perfect equilibrium is used to narrow the large number of subgame perfect equilibria that might arise. Markov perfection requires that firm actions only depend upon the current state of the world – in this case, who was the incumbent
and who was the entrant in the previous period (Maskin and Tirole, 1988; 2001). In addition, it is assumed that the previous value of $\tau$ is derived using the Nash bargaining solution where the entrant and incumbent have equal bargaining power. This gives

$$\tau = \delta v_i (1 - \frac{1}{2}(\sigma_i + \sigma_p)) + \delta (V_i - v_e) \frac{1}{2}(\sigma_i + \sigma_p).$$

It should be noted, however, that the conclusion would be unchanged even for a more general bargaining outcome so long as the entrant and incumbent were each (weakly) better off by agreeing to the license agreement versus entering into competition with one another.

**Proposition 1.** Licensing is the unique Markov perfect equilibrium if and only if:

$$(\sigma_p - \sigma_i)(\sigma_p - \sigma_i - \sigma_p) \geq 0$$

Otherwise, competition is the unique Markov perfect equilibrium.

The proof proceeds by solving (VI), (vI) and (vE) simultaneously and substituting them into (1) which yields the condition of the proposition. Note that these are the relevant payoffs to consider should one incumbent-entrant pair consider deviating and not agreeing to license. Uniqueness follows by considering what happens should an incumbent and entrant pair expect that payoffs will be those under competition – solving (VI), (vI)’ and (vE)’ simultaneously – and demonstrating that the same condition as in the proposition determined whether they will license or not.

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14 Markov perfect equilibrium is a commonly used refinement of subgame perfect equilibrium for dynamic games. Its chief use is to remove supergame-type punishments from the infinitely repeated game. The equilibria analyzed in this paper are all subgame perfect.
Figure One: Licensing Equilibrium Outcomes

Figure One depicts the equilibrium outcomes in \((\sigma_i, \sigma_p)\) space where, for convenience, it is assumed that \(\sigma_{ip} \leq \frac{1}{2}\).\(^{15}\) Intuitively, Proposition 1 demonstrates that, regardless of whether licensing occurs in equilibrium or not, \(V_i \geq V_i + V_E\) if and only if \(\sigma_{ip} \geq \sigma_i + \sigma_p\). Specifically, if \(V_i \geq V_i + V_E\), the firms want to agree to an outcome that maximizes the probability that one of them becomes an incumbent innovator. If \(\sigma_p > \sigma_i\), the current incumbent has the best chance of achieving that position by remaining as an incumbent. Consequently, the firms agree to license in order to preserve the current incumbent’s role.

In contrast, if \(\sigma_i > \sigma_p\), the current entrant has the greater likelihood of becoming the lead innovator in the next generation. Jointly, the firms want that lead innovator to be the incumbent and so to achieve that they do not license and the current entrant displaces the incumbent.

\(^{15}\) If this wasn’t the case, then there would be a triangular area on the top right hand corner of the diagram where \(\sigma_i + \sigma_p > 1\) which is outside the range of feasible outcomes but otherwise the areas for each equilibrium outcome would be roughly the same.
current incumbent as a producer. Interestingly, the end result is competition.

At this point, it is instructive to return to the informal case-based argument that cooperative commercialization may not be undertaken because the start-up innovator cannot be compensated for a loss of future innovative rents. The argument is that, by licensing, the start-up forgoes the incumbency position and the advantages that brings in terms of future innovative profits. In our formal model here, this factor would be most salient when \( \sigma_i \) is high. When this is the case, an entrant who forgoes licensing has a good chance of becoming an incumbent who is the innovation leader.

However, Proposition 1 demonstrates that this informal argument only partially drives a lack of cooperation in equilibrium. It is not simply that \( \sigma_i \) is large but that \( \sigma_i \) is large relative to \( \sigma_p \) that matters. If that is the case, then, by not licensing, the entrant’s chances of becoming an incumbent innovation leader in the next generation are maximized. This provides some formal support for the informal argument. That said, the motivation for the lack of a licensing agreement is to leverage off the entrant’s future innovative potential and so, in this respect, captures the spirit of the informal arguments.

Nonetheless, even when \( \sigma_i > \sigma_p \), it may be that \( V_f < v_f + v_E \). In this case, the firms will agree to license to ensure that the current incumbent’s position is preserved. Thus, a relatively high \( \sigma_i \) can drive licensing. In contrast, when \( \sigma_p > \sigma_i \), minimizing the likelihood that one of the firms becomes an incumbent innovator involves putting the current entrant in an incumbent producer position. Consequently, they choose forgo licensing in order to achieve this outcome. Thus, Proposition 1 demonstrates that the informal argument that the entrant’s innovation-based capabilities may drive licensing over competition do not necessarily hold up when those capabilities are potentially very high.
In summary, the key dynamic difference between licensing and not licensing is that the identities of who is the incumbent producer in the current generation changes and the firms may want to maximize the chances that one of them, in particular, becomes the innovation leader. When they have asymmetric dynamic capabilities, licensing changes the probability that one of them will become the innovation leader and it has been shown that this is sometimes not to the firms’ mutual advantage.

Acquisition

Licensing is not the only form of negotiation for the market. Another commonly practiced outcome involves entrant innovators being acquired by incumbents; perhaps in situations where a licensing agreement or shift in intellectual property rights is infeasible or in preference to those agreements. Both licensing and acquisition share in common the outcome that an agreement means that the current incumbent retains its incumbency. The difference between them is what happens to the entrant. While, under licensing, the entrant returns to the pool of potential entrant innovation leaders, under acquisition, it is removed as a potential independent innovator. Instead, the entrant innovator’s capabilities are added to those of the incumbent. Consequently, it assumed here that this alters – from $\sigma_p$ to $\sigma_q$ – the chance that the integrated incumbent will become the innovation leader in the future. Note that this is a very idealized view of acquisition. It basically, says that in integrating capabilities, an acquisition can achieve the same outcome as if those capabilities were acquired through the joint experience of innovating and producing. In general, it is likely that acquisition will be less perfect. Nonetheless, here I consider when acquisition might be an equilibrium outcome relative to competition and also relative to licensing under these idealized conditions.

The timing of the game is identical to that described above except that in the negotiation
stage, $E$ is negotiating with $I$ over an acquisition. For the moment, it will be assumed licensing is not possible. The implications of relaxing this restriction will be explored below.

There will be gains from trade from acquisition rather than competition if:

$$
\Pi - \tau + \delta \sigma_p V_I + \delta (1 - \sigma_p) \nu_I + \tau \geq \Pi + \delta \sigma_p v_E + \delta \sigma_V + \delta (1 - \sigma) \nu_I
$$

(2)

This highlights the difference between the gains from trade from acquisition as opposed to licensing (1). First, acquisition improves the ability of both firms to together earn $V_I$ rather than $\nu_I$; which occurs if $\sigma_p \geq \sigma_I$. As noted earlier, it is reasonable to suppose that free disposal, the ability to retire resources with certain capabilities, would apply and so this condition will always hold.

Second, an acquisition causes the firms to jointly forgo a chance of earning $v_E$. In effect, acquisition might increase the probability that a third party (another potential entrant) becomes the innovation leader. This occurs if $1 - \sigma_p > 1 - \sigma_I - \sigma_p$ or $\sigma_p < \sigma_I + \sigma_p$. In this case, acquisition confers a positive externality on potential entrants; something which is internalized if no acquisition takes place.\(^\text{16}\)

Turning to the payoffs in each period, note that $V_I$ remains as in (VI) above but the other payoffs become:

$$
\nu_I = \Pi - \tau + \delta \sigma_p V_I + \delta (1 - \sigma_p) \nu_I
$$

(vI”)

$$
v_E = \tau
$$

(vE”)

\(^{16}\) Note that if the ‘principle of selective intervention’ applied then it could not be the case that $\sigma_p < \sigma_I + \sigma_p$. However, as noted earlier, it may be that to take advantage of this would require restructuring. In its absence, a firm might still choose to integrate its capabilities at some technical loss in efficiency if there were other advantages from so doing.
Using, the Nash bargaining solution, $\tau$ is given by:

$$\tau = \delta v_i - \delta \sigma_p \frac{1}{2} v_e + \delta \frac{1}{2} (\sigma_i + \sigma_p)(V_i - v_i).$$

Using this, the following proposition can be proved.

**Proposition 2.** Acquisition is the unique Markov perfect equilibrium if and only if:

$$\sigma_p - \sigma_i - \sigma_p \geq 0$$

Otherwise, competition is the unique Markov perfect equilibrium.

The proof of the proposition proceeds along the same lines as Proposition 1. Figure Two depicts the equilibrium outcomes. Significantly, the gains from trade from acquisition are positive if and only if $\sigma_p \geq \sigma_i + \sigma_p$. In this case, acquisition reduces the probability that a third party (entrant) will become the innovation leader while, in addition, ensuring that the merged firm, should it become the innovation leader, will preserve its combined capabilities for longer. This reflects a common intuition that when there are complementarities (in this case, between production and innovation-based capabilities) integration is preferred to non-integration. As will be demonstrated below, this conclusion is qualified if innovation leaders choose the rate of innovation.

*Figure Two: Acquisition Equilibrium Outcomes*
Comparing Licensing and Acquisition

Of course, often, firms may have options of choosing between licensing and acquisition as a mode of cooperative commercialization. Comparing (1) and (2), acquisition will have higher gains from trade than licensing if:

\[
\delta(\sigma_p - \sigma_i)(V_i - v_i) - \delta \sigma_p v_E \geq \delta(\sigma_p - \sigma_i)(V_i - v_E - v_i)
\]

\[\Rightarrow (\sigma_p - \sigma_i)(V_i - v_i) \geq \sigma_i v_E \tag{3}\]

The interpretation here is quite intuitive. Acquisition yields the benefit of a potentially higher probability of incumbent innovation leadership with the cost of losing a chance at an entrant position in the next generation.

Substituting the equilibrium payoff values determined by (VI), (vI) and (vE) (or (vI)” or (vE)” for that matter) into (3) implies that (3) will hold if and only if:

\[
\sigma_p - \sigma_i \geq \sigma_i \tag{4}
\]

Notice that acquisition is preferred to licensing if \( \sigma_p \geq \sigma_i + \sigma_p \); that is, whenever it would otherwise be an equilibrium. This is because acquisition has the additional impact of reducing the probability that third parties become the innovation leader. Figure Three depicts the equilibrium outcomes.
Empirical Implications

Figures One, Two and Three provide a clear set of empirical predictions as to when we might expect to observe cooperative rather than competitive commercialization. The empirical challenge in verifying this theory is in finding proxies for the dynamic capabilities themselves. While these will likely reflect the market and institutional structure of industries under study, the dynamic capabilities here are specifically related to experience in various previous activities. For example, the production-based dynamic capability could be captured by variables that identify experience in production including the number of product launches, the level of past sales, the longevity of the firm as a producer. The innovation-based dynamic capability could be captured by measures of innovative experience including the level of past research and development and the stock of patents generated. For firms that have both innovation and production experience these measures would have to be interacted to capture any synergies that...
might arise. Thus, the theory provides a basis for the collection of data to understand the dynamic drivers of commercialization choice.

3. Extensions

The model above is simplified so as to highlight the main dynamic consequences that arise from negotiations for the market. Here I examine two extensions that are illustrate how some additional factors – namely, the static drivers of cooperation and the potential endogeneity of the rate of innovation – impact upon the results above.

Static drivers and product market competition

In SW, innovation and entry by an entrant innovator leads to a single period of product market competition. To capture this here suppose that during that period of competition, the entrant, with its superior product, could earn a fraction, $\alpha$, if monopoly profits while the displaced incumbent would earn 0. Following that period, as in SW, the entrant can earn monopoly profits for as long as it remains the incumbent.

In this case, two things change. First, under competition, $(\nu_E)'$ becomes:

$$

\nu_E = -\delta (1-\alpha) \Pi + \delta \nu_i' + (1-\sigma_i) \delta \nu_i

$$

Second, the gains from trade from licensing (1) becomes:

$$

\Pi - \tau + \delta \sigma_p \nu_i + \delta (1-\sigma_p) \nu_i' + \tau + \delta \sigma_p \nu_E - \delta (1-\alpha) \Pi + \delta \sigma_i \nu_i' + \delta (1-\sigma_i) \nu_i

$$

Joint Payoff from Cooperation

Joint Payoff from Competition

$$

\Rightarrow (1-\alpha) \Pi + (\sigma_p - \sigma_i)(\nu_i - \nu_E - \nu_i') \geq 0

$$

This will also change the negotiated licensing fee to take into account the additional static benefit relative to competition of $(1-\alpha)\Pi$.

This increases the range of parameters where licensing is an equilibrium but the question
of interest is whether, when the dynamic component is negative, can it outweigh the static benefits, making competition an equilibrium? To see that competition can still be an equilibrium, note that the dynamic components have greater weight the less the future is discounting. Letting $\delta$ approach 1, and substituting in equilibrium values for the payoffs, (5) becomes:

$$1 + \frac{(\sigma_p - \sigma_i)(\sigma_{iq} - \sigma_i - \sigma_p)}{(1-\sigma_i)(1-\sigma_{iq})} \geq \alpha$$

(6)

Figure Four depicts the resulting outcome.

Figure Four: Licensing Equilibrium Outcomes

Now suppose that $\sigma_{iq}, \sigma_p \rightarrow 1$, then the LHS of (6) becomes infinitely negative and can never hold. Thus, at this extreme, competition is an equilibrium. On the other hand, the reverse does not hold. That is, as $\sigma_{iq}, \sigma_i \rightarrow 1$, then (6) becomes positive always. This means that competition, as an equilibrium, when there is potential product market competition, is preserved when $\sigma_p >> \sigma_i$ but not for the reverse. This is because, at those extremes, $\sigma_{iq} < \sigma_i + \sigma_p$ but it is
only where productive capabilities are relatively high that firms choose competition so as to maximize the chance that the (previous) incumbent becomes the next innovation leader.

This adds additional insight into the informal argument that a higher $\sigma_i$ should be associated with competitive rather than cooperative commercialization. When there are short-term gains from cooperation, it turns out that the cases where a higher innovative capability leads to competition do not arise because, in this case, joint payoffs are maximized by keeping the entrant in the entrant role; something that is achieved by cooperation and not competition. This is the opposite of what the informal arguments were suggesting.

*Endogenous rate of innovation*

One key aspect of SW that is abstracted away from in the model here is the choice over the rate of innovation by an innovation leader. In the model thusfar, it is assumed that once an innovation leader is selected, that firm generates a new product immediately. To accommodate the notion that innovating may take time, it is assumed that stage 3 – the innovation stage of the game – involves the innovation leader engaging in research effort until such time as an innovation appears. During that stage, the incumbent earns $\Pi$ in each period (and periods are still assumed to be discounted by a factor of $\delta$).

Following stage 1, having been selected, the innovation leader continues in that position until an innovation is actually generated. The innovation leader ($E$ or $I$) chooses research intensity, literally, the probability that an innovation is generated in any given period ($\phi_e$ or $\phi_i$) where the choice lies in the range, $[\phi,1]$. It is assumed that, regardless of the level chosen,
research intensity involves no cost.\textsuperscript{17} This simplifies notation because, as proven in Proposition 3 below, incumbent innovators face negative marginal returns to research intensity while entrant innovators face positive marginal returns. Consequently, in equilibrium, $\hat{\phi}_I = \phi$ and $\hat{\phi}_E = 1$. This allows us to parameterize the life of firm in a particular role; especially the incumbent.

The fact that $\hat{\phi}_I < \hat{\phi}_E$ adds a new dimension to the value of incumbency. While in the baseline model, $V_I \geq v_I + v_E$ is equivalent to $\sigma_p \geq \sigma_i + \sigma_p$, here, having an incumbent innovator increases the expected life of the current innovation and the length of time the producer of that product generation can earn monopoly rents. This makes it more likely that $V_I \geq v_I + v_E$ and the incumbent and entrant will want to reach an arrangement that maximizes the probability that one of them becomes an incumbent innovation leader. The insight drives the following result:

**Proposition 3.** Licensing is the unique Markov perfect equilibrium if and only if:

$$\left(\sigma_p - \sigma_i\right)\left(1 - \phi(1 - \sigma_p) - \sigma - \sigma_p \right) \geq 0$$

Otherwise, competition is the unique Markov perfect equilibrium.

The critical elements of the proof of this is the recognition that (1) still determines the gains from trade while the returns to an additional unit of innovation intensity by the entrant is given by $\tau - (1 - \sigma)_I \delta v_E > 0$, while the return to the incumbent is given by $(1 - \sigma_p) \delta (V_I - v_I) < 0$; resulting in the incumbent choosing the minimum innovation rate to reduce the risk of losing control as an innovation leader while the entrant innovators more intensively so as to earn the license fee sooner. The details of the proof are in Gans (2010).

Licensing serves a similar dynamic role to that in the baseline model. The choice of whether to license or not determines who is likely to become an incumbent innovation leader. In

\textsuperscript{17} This can easily be introduced with little change to the results (see Gans, 2010). In addition, Gans (2010) demonstrates that more than one firm can be innovating towards a new product generation and the results below are largely unchanged.
this case, having an incumbent innovation leader increases the value of the innovation and so it is more likely that $V_i$ will exceed $v_i + v_e$ even if $\sigma_{ip} < \sigma_i + \sigma_p$. Thus, the qualitative results from the baseline model continue to hold. However, it is now the case that the choice of licensing conditional on relative innovation-based and production-based capabilities will have an impact on the rate of innovation observed in the industry.

This interaction is stronger when negotiations are over whether an entrant firm is acquired by the incumbent. In this case, acquisition occurs if and only if $\sigma_{\text{ip}} - \sigma_i - \sigma_p \geq -\delta(1-\phi)\sigma_p(1-\sigma_{ip})$. Notice that this is a weaker condition than in Proposition 2 and now $\sigma_{\text{ip}} \geq \sigma_i + \sigma_p$ is not a necessary condition for acquisition. Moreover, whenever acquisition takes place it results is a lower expected rate of innovation in the industry.

Finally, the relative returns to acquisition over licensing are also impacted on by the reduced incentives of an incumbent innovation leader. Specifically, acquisition occurs rather than licensing if and only if: $\sigma_{\text{ip}} - \sigma_p - \sigma_i \geq -\delta(1-\phi)\sigma_i(1-\sigma_{ip})$ which again is a weaker condition than (4). Thus, the returns to acquisition over licensing are higher when the incumbent has the ability to slow down the rate of innovation.

4. **Alternative Contracting Possibilities**

In the baseline model, the only opportunity for a commercialization choice to be made is when an entrant develops a new innovation. At that point, there is still uncertainty as to who will be the innovation leader in the next generation. Consequently, the choice involves a commitment as to roles in the industry prior to the resolution of that uncertainty. This is a natural timing given that such uncertainty may be resolved long after the innovation is generated and the empirical evidence suggests that cooperative agreements, if they occur, are
struck close to the time a patent is generated (see Gans, Hsu and Stern, 2008).

Nonetheless, it is useful to consider alternative contracting possibilities that alter the timing upon which commercialization choice or roles in the industry might be chosen. In this section, I consider three such variations including restructuring by an incumbent, delay negotiation or renegotiation and partial capability acquisition. These provide alternative predictions on commercialization choices that may be applicable in certain empirical environments.

**Restructuring and spin outs**

In the model thusfar, the only way an incumbent innovator can emerge is if an incumbent producer of the current generation becomes the innovation leader for the next generation allowing it to acquire innovation and production-based capabilities together. This is desirable if $\sigma_p \geq \sigma_i + \sigma_p$ implying that an incumbent innovator receives a higher payoff than the sum of returns to an incumbent and an entrant innovation leader.

However, what if $\sigma_p < \sigma_i + \sigma_p$? In this case, an incumbent innovation leader earns a lower payoff than if it and an entrant innovation leader were separate. In this case, an alternative possibility that may be available would be for the incumbent, having been selected as an innovation leader and acquired the ‘know how’ to innovate towards the next product generation to restructure itself. That is, rather than continue to research and acquire, within the same firm, both production and innovation experience, it could *spin-out* a separate innovator entrant from its incumbent producer.

If such restructuring was feasible and separate firms could specialize in producing the current generation and innovating towards the next, what impact will this have on observed outcomes in negotiation for the market? For both licensing and acquisition, this will only
change outcomes where $\sigma_{ip} < \sigma_i + \sigma_p$ because otherwise no restructuring will take place. Thus, it will not impact on the acquisition case. In the licensing case, the fact that restructuring can occur implies that $V^i_j = V_I + V_E$. Examining (1), the gains to trade from licensing become zero and so static drivers would be expected to dominate in the commercialization choice.

**Delayed negotiation**

When $\sigma_{ip} \geq \sigma_i + \sigma_p$, an incumbent and entrant have a joint interest in maximizing the probability that the producer of the current generation is also the innovator for the next generation. In the baseline model, negotiations over who is that producer take place prior to the determination of who the innovation leader in the industry is. Consequently, while negotiations allow the parties to increase the likelihood that one of them becomes the innovation leader, after the fact, that still may not arise.

The issue to be examined here is whether there are actions the incumbent and entrant can take to eliminate that risk. For instance, one possibility would be to delay any negotiations until it is determined who the innovation leader is. If the innovation leader turns out to be the previous entrant, no negotiations will take place and that entrant will become an incumbent innovation leader. If the innovation leader turns out to be the previous incumbent, a licensing deal will arise with the production rights transferred to that firm who can continue to acquire a production-based capability alongside innovation based-capabilities. Interestingly, the same licensing deal is possible even if the innovation leader turns out to be a new entrant.

These considerations imply that, if the innovation leader is an entrant, the payoffs to that entrant and the current incumbent at the end of the previous period that involved an entrant innovation leader are:
\( v_E = \delta (\sigma_i V_f + (1-\sigma_i)\tau) \) \hspace{1cm} (7)

\( v_f = \Pi + \delta \sigma_p (V_f - \tau) \) \hspace{1cm} (8)

That is, an entrant innovator expects to become an innovation leader with probability \( \sigma_i \) and to sell its production rights otherwise while a non-innovating incumbent expects to earn the monopoly rents and, if it becomes the innovation leader to purchase production rights from the previous entrant.

What is interesting here is that the licensing deal may not be between the entrant and incumbent but between the entrant innovator and a new entrant. In either case, the sale of a production rights creates an incumbent innovation leader as opposed to having a separate entrant innovator and non-innovating incumbent. Thus, using the Nash bargaining solution, \( \tau = \frac{1}{2}(V_f + v_f - v_E) \). Substituting this and solving using (VI), (7) and (8), it is straightforward to show that a licensing agreement will be reached if and only if \( \sigma_p \geq \sigma_i + \sigma_p \). Compared to Proposition 1 this expands the domain where a license agreement is reached relative to where competition occurs.

Delayed negotiation is not the only means by which this outcome could arise. In general, renegotiation can take place whereby a licensing deal is undertaken prior to the selection of the next innovation leader and upon that selection, whoever holds production rights to that product generation, negotiates to sell them to the innovation leader.

That said, the scope for renegotiation depends critically upon the incidence of the acquisition of production-based capabilities. The baseline model – for notational convenience – sets the timing of the acquisition of these capabilities to be after the selection of the next innovation leader. However, it is easy to imagine many instances whereby the acquisition of those capabilities occurs when the new product innovation is generated and a significant time
prior to the emergence of revelation of the next innovation leader. In this case, the only time whereby licensing or other forms of cooperative commercialization can determine who realizes those production-based capabilities is prior to the resolution of uncertainty as to who might acquire complementary innovation-based capabilities. Put simply, in some environments, there may be no simple way of using contracts to combine the two types of capabilities. That said, ultimately, whether this is possible or not is an empirical issue.

**Entrant participation in production**

While direct renegotiation over production rights in a way that allows production and innovation-based capabilities to co-evolve may not be possible, one practice that has been observed is start-up innovators negotiating co-promotion and other production-related rights as part of licensing deals. For instance, Wakeman (2008) identifies that about one third of all start-up deals in his biotechnology sample involved start-up firms retaining roles in marketing, sales, clinical trials and development collaboration. While his interpretation of such arrangements is to increase a start-up’s ability to commercialize independently in the future, it is also possible that this is a means of gaining experienced based capabilities that combine innovation and production elements. In other words, rather than having just $\sigma_i$ as the probability of becoming a future innovation leader, this arrangement allows the start-up to generate a probability, $\sigma'_p \in (\sigma_i, \sigma_p)$ of becoming the next innovation leader.

There are several implications of this possibility on the analysis thusfar. First, the condition as to whether such a licensing arrangement is entered into or not becomes:

$$\Pi - \tau + \delta \sigma_p V_t + \delta (1 - \sigma_p) v_j + \tau + \delta \sigma'_p v_E \geq \Pi + \delta \sigma_p V_E + \delta \sigma'_p V_t + \delta (1 - \sigma_i) v_j$$

$$\Rightarrow (\sigma_p - \sigma_i)(V_t - v_j - v_E) \geq (\sigma_i - \sigma'_p) v_E$$

(9)
which is involves a larger set of parameters than in Proposition 1 holding $\sigma_p$ constant (although strictly speaking that parameter is likely to be lower as a result of such an arrangement). Second, comparing licensing to acquisition, $(\sigma_{\text{acq}} - \sigma_p)(V - v_f) \geq \sigma_{\text{acq}}^* v_E$ is less likely to hold meaning that acquisition may not occur even if $\sigma_{\text{acq}} \geq \sigma_i + \sigma_p$. This is intuitive as the capabilities transferring properties of licensing have improved. Finally, it is easy to see that the license payment to the start-up firm will be smaller the higher is $\sigma_{\text{pr}}$. This is consistent with Wakeman’s (2008) evidence that start-up firms who are in a stronger financial position (i.e., less cash constrained) are more likely to enter into co-promotion licensing deals with incumbents.

5. Conclusion and Future Directions

This is the first paper to consider the option of negotiating for the market in a dynamic environment underpinned by competition for the market. It was demonstrated that dynamic considerations impact upon this decision in a way not captured by a purely static focus. In particular, the on-going roles of the parties of a licensing deal matter in terms of rent capture and the returns to licensing over competition. In turn, these on-going roles are related to dynamic capabilities – that is, the probability that a firm will have an innovative advantage in research towards the next generation of product based on its current role (as entrant or incumbent).

In this regard, perhaps the most interesting finding was that entrants and incumbents may not sign cooperative licensing agreements even though this would prevent the dissipation of monopoly profits and duplication of complementary investments. This occurred because to do so would send the entrant back to compete for the next generation of innovation in situations
where the incumbent had stronger capabilities in this regard. This naturally leads to the question as to whether the firms could choose which one of them would return to innovative competition and which would remain as the incumbent.

This is an interesting issue and in many respects goes to the heart of what a dynamic capability is and how it is acquired. An incumbent is likely to be strong because of its previous product market position and this likely relates to investments it has made in the past. An entrant would have to similarly make those investments to strengthen its future role and thus, one of the gains from licensing (preventing such duplication) would be lost. In addition, with anti-trust laws, it is not clear that the incumbent could cede its product market position so readily. Non-exclusive licensing might play a role here but there would be some on-going dissipation of monopoly rents. Similarly, the entrant could acquire the incumbent. However, this might necessarily preclude it from becoming a strong innovative entrant unless some form of restructuring was possible. Thus, there appears to be good reasons why changing positions is not a simple choice and so it is natural to explore innovative dynamics when this is impossible. However, a proper exploration of these issues remains an open area for future research.

There are several other directions in which the results of this paper could be extended and explored in future research. First, in this paper, dynamic capabilities were considered exogenously. Either firms had them (to a certain degree) or they did not. In reality, the acquisition of such capabilities is likely to be a key and on-going strategic choice for firms. Thus, endogenizing this choice and relating those capabilities to more fundamental market conditions (as in Sutton, 2002) would appear to be a promising avenue for future research. The model here provides a framework upon which such an extension might be based.

Finally, this model shares with many others a simple consideration of innovative
strategy – namely, innovative intensity. Recent work by Adner and Zemsky (2005) goes beyond this to consider impacts on other strategic variables such as prices, market monitoring, firm size and the rate of overall technological progress. Their model is dynamic but does not consider the choice of commercialization strategy – it only considers a competitive route for start-ups. Linking their approach with the endogenous choice of commercialization strategy as considered here may lead to a richer picture of the innovation environment and the role of displacing or disruptive technologies on market and technological leadership in an industry.
References


