Oxera

Agenda

Advancing economics in business

Economics in managerial decision-making: the case of patent licensing

Strategic decision-making always takes place under uncertainty—not least when it comes to patent licensing. Luckily, clever use of economics can provide a small but decisive edge. Dr Pekka Sääskilahti, Director of Economics, Nokia Corporation, discusses some possible best practices in using economics to support managerial decision-making in patent licensing, with a focus on the telecommunications industry

Patent licensing in the telecoms industry is characterised by heavy litigation, with notable recent cases between Apple and Samsung, Apple and Nokia, and Nokia and Qualcomm. Patent litigation is costly, and one might question why it takes place at all, since the sums at stake are high and the parties could avoid business disruptions and save on litigation costs by licensing instead. Indeed, as predicted by Coase's famous theorem, parties can reach an agreement, and any misallocations of value are cured, if property rights are well defined.[1] But it is also well known that many imperfections cause Coase's theorem to fail, resulting in efficiency losses. Data suggests that the losses are not small—for example, in the USA in 2005, 3.4% of disputes were not agreed but determined through a court process,[2] and a major patent litigation in the telecoms sector may involve hundreds of workers over the course of several years. Thus, inefficiency in reaching licence agreements seems puzzling, but it becomes less so when firms' private motives are analysed from the perspective of game theory.

Litigation as an economic good

Patents are difficult to license. Nobody really wants a licence, but sometimes it is better to have one. The 'good' that is traded in licensing is not the technology itself—rather, the patent-holder simply provides assurance that they will not sue the licence-holder for infringement. Sure, this may involve elements of technology transfer, as an early licence may allow more efficient future research and development (R&D) paths, but in general, licensing is only about bargaining how to share the profits that the alleged infringer can make, and litigation is just an inherent extension of negotiations.

As a process rather than a one-off event, the costs of litigation are incurred over time, but the gain is realised only at the end of the process. Hence, for the negotiating parties, the questions are how the value of a licence evolves during negotiations, and when to accept the offer on the table. Also, as noted, litigation involves uncertainty, and parties may hold highly asymmetric views at the start of the negotiations about the probability that the patent will be found to be valid and infringed. Consequently, actions that improve the available information give an advantage in the negotiations.

Underlying any dispute is the question about the value of patents. Patent valuation methodologies have been under progressive development in both the academic literature and practical applications, and it is an area where economics helps.[3] The nature of economic analysis is typically backward-looking, focusing on the value of historical infringement and appropriate damages.

The focus shifts from the past to the future when economics is applied in the context of managerial decision-making. To my knowledge, firms do not typically employ economists to undertake advanced modelling to support licence negotiations. One reason is that, in approaching the issue from a damages analysis angle, economists often focus on getting the final number 'right'. A skilled economist stands out here. Rather than providing an estimate for the final number, a more reasonable approach is to describe the possible states of the world (ie, assumptions) and explain the optimal strategies in each state. The challenge is how to construct a model that captures the key drivers for decision-making. As a result of such an

The content in this article is based on recent literature, and the views are those of the author. They do not necessarily represent those of Nokia or any other party mentioned.

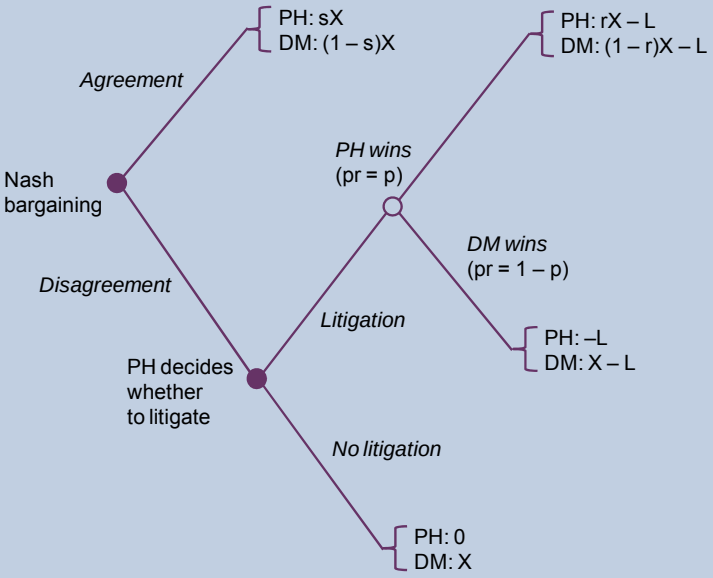
analysis, management has to state explicitly which set of assumptions they believe in, and make their decision accordingly. That's their job, not the economist's.

In the box below, I illustrate how the value of a patent licence flows from the threat of litigation, and how a decision can be framed in terms of assumptions. Licence negotiations involve considerable strategic planning, legal tactics, and negotiation skills, yet the optimal strategy can be summarised as a set of actions that make the counterparty's case of not agreeing as bad as possible, while controlling the own costs of not agreeing. In other words, the player who has less to lose if the negotiations break up will have the upper hand. The effectiveness of different tactics can be understood only with a good grasp of the determinants of the licence fee.

Moving towards the real world: failure of Coase's theorem, and how to get the upper hand in negotiations

So far, so easy. Problems start compounding when the licensing case becomes more extensive. Allowing design-around and invalidation, or the explicit modelling of injunctions, makes the computations more complex, but the prediction from the model described here is still that the parties reach early agreement. The same applies to cross-licensing situations. Under what circumstances would the theory actually predict litigation, or even prolonged litigation? Transaction costs and asymmetric information have been found to lead to the failure of Coase's theorem, yet they should not impede negotiation agreements in cases involving corporations with ample resources. Indeed, the main point is not whether an agreement is eventually signed, but who gains from prolonging the litigation.

A simple illustration of patent licensing



- **Two players: the PH and the DM.**
- **Value of the patented innovation is X (DM has implemented the innovation in its product).**
- **Nash bargaining in the first stage where PH's bargaining power is $0 \leq \beta \leq 1$, and, if no agreement is reached, PH chooses whether to litigate.[1]**
- **I assume that litigation is profitable on expected terms.**
- **PH (DM) wins the court case with probability p (1 – p).**
- **If PH wins the court case, it receives rX, $0<r<1$, where r is 'court-imposed profit share'.[2]**
- **Both players pay their own legal fees L (assumed symmetric)—ie, American system.**
- **The solution is obtained by backward induction, and the equilibrium licence fee is $s^*=pr – (1 – 2\beta)L/X$.**

Let's look at the patent-holder's case at the point where the alleged infringer has made an offer, R, for a licence. Should this be accepted? Typically, the next step would be to find the most accurate estimate for the equilibrium licence fee s*, and the offer on the table should be accepted if R > s*. However, this is not a helpful way to frame the decision, and it might be imprudent if the analysis needs to be produced as part of legal discovery.

Fixing s* with historical data, or by using well-known benchmarks (eg, the Goldscheider rule,[3] also known as the 25% rule), can actually be counterproductive, as this data affects the risk preferences of the licensing team. I explain this in more detail below. Rather than framing the decision in terms of the best guess of s*, it should be framed in terms of the potential ranges of the key determinants of s*—ie, the assumptions.

Note: **PH**, patent-holder; **DM**, downstream manufacturer; **X**, value of innovation; **L**, litigation cost; **r**, court-'imposed' sharing rule; **p**, patent strength (PH's probability of winning); and **s**, agreement sharing rule. [1] The bargaining power can be rationalised by the relative discount factors of the negotiating parties. [2] The model abstracts away, for example, injunctions. Therefore, if the patent-holder wins the court case, they receive damages and automatic injunction. But since both players would find it profitable to sign a licence so that the manufacturer can continue selling, I make the assumption that the value of damages and a forward licence equals rX. [3] See, for example, Goldscheider, R. (1995), 'The Negotiation of Royalties and other Sources of Income from Licensing', *IDEA: The Journal of Law and Technology*, **36**, pp. 1–17.
Source: The model is a simplified version of models analysing patent licensing. See, for example, Farrell, J. and Shapiro, C. (2008), 'How Strong Are Weak Patents?', *American Economic Review*, **98**:4, pp. 1347–69, September; and Shapiro, C. (2010), 'Injunctions, Hold-Up, and Patent Royalties', *American Law and Economics Review*, **12**:2, pp. 509–57.

Asymmetric information tends to result in differing positions about the patent value, and can therefore increase the likelihood of litigation. Litigation has the benefit of reducing informational asymmetry, as parties learn about the patent during the course of the case. An agreement is easier to reach with more common information. When information is revealed gradually over the course of litigation, the game is similar to a 'war of attrition', where the players stay in the game and incur costs (lawyers' fees, proactive design-around costs, opportunity costs for management time) until one player finds it profitable to give up. Having gained better information—especially, an understanding of what information the counterparty has—is an advantage, while revealing information to the opponent can also be profitable if it changes their behaviour in the desired direction. A realistic theoretical model helps in hypothesising about the information that the counterparty is relying on and its strategy. For example, I would typically seek to understand the counterparty's financial model (in one case, I was even able to assess their discount rate reasonably well). This information helps to optimise the term structure of a licence.

Any major licensing case involving litigation has a long time horizon (a period of two years or more is not atypical), and the game can change shape during the negotiations (eg, with the arrival of new case law). In anticipating such changes, a firm might seek to prolong the litigation. This creates value that is captured by the firm by staying at the negotiation table (and paying lawyers' fees) and observing how the game changes with the arrival of new information. This set-up corresponds to a real options model. If the firm ignores the option value, it may enter into an agreement 'too early' or at sub-optimal terms.

To increase the probability of winning in court, the plaintiff often selects multiple patents to sue with. The key to assessing the probability of winning a case is to understand how correlated the probabilities of infringement and validity of the patents in question are. At the extreme, when all the patents come from the same line of research and have been prosecuted by the same people, the correlation is close to one. In this case, if the defendant knocks one patent down, they knock them all down. The main point of litigating with multiple patents is that it increases the probability of winning, but the trick is to find quality patents that are also sufficiently independent. This is not a trivial task when a respectable portfolio can consist of more than 10,000 patent families. Technical and legal screening can be made easier through efficient portfolio management, but the size of the portfolio means that a statistical approach is helpful. The academic literature has approached this problem ingeniously with a real options approach using patent renewals to estimate the private value of patents. This approach can be taken much further with the in-house data that corporations possess. As a result, sophisticated portfolio management tools can also help in gaining the upper hand in licensing negotiations.

One reason for prolonged litigation can be strategic commitments.[4] A player may find it optimal to tie their hands on something that increases their payoff from not agreeing, which consequently increases their

Licensing in the telecoms industry

There are specific characteristics of the telecoms industry that make efficient licensing difficult. Technological innovation takes place in many firms and non-profit institutions. The response to the division of R&D has traditionally been standardisation, which reduces the transaction costs of access to innovation and increases the size of the end-product market by guaranteeing compatibility between the products of different vendors. Standardisation is thus a mechanism to transfer technology, but it presupposes that the rights to the standardised technology are well defined. To ensure this, a firm owning patents critical to the standard is obliged to declare them as 'essential'. Typically, it is also asked to promise to license them under fair, reasonable and non-discriminatory terms (FRAND), for example.[1] Conflicts tend to arise because of the following practices.

- **Although the vast majority of FRAND licence agreements are entered into amicably, FRAND as a concept can lead to variations in interpretation that may escalate to litigation—even 'free-riding' standard essential patents by trying to avoid obligations to compensate for the use of intellectual property.**
- **Because essentiality declarations are not screened for accuracy, there is an incentive to over-declare in order to expand one's essential patent portfolio.[2] Known as 'padding', this leads to more asymmetric information and high uncertainty about the true essentiality of the patents.**
- **In many cases, standardisation is a cumulative process that takes years. For example, 3G standard, UMTS, was initiated in 1998. It builds on older GSM and CDMA standards, but the first commercial network was launched only in 2001, and mass-market handset volumes were reached a few years later. Due to the evolutionary nature of standard-setting, an efficient early licence agreement may be difficult to find as the parties cannot contract on all relevant future contingencies.**

Note: [1] Giving a FRAND commitment is voluntary—although, if a FRAND commitment is not available, the standards-setting organisation would need to 'design around'. [2] See Dewatripont, M. and Legros, P. (2008), '"Essential" Patents, FRAND Royalties and Technological Standards', CEPR Discussion Paper no. 6925.

equilibrium licence payoff. Such commitments in patent litigation are common in firms that are running licensing as a business. The licensor can create a position in an agreement that is contingent on future licensing cases. A typical example is the most-favoured-nation (MFN) clause, which implies a reduction in royalty income from previous licences with MFNs if the same patents are licensed later on more favourable terms.

Adding multiple patents, incorporating potential changes in the game structure, and extending the time horizon make the economic model computationally more complex, and an analytical result quickly becomes out of reach. When it is not possible to obtain such a result, a numerical result can still be computed by working with scenarios or simulations. A simulation is often particularly helpful as it gives not only the expected values for possible actions, but also a probability distribution that can be used in assessing the robustness and risk profiles of the optimal actions.

Identifying and exploiting behavioural biases: a laboratory experiment

The prediction from the theoretical model, even if extended to be more realistic, is that rational parties eventually reach an agreement—yet there is empirical evidence that many cases are never settled. Hence, together with two academic colleagues, I investigated whether there was an explanation for the inefficient litigation conundrum from outside standard rational economics. In Miettinen, Ropponen and Sääskilahti (2011),[5] we use the bargaining model illustrated in the box on page 2 in a laboratory experiment to test people's rationality, risk preferences, and deviations from self-interest preferences. See the box below.

Our first observation is that people are not perfectly rational in the experiment, as they litigate much more often than is optimal. Second, counter to conventional wisdom, an increase in risk surrounding the court judgment induces more litigation, particularly when the costs of litigation are high. This has three alternative explanations:

- people erroneously think that they have control of uncontrollable random events;
- people fall into social comparison of payoffs between the roles of the patent-holder and the defendant, and, in pursuit of higher equity, the patent-holder who has lower payoff is willing to take legal action, even if it constitutes a negative expected value bet;
- people over-weight low-probability events.

Our evidence points to the second explanation. The fundamental reason is that differences in the game payoffs cause bias in self-regarding preferences. After failed negotiations, the patent-holder faces a lower payoff than the manufacturer, and compares this payoff difference against some reference payoff difference that the patent-holder had in mind during the negotiations (ie, a more equitable one). The post-negotiation situation therefore constitutes a 'loss domain' for the patent-holder, who, in turn, seeks to bridge the payoff gap with a negative expected value bet—by taking a legal action. We show that increasing risk and litigation costs actually strengthen the litigation motive, since the payoff gap is reduced most if the patent-holder wins. This finding goes against the earlier literature. Interestingly, we find that the patent-holder's social comparison-driven litigation strategy is correctly anticipated by the manufacturer. We observe more settlements in initial negotiations when litigation costs are higher than in other test situations, but this is not due to cautious demands in bargaining by the defendants (who are anticipating a high rate of litigation). Rather, it is because the patent-holders are risk-averse during bargaining. Hence, there is a reversal of the patent-holder's risk preferences between negotiations and litigation. In negotiations, patent-holders are risk-averse (less aggressive), as a settlement would give them a positive payoff gain, but, if the negotiations break, they become risk-loving (aggressive) as the social comparison drives them to try to regain lost ground with a desperate bet.

The reference point that emerges during negotiations determines the risk preference of the patent-holder. In addition to the social comparison, we find that the aspiration level about the negotiation outcome influences the reference point. This has an interesting implication for real-world decision-making. If the management sets high financial targets for the negotiation team, it simultaneously influences the team's risk behaviour. For example, the management

The pros and cons of laboratory experiments

In our study, the pros and cons were as follows.

- **A laboratory experiment gives the benefit of control of the external environment, which cannot otherwise be reached. We are able to evaluate different policy regimes.**
- **An important benefit is the possibility of observing what kind of settlements take place, so we do not suffer from the selection bias present in real-world litigation data (data available *only* from cases that have been litigated).**
- **We can directly compare agreements while, in the real world, the licence agreements are typically designed *not* to be comparable for strategic reasons (eg, in order to 'design around' MFN clauses).**
- **A laboratory environment differs from the real world, challenging the applicability of laboratory results.**

might set an incentive scheme that pays out only if the negotiation team reaches an agreement with very favourable terms. Since the negotiation team has to exert effort to do well, their assessment of the personal bonus scheme puts them in a similar position to that of the patent-holder after negotiations have broken down, if the team's own judgement of a feasible outcome falls below the set target. As a result, the negotiation team will adopt a high-risk (high-reward) strategy. At the same time, the management may prefer a risk-averse strategy (in order to minimise losses in the adverse case, for example), which results in misaligned incentives. The problem for an economist supporting management decision-making is to accommodate the complex risk preferences in the model. A typical discounted cash-flow model is risk-neutral, so it seldom reflects the preferences of both management and the negotiation team. The economic advice should consist of not only the optimal strategy under different assumptions about the value drivers, but also the risk profiles of different strategies, which can then be used to agree explicitly on the acceptable risk.

Concluding remarks

I have introduced a simple model for analysing patent licensing and provided some guidance for how it can be augmented and exploited in real-world licensing cases. The model is the work horse for 'old-school' licensing, but it is of relevance to newer areas of intellectual property rights (IPR) business, such as the market for patents or designing IPR-based ecosystems.

Finally, competitive advantage is created by using tools that are hard to replicate. The development of such tools involves high risk, and shares similarities with the process of scientific research. Therefore, the management's role is critical in tolerating high risk to support the application of advanced economics in business.

Pekka Sääskilahti

[1] Coase, R. (1960), 'The Problem of Social Cost', *Journal of Law and Economics*, **3**, October, pp. 1–44.
[2] Langton, L. and Cohen, T.H. (2008), 'Civil Bench and Jury Trials in State Courts, 2005', Bureau of Justice Statistics Special Report, October.
[3] See Oxera and a multi-jurisdictional team of lawyers led by Dr Assimakis Komninos (2009), 'Quantifying Antitrust Damages: Towards Non-binding Guidance for Courts', study prepared for the European Commission Directorate General for Competition, December.
[4] See Ellingsen, T. and Miettinen, T. (2008), 'Commitment and Conflict in Bilateral Bargaining', *American Economic Review*, **98**:4, pp. 1629–35.
[5] Miettinen, T., Ropponen, O. and Sääskilahti, P. (2011), 'Gambling for the Upper Hand – Settlement Negotiations in the Lab', *Jena Economic Research Papers*, **5**, no. 2011-022.