

Explaining the Remuneration Structure of Patent Licenses

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INTRODUCTION

Markets for technologies are growing at an increasing pace (Arora, Fosfuri & Gambardella, 2001; Gans & Stern, 2003; Mendi, 2007; Rivette & Kline, 2000). Licensing is the most visible mechanism employed to exchange technologies among firms (Athreye & Cantwell, 2007; Kamyiama, Sheehan & Martinez, 2006). Nevertheless, there is an increasing evidence revealing the existence and relevance of several problems that still hamper license negotiations, mainly due to the difficulty for both the licensee and the licensor to reach mutually acceptable financial and non-financial contractual terms (Cockburn, 2007; Razgaitis, 2004, 2005, 2006). For this reason, it emerges that valuation issues and the design of an appropriate remuneration structure become crucial for the achievement of a satisfactory licensing agreement. Accordingly, the aim of this paper is to analyze the determinants of the remuneration structure of a patent license. First, we explicitly focus, theoretically and empirically, on the determinants of the remuneration structure of patent licenses, and in particular on the role of the upfront fee. Second, we embrace the licensee's perspective to explain the remuneration structure by referring to two theoretical approaches: agency and real options theory. Specifically, consistent with real options theory, we consider the initial fee paid by the licensee analogous to the premium of an option to commercialize the patented technology in the future. As such, the upfront fee should be positively affected by market uncertainty and technological potential. Using a sample of 124 licenses involving about 900 USPTO patents, while controlling for several dimensions of the licensor/licensee relationship, the licensed patents, and industry characteristics we find overall support for these ideas.

THEORETICAL FRAMEWORK AND HYPOTHESES

The upfront fee and the royalty rate are the main economic parameters to be defined before entering in a patent license. So far, theoretical and empirical work has examined the choice between different forms (regardless of their amount) of licensing contracts, mainly fee-based, royalty.-based or fee- and royalty-based. The main determinants of these choices are risk sharing and information asymmetries (e.g., Gallini & Wright, 1990; Bosquet et al., 1998). A different stream of literature, instead, has examined this problem within the framework of agency theory, focusing on franchising contracts. The basic idea is that the remuneration structure needs to address a problem of two-sided moral hazard (Bhattacharyya and Lafontaine, 1995; Brickley, 2002; Lafontaine, 1992; Lafontaine and Shaw, 1999; Lal, 1990). In few words, the existence of royalties provides an incentive to both franchisors and franchisees to produce a greater effort through the mechanism of revenue sharing. This problem of double-sided moral hazard can be extended to several contracts based on profit or revenue sharing, including licenses (Bhattacharyya & Lafontaine, 1995). The principal assumption characterizing these models holds that the remuneration structure of the contract (upfront fee and royalties) is negotiated in two steps (e.g., Brickley, 2002; Lafontaine, 1992; Lafontaine & Shaw, 1999). Indeed, after fixing r^* (an optimal royalty rate), some downstream profits are left to the franchisee. Under the extreme assumption that the franchisee is kept at his reservation utility levels, the upfront fee will extract all the franchisee's downstream profits.

In this paper, we extend this theoretical framework to patent licenses. However, building on the real-option theory predictions (Pitkethly, 2006), we argue that the upfront fee is object of negotiation and will depend on the licensee's willingness to pay to enter the licensing contract depending on the level of

market and technological uncertainty associated to the licensed patent. In fact, given their structure, patent licenses can be seen as options from the licensee's perspective. When entering a licensing contract, the licensee pays an initial fee (premium to buy the option) to acquire the right (option) to develop and commercialize the technology protected by the patent. This is an important form of flexibility. Similarly to the underlying asset of a financial option, the NPV associated to the exploitation of the licensed patent is subject to volatility over time (Kulatilaka & Perotti, 1998; McGrath, 1997). In order to analyze the effect of volatility on the option value of patent licenses, we decompose uncertainty into the market and technological domains, as done by previous studies on real options (eg., Anand, Oriani & Vassolo, 2007; MacMillan & McGrath, 2002; Oriani & Sobrero, 2008). Based on that, we expect the following:

Hypothesis 1. The initial fee of a patent license increases with the degree of market uncertainty

Hypothesis 2. The initial fee of a patent license increases with the degree of technological potential

METHOD

In order to test our hypotheses we rely on patent and licenses data. Starting from the IP database developed by the Financial Valuation Group¹ we developed a complex research design matching different kind of data drawn by several data sources. Among these, the NBER dataset (Hall, Jaffe and Trajtenberg, 2002) and the OECD STAN database. We then integrate these data with all the information available in the original dataset at the license level, specifically including the remuneration structure (amount of the upfront, royalty rate). Out of the initial 224 observations, we relied on a subset of 124 for the analysis. The reason for this drop is threefold. First, we could not include those upfront payments that were not disclosed; second, we preferred to omit those contracts without upfront fee, because they represent a distinct contractual form (Gallini and Wright, 1990; Bosquet, 1998; Vishwasrao, 2007); third, we had to drop those observations with missing values in the remaining variables included in the analysis.

Dependent variable. The *initial licensing fee* is our dependent variable, which we considered analogous to the premium paid by the licensee to buy a call option. **Explanatory Variables.** The first independent variable refer to *market uncertainty* that reflects the potential demand for the licensed technology. Consistently with previous research, we measured such variable as the standard deviation of the market growth rate from year t-5 to year t (the year of the license). The second explanatory variable is *technological potential*. It is related to the technical and manufacturing feasibility of the patented technology, which ultimately affects its commercial potential (Huchzermier & Loch, 2001; Ziedonis, 2007). Following previous studies (Lanjouw & Shankerman, 2001; Ziedonis; 2007), we measured this variable using the number of backward citations contained in the USPTO patents to previous USPTO patents. **Control variables.** We also control for several characteristics of the contract, the patents, the parties and the industry.

RESULTS

As shown in Table 1, our results support our two hypotheses. Specifically, considering market uncertainty, we found that the initial fee of a patent license increases with the degree of market uncertainty. The coefficient is statistically significant at a 5% level. We also find support for hypothesis 2, claiming that the initial fee of a patent license increases with the degree of technological potential. However, the level of significance of the technological potential variable dropped to a 10% level in model 4 providing weaker support for hypothesis 2.

DISCUSSION AND CONCLUSION

Patent licensing in the market for technology is increasingly used. However, at the same time there is also substantial evidence of considerable impediments hindering the matching of licensees and licensors. In recognition of that, in this paper we aimed to shed new light on the remuneration structure of patent licenses. The contribution of the paper is threefold. First, we have enriched the insights provided

¹ <http://www.fvginternational.com/index.html>

by the agency theory with the innovative framework provided by the real option theory. Second, focusing on the licensee's perspective – which has generally been underinvestigated in the licensing and markets for technology literature – we have argued that patent licenses provide the licensee with a flexibility of use that has not been accounted for so far. Third, we tested our hypotheses based on real options theory on an original cross-industry sample of 124 patent licenses including information on the precise amount of initial fee paid by the licensee to enter the contract.

REFERENCES

- Anand, B.N. & Khanna, T. 2000. The Structure of Licensing Contracts, *The Journal of Industrial Economics*, 48(1): 103-135
- Anand, J., Oriani, R. & Vassolo, R. 2007. Managing a Portfolio of Real Options, *Advances in Strategic Management*, 24, in press
- Arora, A., Fosfuri, A. & Gambardella, A. 2001. *Markets for Technology*. Cambridge, MA: The MIT Press
- Athreya, S. & Cantwell, J. 2007. Creating competition? Globalization and the emergence of new technology producers, *Research Policy*, 36: 209-226
- Atuahene-Gima, K. & Patterson, P. 1993. Managerial Perceptions of Technology Licensing as an Alternative to Internal R&D in New Product Development: an empirical investigation, *R&D Management*, 23(4): 327-336
- Bhattacharyya, S. & Lafontaine, N. 1995. Double-sided moral hazard and the nature of share contracts, *RAND Journal of Economics*, 26(4): 761-781
- Bousquet, A., Cremer, H., Ivaldi, H. & Wolkowicz, M. 1998. Risk sharing in licensing, *International Journal of Industrial Organization*, 16(5): 535-554
- Brickley, J.A. 2002. Royalty Rates and Upfront Fees in Share Contracts: Evidence from Franchising, *The Journal of Law, Economics & Organization*, 18(2): 511-535
- Caves, R., Crookell, H. & Killing, P. 198. The Imperfect Market for Technology Licenses, *Oxford Bulletin of Economics & Statistics*, 45: 249-67
- Cockburn, I.M. 2007. *Is the Market for Technology Working?* Paper prepared for the Conference on Economics of Technology Policy, Monte Verità, June
- Financial Valuation Group 2007. The FVG IP database, www.fvginternational.com/ipdatabase.
- Gallini, N. & Wright B. 1990. Technology transfer under asymmetric information, *Journal of Economics*, 21(1): 147-160
- Gans, J. & Stern, S. 2003. The product market and the market for “ideas”: commercialization strategies for technology entrepreneurs, *Research Policy*, 32: 333-350
- Hall, B.H., Jaffe, A. B. & Trajtenberg, M. 2002. *The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools*. NBER Working Paper Series
- Huchzermeier, A. & Loch, C. H. 2001. Project Management under Risk: Using the Real Option Approach to Evaluate Flexibility in R&D, *Management Science*, 47: 85-101
- Kamiyama, S., Sheehan, J. & Martinez, C. 2006. *Valuation and Exploitation of Intellectual Property*. OECD STI Working Paper 2006/5, June
- Katz, M.L. & Shapiro, C. 1985. Technology Adoption in the Presence of Network Externalities, *Journal of Political Economy*, 94(4): 822-841
- Kulatilaka, N. & Perrotti, C. 1998. Strategic Growth Options, *Management Science*, 44(8): 1021-1031
- Lafontaine, F. & Shaw, L.S. 1999. The Dynamics of Franchise Contracting: Evidence from Panel Data, *Journal of Political Economy*, 107(5): 1041-1080
- Lafontaine, F. 1992. Agency theory and franchising: some empirical results, *RAND Journal of Economics*, 2: 263-283
- Lander, D. M. & Pinches, G. E. 1998. Challenges to the Practical Implementation of Modelling and Valuing Real Options, *Quarterly Review of Economics and Finance*, 38: 537-567
- Lanjouw, J.O. & Schankerman, M. 2001. Characteristics of Patent Litigation: A Window on Competition, *The RAND Journal of Economics*, 31 (1): 129-151

- MacMillan, I. C., & McGrath, R. G. 2002. Crafting R&D project portfolios, *Research Technology Management*, 45: 48-60
- McGrath, R. G. 1997. A Real Options Logic for Initiating Technology Positioning Investments, *Academy of Management Review*, 22(1): 13-30
- Oriani, R. & Sobrero, M. 2008. Uncertainty and the Market Valuation of R&D within a Real Options Logic, *Strategic Management Journal*, forthcoming
- Pitkethly, M. 2006. *Patent Valuation and Real Options*. In Bosworth D., Webster E. (Eds.), The Management of Intellectual Property. Cheltenham: Edward Elgar
- Rivette, K. & Kline, D. 2000. Discovering New Value in Intellectual Property, *Harvard Business Review*, January-February: 55-66
- Vishwasrao, S. 2007. How do firms pay for foreign technology?, *International Journal of Industrial Organization*, 25: 741-759
- Ziedonis, A. A. 2007. Real Options in Technology Licensing, *Management Science*, 53: 1618-1633

TABLE 1
Determinants of Upfront payment. Results from robust OLS regressions.

	Control Model	Market Uncertainty Model	Technological Potential Model	Full Model
Market Uncertainty		16,339 *** [5.596]		13,909 ** [5.316]
Technological Potential			0,025 * [0.013]	0,022 * [0.013]
Patent Value	-0,005 [0.018]	-0,007 [0.018]	-0,001 [0.017]	-0,003 [0.017]
Royalty Rate	-0,146 * [0.076]	-0,151 ** [0.075]	-0,143 * [0.074]	-0,147 ** [0.074]
License Scope	0,019 [0.061]	0,02 [0.061]	0,079 [0.053]	0,074 [0.054]
Licensed Term	0,041 ** [0.021]	0,04 * [0.021]	0,043 ** [0.020]	0,042 ** [0.020]
Exclusive	-1,139 ** [0.514]	-1,196 ** [0.505]	-1,125 ** [0.500]	-1,175 ** [0.493]
Worldwide	-0,604 [0.578]	-0,528 [0.567]	-0,657 [0.580]	-0,587 [0.573]
Business Proximity - Licensor vs Licensee	0,483 [0.563]	0,402 [0.562]	0,417 [0.559]	0,354 [0.559]
Business Proximity - License vs Licensee	0,395 [0.446]	0,326 [0.441]	0,431 [0.446]	0,368 [0.445]
Non Profit Licensor	-0,777 [0.848]	-0,733 [0.822]	-0,776 [0.834]	-0,739 [0.813]
Licensor Individual	-1,05 ** [0.500]	-0,98 * [0.499]	-0,948 * [0.527]	-0,898 * [0.523]
Market Growth rate	12,799 [18.562]	11,711 [17.405]	9,514 [17.737]	8,905 [16.776]
Chemicals Industry	0,312 [0.479]	0,27 [0.477]	0,27 [0.491]	0,238 [0.488]
Constant	12,28 *** [0.710]	11,697 *** [0.739]	12,477 *** [0.712]	11,962 *** [0.742]
Number of observations	124	124	124	124
R-Square	0,227	0,25	0,261	0,278
Adj. R-Square	0,144	0,162	0,174	0,185
F-test	5,015 ***	5,847 ***	5,191 ***	6,128 ***

*: p<0.1, **: p<0.05, ***: p<0.01. Standard errors are reported in brackets