LICENSING AS A SOURCE OF FINANCING

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ABSTRACT

Although the licensing phenomenon has gained attention over the last decades, the role of licensing contracts as a source of external finance for innovation has been under-investigated by scholars so far. Empirical evidence, instead, suggests that accessing capital is among the most common reasons to out-license. In some circumstances licensors is required to further develop the licensed technology which the licensee may finance by paying an upfront fee. Thus, the need for extra finances may affect the decision of the licensor to negotiate and thus actually agree on a specific form of payment. The aim of our paper is to investigate whether financial constrained licensors are more likely to choose an upfront license and more incline to credit a portion of the initial fee against future royalties to meet their short-term financing needs. We investigate this issue by relying on a original dataset of patent licenses.

Keywords: Innovation Financing, Patent licensing, Financial Constraints, Upfront Fee

INTRODUCTION

The problem of innovation financing has been extensively debated by the literature and professional practice. Starting from the 90s, several authors (e.g. see Hall, 2002 for a review) have argued that internal finance is the primary source of financing of firms' research and development (R&D) investments. The reason for this resides in the imperfections of the capital markets (Fazzari et al., 1988), which are exacerbated for R&D investments because of the non-rival nature of the asset (knowledge) created (Nelson, 1959; Arrow 1962) and the existence of information asymmetries – related to the *lemons problem* (Akerloff, 1970) - between companies and suppliers of external finance (Himmelberg and Petersen, 1994). Clearly this issue does not affect all firms in the same way. Rather, the financial constraints to R&D investments may be more severe for high technology small firms - which are meant to be more innovative and thus spur the innovation progress – which often lack financial resources to carry on R&D projects (Himmelberg and Petersen, 1994; Guiso, 1998; Carpenter and Petersen, 2002; Scellato, 2007).

Within the new competitive scenario, as a consequence of the dematerialization of the determinants of firms' competitive advantage and the increasing costs of R&D to come out with new technologies and products, financial constraints have became more and more binding for innovative companies and more difficult to overcome. For this reason, and given the widespread employment of intellectual property rights (IPRs) in the management of the innovation process, new financial tools have been designed with IPRs serving as underlying assets (IP-backed financing) to provide extra financing for high-tech companies (e.g. Edwards 2001; Agiato, 2002). Among others, there are two basic types of patent-backed transactions: patent-backed loans and patent-backed securitization. Within the former type of transactions, patents function as loan collaterals; within the second one, instead, patents are the underlying assets and their future or guaranteed cash flows turn into marketable securities (e.g. Edwards 2001; Wantanabe, 2004; Stone and Zissu, 2006; Calderini and Odasso, 2008). Whereas these transactions seem to be potentially useful for high tech firms to overcome financial constraints, their use is still limited by high transaction costs, which basically exclude smaller firms, and the severe information asymmetries between the firm holding the patent(s) and the external investors..

In addition to the recent attention to the abovementioned forms IP-backed financing, it has to be remarked that licensing practices have became very popular among high-tech companies (Anand *et al.*, 2000; Arora *et al.*, 2001; Athreye *et al.*, 2007; Chesbrough, 2003; Fosfuri, 2006; Gu *et al.*, 2004; Kim *et al.*, 2006) and, as a consequence, patent licenses revenues have skyrocketed to more than 100 billion dollars nowadays (Litchtenthaler, 2007). Notwithstanding this increasing attention, to the best of our knowledge the role of licensing as a source of external finance has not been extensively discussed so far. The reason is at least twofold. First, licensing has been initially considered as an additional way to get extra revenues generally for large firms. Second, the access to detailed data on the payment structure of licensing agreements has been usually hampered by the limited disclosure of this competition-sensitive information. With these considerations in mind, the aim of this paper is to contribute to the current debate on the use of patent licensing for the financing of innovation activities. We draw from the theoretical insights of Kulatilaka and Lin (2006), who have elaborated a theoretical model to analyze the effect of licensing on the financing of technology development. We develop a set of hypotheses to predict the choice of the payment structure of a licensing contract based on the potential financing needs of the licensor. Moreover, by investigating the choice of the form and the extent of payments of a set of patent licenses, we find that financially constrained licensors are more likely to set contracts including upfront fees.

The reminder of this paper is organized as follows. The following section focuses on the development of the hypotheses to be tested drawing from previous theoretical works, empirical contributions and novel insights. Subsequently, the research design is comprehensively illustrated with the description of data, the specification of the econometric technique employed and the definition of the variables included in the analysis. The results are then presented and the paper finalizes with a section dedicated to the discussion and some conclusive remarks.

THEORY AND HYPOTHESES

Given the widespread diffusion of knowledge and the increasing complexity of products to meet the more and more sophisticated customers' needs, firm's reliance on external sources of knowledge have become a necessary condition to catch up with competition. In the pursuit of innovation, high-tech companies are increasingly deploying cooperation strategies –like licensing and joint ventures – in order to face technological and demand uncertainty (e.g. Kulatilaka and Lin, 2006; Markman, Gianiodis, Phan, & Balkin, 2005).

According to some scholars (e.g. Gompers and Lerner, 1999; Hall, 2002), start-up firms may enter into contracts with established firms to license out their patents in exchange for an upfront payment which serve to meet their initial funding needs. According to Kulatilaka and Lin (2006:1831) "[…] *at t = 0 the presence of uncertainty may cause financial constraints. In such cases, a licensing arrangement with a down payment could be used as a form of external financing*". According to the authors, the licensor will even pre-commit to a royalty cap, leading to some expected losses (which equal gains accrued to the licensee), in order to be fuelled as much as possible by cash (upfront fee). Basically, "[b]*y lowering L (royalty cap), M (the licensor) can increase the amount of down payment it receives up-front. In particular, M receives the maximum amount by committing to L = 0, that is, allowing N (the licensee) to use its technology for free at t = 1*" (Kulatilaka and Lin, 2006: 1833).

The financing issue can be also investigated from the licensee's point of view. Several times, after the conclusion of a license agreement additional development is needed to convert the licensed technology to a product which is ready to be sold in the market. This is generally the case of university licensing and start-up licensees. The reason is twofold. On the one hand, only a very little percentage of university licensed technology is ready for commercialization, as shown by mounting empirical evidence (e.g. Jensen and Thursby, 2001). On the other hand, start-ups - which rarely have a positive cash flow during the first years of operation - would be much more willing to avoid upfront commitment to conserve the company's cash for investment in product development (AUTM, 1999). In recognition of this situation, Feldman, Feller, Bercovitz and Burton, (2002) demonstrated that American universities are experimenting new mechanism (equity agreements) to generate revenues from their intellectual property rights in lieu of traditional license contracts. By embracing the university (licensor) perspective, the authors investigated the upside potential of equity agreements which gives the university "*the opportunity to share in the fortunes of a firm rather than just in the fortunes of a technology that may have contributed to the development of the firm but did not directly result in a commercial products*" (Feldman et al., 2002: 110).

Inspired by these seminal insights, the aim of this paper is to investigate the role of licensing as source of innovation financing. Starting from the IP-backed finance literature, the investigation of the impact of licensing on financing technology development calls for a change in perspective. If we take the licensor's perspective, the emphasis is no longer put on the stream of revenues generated by licensed patents as a guarantee of the external financing but rather on the trade-off between future and upfront forms of payments which impacts on the present availability of monetary resources for the licensor. In addition, the external financer is replaced by the licensee who generally is an industrial firm that by definition shares some strategic objectives with the counterpart. Finally, the financial instrument is the license itself that build upon a well-defined payment structure (e.g. upfront, milestones, royalties) and may include a number of contractual provisions which are specifically drafted around the exploitation of the licensed technology in question.

Within this framework, we investigate the role of licensing in the financing of R&D investments leading to technology development (e.g. in the form of new subsequent patent). We follow Kulatilaka and Lin (2006) in recognizing that in some circumstances licensor firms may be required to further develop the licensed technology[1] and to do so

[1] "The payment [upfront fee] is designed to create immediate commitment to the relationship on the part of the licensee. The money is useful to the licensor as it may provide funds for further IP protection, or represent recovery of a portion of R&D costs" (Simon Rowell. 2008. "New Zealand: Strategic Tips For

they need funds which the licensee may provide. Thus, the need for extra finances may affect the decision of the licensor to negotiate and thus actually agree on a specific form of payment. In sum, a financial constrained licensor would much more be willing to agree on an upfront payment in the place of future stream of revenues (both fixed and variables) and, in addition, he will bargain a certain amount of upfront fee according to his financing requirements. Although easily argued that a highly financial constrained licensor would ask for more upfront, this may not be always the actual outcome. Sometimes, in fact, the licensor may agree on a lower upfront to downsize the risk that the licensee would give up on the transaction. Also, if the licensee is unwilling to pay a significant upfront fee[2], and the licensor requires funds in the short term, he may consider proposing a lower upfront fee that is credited against licensee's royalty account (e.g. Kulatilaka and Lin, 2006).

Based on these considerations, we formulated the following hypotheses:

Hypothesis 1: Financially constrained licensors will be more likely to choose a contractual scheme with an upfront fee

Hypothesis 2: Financially constrained licensors will have a higher propensity to exchange royalties with upfront fees

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Adding Value To Licensing Transactions"**,** available at http://www.mondaq.com/article.asp?articleid=70118, retrieved on Monday 16th of February)

[2] According to Contractor (1981), one of the reasons explaining the existence of mixed contract (upfront against royalties) is the licensee's liquidity constraints. This is also consistent with the recent findings by Feldman et al. (2002) as highlight in the previous section.

DATA AND METHOD

Data

In order to address our research question, we defined a patent licenses-based research design providing information on license terms of payment, license markets, licensed patents and licensing parties. As already advanced in the introduction of this paper, it should be emphasized that due to the strategic relevance and competition-sensitive nature of information included in these contracts (Cockburn, 2007) we encountered a number of difficulties to collect data useful for analysis. For this reason, we also had to rely on multiple sources of information in order to get full data on investigated contracts. We combined the Financial Valuation Group Intellectual Property (FVGIP)[3] dataset with data drawn from the USPTO and NBER dataset, Thomson Research and DataStream, as explained in the following paragraphs.

The FVGIP database is a compilation of intellectual property transactions gleaned from publicly available documents. It contains detailed information on the transactions – the date of the event, the type of agreement, a brief synopsis of the transaction, a detailed description of the remuneration structure, and the USPTO identification number of patents involved – and the parties – the names of the licensor and the licensee, their respective SIC and NAICS industry codes and their pertaining countries. By extracting only patent and technology license agreements, as such coded in the proprietary dataset, we drew about 600 licenses concluded in the period 1970-2001. Of these contracts, we were able to find the original document (License Agreement) or some references in other company filings (e.g. S1, 8K, 10K) from the Security Exchanged Commission (SEC). Out of the initial 600 licenses, the FVGIP dataset reported the clear identification of the USPTO number attached to the single patent in only 110 cases. In order to obtain the patent identification number for the remaining licenses we carefully read through all the license contracts. Whenever it was impossible to directly find the desired information, we got it by browsing the USPTO dataset on the bases of the information available in the text of the contracts (e.g., the application number or the title

[3] This dataset is maintained by the Financial Valuation Group (FVG) which is one of the leading business valuation consulting and litigation service firms in North America. (http://www.fvginternational.com/index.html, accessed June 2007).

of the issued patents included in the description of the transaction). In specific cases, it was possible to find the patents by searching for the name of the assignee in the same database in the year of the license jointly with the keywords provided in the brief description of the licensed technology, as provided by FVGIP dataset. Finally, we further filtered the contracts to only keep (pure) licensing or assignment agreements. We thus excluded other transactions eventually referring to R&D collaboration or settlement agreements, cross-licensing, technology purchases and plans of merge that were incorrectly listed under the heading “Transaction/Patent Licenses” in the original dataset. At the very end of this data collection process, we came up with a final sample of 225 licenses involving almost 900 USPTO patents unilaterally exchanged among licensor and licensee firms.

On the basis of the same screening activity described above, we were able to collect comprehensive data on the payment structure and the main legal clauses agreed between parties. Specifically, by reading the original documents, we could make a distinction between ‘with upfront’ and ‘without upfront’ licenses as well as ‘royalty-based’ and ‘royalty-free’ licenses. We also accounted for the inclusion of either minimum royalty and milestones which are fixed cash payments due on each anniversary of the license or upon the crossing of some milestone events (e.g. clinical test in the Pharmaceuticals), respectively. The reading of the contract also allowed to distinguish between exclusive and non exclusive licenses and to identify the variable we called scope reflecting the number of patents involved in the license.

At the firm level, we integrated the information on names, geographical region and industry, which were already available, with the number of employees of companies involved in licensing agreements drawn from proprietary or publicly-available data source (e.g. Thomson Research, DataStream, Lexis and Nexis and so on). Consequently, we matched the name of our licensors and licensees with the assignee names recorded in the National Bureau of Economic Research (NBER) dataset (Hall, Jaffe & Trajtenberg, 2002) and its 2002 update[4] in order to rebuild their overall patent

[4] Publicly available at http://www.nber.org/patents/

portfolio. By doing so, we automatically got all the required statistics for each licensee/licensor patent (e.g., number of citations made and received, claims, IPC technological classes, and so on). We performed the same matching procedure to collect the relevant statistics on each licensed patent. Finally, in order to collect data at the (geographical) market level by industry, we relied on Thomson Datastream that is recognized to be the world's largest (proprietary) financial statistical database[5]. We chose the Datastream industrial price index as it summarizes the overall market performance of the main listed firms operating in each industry by country. For the sake of data homogeneity, we downloaded data at aggregated level (4digit SIC). To make sure, thus, that it was equally likely to find industries data for all countries involved in the licenses, including Indonesian and Asian countries, and to correctly compute the average value when needed. For this purpose, we performed a two-stage correspondence. We first matched the 4digit SIC of our licenses[6] with the Thomson Financial macro classifications. We then matched these codes with the corresponding Datastream codes[7]. At the end of this process we were able to gather information for five macro industries, which are Consumer Goods, Healthcare, High Technology, Industrials and Materials at the year of the corresponding license[8]. As concerns geographical markets, since many licensees were granted the right in different countries simultaneously, we defined 12 combinations of geographical areas (countries/continents) which we accounted for while downloading data. [9]

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[5] See more at Thomson Datastream website (available at http://www.datastream.com/, retrieved in Febraury 2009)

[6] Since the FVGIP database records the licensors' and licensees' SICs, while only providing a qualitative description of the industry involved, we first had to find the exact match of this description among those available for the licensing parties of our sample. This allowed us to get the corresponding SIC attached to each license..

[7] The SIC-Thomson Codes-Datastream Codes correspondence table was provided by the Thomson stuff upon our request.

[8] Consumer Goods includes the following SICs: 2092, 2200, 2676, 2844, 2479, 3578, 3944, 3949, 3990, 6794, 7382, 8221, 8731, 8999; Healthcare includes the following SICs: 2834-2836, 3841-3845, 3851, 5047, 8071, 8099; High Technology includes the following SICs: 3575-3577, 3651, 3661m 3663, 3669, 3674, 3679, 3825, 3861, 4813, 7372-7374; Industrials includes the following SICs: 3011, 3060, 3480, 3540, 3550, 3559, 3640, 3699, 3711, 3713, 3714, 3823, 5087, 8711; Materials includes the following SICs: 1220, 1321, 1623, 2650, 2851, 2870, 2911, 3080, 3086, 3089,, 3290, 3291, 3390, 3533, 3629, 3691, 4953, 4959, 5172, 9511.

[9] In order to perform a cross-check and make the results of our analysis be trustworthy, we referred to an alternative data source: the OECD STAN database. We made use of the *value added* variable found in the OECD STAN database as a measure of economic activity. Accordingly, we were able to extract data from all OECD countries plus Japan and Korea. For each country we gathered data within five years from the license at the industry level based on the SIC codes. By relying on the ISIC-SIC correspondence table - being the OECD values gathered according to the former standard - we made sure to have a consistent value to be attached to each license.

In the very end, our analysis could rely on a relational database, providing information on license terms of payment, licensed (geographical) markets, licensed patents and licensed parties.

Econometric Method

In order to jointly estimate the determinants of the probability of having a contract with upfront fees (hypothesis 1) and the amount of the eventual upfront fee (hypothesis 2), we adopted the censored regression model with a stochastic threshold described by Maddala (1983), where basic linear regression equations explaining the upfront fee is jointly estimated with a Probit equation whose dependent variable is a dummy equal to one when an upfront fee is included in the contract. The method of estimation is maximum likelihood, with the two equations allowed to be correlated, as in Bound et al. (1984). In this way, the error in predicting the probability of having an upfront fee can be correlated with the error in the R&D equation. The model that we estimate is then written as follows:

$$d_i = 1(Z_i\delta + \varepsilon_{1i} > 0)$$
$$y_i = d_i \cdot (X_i\beta + \varepsilon_{2i})$$
$$\begin{pmatrix}\varepsilon_{1i} \\ \varepsilon_{2i}\end{pmatrix} \sim N\left[\begin{pmatrix}0 \\ 0\end{pmatrix}, \begin{pmatrix}1 & \rho\sigma_2 \\ \rho\sigma_2 & \sigma_2^2\end{pmatrix}\right]$$

[1]

where d_i is a dummy equal to one when upfront fee is present and y_i is the variable measuring the amount of the upfront fee. For this model, it can be shown that the regression of y_i on X_i for the observed data has the following form:

$$E[y_i|d_i = 1, X_i] = X_i\beta + E[\varepsilon_{2i}|\ \varepsilon_{1i} > -Z_i\delta] = X_i\beta + \rho\sigma_2\lambda(Z_i\delta)$$

[2]

where $\lambda(.)$ is the inverse Mills' ratio for normal distribution. The Heckman two-step estimator for this model involves estimating δ using a Probit equation, forming the estimated λ, and including it in the equation with the other regressors.

Measures

Dependent variables. According to the model specification, we focus our attention on two dependent variables. First of all, we created a dummy called *dUpfront* which is equal to one if the license includes an upfront fee and zero otherwise. Out of the initial 225 observations, our sample contains 143 upfront patent licenses and 68 licenses which do not include any form of initial payment. We dropped the remaining contracts (14) in which the upfront fee was not disclosed for confidentiality reason[10]. Secondly, we focused on the 143 licenses which display a positive upfront. We thus considered the amount of the upfront fee as our second dependent variable. Since this variable does not follow a normal distribution, we took the natural logarithm - *ln(Upfront)* - of the values in order to achieve a better approximation of this distribution.

Independent variables. In order to account for the effects of financial constraints on the probability of having an upfront fee (hypothesis 1), we created the dummy called *size_250* as a measure of financial constraints of our licensors. This dummy is equal to one if the licensor has less than 250 employees and equal to 0 otherwise. We decided to base our measure of financial constraints on size. In fact, smaller firms should exhibit, ceteris paribus, stronger constraints for innovation financing (e.g., Himmelberg and Petersen, 1994). The cut off point[11] was set according to the general distinction between small and medium large firms which is employed in the literature on small business ventures (e.g. Ayyagari et al., 2007). We could have relied on a different measure of financial constraints which truly reflects the trade-off between internal and external sources of finance and thus accounts for the dividend policy of the firm driven by the potential availability of internal-generating cash flows. However, it would have been difficult to collect such information, being the majority of the licensors in the sample not traded in a stock market and thus not obliged to disclose relevant information on their balance sheet data.

[10] These licenses report the following standardized statement “Confidential Information Omitted and Filed Separately with the Security Exchange Commission. Asterisks denote such Omissions”

[11] We are aware of possible precision grinding errors due to the subjective choice of this threshold. For this reason, we also conducted analyses on the bases of an alternative distinction between firms with less than 500 employees and firms with more than that number, as suggested by some authors (e.g. Audretsch and Elston, 2002): the results did not differ significantly.

To test hypothesis 2, we introduced the *Royalty Rate* that the licensee is required to pay by contract and its interaction with *size_250*. The common base for the calculation of the annual royalties is the annual amount of net sales of the licensed products. Both from a theoretical and practical point of view, it is widely held that royalty rates are negatively correlated to the amount paid upfront in revenue sharing contracts (e.g. Brickley, 2002; Lafontaine, 1992; Lafontaine & Shaw, 1999). This is because, expected royalty payments reduce the downstream profits that will accrue to the licensee, so that the higher the royalty rate, the lower the upfront fee that the licensee will be willing to pay. In this paper we argue that a financially constrained licensee will prefer upfront fees to royalties, so that it will be available to forego more royalties to get cash up front. This means that the upfront fee will be more rigid to changes in the royalty rate, i.e. to obtain a higher upfront, a financially constrained licensor will be available to renounce to a higher percentage of the royalty rate than a non-constrained licensor. Therefore, we expect that the interaction between *Royalty Rate* and *size_250* should have a positive coefficient. This would imply that financially constrained licensors are available to forego higher royalties to get more upfront fees.

Control Variables. In our model we control for several features of the contract, the patents, the parties and the industry which presumably affect the choice and the amount of payment of a license.

As explained above, in our model we estimate e probit equation jointly with a linear equation. In the probit equation, we control for the following variables. Regarding the architecture of the contract, we distinguished between patent license either including or not including royalty (*With Royalty*), minimum royalty (*With Minimum Royalty*) or milestone payments (*With Milestones*). A further set of controls is related to parties involved in the transactions. First, we control for information asymmetries, which could be an important factor in the determination of the remuneration structure (Gallini & Wright, 1990). For this purpose we generated a dummy that identify whether the licensee's and the licensor's core business (4digit-SIC code) is the same (*Business Proximity*). Second, we control for the licensee's liquidity constraints which may affect its availability to pay upfront. Symmetric to the variable accounting for financial constraints of the licensor, we included a measure of licensee size, called *Small Licensee* which is equal to 1 if the licensee's employees are less then 250 and equal to 0 otherwise. We expect this variable to negatively affect the probability to have a patent licenses including upfront fee. We finally accounted for the influence of the identity and nature of the licensor on the initial fee by creating two dummy variables. The first one is equal to 1 if the licensor is a *NonProfit* organization – University, University or Public Research Foundations – 0 otherwise. The second variable is 1 if she/he is an *Individual Licensor* (generally, the inventor), 0 otherwise. These two variables may be subjected to different interpretation. First of all, they may represent a proxy for licensor's bargaining power. As such, we expect that individual and non profit licensor will be less likely to conclude patent licensing including upfront fee. A related interpretation may lead to say that these kinds of licensors are less likely to have the expertise – as compared to industrial licensors - to assess the monetary value of the patent licenses and thus to extract this value from the licensee by the means of the upfront. Otherwise, these two measures can be suggestive of different motives to license-out technologies across licensors. For instance, Feldman et al. (2002) have suggested that American university are experiencing new mechanism for promoting the commercialization of their research – equity positions in companies which will save the licensees from committing upfront fee to enter the contract. (AUTM, 1999). Finally, the effect of the *Demand Uncertainty* is also controlled for. It refers to the potential demand for the licensed technology. According to Kulatilaka and Lin (2006:1831) "*at t = 0 the presence of uncertainty may cause financial constraints. In such cases, a licensing arrangement with a down payment could be used as a form of external financing*". In other words, market uncertainty is the background condition which may lead firms to license-out their technology to get extra finance. A frequently used measured of market uncertainty is the volatility of the expected demand for the technology underlying the patent license. Thus, consistently with previous research, we measured such variable as the standard deviation of the market growth rate in the year of the license. In order to do that, we relied on Datastream to get the annual volatility of the industrial price indexes by country according to the following formula: *SDN1#(LN#(X/LAG#(X,12M)),12M)*. Where SDN is the standard deviation of the natural logarithm of the target value (the price index) divided by the same value, however, referring to the year before on annual base (twelve months). After having extracted these data, we calculated the average volatility for each country constellation we observed in order to account for the overall market uncertainty attached to every single license[12].

In the linear equation explaining the amount of the upfront fee, we control for the following variables, besides Demand Uncertainty which is also included in the selection equation. First of all, regarding the non monetary components of licensing contracts, we control for the *License Term*, that is the number of years over which the license will potentially be in force The longer the period the higher the potential value of the patent license cause it allows the licensee to gain more profits (Parr and Sullivan, 1996) and to eventually learn from the licensed patents. The value of the contract should also differ depending on whether is and *Exclusive License* or not. Exclusive license allows the licensee to exploit the licensed technologies without bearing the competition of other licensees in the market. Its effect on the initial fee is not clear a priori. One can argue that the licensor would prefer to get a greater upfront in order to downsize the risk of an unsuccessful exclusive licensee. In this case the expected sign should be positive. A greater upfront is a kind of compensation to have granted an exclusive right to the licensee who is the only responsible of the final outcome attached to the licensed patent(s). This is also consistent to the traditional argument holding that licensees prefer an exclusive license to get the maximum outcome from the licensed patent (Parr and Sullivan, 1996). On the other hand, the inclusion of the exclusivity clause is expectedly tied to higher royalty rate. The reason for that is easy to understand. The licensor would like to benefits from the exploitation/commercialization of the licensed patents which only depends on the licensee's best efforts. We control for this effect including a dummy, called *exclusive* which is equal to 1 and 0 otherwise. Finally, since some licenses include more than one patent, we include a measure of *License Scope*, herein intended as the number of the patents involved in the transactions[13]. The initial amount of payment agreed between

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[12] As already discussed, we also created an alternative measure of this variable. By relying on OECD data, we aggregated the level of economic activity we found for each countries involved in the license (geographical areas) at the industry level. Specifically we computed the standard deviation of the market growth over the previous five years within the time of license characterizing the industry involved in the license. By this way we were able to assess the overall uncertainty involved in the license according to the geographical scope and industry of it.

[13] The fact that the licensee includes more than one patent may not imply that these patents can be

parties also depends on the inherent value of the object of the transaction. Studies on patent valuation based on patent data (e.g., Harhoff, Scherer & Vopel, 2003; Reitzig, 2004; Trajtenberg, 1990) have shown that *Patent Value* can be proxied by the number of forward citations the target patent has received since its grant to date. Since this is a relative measure of such value, depending on how far is the time of its grant from our point of observation, we control for this value by counting the number of citations received until the date of the license. As already anticipated, since some licenses involve more than one patent, we calculate the mean value of this variable. The value of the licensed patents also stems from its *Technological Potential* which is related to the technical and manufacturing feasibility of the patented technology (Huchzermerier & Loch, 2001; Ziedonis, 2007). According to precious studies (Lanjouw & Shankerman, 2001; Ziedonis; 2007), this may depend on how much distant the licensed technology is from the commercialization stage. Accordingly, we measured this variable using the number of backward citations contained in the USPTO patents to previous USPTO patents that represent the relevant state of the art at that moment. In other words, the number of backward citations is a measure of the newness or radicalness of the patented technology. We got this information from the NBER dataset. Since technological potential increases when the number of backward citations decreases, we calculated our measure multiplying the number of backward citations by -1. Whenever the license involves the exchange of multiple patents, we calculated the average technological potential associated to the overall set of patents licensed. Referring to the industry characteristics, we finally account for industries effect by including industry dummies in the regressions according to the industry classification we relied on for downloading data. The five industries identifies are Consumer Goods[14], Pharmaceuticals, High Technology Manufacturing, Industrials and Materials.

exploited separately depending on the licensee convenience. It may depend on the fact that licensed products are more or less complex and therefore more or less difficult to be commercialized.

[14] It is considered the baseline industry in the regression analysis.

RESULTS

Descriptive statistics and correlations

In Table 1 we report descriptive statistics for each variables included in our regression analysis. First of all, we have to highlight that the number of observations on the natural logarithm of the upfront payment dropped to 121 when we account for missing values in the remaining variables included in the analysis. In other words, we loose 23 observations from the original sample of 143 patent licenses displaying positive upfront fee. The interaction between the dummy for financially constraint firms and the royalty exhibits a maximum value of 20. This means that there is at least one small licensor who was able to impose a royalty rate equal to 20% (1*20%). The distribution of royalty rate is right skewed, recoding a maximum value of 22 %. The average duration of a license is 16 years. The variable called patent value – which captures the number of citations received by the licensed patents until the time at which the license agreement was signed– differs very much across observations. The most valued licensed patent records an average of 77 citations. Also technology potential exhibits substantial dispersion ranging from -191 to -1.

Insert Table 1 about there

Table 2 shows the Pearson correlation coefficients of the variables included in the analysis. Their analysis does not cause any major concern regarding the possibility of multicollinearity in the regressions.

Insert Table 2 about there

Regression Results

Table 3 display the results of the two-step Heckman procedure we performed to test our two hypotheses, as described in the previous paragraph. The first column reports the baseline model without interaction between royalty and small_250. The second column provides the results of the same analysis with the inclusion of the aforementioned interaction term. Both exhibit significant Chi-square values suggesting validity of the models. In addition, we find a significant attrition effect indicating that the use of the Heckman selection model to be the right choice (The Likelihood Ratio test is significant at a 5% level).

Model 1 clearly indicates that smaller (financially constrained) licensors are more likely to sign a licensing contract involving the payment of an upfront fee. The coefficient of the licensor size is positive and significant at the 5% level, supporting our first hypothesis. This suggest that licensing allow the licensor to get immediate cash, which serves to mediate their capital constraint providing immediate funding compared to potential future funding is choosing a royalty rate based license agreement. Model 1 also confirms that several characteristics of the licensing contracts significantly affect the initial licensing fee. As expected, the initial fee is negatively related to the royalty rate. The negative coefficient is significant at the 1% level. Also, the amount of the upfront fee is positively related to the duration of the license and the technical potential of the licensed patent. Both coefficients are significant at the 10% level. In addition, demand uncertainty does have a significant impact on both the likelihood to sign an upfront-based license and the size of the upfront payment. However, the sign are opposite. On the one hand, the demand uncertainty may drive the decision to include different forms of payment, which allow for risk sharing among licensing parties (e.g. royalties); on the other hand, after having agreed on the inclusion of the initial fee, the licensor will prefer to extract as much as he can. Intuitively, individual licensors will have less chance to get upfront fee. The coefficient is statistically significant at the 10% level, probably suggesting a lower negotiating power of individual licensors. Finally, as expected, the liquidity constraints of the licensee lower the probability to sign a contract including an initial fee. The sign is negative and statistically significant at 5% level.

Model 2 resembles the analysis depicted in Model 1. However, it also includes the interaction term between the dummy for financially constraint firms and the royalty. We do not find statistical support for hypothesis 2. We in fact found that the interaction term is positive but it never came up as significant. The reason for the lack of statistical significance could be ascribed to the small size of our sample.

Insert Table 3 about there

DISCUSSION AND CONCLUSIONS

In this paper we have examined whether patent licensing contracts can be a useful source of financing for financially constrained firms. Whereas there is a growing attention to patent licenses in the literature, scant attention has been dedicated to the use of licenses as a source of financing. In our opinion, this is an important issue since licensing agreements could contribute to the financing of innovation more effectively than other forms of IP-backed financing. In fact, they may involve lower transaction costs than a financial transaction in which the patents are used as collateral. Moreover, licensing agreements are likely to be less affected by information asymmetries, as the licensee is presumed to know the underlying technology and its potential value better than a financial institution of an institutional investor.

These characteristics make licensing agreements a potentially viable solution to finance innovation for smaller firms. However, there is a potential drawback. Financially constrained licensor might forego a (too) high share of royalties in order to obtain more cash up front. If this is true, the beneficial aspects discussed above (lower transaction costs and information asymmetries) could be more than balanced by profit losses due to the reduction of the royalty rate.

Based on this theoretical framework, we have elaborated two testable hypotheses. First, financially constrained licensors should be more likely to require an upfront fee in the contract (hypothesis 1); second, they should be more available to renounce to royalty rates in order to get a higher upfront fee (hypothesis 2). We estimate jointly the probability and the amount of the upfront fee using a two-step Heckman model. The results fully support our hypothesis 1. This result suggests that smaller (i.e., financially constrained) licensors are more prone to sign a licensing contract involving the payment of an upfront fee. Indeed, the upfront fee could be seen as a way to overcome the financial constraint.

Instead, we do not find statistical support for hypothesis 2. There could be two different explanations. First, it is not true that a financially constrained licensor has to renounce to more royalties than a non-constrained one to obtain more fees up front. This explanation would support even more the use of licensing agreements as a financing source for constrained firms. Second, the lack of statistical significance could be ascribed to the small size of our sample. This question, therefore, deserve further investigation.

Overall, we think that the theoretical predictions and the results presented in this paper shed new light on the use of IP assets, and specifically patents, to overcome the financial constraints of smaller high tech firms. This calls for a deeper analysis on the role of patent licenses for innovation financing. From a theoretical point of view, we believe that two issues, namely transaction costs and information asymmetries, should be investigated further to understand better whether and, above all, under which conditions patent licenses can be effective in addressing the problems related to financial constraints. Empirically, the sample should be broadened in order to improve the statistical significance of our estimations. Moreover, fine grained measures of financial constraints, transaction costs and information asymmetries would be helpful to have more robust and complete results.

Notwithstanding these limitations, this paper draws the attention on a potential use of patent licenses, as an alternative to more complex and costly IP-backed financial transactions, which could be particularly relevant for high tech and smaller firms.

References

Agiato, J. A. 2002. *The Basics of Financing Intellectual Property Royalties*. Essay published in Berman, Bruce: From Ideas to Assets – Investing Wisely in Intellectual Property: New York: 423-441

Akerlof, G. A. 1970. The Market for “Lemons”: Quality, Uncertainty, and the Market Mechanism, *Quarterly Journal of Economics*, **84**: 488–500

Anand BN, Khanna T. 2000. The Structure of Licensing Constracts. *The Journal of Industrial Economics* **48**(1): 103-135

Arora A, Fosfuri A, Gambardella A. 2001. *Markets for Technology: The Economics of Innovation and Corporate Strategy*. The MIT Press: Cambridge, Massachusetts

Arrow, K. J. 1962. Economic Welfare and the Allocation of Resources for Invention*,* in R. Nelson (ed.), *The Rate and Direction of Inventive Activity*. Princeton University Press: Princeton, NJ

Athreye S, Cantwell J. 2007. Creating Competition? Globalization and the Emergence of New Technology Producers. *Research Policy* **36**(2): 209-226

Association of University Technology Managers (AUTM) Licensing Survey. 1999. AUTM: Northbrook,IL.

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

Carpenter R. E. and Petersen, B C. 2002. Capital Market Imperfections, Hig-tech Investment, and New Equity Financing, *The Economic Journal,* **112** (Febraury): F54-F72.

Calderini, M. Odasso C. M. 2008. Intellectual property portfolio securitization: an evidence based analysis. *Innovation Studied Working Paper* (ISWoP), 1/08, Polytechnic of Turin.

Chesbrough H. 2003. *Open Innovation*. Harvard University Press: Cambridge, Massachusetts

Cockburn, I.M. 2007. Is the Market for Technology Working? Obstacles to Licensing Inventions, and Ways to Licensing Inventions, and Ways to Reduce Them**,** Paper prepared for the Conference on Economics of Technology Policy, Monte Verità, June

Edwards, D. 2001. *Patent Backed Securitization: Blueprint for a New Asset Class*. published by Gerling NCM Credit Insurance.

Fazzari, S. M., Hubbard, R. G. and Petersen, B. C. 1988 Financing Constraints and Corporate Investment, *Brooking Papers on Economic Activity*, **1**: 141-206.

Feldman, M., Feller I., Bercovitz J. and Burton R. 2002. Equity and the Technology Transfer Strategied of American Research Universities. *Management Science*, **48** (1): 105-121.

Fosfuri A. 2006. The Licensing Dilemma: Understanding the Determinants of the Rate of Technology Licensing. *Strategic Management Journal* **27**(12): 1141-1158

Gallini, N., Wright B. 1990. Technology transfer under asymmetric information, J*ournal of Economics*, **21**(1): 147-160

Gompers, P. A., Lerner J. 1999. *The Venture Capital Cycle*. MIT Press: Cambridge, MA.

Granstrand, O. 1999. *The Economics and Management of Intellectual Property*. Edward

Elgar Publishing: Cheltenham, UK.

Gu F, Lev B. 2004. The Information Contents of Royalty Income. *Accounting Horizon* **18**(1): 1-12

Guiso, L. 1998. High-tech Firms and Credit Rationing, *Journal of Economic Behaviour and Organization*, **35**: 35-59

Hall, B. H. 2002. The financing of research and development. *Oxford Rev. Econom.*

Policy, **18**(1): 35-51

Himmelberg, C. P. and Petersen, B. C. 1994. R&D and Internal Finance: A Panel Study of Small Firms in High-tech Industries, *Review of Economics and Statistics*, **76**: 38–51

Jensen, R., Thursby M. 2001. Proofs and prototypes for sale: The tale of university

Licensing. *American Economic Review*, **91**(1): 240–259

Katz, M.L., Shapiro, C. 1985. Technology Adoption in the Presence of Network

Externalities, Journal of Political Economy, **94**(4): 822-841

Kessel, M., Hall S. 2006. Avoiding Premature Licensing. *Nature Reviews Drug Discovery*,

5 (December): 985-986

Kim YJ, Vonortas N. S. 2006. Technology Licensing partners. *Journal of Economics and Business* **58**(4): 273-289

Kulatilaka N. Lin L. 2006. Impact of Licensing on Investment and Financing of

Technology Development, Management Science, **52**(12): 1824-1837

Lafontaine, F. 1992. Agency theory and franchising: some empirical results, *RAND Journal of Economics*, **2**: 263-283

Lafontaine F., Shaw, L.S. 1999. The Dynamics of Franchise Contracting: Evidence from Panel Data, *Journal of Political Economy*, **107**(5): 1041-1080

Lichtenthaler U., Ernst H. 2007. Developing reputation to overcome the imperfections in the markets for knowledge. *Research Policy*, **36**: 37-55

Markman, G. D., Gianiodis, P. T., Phan, P. H., and Balkin, D. B. 2005. Innovation Speed: Transferring University Technology to Market, *Research Policy*, **34**(7): 1058-1075

Nelson, R. R. 1959. The Simple Economics of Basic Scientific Research', *Journal of Political Economy*, **49**:297–306.

Rivette, K., Kline D. 2000. Discovering New Value in Intellectual Property. *Harvard Business Review*, January-February: 55-66

Scellato, G. 2007. Patents, Firm Size and Financial Constraints: an Empirical Analysis for a Panel of Italian Manufacturing Firms, *Cambridge Journal of Economics*, **31**: 55-76.

Stone, C. A., Zissu A. 2006. Defining the 3-D securitization space of future export receivables from emerging markets. *Journal of Global Business and Technology*, **2**(2).

Striukova, L. 2007. Patents and corporate value creation: theoretical approach. *Journal of Intellectual Capital*, **8**(3): 431 – 443

Rowell S., 2008. New Zealand: Strategic Tips For Adding Value To Licensing Transactions**,** available at *http://www.mondaq.com/article.asp?articleid=70118*.

Watanabe, H. 2004. Intellectual Property as Securitized Assets. *The Institute of Intellectual Property*, March.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ln(Upfront)	121	12,11	2,37	4,61	18,42
Size_250 - Financial Constraints	182	0,61	0,49	0	1
Interaction Term	182	1,65	2,77	0	20
Royalty Rate	182	2,86	4,01	0	22
Patent Value	182	6,41	11,05	0	77,33
License Scope	182	3,77	6,15	1	41,00
Exclusive License	182	0,58	0,49	0	1
License Term	182	16,03	10,60	1	99,00
Technical Potential	182	-15,92	23,51	-191,41	-1
Demand Uncertainty	182	0,07	0,03	0,02	0
dUpfront	182	0,66	0,47	0	1
Individual Licensor	182	0,16	0,37	0	1
Nonprofit Licensor	182	0,06	0,24	0	1
With Royalty	182	0,54	0,50	0	1
With Minimum Royalty	182	0,24	0,43	0	1
With Milestones	182	0,17	0,38	0	1
Business Proximity	182	0,33	0,47	0	1
Small Licensee	182	0,76	0,43	0	1

Table 2. Correlation Matrix

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
[1]	ln(Upfront)	1																	
[2]	Size_250 - Financial Constraints	0,0371	1																
[3]	Interaction Term	-0,1947	0,4781	1															
[4]	Royalty Rate	-0,2632	-0,0459	0,5106	1														
[5]	Patent Value	0,0809	-0,043	-0,1194	-0,0938	1													
[6]	License Scope	0,112	0,014	-0,1606	0,0505	0,3143	1												
[7]	Exclusive License	-0,2647	0,0766	0,0687	-0,0779	-0,1705	-0,0973	1											
[8]	License Term	0,1374	0,1023	0,0018	0,0037	-0,1197	0,0439	0,1435	1										
[9]	Technological Potential	0,0872	0,0298	0,0128	-0,3192	-0,1924	-0,5185	0,125	-0,0536	1									
[10]	Demand Uncertainty	0,2723	0,1321	0,1236	0,0312	-0,0373	0,1175	-0,2325	-0,0491	-0,0259	1								
[11]	dUpfront		0,1242	0,0485	-0,1791	-0,0119	-0,059	0,1777	-0,0194	0,0787	-0,1684	1							
[12]	Individual Licensor	-0,2459	0,3482	0,2817	0,0636	-0,1379	-0,0277	0,1251	0,01	0,0594	0,0796	-0,0725	1						
[13]	Nonprofit Licensor	-0,2012	-0,2699	-0,0932	-0,0067	-0,1207	-0,077	0,168	0,0188	0,0571	0,0343	-0,0153	-0,1104	1					
[14]	With Royalty	-0,3343	0,0504	0,5415	0,6331	-0,1904	-0,1535	0,11	-0,0615	-0,0155	0,0497	-0,0036	0,132	0,0498	1				
[15]	With Minimum Royalty	-0,3443	0,0471	0,2369	0,1458	-0,0703	-0,1036	0,3136	-0,0653	0,0621	0,0024	0,1483	0,182	0,0761	0,3333	1			
[16]	With Milestones	-0,0481	0,0328	0,0584	-0,0338	0,047	0,0051	0,1466	-0,0061	0,0029	-0,1876	0,2288	-0,1973	-0,0536	0,009	-0,0112	1		
[17]	Business Proximity	0,2271	-0,0142	-0,1083	0,037	0,1364	-0,0232	-0,1172	0,0438	-0,0331	0,0547	-0,0468	-0,1776	-0,1779	-0,1244	-0,1149	-0,1312	1	
[18]	Small Licensee	-0,4171	-0,0833	0,0444	-0,0417	0,0562	-0,1071	0,2505	0,0482	0,1027	-0,229	-0,0475	0,0705	0,1432	0,1465	0,1026	-0,0514	-0,0954	1

Table 3. Regression Results with Standard Errors

	Heckman without Interaction	Heckman with Interaction
ln(Upfront Fee) Equation		
Size_250 - Financial Constraints	-0,157	-0,315
	[0,445]	[0,581]
Royalty Rate	-0,222 ***	-0,269 **
	[0.078]	[0,134]
Patent Value	0,004	0,002
	[0.017]	[0,019]
License Scope	0,048	0,055
	[0,045]	[0,050]
Exclusive License	-0,889 **	-0,923 **
	[0.383]	[0,409]
License Term	0,034 *	0,034 *
	[0,020]	[0,020]
Technological Potential	0,015 *	0,015 *
	[0,009]	[0,008]
Demand Uncertainty	23,204 ***	23,299 ***
	[7,154]	[7,185]
Pharmaceuticals	1,828 ***	1,757 ***
	[0,543]	[0,602]
High-Tech Manufacturing	2,285 ***	2,235 ***
	[0,661]	[0,683]
Industrials	2,823 ***	2,775 ***
	[0,640]	[0,651]
Materials	0,7333	0,661
	[0,669]	[0,688]
Interaction Term		0,066
		[0,153]
Constant	10,523 ***	10,718 ***
	[0,954]	[1,127]
With Upfront Fee Equation		
Size_250 - Financial Constraints	0,478 **	0,475 **
	[0,224]	[0.225]
Individual Licensor	-0,544 **	-0,547 **
	[0,264]	[0,265]
NonProfit Licensor	-0,18	-0,206
	[0,463]	[0,471]
With Royalty	-0,113	-0,113
	[0,198]	[0,198]
With Minimum Royalty	0,306	0,289
	[0,297]	[0,301]
With Milestones	0,616 *	0,587
	[0,356]	[0,366]
Demand Uncertainty	-7,089 **	-7,159 **
	[3,087]	[3,072]
Business Proximity	0,143	0,17
	[0,242]	[0,216]
Small Licensee	-0,445 **	-0,463 **
	[0,212]	[0,216]
Constant	-0,984 ***	1,004 ***
	[0,369]	[0,369]
Number of Observations	182	182
Log Likelihood	-347,97	-347,88
Chi2	72,32 ***	71,87 ***
LR test	4,08 **	4,26 **

*: p<0.1, **: p<0.05, ***: p<0.01