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TECHNOLOGY OUT-LICENSING INTERNATIONALLY: A HOLISTIC VIEW

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Contents

SUMMARY

Area of investigation

Intangible assets account for more than 50% of a market value of the modern company (Kline 2003a; Chesbrough 2003). This setting alludes that effective and adequate management of technologies has become one of the leading competitive priorities of the firms. Companies are not only exploiting their technologies internally, through application in final products and services, but organizations consider the combination of both the internal and external exploitation (Stettner & Lavie 2013; Bianchi et al. 2011; Bianchi et al. 2013). This strategic shift enables companies to achieve full advantage of their overall technology portfolio (Rivette & Kline 2000). One of the ways for firms to accomplish this full exploitation potential of their technologies, both monetary and strategic, is by engaging in technology out-licensing (Arora & Fosfuri 2003a; Frishammar et al. 2012).

As defined by Guadamuz (2005), technology licensing is the "transfer of technology by means of a contract of industrial property rights". However, a licensing agreement may also include a transfer protected or unprotected know-how, training of specialists, transfer of procedures and technical assistance. Licensing agreement is a result of technology licensing and it is constituted by a sourcing firm purchasing the rights to another firm's patents or technology for a lump sum payment and/or royalties (Hagedoorn & Hesen 2007). Licensors are firms that own the essential technologies and licensees are firms that purchase the right to use these technologies (Joshi & Nerkar 2011). The economic good that is traded is knowledge, in the form of technologies, patents, other Intellectual Property Rights (IPRs) or know-how. So out-licensing presents one of the possible contract forms for External Technology Commercialization - ETC (Granstrand 2004), along with joint ventures, spin-offs and patent sales.

Technology out-licensing has becoming increasingly recognized as a serious and necessary strategic activity among the companies (Granstrand 2004; Ziedonis 2007; Arora & Ceccagnoli 2006). Both small, research intensive firms, named "serial innovators", that are specialized in conducting R&D and are basing their business model on technology out-licensing (Hicks & Hegde 2005), and large corporations involved in active technology licensing such as Texas Instruments, Dow Chemical, Hitachi, Kodak, Eli Lilly, Procter & Gamble or IBM (Arora & Fosfuri 2003a; Fosfuri 2006; Arora et al. 2013) are jointly boosting the increased reliance on technology out-licensing. These firms advance further in their strategic decissionning by overcoming their internal fear of the loss of "corporate jewels" (Kline 2003a) and pursue an open innovation approach in their business (Chesbrough 2003; Bianchi et al. 2010; Chiaroni et al. 2010). As a consequence, the worldwide market for technologies is extensively been developing

(Gambardella et al. 2007; Arora et al. 2002; Arora & Fosfuri 2003a) and according to the estimation of Arora & Gambardella (2010) has reached the total size of US$200 billion.

Previous studies find a raising trend in pursuing technology out-licensing, but always stress the complexity it carries with itself (Granstrand 2004). Some studies point out on the extremely low success rates of out-licensing. Razgaitis (2004) reports that only three of hundred out-licensing deals were concluded with success. Although the companies have the technologies on their disposal, only a few achieve positive performance in their out-licensing activities. As Alexy et al. (2009) report, 99% of patent-licensing revenues in the US is generated by the organizations that own around 40% of total US patents, while remaining 60% of the patent holders obtain only around 1% of the revenue. The complexity around technology out-licensing originates from a very particular nature of knowledge as a good traded in technology out-licensing. In essence, knowledge is intangible, idiosyncratic, uncertain, predominantly tacit, with property rights usually poorly defined (Grindley & Teece 1997). Moreover, markets for technologies carry high transaction costs, making out-licensing even more complex (Arora et al. 2013). In other words, organizations attempting to engage in active technology out-licensing are faced with severe managerial challenges (Chesbrough 2007; Bianchi 2010) that might be overcome by proper management of technology out-licensing (Arora et al. 2013).

When speaking about international technology out-licensing, which makes the larger part of overall technology trade (Arora & Fosfuri 2003a), certain idiosyncrasies appear to be even more complex and international business is associated with more risk than the domestic one (Mottner & Johnson 2000). In international out-licensing the risks may be arriving from various sources, like the host country economic and legal factors, the potential of opportunistic behavior; or uncertainties appearing around the valuation of the licensed technology in question (Aulakh et al. 1998). For this reason, company's international out-licensing activity is considered more difficult to tackle than the domestic one, and should be treated more cautiously. In the international business context technology out-licensing has an important strategic role. It has been presented as one of the market entry modes, allowing corporations to expand internationally (Morschett et al. 2010; Tan 2009). As a consequence of this complex and in many cases uncertain activity, even larger discrepancies in performance occure between small number of successful firms and the majority of unsuccessfull firms in the international technology out-licensing (Aulakh et al. 2010).

The previous literature proposes that a holistic approach of the management of firm's IP and technology alliances should be taken in order to ensure that the full value is captured in the organization's technology related strategies (Alexy et al. 2009; Bamford & Ernst 2002; Dyer et al. 2001). However, many questions surrounding the determinants of success and proper management of international technology out-licensing remain unanswered (Aulakh et al. 2010; Arora & Fosfuri 2003b; Arora et al. 2013; Lichtenthaler 2011). Antecedent determining the volume of out-licensing of firms globally, issues

around the international licensing process and deeper understanding of strategic outcomes it offers, are still underexplored. These issues need to be addressed in order to obtain a holistic understanding and so that the companies could become more capable to overcome the complexities that arise in international technology out-licensing. By forming a holistic picture of technology out-licensing abroad, enterprises will become more competent to optimally manage all the issues that are involved around it. In particular, any new insights on this phenomenon may be found useful for its fitting management.

Although the international technology out-licensing itself has been marginally studied previously, there are certain important but overlooked questions that will be explored here. These questions will be integrated in the PhD dissertation as a guidance for framing our research work, and developing a clear and comprehensive understanding of the topic. In terms of methodology, this dissertation balances between the statistical analysis through longitudinal data studies and a multiple case study approach for examining the international technology out-licensing. The unique contribution of this study is seen in the fact that both the technology management literature and international business literature are combined together for the purpose of examining the over-border technology out-licensing. We build our research framework on several base concepts that are derived from both research streams. First, markets for technologies as an international contextual environment for out-licensing among the enterprises has been investigated previously (Arora et al. 2013; Arora et al. 2002; Gambardella et al. 2007; Hicks & Hegde 2005). This literature repeatedly points on the strong inefficiencies in this market that limits the extent of technology trade through out-licensing (Granstrand 2004; Arora et al. 2002). Second, the Open Innovation paradigm and the studies around it contribute to our broad understanding of the logic, benefits and problems underling the international technology licensing out, but also any other innovation and technology management choices (Chesbrough 2003; Chesbrough & Crowther 2006; Huizingh 2011; Chiaroni et al. 2010; Laursen & Salter 2006). In essence, Open Innovation is directed to explore the intersection between internal and external exploitation and exploration of technologies, and the effect that these choices and activities have on other segments of the firm's business. Inbound practices of Open Innovation have been debated more than the outbound side (Bianchi et al. 2011; Lichtenthaler 2009), and the outbound practices have been mostly neglected. Although, the international out-licensing is starting to gain on its momentum (Madeuf 1984; Jiang et al. 2008; Aulakh et al. 1998; Mottner & Johnson 2000; Marshall et al. 2007; Aulakh et al. 2010), the large vast of questions are remaining still to be analyzed. Third, the international market entry mode literature dealing with international out-licensing, observes out-licensing detached and isolated from the studies on this topic that are coming from innovation and technology management research. This is actually the main motivation behind this thesis, aiming to bring closer to the holistic view of international out-licensing by binding together, complementing and amending these two literature streams. The overlooked gap between two literature streams might be the cause for the managerial

drawbacks in out-licensing abroad, which prevents and hinders broader range of enterprises to maximize their financial and strategic benefits contained in the international technology out-licensing activities. Moreover, it can retard the general progress of society, as international out-licensing has been identified as an important mechanism for the dissemination of technologies from developed to underdeveloped countries and for leveraging the overall technological progress across the markets globally (Arora et al. 2002). All above stated, brought us to advance the following research question, as a motivation of this study:

What are the antecedent and organizational level implications for managing international technology out-licensing?

Research strategy

In this doctoral dissertation a collection of three research articles on a unitary topic has been put together. The collected papers are mutually linked to make a cohesive report on our research topic of interest. The aim was to build this dissertation by carefully linking the three papers and logically progressing from one paper to another throughout each of the chapters that follow. The introduction (preceding) and summary (following) of every chapter has been given, in order to indicate how each manuscript logically bridges one of the subtopics within the overall dissertation.

We initiate with building a clear research framework that would allow us to study the international technology out-licensing in a holistic manner. Our research question is phenomenon-driven, so in the first phase we adopt the research framework for studying our phenomenon, but also for extending the current theoretical knowledge on the topic. We aim to have elements of the theory building throughout the articles given in the dissertation, which would build an integrated body of knowledge to be applied to many instances by explaining who, what, when and why certain phenomenon occurs (Wacker 1998). In this process the current research literature is used as a guideline to decide which relationships are important to be investigated. By following this procedure, our aim is to present a holistic view of technology out-licensing abroad that will enable firms to become more proficient in managing this activity.

By considering the literature review given in Chapter 1, we propose the set of research constructs and relationships that will give us an overview of over-border technology out-licensing. In each of the corresponding chapters that follow the Chapter 1, we explain why we focus on the particular research question. In this manner, we avoid repetition of the content and in the Chapter 1 we just give a general introduction and literature review of the topic. The rationale behind our research framework and propositions is that for achieving successful international technology out-licensing the main three elements that cover this activity should be cautiously understood and managed, starting from the international out-licensing antecedent (*antecedent construct*), throughout international out-licensing process (*process construct*) and towards the desired outcome (*outcome construct*). Further, the theoretical framework can be organized through a series of propositions:

Proposition 1: Technology out-licensing internationally is influenced by technology in-licensing from abroad as its antecedent.

Proposition 2: International technology out-licensing management can adopt a process based view.

Proposition 3: International technology out-licensing inhibits organizational learning as its strategic outcome.

In the next part of this research project, it was attempted to empirically asses the propositions above. So, the empirical analysis that follows is made of three research articles that separately consider certain part of the general framework of this research, along with specific research sub-questions. The research paper reported in Chapter 2, with a title "Antecedent of International Technology Out-Licensing Volume: Does Technology In-Licensing from Abroad Help?" analyzes the volume of technology in-licensing from abroad as an antecedent of international technology out-licensing volume. This research paper empirically assesses the Proposition 1, by exploring it on a 10 year longitudinal data sample from the Spanish manufacturing industry. The following research questions were answered:

RQ.1.a: "How does the volume of technology in-licensing from abroad affect the volume of international out-licensing?"

RQ.1.b: "Does internal R&D intensity moderate the relation between international in-licensing and out-licensing volume magnitude?"

The Chapter 3 presents an article titled "Managing International Technology Out-Licensing: A Process Based View and Dynamic Capabilities Development". In this study the process based view perspective for studying the out-licensing was applied. Along the management of the international out-licensing process the development of Dynamic Capabilities was determined. The empirical data for this study were gathered through a multiple case study of the leading Italian pharmaceutical and biotech companies. In this manner, we empirically approach the Propositions 2 by answering to the following research questions:

RQ.2.a: "What are the stages of international out-licensing process?"

RQ.2.b: "Do companies develop Dynamic Capabilities by out-licensing abroad?"

The research article titled "Learning through Technology Out-Licensing Internationally: Organizational Learning and Influence on the Product Commercialization" that is reported in Chapter 4, focuses on exceptionally important strategic outcome as a benefit of international out-licensing. In this study we observe how international technology out-licensing affects product commercialization success abroad, by using a panel data set with 11 years of firm-level observations in the Spanish manufacturing sector. This analysis also relates the corporation's international performance with technology out-licensing. Therefore, in this paper we empirically assess the Proposition 3 by answering to the following research questions:

RQ.3.a: "Do companies learn through international out-licensing to improve their product sales abroad?"

RQ.3.b: " Is there a particular time lagged influence of this learning?"

In Table 1 below, we summarize the research strategy described and used in the doctoral dissertation. It illustrates phases conducted, research questions introduced, methodologies applied and outcomes achieved.

Table 1. Research strategy

Chapter	Research approach	Research question	Research methodologies	Outcomes
2	Theory Testing and Building	***RQ.1.a:*** "How does the volume of technology in-licensing from abroad affect the volume of international out-licensing?" ***RQ.1.b:*** "Does internal R&D intensity moderate the relation between international in-licensing and out-licensing volume magnitude?"	- Literature review - Panel data analysis	Theoretical implications on the relation between international technology in-licensing as an antecedent of international technology out-licensing
3	Theory Testing and Building	***RQ.2.a:*** "What are the stages of international out-licensing process?" ***RQ.2.b:*** "Do companies develop Dynamic Capabilities by out-licensing abroad?"	- Literature review - Multiple case study	Theoretical implications on the process view perspective and Dynamic Capabilities development
4	Theory Testing and Building	***RQ.3.a:*** "Do companies learn through international out-licensing to improve their product sales abroad?" ***RQ.3.b:*** *"Is there a particular time lagged influence of this learning?"*	- Literature review - Panel data analysis	Theoretical implications on the strategic outcomes of international technology out-licensing and its influence on the performance in international markets

In Chapter 1 and 3 the longitudinal dataset was applied for exploring the given research questions. This dataset originates from a survey on a representative sample of Spanish firms from the database Encuesta Sobre Estrategias Empresariales (Survey on Business Strategies, ESEE). It has been collected by a public institution that is financed by the Spanish Ministry of Industry. The ESEE survey complements the information about the industry in Spain provided by the 'Industrial Survey' of the National Institute of Statistics, offering aggregate information at a sectoral level, and the 'Central of Balances' of the Bank of

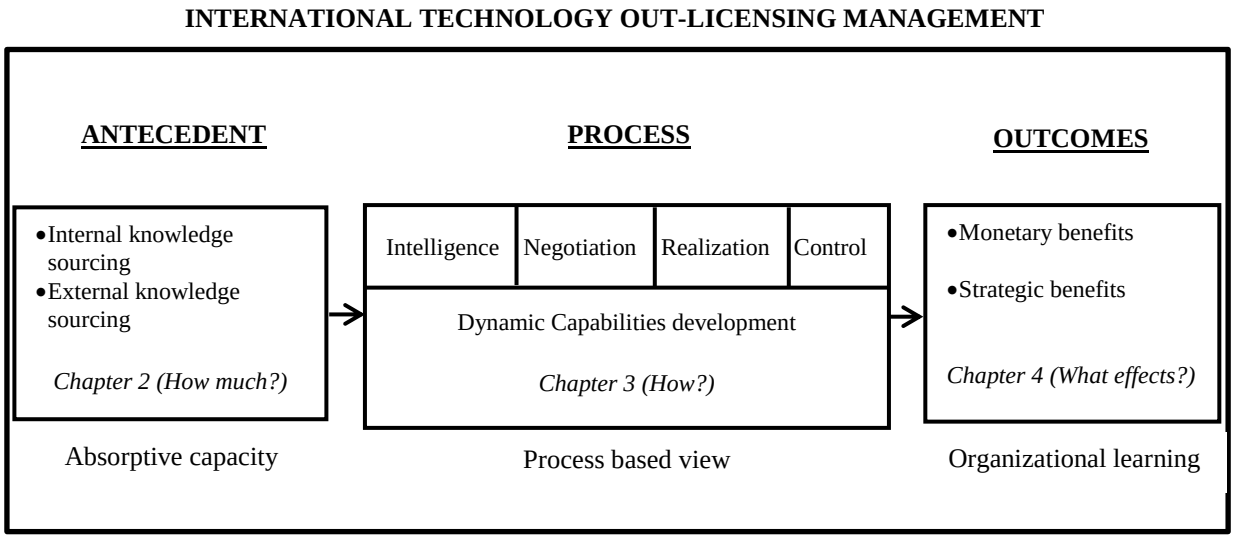
Spain, providing information about the financial activities of companies. It gathers particularly relevant information for our research topic, like data on firm's technological and international business activities. Moreover, it is a unique data source available that reports the yearly incomes from technology out-licensing on a company level. Companies with more than 200 employees were surveyed, but also the smaller companies with more than 10 employees were randomly chosen and included to achieve stratified sampling. Approximately 70% of the selected organizations completed the survey. The overall dataset contains 4.475 firms, each with 11 years of observation (1997-2007) that make altogether 49.225 year-firm observations. We extract the relevant subsample for studies in Chapter 2 (observing only firms reporting their international out-licensing revenues) and Chapter 4 (observing firms that commercialize their products outside the home market). Application of this data set has already found its place in studies questing certain aspects of firms R&D activities (Beneito 2006) and technology exploitation strategy (Bianchi et al. 2013; Kotlar et al. 2013). The focus on the manufacturing sector is particularly fitting in the context of our research, as manufacturing firms are increasingly being forced to rely on innovation because of the shortening of product life-cycle and fast obsolescence of products (Tushman & Anderson 1986). In this term, technology trading demonstrates an important role in their business strategies. Moreover, new product pioneering has higher importance in manufacturing than in service companies, leading to a closer link in our studies between product development related strategies and technology licensing related strategies (Song et al. 1999).

For the in-depth study of international technology out-licensing process, from the Chapter 3, the comparative multiple case studies were applied (Yin 2003). By using this methodological approach we were able to examine each case thoroughly and compare the findings across the cases (Eisenhardt & Graebner 2007). As a result of a theoretical sampling logic (Siggelkow 2007), in this study the four leading Italian pharmaceutical and biotech firms were selected. Pharmaceutical and biotech industry have proven a strong presence of active licensors (Schilling 2009, 2009; Kim 2009; Arora & Ceccagnoli 2006; Rivette & Kline 2000; Grindley & Teece 1997) making them appropriate for our analysis. Moreover, the existence of an active market for technology in the chemical processes (Arora et al. 2001) allowed us to look into the international technology trade. Initially, the potentially interesting firms involved in international out-licensing were identified in consultation with the experts from the Licensing Executives Society Italia (LES Italia), which is a specialized and nonprofit organization operating in the areas closely associated with technology licensing. When building our case studies we were interested in the managerial activities met during technology licensing abroad. Although the research results coming from this exploratory case study analysis are not statistically generalizable (Yin 2003), but exploratory, they offer straight forward suggestions and insights that should facilitate the management of over-border out-licensing of the enterprises.

Emerging holistic view of international technology out-licensing

This thesis adopts a research framework in order to holistically analyze international out-licensing of technologies. The objective of this research project is to study the most relevant elements related to management of technology out-licensing abroad, through understanding the antecedent, process and strategic outcomes resulting from it. We do so by integrating three research articles that explore each of the three issues related to technology out-licensing abroad. These articles are logically linked so that they form a cohesive and unitary form for presenting our findings in regards to international out-licensing. The schematic representation of the research framework is illustrated in Figure 1.

Figure 1. Schematic representation of research framework



Our research findings advance the understanding of **international technology out-licensing antecedent** that explains the magnitude of volume of international out-licensing triggered by the overall amount of technology in-licensing from abroad. This relation is moderated by the firm-level absorptive capacity, defined as ability to acquire, assimilate, transform and exploit the external knowledge (Zahra & George 2002), and is captured through the internal R&D investment intensity. Then the process behind the over-border technology out-licensing is looked at (**international technology out-licensing process**), along all the relevant process stages and managerial questions. The adoption of the process view enabled us to recognize the Dynamic Capabilities that were developed along it. Finally, as a result of the proper process management the strategic outcomes (**international technology out-licensing strategic outcomes**) are discussed. In particular, these outcomes are considered through the organizational learning that takes place when firms out-license their technologies, and their effect on the product sales commercialization performance abroad.

In this study we expand the perspectives and research approach in international out-licensing by combining technology management literature and international business literature. This unified approach strengthens the explanatory power of the PhD dissertation. We go beyond the previous works that were limited on either technology management, like in Madeuf (1984) or Reddy & Zhao (1990), or international business perspective, like in Contractor (1984) or in Morschett et al. (2010), but in essence tackle with the same phenomenon. Our research empirically demonstrates that important concepts from both literature streams could be linked together and offers a stronger understanding of the international technology out-licensing management as a whole. These concepts are: absorptive capacity and Dynamic Capability (given in Chapter 2 and 3) with a technology management emphasis; and organizational learning (discussed in Chapter 4) with a more international business research background.

We use each of the concepts described above to explore a particular segment of the overall holistic picture of international technology out-licensing that is developed in this thesis. We deal with **international technology out-licensing antecedent**, through the study of effect of in-licensing from abroad (external knowledge sourcing) on the out-licensing internationally (external knowledge exploitation). The volume of in-licensing and the effect it has on the volume of out-licensing is in question here (Chapter 3). Absorptive capacity as concept from both technology management literature and international business literature (Cohen & Levinthal 1990; Zahra & George 2002; Brown et al. 2003), explains the acquiring, assimilating, transforming and exploiting of the external knowledge. In the framework of this doctoral dissertation, we rely on it to put together an understanding how the in-licensed technologies from foreign markets enlarge the volume of over-border technology out-licensing. In this sense, we are raising the "how much" question. The Chapter 3 is actually concentrated on the points around the management of the **international out-licensing process** itself, from the moment of its initiation towards the completion of knowledge transfer and control phase that follows afterwards (Chiaroni et al. 2010). Moreover this segmented and structured process inhibited the Dynamic Capability development within the organization. Finally, we wanted to understand in depth the benefiting result or an outcome for the licensor firm after the international out-licensing process closure. So, the interest point is shifted, on the post-licensing benefits that we present in Chapter 4, and that have been marked as important in previous studies (Tan 2009; Jiang et al. 2008). Particular organizational learning benefit reflected on the improvement of product commercialization abroad and triggered by international out-licensing, has been marked as the **international technology out-licensing strategic outcomes** concept. In the technology markets that are characterized with very strong inefficiencies and limited transparency (Arora et al. 2013), solely the possession of high quality and innovative technological assets does not guarantee the full exploitation and maximum profiting from them. So, in this research we are closer in

explaining and facilitating the maximization of the benefits extraction from already available technology resources in the firm.

Our theory advances all three of the concepts as it wraps it up in a novel and joint approach to already studied phenomenon. In Chapter 2 we suggest several relevant issues for the antecedent of international technology out-licensing volume:

- The external technology sourcing and external technology exploiting should be strategically managed jointly.
- The volume of external technologies firms import from companies abroad by technology in-licensing (as an input) affects the volume of international technology out-licensing (as an output).
- The level of absorptive capacity companies develop and nourish through their intensive investment in internal R&D has a moderating effect on the relation between international out-licensing volume and in-licensing volume from abroad.
- The internal R&D should not be neglected even when firms heavily rely on the external sourcing of knowledge.

In regards to the implementation itself of technology out-licensing in global market, the critical aspects of its management where presented in Chapter 3:

- The process based view of international technology out-licensing is fitting for the management of its implementation.
- Each phase has its distinctive role in the development of Dynamic Capabilities of the firm along the process.
- This process consists of well-defined sequences of activities that drive the post-licensing outcomes.

The essential abstract nature of out-licensed technologies enables repeated use of these technologies in diverse products by the licensee firms in their own product development and commercialization. By observing how the licensee firms apply the technologies of licensor in their own products and by following the commercial performance of these products, licensing firms achieve an important organizational learning. Learning permits licensor companies to avoid the high investment in multiple product development of new products that might not achieve satisfactory market success. This notion allowed us to view international technology out-licensing as a strategy for organizational learning by out-licensors (Chapter 4):

- By out-licensing abroad and offering their technologies to companies in foreign countries licensors are enabled to strategically benefit from it.

- The organizational learning takes place because out-licensing firms observe and imitate how their technologies are shaped in products internationally and which of those products achieve superior performance. This results in positive influence on product commercialization abroad.
- Strategic out-licensing abroad for the purpose of organizational learning should be effectively and constantly followed, as its effect is maximized in the short time lag window.

In conclusion, our theory posits that by linking and intervening technology management research and international business research, technology out-licensing abroad receives a more comprehensive understanding and in that sense more advanced insights for its proper management. The framework we proposed for structuring the relevant elements in the holistic view of international out-licensing, going from antecedent of its volume, the process itself and the strategic outcomes that result from it, presents a good foundation for analysis and should be developed also in further studies.

CHAPTER 1:

International Technology Out-Licensing: Literature Review

The purpose of this Chapter is to review the academic literature that is relevant for the doctoral dissertation. Along the literature review main findings from technology management literature and international business literature will be elaborated, to achieve a holistic view of international technology out-licensing management. It will introduce and describe the research problem that will further be addressed. In this Chapter the relevance of the international technology out-licensing from both the stand point of practitioners and academics will be presented, and the main reasons for its investigating will be clarified. Initially we will define the technology out-licensing in general and explain its importance and the role within the firms. Some of its main characteristics will be given and the evidence of its increasing importance in the contemporary business will be presented. Moreover, we will show that international technology out-licensing is increasingly pursued by corporations. Finally we will analyze the complexities caused when practicing it, discuss the managerial challenges that firms are confronted with, and indicate on the relevant research gaps.

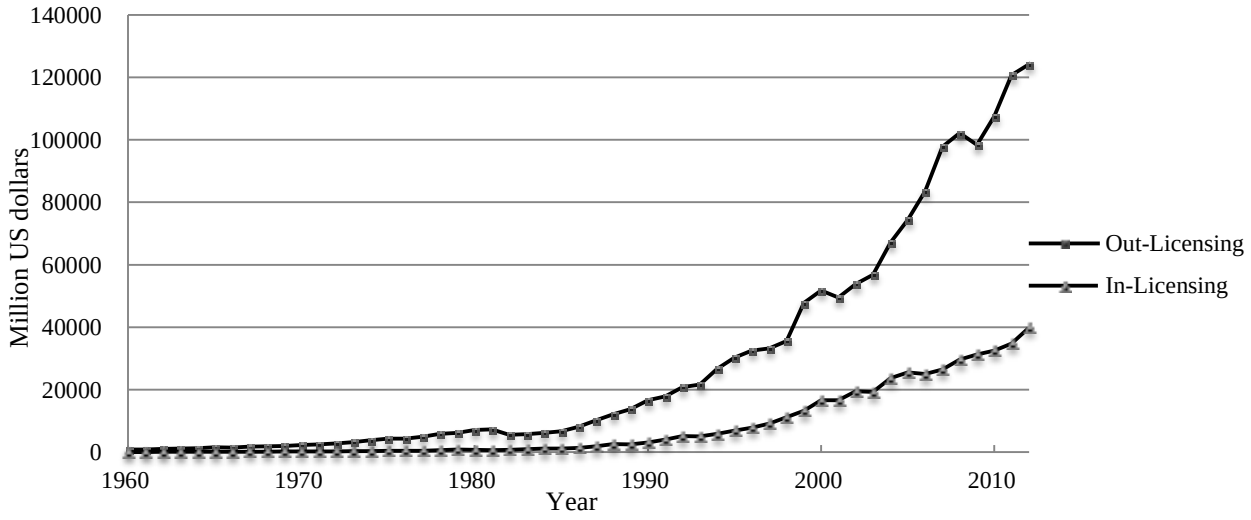
1.1. The definition and anecdotal evidence of technology out-licensing

As defined by Guadamuz (2005), technology licensing is "the transfer of technology by means of a contract of industrial property rights". However, a licensing agreement may also transfer protected or unprotected know-how, training of specialists, transfer of procedures and technical assistance. Licensing agreement is a result of technology licensing and it is constituted by a sourcing firm purchasing the rights to another firm's patents or technology for a monetary payment (Hagedoorn & Hesen 2007). Licensor still remains the owner of technological knowledge and monetary payment may take different forms: up-front or lump-sum payment, fixed payments (milestones) usually linked to specific contingencies (like initiation of technology development or new product launch), and variable payments (running royalties) that are calculated as the percentage of value of sales of the product incorporating the licensed technology. When the licensing contract is drafted, as a part of it a set of clauses that define the following are stated: the scope of the contract (e.g. territorial extent of rights or fields of use restrictions), the exclusivity of rights (preventing the technology owner to license the technology to any other entity (Aulakh et al. 2010) and the duration of the agreement. Licensors are firms that own the essential patents and licensees are firms

that purchase the right to use these patents (Joshi & Nerkar 2011). This work gives detailed understanding particularly on technology out-licensing, and does not observe trademarks, service marks and copyrights.

The growing evidence showing that the technology could be disembodied from physical goods and traded, has made space for the creation of the organized markets for technology (Arora et al. 2002; Arora et al. 2013). Markets for technology are especially recognized in high-tech industries, such as biopharmaceutical, chemical and semiconductors, showing a considerable growth during 1990s. On the global level, Arora et al. (2001) estimated that worldwide market for technology in the 2000s was in the range of $35-50 billion; whereas Kline (2003a) states that US licensing revenues grew from $15 billion a year in 1990s to $100 billion a year in 2002. Similar steady growth of international technology licensing has been reported in the "U.S. International transaction report" (Bureau of Economic Analysis, 2013) that is illustrated in Figure 1.1 and follows the international out-licensing and in-licensing revenues of US companies in the period 1960-2012. Growing technology markets imply that there are firms buying, selling and exchanging technologies (Gambardella et al. 2007) mostly relying on the technology licensing. This phenomenon enhances the birth and diffusion of "serial innovators" firms (Hicks & Hegde 2005), whose main business is to produce and sell technologies.

Figure 1.1. Growth of Technology Out-Licensing Abroad and In-Licensing from Abroad by US Companies (1960-2012)



The increased role of the technology licensing can be noticed likewise on the firm level in companies like Qualcomm. Qualcomm owns several hundreds of patents for the Code Division Multiple Access (CDMA) wireless technologies and has licensed its essential patent portfolio to many telecom equipment manufacturers internationally. By out-licensing its technologies Qualcomm earned more than one-third of

its total revenues from out-licensing (Associated Press Financial Wire, July 25 2007). IBM's undeniable success in out-licensing of its software and patents, allowed the company to earn approximately $2 billion of licensing revenues a year (Preston, 2005). Monetary benefits have been vital even for smaller companies. In 2006, Singapore based company called Creative Technology, operating in digital music player industry, received a $100 million licensing fee (that was around 90% of their yearly profits) by the Apple Computers (Burns 2007). Non-monetary benefits can be observed in a Swiss company called Sulzer Rueti. This company transferred its technologies to Japanese partner and during the time of this partnership, this partner contributed with 150 new ideas to improve the technology. This enabled Swiss company to develop new products and improve its performance (Koruna 2004a).

The formation of technology markets is a global phenomenon (Arora et al. 2002). Globalization of business environments pushes for quick and simultaneous entry into multiple foreign markets, shorter technology life cycles and higher R&D costs for developing new technologies (Ohmae 1989). All of this necessitates for the exploitation of firms' technological assets on a global scale (Arora & Fosfuri 2000). Firms earn billions of dollars in revenues worldwide through out-licensing activities (Fosfuri 2006), and anticipate further growth through licensing out their technologies (Economist 2005).

1.2. Drivers of technology out-licensing

Licensing dilemma is a term, which describes an idea that technology licensing entails a trade-off. The focus of the licensing dilemma is on the licensor's decision about whether to license-out technologies or commercialize them in-house. In his work, Fosfuri (2006) described licensing dilemma as a trade-off between the revenue effect and profit dissipation effect. Both the revenue effect and the profit dissipation effect influence the licensor's profits (Arora & Fosfuri 2003a). In the licensing dilemma research the non-monetary/strategic dimension of licensing, like blocking of entry (Gallini 1984) or competitors selection (Rockett 1990) or setting and controlling of industry standards (Katz & Shapiro 1985), have usually not been regarded. The revenue effect is defined as "the present value of the flows of money accruing to the licensor in the form of licensing payments, net of all possible transaction costs that bear on the seller of the technology" (Fosfuri 2006), while the profit dissipation effect is seen as the reduction in the licensor's profits (all profits apart from the payments incoming from licensing agreement) that usually come either as a consequence of an additional firm competing in the product market, or as a result of increased aggressiveness of an existing firm. In the profit dissipation effect new competition that was brought in by the issued licensed technology, may reduce the price–cost margin and diminish the market share. So, the licensors itself is responsible for the loss of the market share, which also leads to the profit reduction. In other words, licensing dilemma is seen as a firm's need to balance the licensing payments net of

transaction costs (revenue effect) against the lower price–cost margin and/or reduced market share implied by increased competition from the licensee (profit dissipation effect). Fosfuri (2006) in his seminal work on licensing dilemma finds that the rate of technology licensing displays an inverted U-shaped relationship with the number of potential technology suppliers. Further on, he introduces two other potentially important determinants of a firm's rate of technology licensing: the licensor's market share in the product market and the degree of technology-specific product differentiation. Both the market share of licensor and the degree of technology-specific product differentiation are negatively related to the rate of technology licensing. The aspect of licensing dilemma is linked to the licensing decision (whether to license or not) and has been explored extensively.

The growth of technology out-licensing is driven for multiple reasons. First, there has been an increase in the division of innovative labor, as the specialization of the relevant actors along the value chain of technological innovation is occurring. Caused by this growth in the specialization of labor, the upstream technology suppliers have emerged, who are increasingly transferring their research outputs to enterprises capable of manufacturing (relying on licensed technologies) and marketing these products (Arora et al. 2001). Second, the Open Innovation paradigm has rapidly diffused among the business world. Defined by Chesbrough (2003), the Open Innovation idea stresses the need for "leveraging external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology" (Chesbrough 2003, p. 24). This view is in contrast with the traditional approach, which was limited on the internal R&D and in-house commercialization of R&D outputs in final products. So, Open Innovation perspective has actually promoted the idea of higher reliance and import of external technologies within contemporary business organizations, causing the growth of technology out- and in-licensing (Arora et al. 2001). Third, the Intellectual Property protection has become stronger, which mitigated the well-known appropriability concerns (Grindley & Teece 1997). The enforcement of IPR has facilitated the technology out-licensing itself by lowering the risks and transaction costs (Anand & Khanna 2000b). Fourth, the globalization of business environment has forced companies to more intensively exploit their technologies internationally (Arora et al. 2001), enabling simultaneous and rapid expansion in more markets around the world. And fifth, as firms have started increasingly to realize that a big part of their technology portfolio is underutilized (according to Kline (2003a) often more than 50%), they have engaged more actively to out-license their technologies (Huston & Sakkab 2006).

Some particularly strategic drivers have also contributed to this extensive growth of international technology out-licensing. First, out-licensing in international markets has allowed firms to rely on out-licensing as a market entry strategy. Moreover, it is consider lower in risk and resource commitment than other options for entering markets internationally (Morschett et al. 2010) Second, through technology out-licensing firms are able to establish proprietary technologies as industry standards (Gallini 1984).

Companies create positive network externalities (Katz & Shapiro 1985) by out-licensing heavily their technologies, in order to increase the value of these technologies as the number of consumers using them increases (Koruna 2004a). Positive network externalities can be understood by looking at the growth of the perceived value in the eyes of the product customer, which is directly driven by the number of the product users within the same network. Third, when firms out-license their technologies to third parties they can achieve technological leadership by lowering the interest of other organizations to invest in the same technologies. In that manner, licensors slow down or totally cancel-out their rivals from pursuing intensive R&D in the same technological field (Arora et al. 2001). Fourth, out-licensed technologies are transferred to recipients that use and improve them for their own purposes. Companies that out-license realize a learning effect inhibited by this technological use and improvement of technology recipients (Arora 1997). And fifth, by active out-licensing firms reputation as a high-level technological developer is built, as larger number of licensees serve positively for the increased visibility of the licensor (Lichtenthaler & Ernst 2007). Moreover, by developing a strong networking capability, enterprises enhance their product and technology innovation (Mu & Di Benedetto 2012).

However, usually diverse strategic and monetary drivers are intervened together and jointly driving the growth of technology out-licensing. As it can be concluded from above, most of these drivers actually accomplish their full potential and make sense only when technology out-licensing is placed into international markets perspective. Though the focus on international technology out-licensing is not a common practice in the out-licensing literature, and for that reason still remains vaguely explored (Mottner & Johnson 2000; Aulakh et al. 2010). In order to overcome this gap, further on we observe only the international out-licensing with its peculiarities given in the next section.

1.3. Technology out-licensing in international business literature

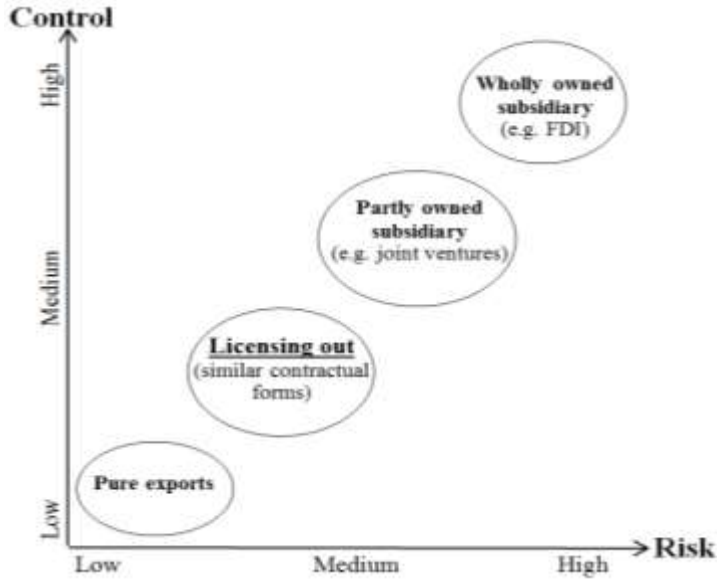
1.3.1. Technology out-licensing as a foreign market entry mode

In the international business literature, technology licensing has mostly been studied in the context of the foreign market entry modes (Ahsan & Musteen 2011; Brouthers & Hennart 2007; Jiang et al. 2008; Herrmann & Datta 2002; Zhao et al. 2004; Marshall et al. 2007), along with exports, joint ventures and wholly owned subsidiaries. Based on the features of technology licensing in foreign markets, it is commonly compared with other entry modes (Anderson & Gatignon 1986; Buckley & Casson 2009; Contractor 1984). Some works argument that the licensor's net profit received by licensing is lower than the net profit that may be extracted by keeping the technology inside the company (Kotabe et al. 1996), suggesting that that transaction and opportunity costs are excessive in the technology transfers to other

firms. As a result, licensing has been viewed as a second-best entry strategy, which companies should rely on only to extract value of mature technologies (Telesio 1979). Authors claim that companies engage in international technology licensing primarily in order to gain experiential knowledge about foreign markets before they commit additional resources to those markets (Johanson & Vahlne 2009; Johanson & Vahlne 1977; Morschett et al. 2010). However, enterprises are more extensively utilizing international licensing as a proactive strategy not just for the profits, but also to obtrude industry standards and to gain competitive advantage in foreign markets (Hill 1997; Kotabe et al. 1996; Aulakh et al. 2010). Overall, this literature largely concentrates on the choice of international market entry mode, where technology licensing in foreign markets is viewed as a low-investment, low-risk and low-return alternative, providing least control to the licensing firm (Johanson & Vahlne 1977; Agarwal & Ramaswami 1992; Brouthers & Hennart 2007). Academics explain the low-involvement/low-control features of licensing as an entry mode are results of a non-obligatory equity participation of the licensor (Hill & Kim 1990). Control is referred to as a need of a company to influence systems, methods and decisions in the foreign market (Anderson & Gatignon 1986) and entry mode determines whether an enterprise has a full control over the foreign unit or shares it with the partner (Arregle et al. 2006). Entry modes offering greater ownership in the foreign market operations are considered to have higher control. Some authors (Blomstermo et al. 2006; Meyer et al. 2009) distinguish entry modes types only as high control modes (e.g. wholly owned subsidiary) and low control modes (e.g. licensing).

Figure 1.2 illustrates where international technology out-licensing is positioned, in terms of the risk and control levels, in the foreign market entry mode literature. When classifying the market entry mode along the control and risk features, wholly owned subsidiary gives the most control to the firm and makes it more exposed to risk because the overall decisioning responsibility is on the firm. By reducing the control and sharing both investment resources and power on influencing the decisions in the international market, also reduces the risk level. Partly owned subsidiaries (e.g. joint ventures) are still offering higher control levels to the company, while carrying less risk. International technology out-licensing presents an option for internationalization, characterized with lower investment, lower risk and low return levels, also providing least control to the firm that licenses its technology. The risk is minimized if the company engages in pure export, which is a market entry mode that offers the minimal level of control but still asks for delivering the fully developed products that need to capture its share of international market.

Figure 1.2. Positioning international technology out-licensing, in terms of the risk and control levels, in the foreign market entry mode literature



1.3.2. Managing international out-licensing

Most of the studies on international out-licensing management have focused on the issues considering the choices of specific elements in licensing contracts. Authors have gone into questions concerning the management of international technology out-licensing contracts. In that sense the previous literature on the international technology out-licensing management has discussed about:

- **Compensation choice:** The level of licensors' ability to influence independent licensees depends on the licensing agreement compensation structure. While the lump-sum compensation consists of a one-shot transaction between two firms, and thus involves only limited interaction between them after the agreement is signed, the royalties-based compensation ties the licensor and licensee much closer as licensor continuously extracts revenues from the licensed technology because it is dependent on the market performance of licensee. Aulakh et al. (1998) empirically study these relations and find that the host country legal and economic environments along with the stage in the technology life cycle are significant predictors of compensation structures. Moreover, they show that licensors prefer lump-sum fee payment agreements if the IP protection uncertainty is higher and when it is more complex to intake licensing revenues from the foreign markets.
- **Contract specification:** The contract specifications that are implemented in out-licensing agreement shape the international out-licensing features. Marshall et al. (2007) look into the dispersion pattern characteristics of the international licensing agreements (exclusive versus multiple licensing). They find that licensing exclusivity is linked to the market entry effectiveness.

On one hand, they say that exclusive licensing helps in maintaining the flexibility of future moves, because this single licensee may be easily accounted as a collaboration partner in the future. On the other hand, in non-exclusive licensing firm's competitive standing in the market is improved by broadening its user base (Hill 1997) and establishing some berries for entry for subsequent competitors (Eswaran 1994). In any case the licensing exclusivity demonstrates a strong strategic importance.

Aulakh et al. (2010) similarly studied the nature of rights granted in inter-firm licensing relationships, by conceptualizing licensing rights through the number of licenses granted and exclusivity rights given to international licensees internationally. Their results propose that there is a greater propensity to use non-exclusive (multiple) licensing when differentiated products can be developed from the licensed technology, or when there exists a threat that a substitutive technologies could enter to the market. The use of exclusive (single) licensing agreement is more probable when the innovative technologies are in question, which require higher degree of asset-specific investments from the licensee. Interestingly this study does not find any impact of IP protection abroad on the decision to grant certain licensing rights to licensees. Authors explain that by suggesting only marginal relationship between IP protection and a licensing decision internationally. This finding is consistent with the research from Arora & Ceccagnoli (2006a), who find that the IP protection effectiveness has a positive effect on the increase of licensing propensity only when the potential licensors are lacking complementary resources to commercialize their technologies. However, when companies possess complementary resource, the patent protection negatively drives licensing propensity.

- **License duration:** The length of licensing agreement abroad presents an important part of the licensor's choice. Jiang et al. (2008) explore the length of international out-licensing agreement through a real option perspective. Their empirical findings demonstrate that the market and technology uncertainties internationally cause shorter duration of the agreements.
- **Licensee selection:** The proper selection of partners for international technology out-licensing has been marked as an important issue that lowers the risk in this activity (Mottner & Johnson 2000). Kim (2009) presents the potential factors affecting the choice of international licensing partners by using a comprehensive data set of worldwide licensing deals. He found that the transaction and learning cost are highly relevant for explaining the propensity of making two entities to engage in over-border licensing agreement. In this study the explanatory factors related to the knowledge appropriability (i.e. strength of IPR protection), familiarity between partners through prior licensing agreements, and business similarities have been considered. The resulting findings show that corporations will tend to be a part of the international licensing agreement when: there is a

stronger IP protection in the licensee country, when the partnering companies are more familiar through their prior agreements, and when their market profiles are closer to each other.

However, there are few studies that explored the firm specific managerial features that find their importance for framing international out-licensing activities as a whole (Kim 2009) and leading to the proficient management of international out-licensing. Thus the aim of this dissertation is to understand particular firm level features that are relevant for management of the international out-licensing antecedent, process and strategic outcome. The rationale behind our research framework and propositions is that for achieving successful international technology out-licensing the main three elements that cover this activity should be cautiously managed. We begin with the focus on the international out-licensing antecedent in Chapter 2 (*antecedent construct*), than proceed throughout international out-licensing process in Chapter 3 (*process construct*) and finally towards the desired outcome that are discussed in Chapter 4 (*outcome construct*). In each of the chapters that follow the literature review of the corresponding construct is given. Moreover, in each of the chapters we thoroughly explain and position the relevance of each of the constructs in the overall topic on international technology out-licensing management. In Chapter 5, we sum up and conclude with the general findings from this dissertation and propose potential further directions that would be interesting to study.

CHAPTER 2:

Antecedent of International Technology Out-Licensing Volume: Does Technology In-Licensing from Abroad Help?

In Chapter 2 the study with the title "Antecedent of International Technology Out-Licensing Volume: Does Technology In-Licensing from Abroad Help?" is explained. Although the reasons why firms out-license their technologies abroad have been studied extensively, only limited research has been done on the firm level characteristics that determine the magnitude of international technology out-licensing. The empirical evidence illustrate that there are certain firms reaching enormous amount of out-licensing volume, while others do not.

One of the ways to approach and study this phenomenon is by looking at the magnitude of technology in-licensing from abroad (as a firm's source of knowledge) and its effect on the magnitude of technology out-licensing internationally. However, international business, along with the technology and innovation management literature, may lead us to two opposite assumptions. First is that in-licensing from abroad positively contributes to venture's innovativeness and it enables more out-licensing internationally. Second is that companies that in-license from abroad extensively may lose the momentum of their own R&D and by that become more indolent in their innovation production and out-licensing abroad. For this reason here we examine the research question RQ.1.a: "How does the magnitude of technology in-licensing from abroad influence the magnitude of out-licensing internationally?". Further, we look at firm's absorptive capacity, measured as the intensity of internal R&D, to understand whether it has a moderating effect on this relation. So we raise another research question: RQ.1.b: "Does internal R&D intensity moderate the relation between international in-licensing and out-licensing volume magnitude?". We study this interaction on the panel data set of 702 Spanish manufacturing firms, who's out-licensing volume has been recorded in 10 years time frame (from 1998 to 2007).

In this chapter we will give forward the literature review on the related topic both from the international business research and innovation and technology management studies. We will describe the data we rely on, statistical methodology applied and present the results that will be discussed. Finally the main conclusions will be presented and some suggestions for future studies will be given.

2.1. Introduction

The increase of market for technology size has become evident in the last 20 years (Arora et al. 2002; Gambardella et al. 2007; Arora et al. 2013). Direct cause of this growth might be found in increasing technology licensing among the firms (Aulakh et al. 2010; Shepard 1987; Arora et al. 2002; Granstrand 2004). This growth is seen as a consequence of both inbound and outbound licensing. Although the reasons why firms out-license their technologies have been studied extensively (Atuahene-Gima & Patterson 1993; Tan 2009; Kotabe et al. 1996; Tsai & Wang 2009; Aulakh et al. 2010), little is known about firm level characteristics that determine the magnitude of technology out-licensing (Walter 2012; Hoang & Rothaermel 2010).

Arora et al. (2002) suggest that international, over-border, licensing transaction have particular importance for the growth of market for technologies. Anecdotal evidence indicates an enormous increase of volume of international technology licensing. For example, OECD studies (2009) show that between 1996 and 2006 the overall value of technology exchange within the Organization for Economic Co-operation and Development (OECD) nations has grown by 63%, when observed as the percentage of gross domestic product (GDP). Moreover, the worldwide amount of technology licensing revenues has reached the value of $100 billion (Economist, 2005). However, although some firms reach enormous amount of out-licensing volume (like IBM or Texas Instruments (Grindley & Teece 1997)) others do not. On one side, this disperse difference in out-licensing volumes abroad among enterprises might be explained by already widely studied topic dealing with firm's decision whether to out-license or keep the technologies inside the firm (Fosfuri 2006; Arora & Ceccagnoli 2006). On the other side, the magnitude of out-licensing volume may be resolved by the firm's ability to offer its innovative technologies in the market for technology, which has not received comprehensive research attention (Walter 2012; Atuahene-Gima 1993a). So, we focus on exploring what determines the magnitude of firm's international out-licensing volume.

The configuration of R&D activities and sources of new technologies directly drive the firm's out-licensing (Teece 1986; Fosfuri 2006; Jiang et al. 2008; Mottner & Johnson 2000; Aulakh et al. 1998). Leone & Reichstein (2012) explain that in-licensing of technologies presents one of the sources of new technologies, but also an important trigger for innovation inside the firm. As out-licensing presents a direct consequence of innovative firms (Teece 1986; Mottner & Johnson 2000; Hill 1992; Grindley & Teece 1997; Lin 2011), we could assume that in-licensing positively stimulates out-licensing. However, companies that strongly rely on in-licensing as a sources of new technologies, might neglect and degrade its own innovation development capacities, causing in-licensing to negatively stimulate out-licensing (Walter 2012). This relationship should be even more significant in the international context, where

enterprises have an option in-license more diverse technologies (Zahra et al. 2000), more advanced technologies (Arora et al. 2002) or even less costly as the in-licensing company does not need necessary to present the direct competitive threat to the foreign licensor (Athreye & Cantwell 2007). For this reason here we examine the research question: "How does the magnitude of technology in-licensing from abroad influence the magnitude of out-licensing internationally?". Both supply and demand side of licensing have been explored by previous works separately, but the interaction among in- and out-licensing has received only minor attention (Walter 2012). The stream of studies on the exploitation of external technologies in own product development is wide and well developed (Atuahene-Gima & Patterson 1993; Lichtenthaler & Frishammar 2011; Schilling & Hill 1998; Bianchi et al. 2013), but there are only a few research works dealing with exploitation of external technologies in the external technology exploitation process (Hoang & Rothaermel 2010).

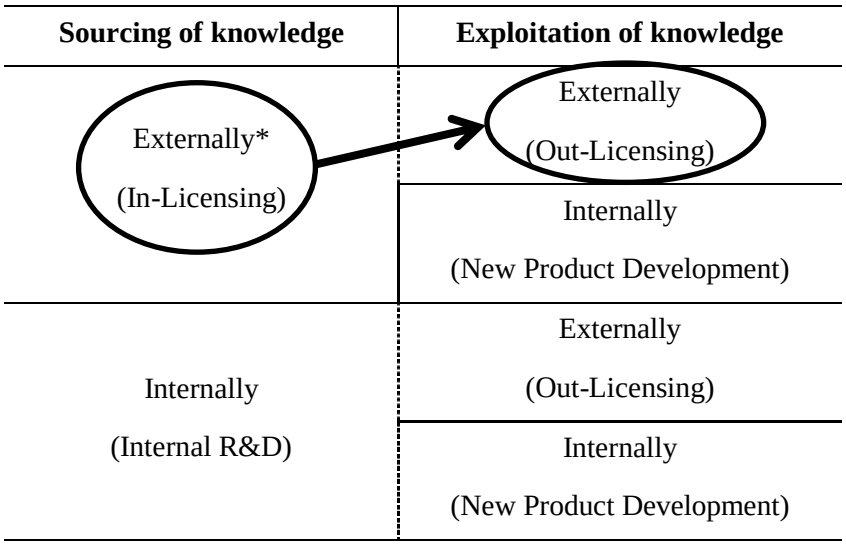
To study the interaction between international in-licensing and out-licensing, we use the panel data set of 702 Spanish manufacturing firms, who's out-licensing volume has been recorded in the 10 years' time frame (from 1998 to 2007). Our results indicate that in-licensing from abroad has a positive impact on the volume of international out-licensing. Moreover, the intensity of internal R&D over total R&D positively influences this relation. These findings imply that organizations should optimally rely on technology in-licensing along with continuous investment in their internal R&D, in order to maintain higher magnitude of international out-licensing volume. Our findings contribute to the previous literature on technology management, by again indicating that technology sourcing and R&D investment activities should be closely coordinated for optimal outcome achievement (Hung & Chou 2013; Atuahene-Gima & Patterson 1993), and that technology exploitation and exploration strategies should be aligned (Hoang & Rothaermel 2010; Stettner & Lavie 2013; Bianchi et al. 2013).

Our paper is structured as follows. In the next section we briefly review the technology and R&D management literature that dealt with determinants of technology out-licensing output volume as one of the strategies for external technology exploitation. In particular in this review, we input some relevant insights resulting from the international business perspective. After presenting the literature review, we proceed with the introduction of the data set we used in this study and a brief summary statistics of variables included in the regression. In the section that follows we describe in detail the methodology we use and discuss the results we obtain. The final section elaborates our findings, explains the theoretical and managerial contributions and proposes several interesting directions for future studies.

2.2. Literature Review and Hypothesis Development

The volume of out-licensing amount is pushed by numerous benefits that are enabled by out-licensing, like reduction of risks and costs around product development (Atuahene-Gima & Patterson 1993; Lee & Lieberman 2010), extraction of additional revenues from mature technologies (Kotabe et al. 1996), rapid progress in diverse and international markets (Tan 2009; Agarwal & Ramaswami 1992; Johanson & Vahlne 2009), and accomplishment of higher returns from initial R&D investment (Tsai & Wang 2009). Also changes in the business environment drive the technology out-licensing growth, like high increase of R&D and technology development costs and risks (Sikimic et al. 2013; Austin, 2006), tendency to reuse technologies in more products since the product life-cycle have been shortened (Hoang & Rothaermel 2010; Danneels 2007), globalization of the markets and need for entry in multiple markets (Aulakh et al. 2010; Morschett et al. 2010), and stronger intellectual protection rights (IPR) (Aulakh et al. 2010; Arora & Ceccagnoli 2006). However, the clear antecedents of higher out-licensing volume are not well known. In other words, the impact of in-licensing on out-licensing volume can be on a more abstract level viewed as the influence of external source of knowledge (technology out-licensing) on the amount of external exploitation of knowledge (out-licensing). We present in Figure 2.1 which exact relation from technology management research we address in this work. We will also reflect on the some particular insights that distinguish these activities in the international context.

Figure 2.1. Positioning our research interest in the current technology management literature



*The arrow marks the relation studied in this research

2.2.1. External exploitation (by out-licensing) of externally sourced knowledge (by in-licensing)

Technology management literature has shown that technology in-licensing raises the level of innovativeness of an organization (Atuahene-Gima 1992; Atuahene-Gima 1993a; Parida et al. 2012). Innovative technologies present the necessary economic good needed for the exchange in the technology out-licensing transaction (Enkel et al. 2009; Lichtenthaler 2009). In other words, in-licensing can be viewed as a tool for busting innovation performance of the company by expanding its knowledge breath and understanding (Roberts & Berry 1984). It enables firms to compress time and risks around R&D investment, and in that sense facilitates more efficient delivery of innovative outcomes (Markman et al. 2005). When innovative performance is more superior, it should lead towards more external technology exploitation in the form of out-licensing

By in-licensing technologies, firms feed their inventive capacity with novel knowledge of other organizations (Rigby & Zook 2002), and in that manner expand their basic knowledge base. Moreover, the extensive inward transfer of technologies fosters a strong learning from other organizations (Johnson 2002) that helps firms capture some part of the competitive advantage of the out-licensing entities. So, in-licensing makes firm more competitive in the technology market and should secure higher bargaining power in technology out-licensing activities (Gans & Stern 2003; Teece 2006).

Technology in-licensing expands the internal knowledge foundation of the firm and broadens the innovation perspective potential (Kim & Vonortas 2006; Arora & Fosfuri 2003a; Anand & Khanna 2000b). When having a broader variety in the knowledge base, firms can combine new and novel knowledge that directly increases the potential volume of out-licensing (Choi 2002; Flemming & Sorenson 2004). Innovations are not always delivered by organization with a large bum of innovations but by organization with more distant technology exploitation potential than the one solely offered by its internal research (Laursen et al. 2010). Broader knowledge base is a better starting point for higher out-licensing volume.

Moreover, in-licensed technologies are already proven and more advance developed (Roberts & Berry 1984; Authane-Gima 1993). In this manner firms avoid the failures in the application of in-licensed technologies and can learn from the mistakes of developers of technologies (Gomory 1989). In-licensing actually might be seen as an alternative of in-house R&D (Arora et al. 2002; Silverman 1999; Fosfuri 2006), and can support the development of complementarities linking the licensed technology and in-house R&D (Veugelers & Cassiman 1999). These advantages given by in-licensing may compensate the lacks of firm's own R&D, making companies more capable of higher out-licensing volume.

In the international perspective these aspects of in-licensing benefits that are relevant for superior out-licensing volume become more evident and meaningful. In this relation, the technology base coming from international in-licensing will be much more scattered in terms of technologies and applications it

offers. Additionally, companies that engage in inward licensing from international market become more globally exposed and build up ties with multiple organizations outside their home country (Atuahene-Gima 1993b; Shahrokhi 1987). These globally spread ties make firms more capable to out-license in foreign countries, resulting in higher volume of over-border out-licensing. In general, the positive relationship between inward licensing and other activities in foreign markets has been shown (Ford 1985) and international technology market has shown an important role in diffusing the technology knowledge across countries (Arora et al. 2002).

All above stated, firms that in-license technologies from abroad become more innovative, more able to offer a wider range of top-conch technologies and more internationally present. For this reason we might expect from firms that have higher volume of in-licensing from abroad to achieve higher volume of international technology out-licensing. Thus we hypothesize:

H1a: Volume of technology in-licensing from abroad has a positive impact on the volume of technology out-licensing internationally.

But, some research finding advocate on the opposite relations, the negative influence of in-licensing volume on out-licensing volume (Walter 2012). They present different arguments for this relation. First, in-licensing may demoralize the R&D staff of the firm that in-licensed the technology, because of the limited control they have over the technology and because they are up to some extent dependent on the licensor for the maintenance of technology (Lowe & Taylor 1998; Sen & Rubenstein 1989). This can cause the in-licensor to lose its R&D momentum and become too much dependent on the technology feed from other firms, leading to a type of competency trap (Levitt & March 1988). Firms that heavily rely on external knowledge needed for their basic R&D have a relative disadvantage when it comes to acquiring some skills and resources necessary to follow the technological change (Bettiset al. 1992; Lei & Hitt 1995). Second, the technology transfer process may cause certain problems, because the organization depends from the supplier side ability to transfer knowledge. Knowledge transfer is in many cases complex and may need former experience and routines that facilitate it, by considering needs of the buyer and proper communication of know-how (Kogut & Zander 1993). Furthermore, integration costs for the in-licensed technologies highly depend on the desorptive capacity of the firm transferring knowledge (Grindley & Teece 1997). Desorptive capacity is seen as an ability of a firm to transfer knowledge more effectively (Müller-Seitz 2012). Third, the inward transfer of technology may provoke the not-invented-here syndrome, as a barrier for external knowledge acceptance within the in-licensing firm (e.g. Katz & Allen 1982). If the internal R&D staff does not accept external technologies well, it will degrade and

decrease their potential to achieve high out-licensing volume. So, there are certain indications that suggest that the amount of in-licensing diminishes the out-licensing volume.

When considering the inward licensing from the companies in foreign market, the proposed negative influences can be also recognized and also a few more might be added. For example, the cultural and language barriers that differentiate firms from particular country setting make these problems even more substantial, because knowledge is embedded in distinct social contexts and dissimilarity between partners increases the difficulty of knowledge transfer (Kogut & Zander 1992). So, the desorptive capacity in the international context has even stronger role in order to secure the proper technology transfer to another company, which will result in the higher volume of out-licensing. Another point is the dominant logical, knowledge base and organizational structures that are usually not compatible when firms from different countries are considered (Lane & Lubatkin 1998).

Problems with higher reliance on external knowledge source, with complex knowledge transfer, knowledge transfer capabilities and cultural differences among the firms involved in the knowledge transfer might indicate that in-licensing from a broad actually has a negative influence on the overall international out-licensing volume. In this light we propose the following hypothesis:

H1b: Volume of technology in-licensing from abroad has a negative impact on the volume of technology out-licensing internationally.

2.2.2. Moderating role of internal R&D

Previous literature explains that internal R&D experience is critical for building firm's absorptive capacity, defined as firms ability to acquire, assimilate, transform, and exploit external knowledge to produce a dynamic organizational capability (Zahra & George 2002). Acquiring, assimilating, transforming, and exploiting external knowledge are important for enabling firms to accomplish greater volume of out-licensing. It is especially relevant for successful adaptation of radical technological innovation (Cohen & Levinthal 1990), which pushes forward the knowledge frontier and enables more out-licensing of technologies coming from it. To overcome the problems of knowledge transfer that are particularly strong in the international context (Simonin 1999), firm needs significant investment in its internal resources (Mora-Valentin et al. 2004; Rothaermel & Deeds 2006; Simonin 1999)

The extent of a firm's absorptive capacity, also understood as its ability to recognize the value of new, external information, assimilate it, and apply it to commercial ends (Cohen & Levinthal 1990) can drive the returns on subsequent investments to develop new knowledge or exploit both new and existing knowledge (Minbaeva et al. 2003). Thus, the certain internal capabilities have an essential role in resolving if enterprises are capable for efficient leveraging of the in-licensed technologies in their out-

licensing activities. Moreover, intensity of internal R&D can also contribute to ambidexterity, defined as the 'ability of a firm to simultaneously explore and exploit' its knowledge (O'Reilly & Tushman 2008). In our case, it is exploited through the dependence of international in-licensing volume on the out-licensing volume.

In terms of absorptive capacity, researchers have repeatedly point out on significance of transformative skills and routines needed for firms to benefit from and adjust to rapid technological change (Cohen & Levinthal 1990; Lane & Lubatkin 1998; Zahra & George 2002). This aspect of organization's absorptive capacity is built by steady and continuous engagement in basic research and exploratory experience (Cohen & Levinthal 1989; Cohen & Levinthal 1990). Not only that the intensity of internal knowledge investment improves the firm's ability to exploit this knowledge, it also helps companies to monitor, screen, evaluate, and leverage knowledge that is generated externally (Helfat 1997). More generally, (Laursen & Salter 2006) demonstrate that by pursuing a larger volume of external knowledge without the requisite internal absorptive capacity, causes the reduced innovative performance in U.K. manufacturing firms (Laursen & Salter 2006).

These arguments put forward the reasoning suggesting that internal R&D efforts and investments allow companies to achieve higher absorptive capacity. The absorptive capacity is relevant for the proper acquiring, assimilating, transforming, and exploitation of external knowledge. So, in order to achieve higher volume of out-licensing internationally, companies have to nourish their internal R&D that should positively moderate the exploitation of the technologies in-licensed from abroad. For this reason we hypothesize:

H2: Internal R&D intensity positively moderates the impact of technology in-licensing from abroad on the volume of technology out-licensing internationally.

To test our hypothesis, we proceed to the statistical analysis.

2.3. Data

The dataset we employ in this study originates from a survey on a representative sample of Spanish firms from the database Encuesta Sobre Estrategias Empresariales (Survey on Business Strategies, ESEE), collected by a public institution that is financed by the Spanish Ministry of Industry. The ESEE survey complements the information about the industry in Spain provided by the 'Industrial Survey' of the National Institute of Statistics, offering aggregate information at a sectoral level, and the 'Central of Balances' of the Bank of Spain, providing information about the financial activities of companies. In this

sense it is a unique data source that reports the amount of out-licensing in terms of value in Euro, achieved by a company in a one year time frame.

Population of manufacturing companies with more than 10 workers in the initial year when the survey commenced (1990) is included in the sample. Further, this survey follows both the exhaustive and random sampling criteria: as the questionnaire was sent to all firms with more than 200 workers and to a random sample of firms with less than 200 workers but more than 10 workers. As we poses the survey for the period 1998-2007, there are some companies with less than 10 employees, as employees could leave and join the company from the initial year when the survey was initiated. This is a positive side of the survey, as it also captures the dynamics of size change of the observed company.

Focus on the manufacturing sector is particularly valuable in the context of our research, as we explore the out-licensing volume of firms whose business is not solely based on out-licensing (like research centers without any production and that only develop and out-license technologies). So, this allows us to clearly distinguish the relation of out-licensing volume depending from the in-licensing volume, by also offering firms an option not to out-license at all. This database has already been used in the studies that were questing certain aspects of firms R&D activities (Beneito 2006) and technology exploitation strategy (Bianchi et al. 2013; Kotlar et al. 2013).

The initial dataset contained 4.475 firms, each with 11 years of observation (1997-2007) that make altogether 49.225 year-firm observations. Our focus is on the out-licensing activities followed by firms out-licensing volume, so we take from the overall population only the firms that report their out-licensing activities. So, our focused sample is made of 10 years of observations (1998-2007) of 702 companies (making total 7020 firm-year observations) that report the amount of volume of their international out-licensing activities. The overall population does not offer any information for firm's licensing engagements in the year 1997. This year does not add any information to our analysis and we do not consider it in this sample.

Since this study relies in its statistical analysis only on the firms that report their technology out-licensing incomes from abroad in every year[1], we have tested for the sample selection bias. To directly test whether this sample selection bias exist, we have adapted for our specific needs the standard Wooldridge's (1995) variable addition test for selection bias in panel data and followed the proposed methodology from Semykina & Wooldridge (2006) that allows for this test also when the unobserved heterogeneity and endogenous regressors are present. In brief the procedure is the following, in the first step we have

[1] Note that our subsample includes companies that: do not have any out-licensing incomes from abroad in any of the observed years (their international out-licensing volume equals zero in all years), have out-licensing incomes from a broad in some of the observed years (their international out-licensing volume takes value not equal to zero in some years), and companies that have out-licensing incomes from a broad in all of the observed years (their international out-licensing volume takes value not equal to zero in all the years).

estimated a probit model on companies reporting or not reporting their revenues from technology out-licensing abroad. The dependent variable in this model is the binary variable taking value 1 if the company reports international out-licensing revenues and value 0 if it does not report. The independent variables for this probit sample-selection model are variables that capture the general characteristics of the firm (e.g. size, age, industry and R&D intensity) and the variable that show whether or not the firm reported in the survey the amount of international in-licensing revenues. In the second step we have extracted the estimated coefficients of this model, which were used in order to obtain the inverse Mill's ratio control factor for all the firms that constitute the initial sample. Further, we insert this time-varying ratio as a control variable for the sample selection bias in our system GMM[2]. By adding this additional variable we control for the unobserved heterogeneity that affects firm's probability of being sampled. In the Appendix 2.A (Table 2.4) we again report the estimates of the Models 1, 2 and 3 (that are thoroughly explained in section 2.4). The results given in all three models indicate that the coefficients of the inverse Mill's ratio are not statistically significant, meaning that there is none remarkable sample selection bias present. Moreover, the inclusion of the control for the inverse Mill's ratio does not greatly influence our results and our variables of interest stay strongly significant. Similar methodology has been applied in the papers from Colombo et al. (2009, 2013).

Further, our data implements the information on inflation from the Spanish National Institute for Statistics (INE), which we use to take into account the annual inflation from December previous year to December of the current year (as also the data given in the sample relate to the December of the observed year). We apply the well-known deflating procedure to deflate the nominal values, by taking the first year (1998) as the reference year. This inflation-adjustment is frequently used in other panel data studies (Arellano & Bond 1991), while it strengthens the model. In Table 2.1 we illustrate the sample break-down according to the industry and mean volume of out- and in- licensing. Our sample shows that some industries demonstrate higher out-licensing volume in general (like chemical and pharmaceutical or sectors developing any complex technical machinery or electronics), which is consistent with previous literature (Arora & Fosfuri 2000; Gans & Stern 2003; Grindley & Teece 1997). Again, the volume of in-licensing from abroad is higher than from out-licensing, which is aligned on the previous finding suggesting that most of the manufacturing firms still do not engage in an proactive out-licensing strategy (Granstrand 2004; Lichtenthaler 2011). For the purpose of examining the exact relation, we continue to the regression modelling.

[2] As suggested in the paper from Semykina & Wooldridge (2006) the inverse Mill's ratio is treated as an exogenous covariate in our system GMM analysis.

Table 2.1. Sample break-down according to industry, mean volume of technology out- and in-licensing

Industry	No. of firms	Mean Volume of Technology Out-licensing	Mean Volume of Technology In-licensing
1. Meat products	17	0	62,84
2. Food and tobacco	52	6.915,69	259.409,90
3. Beverage	10	0	62.049,79
4. Textiles and clothing	54	0	13.611,71
5. Leather, fur and footwear	15	2.671,44	291,66
6. Timber	14	0	11.202,55
7. Paper	31	2.696,68	19.814,46
8. Printing	32	2.344,37	7.543,29
9. Chemicals and pharmaceuticals	62	20.399,62	465.463,30
10. Plastic and rubber products	48	3.027,86	87.284,05
11. Nonmetal mineral products	33	4.875,09	309.996,20
12. Basic metal products	36	4.601,06	107.768,50
13. Fabricated metal products	66	446,34	26.944,27
14. Agricultural and industrial machinery and equipment	60	7.907,86	85.842,63
15. Computer products, electronics and optical	11	8.190,43	31.595,68
16. Electric materials and accessories	45	4.747,99	96.535,00
17. Vehicles and accessories	45	6.541,60	747.287,40
18. Other transport equipment	16	16.168,23	160.726,20
19. Furniture	36	1.226,17	8.279,22
20. Other manufacturing	19	1.748,43	125.238,80
Total	**702**	**5.292,29**	**161.109,70**

2.4.1. Dependent variable

To observe the relation between the volume of technology out-licensing from abroad on the international out-licensing, we take the natural logarithm of the reported value of international technology out-licensing as an independent variable of interest. By doing that we follow the straightforward influence of in-licensing volume on the out-licensing volume. The aim of this paper is not in exploring the decision of firms whether to out-license or not, which was extensively studied already (Kim & Vonortas 2006; Fosfuri 2006), but to observe the relation of in-licensing volume on the overall amount out-licensing volume. Annual amount of revenues coming from international technology out-licensing is given in Euro, but since it is a highly skewed variable, we add one to it and calculate the natural logarithm of it. We name this variable ***International Out-licensing Volume*$_{(t)}$ – IOLV$_{(i, t)}$**.

2.4.2. Independent variables

In the survey the yearly spending on the technology in-licensing from abroad is given. This value we use to explore the influence of in-licensing on out-licensing in foreign markets, and has been used before in technology management studies (Athreye & Cantwell 2007; Sine et al. 2003). This variable is applied to test the hypothesis H1a and H1b, in order to see whether in-licensing drives a positive or negative effect on out-licensing. Again, these values are given in Euro and have a highly skewed distribution, so we add one to the value and take natural logarithm of it. This is a common transformation done on the skewed variables (Gambardella et al. 2007; Gruber et al. 2008). In the study we name this variable ***International In-licensing Volume*$_{(t)}$ – IILV$_{(i, t)}$**.

2.4.3. Moderating variable

In hypothesis H2 we are looking at the moderating role of internal R&D. In particular, our aim is to understand how the intensity of internal R&D investment, over overall R&D investment effects the relation between in-licensing from foreign markets and out-licensing to foreign markets. For this purpose we calculate the **Internal R&D Intensity$_{(t)}$ – IRNDI$_{(i, t)}$** variable as the percentage (taking value 0-100) of the investment in internal R&D over the total investment in R&D annually in the company. This variable has been commonly used in previous literature as a measure of firm's absorptive capacity (Zahra & George 2002) that we apply here to capture to moderate firms ability to acquire, assimilate, transform and exploit the in-licensing technologies from abroad in order to deliver more novel innovations and achieve higher amounts of international out-licensing.

2.4.4. Control variables

This study relies on all the well-developed control variables that are relevant in the technology out-licensing context. On the first place, complementary resources play an unavoidable role. As Teece (1986) has argued that engagement in out-licensing activities is highly dependent from the patent protection of innovations and their lack of complementary assets for manufacturing and marketing technologies in their own products. He explained that accessing to these complementary resources might be difficult and expensive, because they cannot be "rented" and it is costly to acquire them, but also time-lasting to develop them themselves. So, we need to control for the presence of complementary resources in order to explain the volume of out-licensing. By looking at the previous works, and suggestions that complementary assets are diverse in nature, we break-down the complementary assets in five more fine grained measures. First, the control variable for manufacturing complementary resources is included (**Manufacturing Complementary Resources$_{(t)}$ – MnCR$_{(i,\ t)}$**). It is obtained as a measure indicating the ratio of the value in Euro of firm's tangible fixed assets over total assets, as reported in the balance sheet (Bianchi et al. 2013). It captures the book value of property, plants and equipment adjusted for depreciation, depletion and amortization, and is in the range 0-100. Second, we follow the study of Bianchi et al. (n.d.) and include the control for the relational resources (**Relational Complementary Resources$_{(t)}$ – RCR $_{(i,\ t)}$**). Here it is measured using the composite variable formed from four items. Firms from the survey indicated whether their firm has participated in any technological collaboration, giving the answer option to be with (i) universities, (ii) clients, (iii) suppliers, (iv) competitors. All the answers on these questions were coded in binary variables (taking value 1 for yes and 0 for no). Further, these answers were summed up with equal weighting, and a rank-ordering variable was created. This variable takes a minimum value of 0 when the firm does not have any established technology collaborations, and accordingly the maximum value 4 when the firm has all four types of partners in its technology collaborations. Third, the variable measuring **Marketing Complementary Resources$_{(t)}$ – MrCR $_{(i,\ t)}$** was included in our models. It was measured as the annual intensity of total marketing investment over total sales in the firm (takes value from 0-100). Fourth, the variable explaining the **International Complementary Resources$_{(t)}$ – ICR $_{(i,\ t)}$** of the firm was made by building an equally weighted rank-ordering variable from the binary variables containing information on whether firm has access to the international markets through (i) a foreign parent company, (ii) its own means, (iii) specialized agents or (iv) collective means. These variables take value 1 for companies answering yes and 0 for answering no. So, the minimum value of 0 have the companies who do not have any access to international markets, and value 4 companies that have the access to foreign markets by all four means. Finally, we include the variable for **Total R&D Intensity$_{(t)}$ – TRNDI$_{(i,\ t)}$** to control firms capability for innovation in general. It is calculated as a relation the total annual R&D investment of an enterprise over total amount of company's

yearly sales (in percentage, from 0-100). As patent protection is important for technology out-licensing, the count of total new patents registered by the firm in the observed year is a part of our model (**Patent Protection$_{(t)}$ – PP$_{(i,\ t)}$**). Other scholars have similarly used this variable as a measure of IPR (Gans et al. 2002). In the end we have accounted for another two standard control variable for **Size$_{(t)}$ – SIZE $_{(i,\ t)}$** (measured as the total number of employees in the firm) and **Age$_{(t)}$ – AGE$_{(i,\ t)}$** (presented as the number of years from the year of foundation of the company). Industry and year dummies have been accounted in the modelling.

Next table (Table 2.2) contains the product moment correlations on our total sample, together with the summary statistics of the variables that are used further on. We do not find any significant correlations and the insights from the correlation matrix still do not give us any strong indications regarding the relation of in-licensing on the on-licensing, so we proceed to the Dynamic Panel Data analysis.

Table 2.2. Product Moment Correlations and the Summary Statistics

	1	2	3	4	5	6	7	8	9	10	11
1. International Out-Licensing Volume$_{(t)}$	1										
2. International In-Licensing Volume$_{(t)}$	0.25	1									
3. Internal R&D Intensity$_{(t)}$	0.01	-0.07	1								
4. Total R&D Intensity$_{(t)}$	0.22	0.10	-0.05	1							
5. Manufacturing Complementary Resources$_{(t)}$	-0.15	-0.09	-0.01	-0.17	1						
6. Relational Complementary Resources$_{(t)}$	0.19	0.20	0.02	0.30	-0.12	1					
7. Marketing Complementary Resources$_{(t)}$	0.13	0.10	0.01	0.06	-0.12	0.08	1				
8. International Complementary Resources$_{(t)}$	0.14	0.16	0.05	0.08	-0.03	0.26	0.09	1			
9. Patent Protection$_{(t)}$	0.30	0.16	-0.01	0.22	-0.08	0.12	0.09	0.05	1		
10. Size$_{(t)}$	0.17	0.36	-0.03	0.09	-0.05	0.27	0.09	0.16	0.07	1	
11. Age$_{(t)}$	0.13	0.18	0.06	0.09	-0.08	0.17	0.23	0.19	0.05	0.13	1
Number of observations	6762	6747	3224	6746	6748	6763	2725	6790	6756	6809	6790
Mean	0.49	1.74	68.94	0.69	80.11	0.89	1.50	0.89	0.75	341.94	30.08
Standard error	2.30	4.37	36.12	2.42	18.15	1.19	3.57	0.71	7.15	862.92	23.14
Minimum	0	0	0	0	0	0	0	0	0	3	0
Maximum	12.19	15.62	100	98.92	100	4	45.9	4	233	12311	172

Note that industry and year dummies are included in our analysis, but are not presented in the correlation matrix.

2.4. Statistical approach

The precise research question we raise is to understand the impact of technology in-licensing from abroad on international out-licensing ("How the magnitude of technology in-licensing from abroad influences the magnitude of out-licensing internationally?"). At our disposal we have a panel dataset containing the exact amounts of out-licensing and in-licensing revenues of a company internationally. We perform a firm-level analysis, which in the case of out-licensing volume is not so common, as companies are rarely willing to expose their out-licensing revenues or are obliged by non-disclosure agreement not to expose it, and keep it in secret (Hagedoorn & Hesen 2007). In this section the panel data analyses procedure applied in this work will be explained.

Our models have always the same dependent variable, which is ***International Out-licensing Volume$_{(t)}$***. It is a type of a "sales" variable, usually highly correlated with its lagged values (Salomon & Shaver 2005; Bobillo et al. 2006; Arellano & Bond 1991).. In our case one year lagged value of observed variable has the correlation value of 0.78 with the current value of the variable of interest, and the two years lagged value has the correlation of 0.66. In this case we have chosen the suitable estimation procedure, system GMM estimation. This approach enables us to resolve the issue involved around the high dependence of the current variable amount on the lagged amounts of it. The carefully chosen control variables, discussed in previous studies, were introduced in the regression to clearly isolate the relevant aspects of the effect of in-licensing from abroad on the out-licensing internationally.

Further choice of the suitable procedure is based on the guidance from the paper from Roodman (2009b, 2009a). So, the decision to apply the Dynamic Panel Data approach and the system GMM estimation was made for the following reasons: our dataset fits the criterion of "small T, large N" (in our case T = 10 and N = 702); as in similar studies on the topic on international licensing (Aulakh et al. 2010) we assume a linear functional relationship; the variables included in the model are not strictly exogenous and supposedly could be correlated with past or current realization of the error; and we assume some fixed individual effects, and heteroscedasticity and autocorrelation only within the individuals.

We have built three different models to disentangle the relation of interest, all including the ***International Out-licensing Volume$_{(t)}$*** as a dependent variable, and the one year lagged value of the dependent variable (***International Out-licensing Volume$_{(t-1)}$***) as a part of the right part of the modeling equation. The control variables in all the models are the same, and are taken as described in the section above. Moreover, the two important dummy variables have been fitted into the models, one that presents the firm industry (as described in Frishammar et al. (2012)) and the other presenting the corresponding year of observation (as described by Salomon & Shaver (2005)). In order to make our regression equations more understandable, we present each of the models below.

- **Model 1** uses the *International In-Licensing Volume*$_{(t)}$ - $IILV_{(i,\,t)}$ as the independent variable:

$$IOLV_{(i,\,t)} = \alpha + \beta_1 * IOLV_{(i,t-1)} + \beta_2 * IILV_{(i,\,t)} + \gamma_1 * TRNDI_{(i,\,t)} + \gamma_2 * MnCR_{(i,\,t)} + \gamma_3 * RCR_{(i,\,t)} + \gamma_2 * MrCR_{(i,\,t)} + \\ + \gamma_5 * ICR_{(i,\,t)} + \gamma_6 * PP_{(i,\,t)} + \gamma_7 * SIZE_{(i,\,t)} + \gamma_8 * AGE_{(i,\,t)} + \eta_{(i)} + \varepsilon_{(i,\,t)}$$

- **Model 2** uses the *Internal RnD Intensity*$_{(t)}$ - $IRNDI_{(i,\,t)}$ as the independent variable:

$$IOLV_{(i,\,t)} = \alpha + \beta_1 * IOLV_{(i,t-1)} + \beta_2 * IILV_{(i,\,t)} + \beta_3 * IRNDI_{(i,\,t)} + \gamma_1 * TRNDI_{(i,\,t)} + \gamma_2 * MnCR_{(i,\,t)} + \gamma_3 * RCR_{(i,\,t)} + \\ + \gamma_4 * MrCR_{(i,\,t)} + \gamma_5 * ICR_{(i,\,t)} + \gamma_6 * PP_{(i,\,t)} + \gamma_7 * SIZE_{(i,\,t)} + \gamma_8 * AGE_{(i,\,t)} + \eta_{(i)} + \varepsilon_{(i,\,t)}$$

- **Model 3** uses the *Internal RnD Intensity*$_{(t)}$ *X International In-Licensing Volume*$_{(t)}$ – $IRNDIxIILV_{(i,\,t)}$ as independent variable to capture the moderating effect:

$$IOLV_{(i,\,t)} = \alpha + \beta_1 * IOLV_{(i,t-1)} + \beta_2 * IILV_{(i,\,t)} + \beta_3 * IRNDI_{(i,\,t)} + \beta_4 * IRNDIxIILV_{(i,\,t)} + \gamma_1 * TRNDI_{(i,\,t)} + \\ + \gamma_2 * MnCR_{(i,\,t)} + \gamma_3 * RCR_{(i,\,t)} + \gamma_4 * MrCR_{(i,\,t)} + \gamma_5 * ICR_{(i,\,t)} + \gamma_6 * PP_{(i,\,t)} + \\ + \gamma_7 * SIZE_{(i,\,t)} + \gamma_8 * AGE_{(i,\,t)} + \eta_{(i)} + \varepsilon_{(i,\,t)}$$

In the equations the subscripts *i* and *t* refer to firm and time (yearly) respectively; α presents the constant term; β_1, β_2, β_3 and β_4 are the regression coefficients of the corresponding independent variables; γ_1, γ_2, γ_3, γ_4, γ_5, γ_6, γ_7 and γ_8 are the regression coefficients of the corresponding control variables; $\eta_{(i)}$ presents an unobserved individual specific effect; and $\varepsilon_{(i,\,t)}$ is the error term of the *i*-th cross-sectional unit. The dependent, independent and control variables have already been described before.

In the Dynamic Panel Data analysis, as explained in the paper from Roodman (2009), it is important that all the instruments and specification choices should be reported. Regarding the type of instrumental variables choice, we assume that all regressors, except the variable containing the age and industry of the company, and the year dummy variable, are treated as endogenous and their year lags from 2 to 5 were used to construct the system GGM-type of instrument matrix. Only for the lag value of dependent variable, used as the GMM-style instrument, we consider all the lags from the sample that are above 2[3]. All the GMM-style instruments were used both in the differenced and level equations. We choose to collapse our instrument matrix, in order to achieve more reliable score in the overidentification test. Without collapsing of the instrument matrix, for the entire instrumenting variables one column for each time period and the lags available to that time period is generated. In this sense the number of instruments grows in quadratic relation to the value of T (Roodman 2009b). In order, to limit this high pace of expansion of the instrument count, we collapse our instrument matrix. The IV-style instruments were variables presenting the organization's age and industry, but also the year dummy variables. They were assumed to be endogenous inputted in the instrument matrix in their unchanged state. In terms of the

[3] This was an optimal choice of the number of instruments, since it gave us stable results from the Hansen test (Roodman 2009a). In the paper we present only the results from the modeling that were achieved by application of this optimal choice of lags.

choice between one-step and two-step estimation, we decided to use the one-step estimation that gives higher asymptotical efficiency than the two-step (Arellano & Bond 1991). In the end, the finite-sample correction was applied to model our equations (as given by Windmeijer (2005)). This correction secures the consistency of standard error estimates the presence of any pattern of heteroscedasticity and autocorrelation within panels.

In the Model 3 we are testing the moderating effect of the intensity of internal R&D investment on the effect that in-licensing demonstrates on the out-licensing. The variable used for this purpose (*Internal RnD Intensity*$_{(t)}$ *X International In-Licensing Volume*$_{(t)}$ – IRNDIxIILV$_{(i,\ t)}$) demonstrated the significant collinearity with the variable independent variable (*International In-Licensing Volume*$_{(t)}$ – IILV$_{(i,\ t)}$). For this reason in this study we have applied mean centering procedure on the interaction term that entered the model. This procedure followed the instructions given in papers from Cohen et al. (2003) and Lichtenthaler & Ernst (2009). After describing the statistical procedure we proceed to the results presentation.

2.5. Results

After describing in detail our statistical approach, we carry on the presentation and discussion on the results we have received. In Table 2.3 we report the regression modelling results, from the system-GMM estimation performed. In the table the results from all the three above introduced models (Model 1, Model 2 and Model 3) are shown. The only difference between the models is that independent variables that were fitted in the equations change, while the dependent and control variables, along with industry and year dummy variables stay the same in all three models. The significance and specifications of the dummy variables are not reported in the table below, as their importance is marginal in the context of this research. All the relevant tests for the reliability and validity of our model, which were proposed by Roodman (2009a) were conducted and reported. First, we underline the Hansen test p-values that might indicate on the existence of over-identifying restrictions. As stated in the paper from Roodman (2009b), we follow closely if the Hansen test p-values higher than 0.25, because then we can consider them acceptable. Second, outputs from the test for residual serial autocorrelation are given. Our assumptions is that the first-order autocorrelation in the first-difference in all the models. We use one lag of the dependent variable in the regression equation and in that sense do not expect to have the second-order autocorrelation, which is the case when we rely on the instruments from the second lag and higher in the estimation. So, the choice of lags for instruments is made by looking at the autocorrelation as an indicator of the choice of lags needed for the proper instruments matrix (both for the dependent variable and for any

other variable that is not strictly exogenous). In other words, we can take as instruments the second lag (and higher) of the variables from the model, if there are no second-order autocorrelation.

Table 2.3. Results from the System GMM regression

Dependent Variable: International Out-Licensing Volume$_{(t)}$	**Model 1**	**Model 2** (with Internal R&D Intensity)	**Model 3** (with Internal R&D Intensity as moderator)
International In-Licensing Volume$_{(t)}$	0.189**	0.198*	0.179**
	(2.24)	(1.83)	(2.00)
Internal R&D Intensity$_{(t)}$		0.016	0.009
		(1.23)	(0.86)
International In-Licensing Volume$_{(t)}$ X Internal R&D Intensity$_{(t)}$			0.005**
			(2.72)
Total R&D Intensity$_{(t)}$	-0.148	-0.199	-0.125
	(-1.31)	(-1.54)	(-1.17)
Manufacturing Complementary Resources$_{(t)}$	-0.010	-0.23	-0.015
	(-0.90)	(-0.94)	(-0.65)
Relational Complementary Resources$_{(t)}$	-0.091	-0.229	-0.132
	(-0.38)	(-0.58)	(-0.40)
Marketing Complementary Resources $_{(t)}$	-0.415*	-0.276	-0.133
	(-1.67)	(-0.15)	(-0.57)
International Complementary Resources$_{(t)}$	0.016	-0.074	-0.281
	(0.10)	(-0.25)	(-0.90)
Patent Protection$_{(t)}$	0.001	0.001	0.004
	(0.02)	(0.06)	(0.15)
Size$_{(t)}$	0.000	0.001	0.000
	(0.38)	(0.62)	(0.43)
Age$_{(t)}$	0.012	0.007	0.004
	(1.26)	(0.60)	(0.47)
Constant	2.602	-0.477	-0.237
	(1.37)	(-0.15)	(-0.10)
International Out-Licensing Volume$_{(t-1)}$ (*lagged dependent variable*)	0.474**	0.466**	0.530***
	(2.87)	(2.74)	(3.72)
N	2651	1246	1246
Number of instruments	69	74	79
Number of groups	685	379	379
Average number of observations per group	3.87	3.29	3.29
Hansen test (*p*-value)	0.693	0.528	0.627
First-order autocorrelation (*p*-value)	0.003	0.007	0.004
Second-order autocorrelation (*p*-value)	0.751	0.796	0.758
Year effects (Year dummies)	Included	Included	Included
Industry effects (Industry dummies)	Included	Included	Included

t-values in parenthesis below coefficient estimates.

*** *p*-value < 0.01

** *p*-value < 0.05

* *p*-value < 0.1

In hypothesis H1a and H1b we aimed to test if there is positive or negative effect of the volume of in-licensing from abroad on the international out-licensing amount. In all the three models we find the positive and significant relation of these two variables (in Model 1 significant at $p < 0.05$ level, with t value of 2.24; in Model 2 significant at $p < 0.1$ level with t value of 1.98; and in Model 3 significant at $p < 0.05$ level with t value of 2.00). This provides good support to accept the hypothesis H1a and reject the hypothesis H1b. Then Models 2 and 3 were made to test the H2 hypothesis that proposes a positive moderating effect of internal R&D intensity on the influence of technology in-licensing from abroad on out-licensing in foreign markets. The Model 2 does not presents any significant influence of internal R&D intensity on the out-licensing volume, but in Model 3 we find strong support for our H2 proposing the positive moderating effect. In Model 3 the moderating variable is positive and significant at $p < 0.05$ level, with t value of 2.72.

When it comes to the validity of the models, we attain promising outputs from the Hansen test (p-value for Model 1 of around 0.693; for Model 2 of around 0.528; and for Model 3 of around 0.627). Further, the serial autocorrelation was observed. All three models show that there exists a first-order autocorrelation. However, as we assumed, it diminishes in the second-order (second-order autocorrelation p-value for Model 1 of around 0.751; for Model 2 of around 0.796; and for Model 3 of around 0.758).The 1 year lag of dependent variable is significant and positive, which is consistent in the Dynamic Panel Date modeling context. We may conclude that all of our models show valid test results and we can rely on the given findings.

2.6. Discussion and conclusion

In this study the relationship between the volume of technology in-licensing from abroad on the volume of technology out-licensing internationally was explored in the first step. In the second step the moderating effect of internal R&D intensity on this relationship was observed. The results from our statistically analysis allowed us to accept the hypothesis H1a, which proposed that international in-licensing volume has a positive effect on the technology out-licensing volume in foreign markets. We have rejected the H1b hypothesis that advocated the negative relation. Moreover, we have found strong support for the H2 hypothesis, arguing that the intensity of the internal R&D within the company positively moderates the relationship between in-licensing from abroad and out-licensing internationally. This is similar with the recent findings from Hung & Chou (2013). They show that external technology acquisition strengthens the relationship between external technology exploitation and firm performance, and that both external technology acquisition and external technology exploitation have positive influence

on the performance of the company if the internal R&D investment are high and market environment is turbulent.

We find several reasons for our results. First, companies that in-license more their technologies from abroad they are more probable to reach knowledge frontiers (Arora et al. 2002) and become more competitive in the technology market by developing their own technologies internally. Second, that in-license from abroad shortens their technology development life-cycle, lowers their R&D risks and so firms become more rapid and efficient in delivering innovative technologies to the market (Atuahene-Gima 1992; Atuahene-Gima 1993a; Parida et al. 2012; Markman et al. 2005). Third, by in-licensing technologies from abroad, organizations do expand their internal knowledge foundation and directly broaden their innovation perspective potential (Kim & Vonortas 2006; Arora & Fosfuri 2003a; Anand & Khanna 2000b). And fourth, companies in-licensing internationally become more globally exposed as open innovation oriented firms, but also build up ties with diverse potential buyers of their technologies outside their home country (Atuahene-Gima 1993b; Shahrokhi 1987).

As for the theoretical implications resulting from this research, we recognized the bidirectional relation and importance of observing the external technology exploration and exploitation. So, by this we contribute to the strategic technology management research that stresses the importance of relation between different exploitation and exploration activities (Fang et al. 2009; Stettner & Lavie 2013; Bianchi et al. 2013; Hoang & Rothaermel 2010). This work also adds on the absorptive capacity literature, by indicating that absorptive capacity, inhibited by internal R&D intensity, presents a moderating funnel for external technology sources to external exploitation of technologies (Rothaermel & Alexandre 2008; Cohen & Levinthal 1990). In terms of managerial implications, our results propose a close strategic fitting of firm's processes around the input of technologies in the firm, their transforming and development, and eventually the out-licensing of these new technologies. Another implication is that the internal R&D investment of the company should not be ignored, and that company should constantly invest in all the innovation related activates that are strictly internal.

Future studies could go more in depth in exploration of in-licensing to out-licensing relation, by focusing their study on a licensing deal level. By doing that the issues like type, length, nature and compensation structure of licensing contracts could be viewed (like in e.g. Anand & Khanna 2000b or Marshall et al. 2007) and the results might be explained even more thoroughly. Further on, both the firm level desorptive capacities could be studied by matching two organizations (licensee and licensor) to investigate is there any typical fit between these two firms. Moreover, a larger sample of the companies, that combines more countries would be interesting to study, and would also allow to include the cultural distances concept in the study (similarly like in e.g. Kogut & Singh 1988 or Barkema & Drogendijk

2007). Hopefully we have drawn some attention on this underexplored issue that will motivate other scholars also to take a part in some related research.

2.7. Summary of the Chapter

The research article reported in this Chapter combines external exploration and external exploitation of knowledge in the context of organization's technology management activities. It is presented through the paper titled "Antecedent of International Technology Out-Licensing Volume: Does Technology In-Licensing from Abroad Help?". Two main research questions were raised, one dealing with the effect of in-licensing volume from abroad on out-licensing volume internationally, and the other one looking at the moderating effect of the internal R&D intensity. We find a positive influence of technology in-licensing from abroad on technology out-licensing internationally. Moreover, the positive moderating effect of internal R&D intensity on this relation has been recognized.

In terms of the thesis development, this paper adds a contribution on the antecedent side of international out-licensing because it highlights technology in-licensing from abroad as a valid contributor to the magnitude of the organization's technology out-licensing internationally. It addresses an interesting point looking at the enablers of international out-licensing that leads us to the next step – an in-depth analysis and focus on the international technology out-licensing process itself. So, the results given in this Chapter allow us to proceed in our flow of study towards a more comprehensive view of technology out-licensing abroad.

Appendix 2.A

Table 2.4. Results from the System GMM regression with inclusion of the Inverse Mills ratio for the sample selection bias test

Dependent Variable: International Out-Licensing Volume$_{(t)}$	**Model 1**	**Model 2** (with Internal R&D Intensity)	**Model 3** (with Internal R&D Intensity as moderator)
International In-Licensing Volume$_{(t)}$	0.201**	0.255**	0.218**
	(2.27)	(2.04)	(2.05)
Internal R&D Intensity$_{(t)}$		0.017	0.010
		(1.31)	(0.95)
International In-Licensing Volume$_{(t)}$ X Internal R&D Intensity$_{(t)}$			0.004**
			(2.67)
Total R&D Intensity$_{(t)}$	-0.165	-0.214	-0.133
	(-1.43)	(-1.63)	(-1.24)
Manufacturing Complementary Resources$_{(t)}$	-0.011	-0.024	-0.017
	(-0.97)	(-0.97)	(-0.75)
Relational Complementary Resources$_{(t)}$	-0.108	-0.094	-0.007
	(-0.44)	(-0.23)	(-0.02)
Marketing Complementary Resources $_{(t)}$	-0.422	-0.315	-0.147
	(-1.61)	(-1.36)	(-0.67)
International Complementary Resources$_{(t)}$	0.023	0.042	-0.157
	(0.15)	(0.14)	(-0.56)
Patent Protection$_{(t)}$	0.000	-0.001	0.002
	(0.00)	(-0.03)	(0.10)
Size$_{(t)}$	0.000	0.001	0.000
	(0.43)	(0.55)	(0.31)
Age$_{(t)}$	0.012	0.015	0.11
	(0.92)	(0.91)	(0.74)
Inverse Mills Ratio$_{(t)}$	0.122	2.145	1.940
	(0.09)	(0.90)	(0.77)
Constant	2.623	0.943	0.078
	(1.41)	(0.41)	(0.04)
International Out-Licensing Volume$_{(t-1)}$	0.475**	0.474**	0.545***
(*lagged dependent variable*)	(2.85)	(2.71)	(3.78)
N	2647	1244	1244
Number of instruments	69	74	79
Number of groups	685	379	379
Average number of observations per group	3.86	3.28	3.28
Hansen test (*p*-value)	0.731	0.585	0.638
First-order autocorrelation (*p*-value)	0.003	0.007	0.004
Second-order autocorrelation (*p*-value)	0.756	0.827	0.787
Year effects (Year dummies)	Included	Included	Included
Industry effects (Industry dummies)	Included	Included	Included

t-values in parenthesis below coefficient estimates.

*** *p*-value < 0.01

** *p*-value < 0.05

* *p*-value < 0.1

CHAPTER 3:

Managing International Technology Out-Licensing: A Process Based View and Dynamic Capabilities Development

Technology out-licensing has been recognized for decades as one of the new market entry modes. Companies often issue licenses in foreign countries in order to enter a new market. However, only little is known about the international technology out-licensing process itself. For this reason in this paper we aim to unearth the following research questions RQ.2.a: "What are the stages of international technology out-licensing process?" and RQ.2.b: "Do companies develop Dynamic Capabilities by out-licensing abroad?".

Starting from the approach given in the Dunning's eclectic theory on foreign market entry modes, and by adopting the process view perspective from the technology management literature, and also incorporating the Dynamic Capabilities Framework, this paper tries to unearth the managerial aspects of technology licensing as the foreign market entry mode. In this manner it fits and expands the theoretical framework of this thesis in the part that analyses how the international out-licensing process is managed.

Although technology licensing as a market entry mode has been previously thoroughly explored, limited attention has been given to the possible structured ways companies approach in managing technology licensing for the new market entry purpose. This paper relies on the multiple case study research approach in order to reveal the relevant managerial aspects implemented by Italian pharmaceutical and biotech companies that exploit technology out-licensing in diverse foreign markets.

3.1. Introduction

While competition has rapidly become knowledge and technology based, companies need to effectively manage their technological assets in order to realize any potential inherent in their intangibles and to benefit from their innovation investments (Chesbrough 2003; Teece 1986). Ford (1988) proposed technology licensing as one of the forms for exploiting technology, where knowledge is the economic good exchanged, in the form of technologies, patents, ideas and know-how (Grandstrand 2000). This research concentrates on technology licensing, which may be motivated by some monetary and non-monetary drivers, enabling firms to realize a new market entry (Koruna 2004b; Reitzig 2004; Arora et al. 2001; Grindley & Teece 1997; Veugelers & Cassiman 1999). Practically, licensing for the market entry purpose reduces the entry costs when accessing a market (Fosfuri 2004; Birkenmeier 2003).

Guadamuz (2005) defined technology licensing as "the transfer of technology by means of a contract of industrial property rights". Moreover, a licensing agreement may also transfer protected or unprotected know-how, training of specialists, transfer of procedures and technical assistance. Licensing agreement is a result of technology licensing and it is constituted by a sourcing firm purchasing the rights to another firm's patents or technology for a lump sum payment and/or royalties (Hagedoorn & Hesen 2007). Licensors are firms that own the essential patents and licensees are firms that purchase the right to use these patents (Joshi & Nerkar 2011). Particularly, this paper explores the use of licensing for the foreign market entry purpose.

Researchers claim (Bianchi et al. 2009; Birkenmeier 2003; Escher 2003) that the main barrier to the successful licensing is a lack of appropriate management of it. Licensing management explores all the managerial activities that companies deal with when engaged in technology licensing. There are firms that experience considerable managerial difficulties with it, whereas others realize enormous benefits (Elton et al. 2002; Lichtenthaler & Ernst 2006, 2007). Research on the management of technology licensing activities is still relatively limited and the previous works do not address particularly the managerial challenges (Nakamura & Odagiri 2005). Some research gives insights on the aggregated industry level, but do not explore closely how do firms manage their technology licensing activities (Anand & Khanna 2000; Arora et al. 2001). There are works that have previously focused on the licensing outcomes, but have not concentrated on the managerial activities leading to these outcomes (Kim & Vonortas 2006; Nagaoka & Kwon 2006). However, as far as the authors' knowledge, none of the previous works explore the management of technology licensing, observed as a new market entry mode.

This article aims to give a first step towards closing the research gap in the research on technology licensing as a market entry mode, by addressing the following question: "What are the stages of international out-licensing process?" This question is explored by observing the empirical evidence

coming from explorative case studies from the four leading companies in the Italian pharmaceutical and biotech sector. The paper starts from the Duning's OLI framework from the market entry mode literature, combined with the process view perspective from the technology management literature and some elements introduced in the Dynamic Capabilities perspective. Eventually, in this paper the key findings indicate two points: (i) companies adopt the process view perspective for managing technology licensing as the foreign market entry mode and (ii) throughout the stages of this process firms tend to develop their Dynamic Capabilities (sensing, seizing and reconfiguring).

This article is structured as follows. The second section will give some theoretical foundations from the relevant literature. Section three will explain closer the research approach and the methodology applied. In section five the main findings will be discussed. Section six will conclude with the main ideas deriving from the paper and with the possible directions for the future research. The outputs of the research target at developing a systematic analysis of the critical managerial issues to be faced during technology licensing internationally.

3.2. Literature Review

Starting upon the definition of technology licensing given by Guadamuz (2005): "the transfer of technology by means of a contract of industrial property rights", the brief literature review in context of the management of technology licensing used as the foreign market entry mode. In this context, the technology management and the foreign market entry mode literature were reviewed.

3.2.1. Technology Licensing in Technology Management Literature

There are many works on technology licensing, which are sole theory and do not address managerial challenges (Nakamura & Odagiri 2005). In order to manage licensing properly, researchers stress the importance of strategic openness in the firms (Chesbrough 2007; Davis & Harrison 2001). Companies should be shifting from closed to open licensing strategy (Chiaroni et al. 2010), which does not limit licensing activities only to the transfer of internally unused technologies (Dodgson et al. 2006; Prugl & Schreier 2006), but employs an active licensing with the clear strategic goals. Another point states that companies should establish a formal licensing strategy (Pitkethly 2001; Davis & Harrison 2001; Rivette & Kline 2000), used as the tool for achieving monetary and strategic benefits. There are papers indicating that companies need to implement an active strategy, where they actively seek for licensing opportunities (Fosfuri 2006; Kim & Vonortas 2006). Several authors support the notion that inter-firm collaboration has shown that managing technology transactions requires a process view (Bianchi et al. 2009; Hoffmann 2005; Chiesa & Manzini 1998). Similarly, the importance of a systematic licensing process has been

highlighted (Chiaroni et al. 2010). This systematic licensing process may start upon the technology sale process from Chiaroni et al. (2010). In essence, the idea is to systematize the technology licensing process in several stages and to facilitate management of its activities (Koruna 2004a; Tschirky et al. 2004). The industry experts and the indications from the researches agreed on the fact that a formalized process is important, although the specific number of process stages may vary (Ernst 2002; Cooper & Kleinschmidt 1995). Accordingly, this process does not usually follow all the steps sequentially but iteratively, by including feedback loops and reiterating some phases. In the Chiaroni et al. (2010) study, the major steps of the technology sales process are planning, intelligence, negotiations with potential licensees, technology transfer, and control. Each stage is comprised of specific managerial challenges and main tasks to be performed. These activities are usually complex, differing in every licensing case, and need to have a systematic management that will consider the entire process. The process aims to allow companies to achieve an optimum management of all activities in out-licensing. So, technology out-licensing in foreign markets can be approached as a managed and structured process with the clear aim.

As managerial and organizational processes lead to the development and deployment of firm's Dynamic Capabilities (Helfat et al. 2007), we might assume that management of the licensing process within the firm is closely related to its Dynamic Capabilities development and deployment. Teece (2007) explains that the Dynamic Capabilities framework entails the following components: sensing opportunities and threats, seizing opportunities and reconfiguration of resources. By structuring the technology licensing process, the abilities of companies to sense, seize and reconfigure, are being developed and enstrengthened. Initially, the Dynamic Capabilities approach was made for analyzing the sources of wealth creation and the ways they are captured by enterprises (Teece et al. 1997). The Dynamic Capabilities Framework indicates that companies need to align their resources with the demands of the market through sensing, seizing and reconfiguring activities (Teece 2007). Firstly, firms need to focus on sensing activities, which are seen through seeking for the new opportunities. As stated in the previous works the basic routines of the sensing capability are: (i) generating market intelligence (Galunic & Rodan 1998) and (ii) disseminating market intelligence (Kogut and Zander, 1996). In this phase, companies scan, explore and analyze the information from their surrounding and in this manner discover existing and create new opportunities. Bianchi et al. (2010) develop a step-by-step methodology, based on the TRIZ idea, for the identification of opportunities for licensing firm's technologies outside its core business, which fits the purpose of the sensing phase. Moreover, firms must manage and filter the information from their environment, which enables them to identify information of interest (Ocasio 1997). Secondly, the seizing of opportunities follows, which is related to the pursuing (Van den Bosch et al. 1999) and seizing opportunities of new initiatives (Teece 2007), by considering acquiring, assimilating, transforming, and exploiting knowledge (Zahra and George, 2002), and responding to market intelligence (Teece 2007).

Thirdly, after sensing and seizing of the opportunities, the reconfiguration of resources initiates. Among others, reconfiguration is accomplished by managing strategic fit of the process, observing the appropriateness matters (Galunic & Rodan 1998), timeliness matters (Zott 2003) and efficiency matters (Kogut & Zander 1996). This research analyzes whether the process view of technology licensing used for the foreign market entry purpose allows firms to develop the three Dynamic Capabilities.

3.2.2. Technology Licensing in Foreign Market Entry Mode Literature

Most of the international business literature examines licensing in the new market entry modes context (Aulakh et al. 2009). In the research on the internationalization process models, academics observe licensing from the transaction costs perspective and usually compare its efficiency with other foreign market entry modes, such as exports, joint ventures and wholly owned subsidiaries (Anderson & Gatignon 1986; Buckley & Casson 1976; Contractor 1984). In general, this literature sees licensing as a low-commitment/low return entry mode, which companies use primary to acquire some experiential knowledge on the foreign markets before they continue further to commit to this new market (Arora & Fosfuri 2000; Johanson & Vahlne 1977). Initially licensing was mainly applied as an alternative strategy to FDI (Brouthers & Hennart 2007; Goldscheider 2002), increased competition and faster product and technology cycles have led companies to make a thorough evaluation of their technology portfolio, considering licensing as a commercialization strategy to generate additional revenues at almost no additional cost. When the choice of the market entry mode is in question, licensing is viewed as a low investment, low risk/return alternative which provides least control to the licensing firm (Woznick 1996; Agarwal & Ramaswami 1992). This experiential knowledge of a foreign market is especially valuable because some authors argue that net profit resulting from the licensing transaction and received by the licensor is lower than the net profit received by keeping the technology in-house or licensing it to a firm's subsidiaries (Kotabe et al. 1996). Authors explain that the major reason for this is seen in high transaction and opportunity costs coming from the technology transfer to other firms. Dunnings' OLI eclectic paradigm, extensively used to compare the foreign market entry mode choices (Terpstra & Yu 1988; Sabi 1988; Kogut & Singh 1988; Davidson & McFetridge 1985; Caves 1982; Dunning 1980), puts a strong emphasis on factors influencing the preference for licensing versus FDI to enter foreign markets (Dunning 1993). Dunnings' OLI eclectic paradigm analyzes the foreign market entry mode choices decisions in terms of ownership (O), location (L), and internalization (I), or OLI. Each one of the OLI factors has been associated with precise advantages that can enhance the firm performance. Further on, researchers present licensing as the second-best entry strategy, which primarily enables companies to extract residual value from mature technologies (Telesio 1979).

However, firms increasingly rely on licensing to enter foreign markets and gain global competitive advantage (Fosfuri 2006; Hill 1992, 1997; Kotabe et al. 1996). Only limited attention has been paid to management activities of licensing as a mode of entry, which can provide with an option to grow when uncertainty is resolved favorably, while also offering enough flexibility to abandon the market in the event of negative information (Ahsan & Musteen 2011). In this sense, an important issue not studied thoroughly in the foreign market entry mode literature should answer questions on ‘‘how to license’’ in the foreign markets rather than ‘‘whether to license’’ (Aulakh et al. 2009). Similarly, in this work authors implement the OLI perspective in the technology licensing management, which companies exploit when engaged in licensing for the foreign market entry purpose.

The literature review on technology licensing in technology management and foreign market entry mode literature, points out on a gap in the previous research, not explaining the managerial activities encountered by the companies that engage in technology licensing for the foreign market entry purpose. In order to untangle this overlooked issue, this research observes the case studies originating from the leading Italian pharmaceutical and biotech companies that engage in licensing for this purpose. The analysis adopts several ideas from the reviewed literature, like the process view of licensing aligned with the Dynamic Capabilities framework and Dunnings' OLI eclectic paradigm. The next section provides more detailed information on the methodology applied.

3.3. Methodology

For the purpose of this research comparative multiple case studies were applied (Yin 2003), because they enable an in-depth examination of each case and also enable a cross-case comparison (Eisenhardt & Graebner 2007). As explained in previous sections, this study is more focused on answering 'why' and 'how' research questions, which suite this methodology (Eisenhardt 1989). Different forms and approaches to the management of licensing as a foreign market entry mode have not been significantly documented, which can be appropriately investigated and presented with a qualitative approach. Relying on the theoretical sampling logic given by Siggelkow (2007), this study has chosen to observe four leading Italian pharmaceutical and biotech firms. The pharmaceutical and biotech industry was chosen, because these industries indicate a strong presence of active licensors (Schilling 2009, 2009; Kim 2009; Arora & Ceccagnoli 2006; Rivette & Kline 2000; Grindley & Teece 1997). Importantly, there is an active market for technology in the chemical processes (Arora et al. 2001). When setting up selection criteria on whether to include the company in the research, the following was accounted: (i) selected companies have been identified as active licensors (ii) selected companies have already been engaged in licensing in the foreign

markets; (iii) sample of companies was not limited to any firm size. The "polar type" sampling procedure (Eisenhardt & Graebner 2007) was not used, because it was not necessary for the purpose of this research. The overall performance of licensing was not an issue of interest here, but the managerial activities met during technology licensing for the foreign market entry purpose. However, pure theoretical sampling was enough to allow experimental situation, where the phenomenon of interest was studied under particularly insightful circumstances (Siggelkow 2007). Finally, research results coming from the exploratory case study analysis are not statistically generalizable (Yin 2003), but exploratory. The overall goal is analytical and theoretical, aiming to combine the existing body of knowledge on technology licensing management from the technology management research and research on technology licensing coming from the foreign market entry literature, in order to build a basis for future theoretical and empirical studies on technology out-licensing management in the international markets.

Preliminary list contained ten companies that may fit the explained selection criteria. These firms were identified in consultation with the experts from the Licensing Executives Society Italia (LES Italia), a nonprofit organization that operates in the field of business law, intellectual property and technology licensing, trademarks and intellectual property. LES Italia has more than 300 members, representing the largest firms, industrial organizations, research institutes, law and patent firms that aim to promote opportunities for licensing. Afterwards, each of the firms was contacted in order to gather information on the company and to make and additional check whether it fits the sampling criteria defined. Eventually, the final sample comprised of four firms that met all the criteria stated above. In Table 3.1 some preliminary information on the companies included in the sample are provided.

Table 3.1. Preliminary information on the sampled companies.

Firm	Sector	Total turnover[a] (# employees)[c]	# of patents (# licensing agreements)[b]	Interviewed personnel
Company A[1]	Diagnostic	1.000.000 (3000)	1500 (N.A.)[d]	- Integrated Research Director - Technology Opportunities Director
Company B	Pharmaceutical	68.000 (280)	7 (60)	- Head of Licensing & Business Development - R&D Director -International Sales Manager
Company C	Biopharmaceutical	529.000 (800)	308 (N.A.)	- Marketing e and International Sales Director - Head of Licensing Unit
Company D	Pharmaceutical	500.000 (2000)	258 (50-60)	- Head of Business Development

[1] The names of the firms were omitted on purpose, as the interviewed personnel request.
[a] Total turnover in thousands of euro, as of 2010 (source: interviews and company archival data).
[b] Number of patents and number of licensing agreements (source: interviews, company archival data and company website).
[c] Calculated as full-time equivalent employees.
[d] N.A. = not available.

In the data collection procedure, the research relied on the semi-structured personal interviews with the key informants. All the interviews were conducted in the period between the January 2012 and May 2012. In each company the interviewed persons were heads of licensing units. If the firm didn't have a dedicated licensing unit, either responsible person for the management of research and technology, or person responsible for the international markets was interviewed. In all the cases a second person, generally from R&D or marketing department, was interviewed in order to obtain a different assessment. Moreover, at least one member of the top management team (if present) was interviewed for each firm. A minimum of three interviews for each company was made and a total of thirteen thorough face-to-face interviews were used as a basis of this research. Interviewing multiple respondents from each of the firms was done with the aim to accomplish data triangulation and to reduce the retrospective and personal interpretation biases. All the interviews lasted between 1 and 3 hours, they were digitally recorded and manually transcribed by typing all the interviews in the digital form. For this purpose computer software called Express Scribe has been engaged. Express Scribe is professional audio player software designed to assist the transcription of audio recordings, which enables controlling audio playback using a transcription keyboard (with "hot" keys). This software was particularly useful, while it enabled valuable features for transcribing (like variable speed playback, multi-channel control, file management, etc.).

Importantly, the documented information on the management of technology licensing for the foreign market entry purpose, but also general data on the company, were collected through secondary sources (like internal documentation, project reports and company web site). All the multiple interviews and the documented data collected were primarily used to triangulate the information gathered. The Appendix 3.A presents the major topics of interest and the open-ended questions asked during the interviews. All the major topics and the open-ended questions from the Appendix 3.A have served as a research protocol, allowing the interviewer to lead a semi-structured examination, but also to keep the record of the interview procedure in the case of replication or extension of the analysis (Yin 2003).

When the data analysis started, firstly the collected information was manipulated by relying on the data categorization and contextualization techniques (Miles & Huberman 1999). Secondly, the structured data analysis process was followed. This process consisted of a preliminary within-case study and an explanation building investigation, followed by a cross-case comparison. The investigation in this research initiated by inducing whether the companies from the sample applied any structured process-like approach in managing licensing as the foreign market entry mode, which was suggested in the literature review section. In order to check if within this licensing process in the companies some of the elements of Dynamic Capabilities Framework were recognized (sensing, seizing and reconfiguring) and developed, the Dynamic Capabilities Framework had to be operationalized by giving a set of activities that

characterize each of the Dynamic Capabilities. In Table 3.2 the list and codes of these activities and criteria were provided, which was derived from the analysis of the Dynamic Capabilities literature.

Table 3.2. Operationalization of the Dynamic Capabilities - relying on some elements from the work of Pavlou & El Sawy (2011)

Capability	Brief Description	Code	Basic Routines to identify
Sensing	Spotting and interpreting the opportunities	1.1	Generating market intelligence (Galunic & Rodan 1998)
		1.2	Disseminating market intelligence (Kogut & Zander 1996)
Seizing	Seizing and pursuing the opportunities	2.1	Acquiring, assimilating, transforming, and exploiting knowledge (Zahra & George 2002)
		2.2	Responding to market intelligence (Teece 2007)
Reconfiguring	Reconfiguring assets	3.1	Appropriateness matters (Galunic & Rodan 1998)
		3.2	Timeless matters (Zott 2003)
		3.3	Efficiency matters (Kogut & Zander 1996)

This operationalization was applied to identify whether through the licensing process for the foreign market entry purpose, firms develop these Dynamic Capabilities. The structured procedures for data collection and analysis, but also the semi-structured interviews, were used in order to enhance the reliability of the research (Yin 2003). Table 3.3 (in the Appendix 3.B) presents the brief description of the companies studied, their examples of licensing projects as the foreign market mode and describes the licensing phases identified.

3.4. Results and Discussion

This section presents and discusses the main findings from the case studies. Table 3.4 (given in the Appendix 3.C) gives the results of the analysis of all the process in order to identify the Dynamic Capabilities developed along it. All the companies involved in the research recognized within their international strategy a strong exploitation of licensing for the purpose of expanding outside the home market. Integrated Research Services and Technology Opportunities Director interviewed in front of the Company A explained that operating on a global scale is not just a choice but also a necessity, because innovation in pharmaceutical industry is costly and long lasting (on average it is 12 years from beginning of the development to the market approval, costing between $0.8-1 billion (Austin 2006), with high

attrition rate that allows only 2-3% of products to actually be launched on the market), and the only way to obtain the return of investment is to launch it on a world wide scale. The findings do not aim to categorize, but to present the content of the managerial activities coming from the technology licensing process as the foreign market entry mode. The process perspective helps academics to study, but also practitioners to carry out, the management of technology licensing as the foreign market entry mode. The interviews performed confirm that the phases taken from the paper of Bianchi et al. (2011) considerably reflect the proposed process stages. Furthermore, within the context of this process some elements of the Dynamic Capabilities Framework have been recognized, pointing out that this process like approach enables development of the Dynamic Capabilities for this purpose.

3.4.1. Planning

In the companies examined, the planning stage does not have any observed specificities and it is considered to be a part of the process of building the company's strategy to internationalize in foreign markets. The reason for this finding can be explained by the fact that in the choice of the sample, firms that already have been engaged in active licensing and licensing in the foreign markets, are being examined. So, we do not distinguish clearly the planning phase, because in this case it is already implemented in their overall company strategy. The alignment between the overall firm strategy, and internal and external exploitation programs is the main activity actually performed in the planning stage. In the interview with the Head of the Licensing Unit in the Company D, she explained that her company has already developed strategy to rely on technology licensing for the foreign market entry purpose and that the whole process initiates with data collection on the foreign market.

3.4.2. Intelligence

This phase of the process has in previous studies been characterized by the technological and market environment scan, the sale opportunities identification, and the contractual mode choice (Bianchi et al. 2011). When companies involved in this research decide to enter the foreign market they firstly start with the *market seeking* in which market to enter and afterwards with *partner seeking* within this market. Similar concept has been recognized with other authors, explaining that licensing is shaped by industry level and market level related concepts (Walter 2012). Partner seeking has been identified within the intelligence phase of other similar research works (Bianchi et al. 2011) and has been considered as highly important. Further on, when they involve in the *market seeking*, companies closely process the following parameters:

- **Freedom to operate**: an in-depth study of the state of the art in patents in order to check if there is an already present on that market (see e.g. Company A and B);
- **Exclusivity**: evaluation of the exclusivity of their product; whether firm can attain the allowance to produce and sell the product; presence and availability of similar products on the market (see e.g. Company A and D);
- **Cultural differences**: observing how the general business culture in the country fits firm's ideas for that market; if the cultural differences may facilitate or aggravate their presence in the market (e.g. Company A managers give an example of Japan, where the employees are loyal to the country on the first place, and afterwards to the company, see also Company B);
- **Market size**: see e.g. Company B and D.

The market analysis is the foundation for the *partner seeking*, which includes the evaluation of the following features of potential partners:

- **Financial capabilities**: financial foundations, sales, company size (e.g. Company B states that long decision timing in bigger companies may make problems), see e.g. Company A, B, C and D;
- **Technical capabilities**: portfolio of products, possibility for cross-licensing, degree of specialization (e.g. when Company B licensed the product for tumor in Canada, they explored the companies that are active only for this specific tumor), experience (see e.g. Company A, B, C and D);
- **Commercial capabilities**: presence in the field, location of a partner (e.g. Company A manager explains that suitable partners are in Princeton, New Jersey, where the majority of world pharmaceutical industry is based and it is close to university), presence in other markets (e.g. Company C was seeking for a partner in Russia that was also present in other former Soviet Union and Eastern European markets), see e.g. Company A, B, C and D.

Interestingly, Company C has a fully formalized intelligence process that has a step-by-step procedure for the market analysis and the partner analysis, based on the evaluation of potential markets and partners. The management of this process is led by the dedicated functional unit, specialized for the market intelligence, suggested by other authors as well (Kale et al., 2002; Bianchi et al., 2011). This process initially aims to build a "Long List" of pharmaceutical companies belonging to the main National Trade Associations, after which the public available information relevant to assess partner's generic and specific requirements are being gathered. Company C then filters the data collected, firstly by excluding the companies with an unfitting business model. The unfit companies are recognized as the ones that base their business on the generic drugs production, on the offer of specialized R&D services, on exploitation

of the plain homeopathic treatment ideas, etc. In the next step the in depth desk analysis and profiling of the short listed companies is done by ranking of the short listed companies. In the ranking Company C observes their Product Portfolio Fit (therapeutic field, number of drugs, the expertise they have on the regulatory activities, presence in other markets) and Economic and Financial Soundness (financial foundation of the company). This procedure, in the abstract level, may be employed in other industries as well.

After the analysis of the interviews with the managers, a strong presence of the routines that develop the sensing Dynamic Capabilities has been noticed. 100 percent of the companies from the sample appear to be relying on the routines for generation of the market intelligence (Galunic & Rodan 1998) and dissemination of the market intelligence (Kogut & Zander 1996).

3.4.3. Negotiation

The negotiation stage introduces the communication with partners with the intention to sell the technology and to establish a contractual agreement (Bianchi et al. 2011). Negotiations include several aspects that companies manage when they rely on licensing in order to enter a foreign market. It is considered as a particularly risky stage, because companies need to disclose certain information on their technology in order to negotiate on the technology value and transfer. The person from the Company A responsible for managing the Technology Opportunities Department sees this phase as a "complex process within the process, which needs to be managed extremely cautiously ". All the negotiations are performed in multiple stages manner (see e.g. Company B) and they are concentrated around:

- **Commercial aspects**: dealing with financial indicators and returns (see e.g. Company A, B and D);
- **Technical aspects**: questions of approval for the product on the market, timing and cross-licensing (see e.g. Company A, B and D).

It is important to stress that companies often engage in "multiple- negotiations" (like in the case of Company A). This situation is common when there is a need for so called "stacking provision", which appears when a certain owner of a patented technology intends to manufacture products under the license and for this purpose it needs to obtain additional licenses from other parties who own rights in related, actual or potentially overlapping technologies. This is a case when a company has to negotiate with more companies whose patents they need for production of the current product or whose patents overlap to some extent. In any case in the negotiation phase firms can practice some methodologies that facilitate the overall negotiations, such as Thompson's (2011) mixed-motive negotiation techniques and some practical intangible-asset evaluation methods reviewed in the paper from Smith & Parr (2000).

The negotiation stage also allows enterprises to build up their seizing Dynamic Capabilities. For instance, companies A, C and D, show the significant presence of evolution of their acquiring, assimilating, transforming, and exploiting knowledge activities (Zahra & George 2002), and market intelligence response activities (Teece 2007). By definition, the seizing Dynamic Capability perfectly fits into the main goals of the negotiation stage of the process, but our analysis also puts forward the notion that the presence of routines that enable and expand this capability is identified in the realization stage (like in the example of the Company C and Company D). Nevertheless, in 75 percent of the companies (Company A, B and D) seizing dominates the negotiation stage, and in 50 percent of the companies (Company C and D) it has been also identified in the realization stage. In one firm (Company D), the negotiation phase has an important role for the deployment of the reconfiguration capability in the firm.

3.4.4. Realization

After intelligence and negotiation firms arrive to the realization phase, involving the actual transfer of technology between the counterparts (Bianchi et al. 2011). The major hindrance appearing here is caused by the tacit nature of knowledge, which is difficult, long-lasting and expensive to transfer. So, the managers from the firms studied try to circumvent this obstacle by continuing to provide the support to the partner company even after the transaction has officially been completed. In this manner, partnering firm's business and treatment of the licensed technology is backed up by the licensor firm. The realization stage in licensing process for the purpose of the foreign market entry includes the two aspects:

- **Technology transfer**: seen as pure transfer of know-how and the supporting documentation (Company A, B, C and D);
- **Marketing support**: for instance, Company C makes a detailed marketing support for the partnering company, containing the information and knowledge to enter the market (similar point observed in the Company D).

This marketing support gives closer explanations on the experience of the company and their previous partners in the foreign markets. It is made with the aim to help partners in the new markets to understand how the product works and what benefits enabled by this product should licensee company focus on. The marketing support is transferred to partnering company through trainings, seminars and written documents (similar point observed in the Company D).

This stage enables the development of the seizing Dynamic Capabilities. In 50 percent of the companies realization stage gives firms an opportunity to develop their seizing capability. Seizing and reconfiguring capabilities are more active and operational capabilities in the company. So, it may be concluded that the actual realization phase advances these two, operational capabilities.

3.4.5. Control

As stated in the work from Bianchi et al. (2011), the control stage entails monitoring of the partner's behavior and compliance with the contract. In the licensing process used for a company to enter a foreign market, two main points are controlled after the realization of the technology transfer and marketing support. These points include:

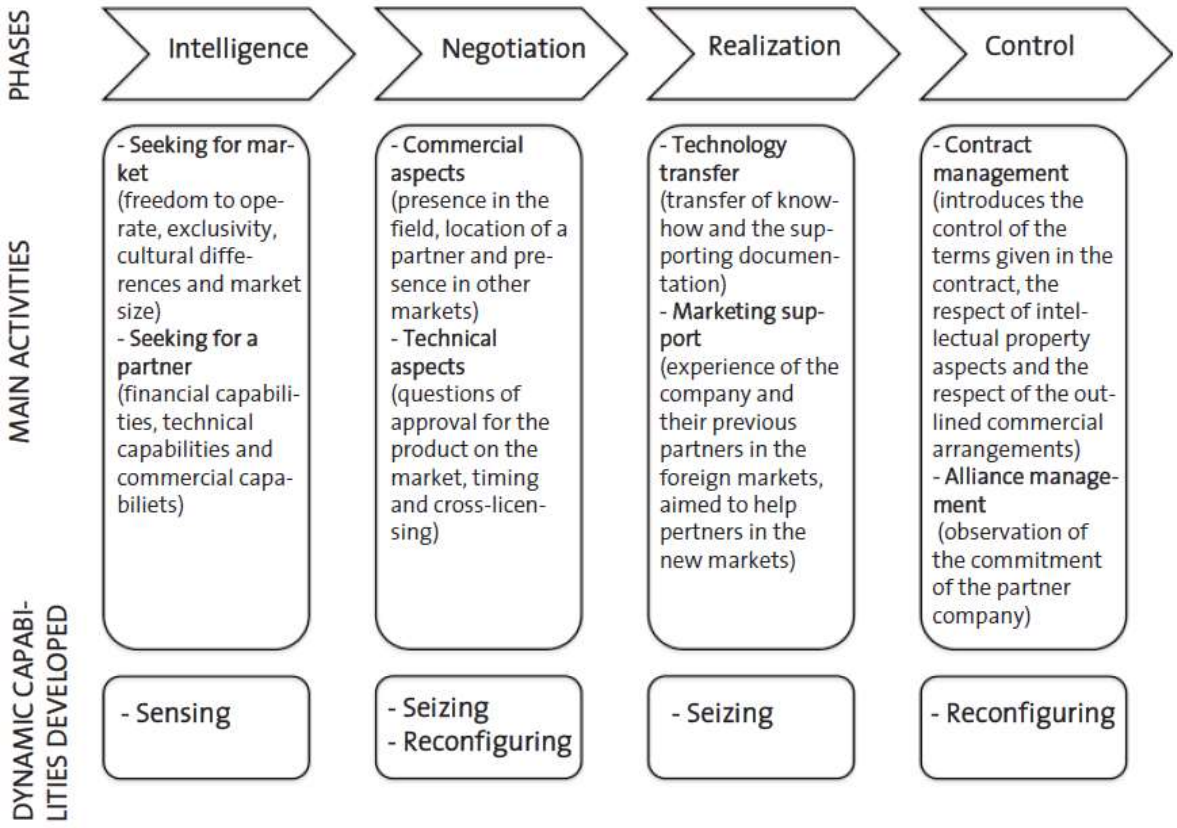
- **Contract management**: introduced the control of the terms given in the contract, which include the respect of intellectual property aspects and the respect of the outlined commercial arrangements (like the achievement of the minimum quantities of sales and fulfillment of the time framework given in the contract, as explained by Company B, C and D);
- **Alliance management**: concentrated mainly on the monitoring the heed of the commitments of the partner company (see e.g. Company B and C).

Both points presented above are controlled on a pre-defined periodic basis relying on conference calls, meetings, additional trainings and written reports. The question of the size of the partner company has a strong impact on the control phase. Head of the Business Development in Company D explains that bigger companies are more autonomous are and more difficult to follow.

Control phase of the licensing process has allowed the formation of the reconfiguring Dynamic Capability. In the 75 percent of the firms some elements that improve the appropriateness matters (Galunic & Rodan 1998), timeliness matters (Zott 2003) and efficiency matters (Kogut & Zander 1996) have been found. As the Head of Licensing & Business Development in Company B said, after the realization of the transfer of the technology, the firm still continues to align the partner company with the points stated in the contract. This is done with the aim to harmonize the timing and the sales amount assigned in the contract.

Figure 3.2 presents proposed process of technology licensing used as the foreign market entry mode, which was developed relying on the findings from this research. In the Figure 3.2, the main activities in each of the phases are presented and also the Dynamic Capabilities which are developed along the process.

Figure 3.2. The process of technology licensing used as the foreign market entry mode with the main activities in each of the phases and the Dynamic Capabilities developed along the process.



3.5. Conclusion

An active technology licensing has become a strategy exploited strongly within the firms. It will certainly be seriously considered in the future in the managerial research and within the companies themselves, because it enables companies to achieve both financial and strategic benefits and returns on their innovation efforts. However, the technology licensing for the foreign market entry purpose is complex and hard to manage. This paper aimed to present the process view perspective, which facilitates its management. To point out, the identified process stages may not fit ideally within the licensing as the foreign market entry mode in all the firms. Different environments and contexts of application of this process view may slightly vary, like they varied also in the firms from our sample. This study also shows that the licensing process used as the foreign market entry mode, enables companies to develop three Dynamic Capabilities (sensing, seizing and reconfiguring), which are useful further on for the company. This paper, however, has not explored the performance issues resulting from the different ways of management of the licensing process as the foreign market entry mode, which is an interesting venue for

the future research. As this is a qualitative based analysis, it is not appropriate for generalizing the results. In any case, the process based view can be appropriately examined by applying the panel data analysis, quantitative research approach, which is one more suggestion for the future research.

3.6. Summary of the Chapter

In this thesis Chapter the paper named "Managing International Technology Out-Licensing: A Process Based View and Dynamic Capabilities Development" was given. We aimed to disentangle the "how to manage technology out-licensing abroad" question. The key findings in this study indicate two main points: (i) companies adopt the process view perspective for managing technology out-licensing abroad and (ii) throughout the stages of this process firms tend to develop their Dynamic Capabilities (sensing, seizing and reconfiguring). This Dynamic Capabilities should be found useful in further business of the firm.

The research findings from this article contribute to a deeper understanding of technology out-licensing in foreign markets in innovation and technology management literature, but also in internationalization literature, by integrating the elements coming from these two research streams. The managerial implications resulting from this paper may be especially useful for the firms operating in the research intensive industries (like chemical, semi-conductor, biotech, etc.), enabling them to recognize the relevant issues in technology out-licensing process for the market entry purpose. Finally, this study is actually an important link between the question on international out-licensing antecedent and strategic outcomes following it. We now shift our focus on the output of this process, seen through the benefits it enables to the practicing firms.

Appendix 3.A

Interview Protocol

- **Company in general:**
  - Portfolio of activities, products/services
  - Firm information (size, businesses, industry, location, geographical location, products and services commercialized, main financial figures)
- **Licensing activities:**
  - Technology licensing to enter foreign market (main goals, amount, frequency, people involved, reference to one or more licensing projects)
  - Firm's degree of internationalization (presence in international market)
- **Licensing process:**
  - Technology licensing process identified ((i) planning; (ii) intelligence (identification and evaluation of exploitation potential); (iii) negotiation; (iv) realization (one-directional or bi-directional technology transfer); and (v) control; boundaries of each of the process stages)
  - Tasks/activities in process stages (management)
  - Degrees of formalization (e.g. (i) formal structures - existence of procedural routines, (ii) informal structures)
- **Dynamic Capabilities:**
  - Please indicate if the following activities appear during your licensing process used for the company to enter a foreign market (indicate also in which process stages these activities appear):
  - Sensing capability:
    (i) generation of market intelligence
    (ii) dissemination of the market intelligence
  - Seizing capability:
    (i) responding to market intelligence
    (ii) acquiring, assimilating, transforming, and exploiting knowledge
  - Reconfiguring capability:
    (i) observing appropriateness matters
    (ii) observing timeliness matters
    (iii) observing efficiency matters
  - Please discuss how practically you perform these activities

Appendix 3.B

Table 3.3. This table presents a brief description of the companies studied, their examples of licensing projects as the foreign market entry mode and describes the licensing phases identified.

Company	Company info	Strategic licensing to enter a foreign market	Recognized licensing stages
Company A	Company A is an integrated international group that operates in life sciences sectors (diagnostics, therapeutics, instrumentation, services). — **Turnover:** over € 1 billion (65% made in foreign markets); data from 2010, data from 2011 are similar and slightly increased. — **Employees:** 3000 — **Core business:** International leader in imaging diagnostics (wide range of products and solutions for all diagnostic methods), have the biggest diagnostic center in Italy (3-4 million analyses per year). — **Operates in:** US, Canada, Brazil, all Continental Europe, UK, Ireland, China, Japan and Scandinavia. — **Number of licensing agreements:** Not available (1500 patents, mostly to form barriers for the few breakthrough patents).	The turning point for the company was in the '80s, when the Company A developed a new breakthrough agent in radiological imaging. On one side this lead to big growth and production, but it was also a company's' decision to become truly international company, operating on a multinational basis. The Company A made a decision not only to have licensees for collecting royalties, but to establish full presence in the market. This presence was mainly through joint ventures, where Company A made a point of having a 51% of the venture (because they really wanted to have this joint venture as something on what they had control, gain direct experience from the territories and not to be seen as just a simple collector of royalties). More recently, some of the companies have become fully owned by Company A, which is their second step when entering a new market. Once the company learns how to behave, the situation is more mature to establish	— **Intelligence:** Company A has alerting services that on weekly basis control patents of their interests. Alerts go through some databases which provide constant update on the given keywords and areas that the company wants to keep under control (alerted on the patent activities from other companies). When company seeks for a foreign partner, it observes portfolio of patents and their degree of specialization (potential for cross-licensing), experience of a partner, business culture of the local country (e.g. Company A managers give an example of Japan, where the employees are first loyal to the country, then to the company), location of a partner (e.g. suitable partners are in Princeton, New Jersey, where the majority of world pharmaceutical industry is based, and it is close to the university). When company wants to enter a new market it observes: **Freedom to operate** (an in-depth study of the state of the art in patents in order to check if there is already

		themselves as a fully owned company.	present on that market); **Exclusivity** (how good is an exclusivity of their product: company may have the allowance to produce and sell the product, but very similar product may be available on the market). — **Negotiation:** Company A negotiates around: **commercial aspects** (financial indicators and return), **technical aspects** (approval for the product on the market and cross-licensing).
Company B	Company B is a family owned pharmaceutical company that is involved both in development and manufacturing of the pharmaceutical products. — **Turnover:** €68 million (10% in foreign markets); income in royalties and down payments is around 2% and it is decreasing. — **Employees:** 280 — **Core business:** Beyond the more traditional activities in the osteoarticular field and in the product pipeline renovation, tumors and the nervous system pathologies present the future areas of interest. — **Operates in:** Italy, France, UK, Canada, USA, Mexico and United Arab Emirates. — **Number of licensing agreements:** 60	Company B licenses only finished products, so they transfer mainly the know-how, dossiers and secrets not covered by patent. Their licensing agreements are also supply agreements for the finished products. The first product from Company B today is a liquid solution for the vitamin D-3, which will probably secure the survival of the company in the next years. Company B is now searching for a partner for the authorization and distribution of the product in the main European countries. They are working hard on the life cycle management, in order to understand which new products can be created around the same molecules. On the other side, company is also improving their business intelligence activities in the other markets.	**— Intelligence:** Company B screens the companies in the market that are active in the same therapeutic field (e.g. the product for tumor they license in Canada, they explore the companies that are active only for this specific tumor), explore the real market size (by purchasing data or doing research by themselves) and cultural differences of the countries. They observe their product portfolio of the local companies, size of the company (long decision timing is in bigger companies may make problems). Company B uses dedicated organized meetings, conferences or specialized fairs to contact partners. — **Negotiation:** Company B does a multiple stage negotiation. Normally, all the aspects of cooperation they combine in one agreement that includes a know-how

			licensing agreement, trademark license agreement and supply agreement of the finished product. — **Control:** Company B has a dedicated functional unit that works only with licensing agreements. It does not only control the **contract management**, but also the **alliance management**. This is done through periodic phone conferences and meetings, where they observe the commitment of the partner company. Company B introduces the control of yearly achievement of the minimum quantities of sales.
Company C	Company C is one of Italy's leading biopharmaceutical companies, with a solid history of developing innovative drugs for illnesses of high social impact. — **Turnover:** €491 million (data from 2009). — **Employees:** 800 — **Core business:** Leadership in core areas of anti-inflammatory, respiratory, rare diseases, neurology, onco/ hematology and nephrology. — **Operates in:** Italy, Germany, Belgium, Spain, Portugal, Poland, Greece, Albania, Turkey, Russia, Kazakhstan, Korea, Hong Kong, Azerbaijan, Armenia, Uzbekistan, Uzbekistan, Tajikistan, Mexico,	Company C was present in Russia, but was not satisfied with the results and wanted to change the partner. The old partner was not a local company, it was an Indian company, and it had a lot of products that were competing with Company C products. So, they found a local partner that was also able to cover the former Soviet Union countries and Eastern Europe (a regional player). The strategy was to give all the portfolio of the company to the partner. The main products in this deal are: a drug for treatment of inflammation associated with pain (the most important product of Company C) and mucolytic drug for	**— Intelligence**: Company C starts with market analysis performed by the dedicated functional unit for licensing. It has a formalized process for evaluation of potential partners, which consists of: Identification of a "Long List" of pharmaceutical companies belonging to the main National Trade Associations; Gathering of public available information relevant to assess partner's "generic and specific requirements"; Exclusion of companies with a clear business model unfit assessed through the analysis of their product portfolio and stated mission (e.g.: generic companies, specialty-R&D companies, homeopathic companies...); In

	Dominican Republic, Venezuela, Brazil, Columbia, Peru and Chile. — **Number of licensing agreements:** Not available	chronic and acute respiratory diseases. Company C generally supplies with the finished product when entering a new market, because it is the way to keep it secret even when the generic production becomes available.	depth desk analysis and profiling of short listed companies; First ranking of short listed companies based on: **Product Portfolio Fit** (therapeutic field, number of drugs, the expertise they have on the regulatory activities, presence in other markets) and **Economic and Financial Soundness** (financial foundation of the company). — **Realization:** Company C made a marketing support (the information and knowledge to enter the market) for the partnering company. It includes the Italian and foreign partners experiences. The main aim is to help them understand how the product works and which its benefits on which they should focus are. — **Control:** Partners needed to send annual marketing plan, attend meetings made to check the progress of registration and sales, send monthly reports containing sales data, comments on sales performance and information on generic products.
Company D	Company D is one of the leading Italian pharmaceutical groups, operates in both the pharmaceutical and the fine chemical industries. — **Turnover:** € 500 million (around 24% from foreign markets)	Company D licenses the right to produce the finished product from the raw material company produces. This is their approach in Korea, Turkey and Greece. The product is the iron compound, which is their innovation breakthrough. It is iron bound	— **Intelligence**: Company D looks at all the countries and finds up to 5 potential countries. Then identify all those possible partners that in these countries could bring their product to target doctors. Company observes in potential partners their

	— **Employees:** 2000 — **Core business:** Its products, all of which have a high therapeutic content, are mainly used in the cardiovascular, immuno-oncological, gynecological, dermatological, orthopedic and neurological areas. — **Operates in:** Italy, Russia, Brazil, Turkey, Greece, Chile, Portugal, USA, Spain, France, Morocco, Albania, Macedonia, Bulgaria, Romania, China, Korea, Vietnam, Iran, Iraq, Egypt, Libya, Algeria, Sudan, Kenya, Georgia…) **- Number of licensing agreements:** 50-60	with milk protein (casein). Company D has this sophisticated binding that is very tight in condition of low PH. When a patient drinks it, it goes to the stomach, where the level of PH is very low, so the biding of the protein towards the iron is very tight and no iron is released in the stomach. When this complex flows into intestine, where PH is very high, the proteins are immediately digested and iron is released and absorbed. In the common treatment of iron deficiency anemia, one of the major side effects is the gastritis problem, especially in the pregnant women. With this product these classic iron side effects are avoided. It was released in the early 90s. In some countries there are generic producers of this compound. Company committed a lot of resources to carefully protect this compound.	structure, portfolio of products, if they had synergies with their portfolio, their sales, their presence in the field, financial capabilities, technical capabilities and commercial capabilities. These data is collected through databank, meetings, personal connections and consultants. **— Negotiation:** After identifying the partner Company D goes with the licensing deal, where they reveal: what, how, in which way and in which timing they have to do. Fundamentally, the question of time is observed. — **Realization:** It can be a transfer of know-how, or it can be even a commercial know-how. It depends on what kind of technology is transferred. If the rights for production are also transferred, the company helps the partner to produce, follows them and informs and advises them. It depends who is their partner, what kind of technology are they transferring. **— Control:** The bigger is the company, the more autonomous they are and more difficult is to follow the project. Company D follows the milestones they put in agreement and key times for the fulfilment of the tasks. Again, the point of time is more contractual than ever.

Appendix 3.C

Table 3.4. The results of the analysis of all the process phases in order to identify the Dynamic Capabilities developed along the process.

Companies		Dynamic Capabilities by code							
		Sensing		Seizing		Reconfiguring			
		1.1	1.2	2.1	2.2	3.1	3.2	3.3	
Company A Process Stages	P								
	I	✓	✓						
	N			✓	✓				
	R								
	C								
Company B Process Stages	P								
	I	✓	✓						
	N			✓	✓				
	R								
	C					✓	✓	✓	
Company C Process Stages	P								
	I	✓	✓						
	N								
	R			✓	✓				
	C								✓
Company D Process Stages	P								
	I	✓	✓						
	N			✓	✓	✓	✓	✓	
	R			✓	✓	✓			
	C								✓

CHAPTER 4:

Learning through Technology Out-Licensing Internationally: Organizational Learning and Influence on the Product Commercialization

This Chapter focuses on the underexplored strategic benefits that technology out-licensing internationally enables. Here we present the paper titled "Strategic technology Out-Licensing Internationally: Organizational Learning and Influence on the Product Commercialization". While the previous chapters introduce a comprehensive review of the management of technology out-licensing research, and position the literature gap, inhere we want to explore the effect of organizational learning resulting from technology out-licensing internationally. This leaning effect may be viewed as an important strategic gain, brought to the enterprises that are engaged in the over border out-licensing. In other words, we will try to bring closer and analyze if (whether or not) and in what way (time effect) technology out-licensing abroad leads to superior product commercialization internationally. We are studying the outcomes of organizational learning; viewed through the growth of product sales in foreign markets. We interpret this international product commercialization growth as a result that derives from firm's international out-licensing.

The organizational learning from out-licensing abroad was suggested both by the technology management literature and international business literature. As organizational learning is intangible by itself, academics commonly approach its analysis by actually following the outcomes of it and certain improvements resulting from it. Thus, we employ the empirical type of research on the panel data set. As we follow the improvements in the volume of product commercialization abroad over time, which is a type of a growth variable and commonly autocorrelated with its time-lagged values, we exploit the difference and system GMM estimators that solve some issues around heteroscedasticity and autocorrelation within individuals. The data used for this study is comprised from the companies from the Spanish manufacturing sector and offers us an opportunity to answer the following research questions RQ.3.a: "Do companies learn through international out-licensing to improve their product sales abroad?" and RQ.3.b: "Is there a particular time lagged influence of this learning?".

The research article reported here focuses on the firms that are engaged in international activities and that commercialize their products in foreign markets in at least one observed year. Finally, the results from this Chapter should close our holistic study of international out-licensing by looking at the outcomes from this business activity.

4.1. Introduction

Some research indicates that technology out-licensing in foreign countries inhibits organizational learning (Zahra et al. 2000; Argote 2011), which leads towards higher performance of firms in international operations (Morschett et al. 2010; Tan 2009; Pan & Tse 2000). By out-licensing abroad firms gather knowledge and build up a sort of learning platform for becoming more successful in their international activities (Hill 1992; Brouthers et al. 2008; Morschett et al. 2010). Since the success of international operations strongly influences the survival and performance of a firm in general (Zahra et al. 2000; Yeoh 2004; Gao et al. 2009; Hitt et al. 1997), it is especially important to address strategic out-licensing abroad. This paper focuses on the organizational learning that takes place when organizations out-license their technologies abroad, because out-licensing allows firms to observe and imitate how their technologies are implemented in products internationally and which exact implementation of their technology in the product achieves higher product sales.

This view presents a junction between technology management and international business research. On one side, technology management scholars show that technology out-licensing grants companies an opportunity to achieve both monetary and strategic benefits (Arora & Fosfuri 2003a; Granstrand 2004; Lichtenthaler 2009; Bianchi, Chiaroni, et al. 2011). These strategic benefits are seen as a way for enterprises to extract additional value from their research investments by technology out-licensing[4]. The strategic goals realized by out-licensing can be diverse, like establishing industry standards in markets (Grindley & Teece 1997; Arora & Fosfuri 2003a; Koruna 2004a), allowing firms to gain access to external knowledge (Grindley & Teece 1997; Arora & Ceccagnoli 2006), or achieving international expansion (Arora & Fosfuri 2000; Jiang et al. 2008; Aulakh et al. 2010). We particularly analyze the international expansion benefits that technology out-licensing delivers. On the other side, the vast body of international business literature explores strategic licensing as an important step towards firm's success in their foreign operations (Morschett et al. 2010; Buckley & Casson 1998; Tan 2009; Johanson & Vahlne 2009; Aulakh et al. 2010). International business scholars view out-licensing as one of the market entry modes that inevitably supports firm's international advancement (Meyer et al. 2009; Buckley & Casson 1998; Giarratana & Torrisi 2010; Agarwal & Ramaswami 1992; Johanson & Vahlne 2009). Companies are starting to realize both the financial and the strategic benefits granted by international out-licensing, and are growingly pursuing it (Arora et al. 2013; Bianchi et al. 2010; Granstrand 2004). As a result, the "U.S.

[4] Although this paper focuses on strategic licensing, companies also may license out to extract additional value of mature (Telesio, 1979), underutilized (Arora & Fosfuri 2003a; Gans et al. 2002) or even unused technologies (Chesbrough & Garman 2009).

International transaction report" records an annual growth in the volume of international out-licensing by U.S. firms of around 11.5% (Bureau of Economic Analysis, 2013) and some researchers even propose a potential commencement of a shift towards a pro-licensing era (Granstrand 2004).

Despite that the literature presents that there is a positive impact of international out-licensing on the success in foreign markets (Glass & Saggi 2002; Buckley & Casson 1998; Aulakh et al. 2010; Barkema & Drogendijk 2007; Chen 2005), the organizational learning taking place when firms out-license their technologies in foreign markets is still vaguely explored. In this sense, only several questions on this topic have been tackled so far: if companies learn from their international out-licensing engagements (Davis and Harrison 2001; Rivette and Kline 2000; Anand and Khanna 2000; Gambardella, Giuri, and Luzzi 2007; Lichtenthaler 2005), what ventures learn when they out-license internationally (Blomstermo et al. 2006; Jiang et al. 2008; Bianchi et al. 2013; Barkema & Drogendijk 2007; Gao et al. 2009), how is this knowledge transferred to licensors (Jiang, Aulakh, and Pan 2008; Granstrand 2004; Bragg and Lowe 1989) and when this out-licensing enabled organizational learning actually conveys companies to accomplish higher performance in their international business (Barkema & Drogendijk 2007). However, previous works do not address all the segments of international business that might be improved by out-licensing internationally. So, the direct link between out-licensing internationally and improvement of firm's product commercialization abroad has not been discussed yet. Former studies only consider some general improvements of firm's international business (Zahra et al. 2000) or survival of firms subsidiaries and investments abroad (Shaver et al. 1997; Gao & Pan 2010).

To address this gap, we analyze the successes of product commercialization internationally, which is inhibited by learning that takes place when firms out-license their technologies outside the home market. In this light, we adopt an organizational learning perspective and examine two research questions: "Do companies learn through international out-licensing to improve their product sales abroad?" and "Is there a particular time lagged influence of this learning?". We particularly delve into the product commercialization learning gains and its relation to technology out-licensing, because previous studies show that the product development strategy and licensing strategy should be aligned (Bianchi et al. 2013; Lichtenthaler 2011). Further, organizations strive to implement their technologies in their own product development and achieve higher profits from their product sales, because the high technology transaction costs and opportunity costs of technology transfer make the net profit extracted by technology out-licensing lower than profit extracted by applying technology in firm's own products (Kotabe et al. 1996; Teece 1986). Moreover, Grindley & Teece (1997) warn that it can be a risky strategy if firms become pure licensing companies that are not directly involved in the product market, manufacturing and product design itself. They allude on a more positive outcome if firms do both, and on licensing as an option that does not mutually exclude the self-production (Arora et al. 2002). So, enterprises may out-license

internationally to learn about diverse ways to apply their technologies in products and to boost their product sales abroad.

Here we apply a panel data analysis, which is particularly suitable to examine the organizational learning effect and temporal relationship between out-licensing and product commercialization internationally (Salomon & Shaver 2005), because it allows us to follow the firm's learning outcomes over time. However, learning is intangible by itself, and it is problematic to measure weather it occurred. To solve this issue some authors observe if the organizational learning took place by following the changes in practices and routines in the company (Levitt & March 1988) or changes in products and services (Helfat & Raubitschek 2000). In this paper we measure the changes in performance through the increase of volume of firm's product sales globally, as an indication that organizational learning commenced (Argote et al. 1990). This approach allows us to capture tacit and explicit knowledge (Nonaka & von Krogh 2009), both needed to achieve higher performance (Argote & Miron-Spektor 2011). We use system GMM estimators that solve issues around heteroscedasticity and autocorrelation within individuals in a dynamic panel data setting (Roodman 2009b). Our study is performed on the panel data set comprised of companies from the Spanish manufacturing sector.

This research makes three major contributions. First, this research extends the technology management literature on technology out-licensing as it examines strategic out-licensing through the organizational learning lenses. Second, rather than viewing only the current effect of technology out-licensing on firm's performance, we consider also the time lagged influence and the strategic outcomes of technology out-licensing abroad. Third, the relationship between licensing out and firm performance in international markets has been suggested in the literature, but nothing is known about direct learning effect that out-licensing has on firm's product sales globally. Moreover, this study wants to resolve how the effect of international out-licensing on product sales abroad changes depending on the time lag of out-licensing and product sales enhancement, whether it takes more or less time for the effect to take place.

In essence, our results show that out-licensing abroad empowers the organizational learning, which is later reflected in the higher product sales internationally. The learning is realized as a result of licensors ability to monitor its out-licensed technologies, and learn by observing and imitating licensees applying them in their own products. In this way, licensor makes a clear distinguishment of an optimal product that was developed based on its licensed technologies. Interestingly, we have found that the window of time lag between out-licensing and the demonstrated learning effect is also relevant, stressing the particular importance of the international technology out-licensing in recent time lag.

The next section briefly reviews the extant research on international out-licensing by viewing the technology management and international business literature insights and also considering the organizational learning theory. We also discuss how these arguments could be reflected to the

organization's product commercialization internationally. Afterwards, we introduce and describe the data set that was employed by providing some descriptive results. This section is followed by a section introducing the method employed to test our arguments. Then we proceed with presenting the empirical results and discuss the findings. In this final section we also draw the major conclusions, indicate some weaknesses of the study and suggest opportunities for future research.

4.2. Literature review

4.2.1. Organizational learning by out-licensing abroad

Organizational learning is defined as a change in organization that occurs as the organization acquires experience (Argote & Miron-Spektor 2011)[5]. In this research organizational learning can be seen as a function of international experience resulting from technology out-licensing. In this perspective international technology out-licensing enables firms to learn how to implement their technologies in products and which exact implementations lead towards higher product commercialization in foreign markets. Experience comes from the application of licensors' technologies in products of licensees abroad, permitting indirect organizational learning (Levitt & March 1988). Knowledge may be acquired in multiple ways (Huber 1991): experientially (learning from experience or activities), vicariously (learning by observing others), by searching for information about organization's environment, by grafting (learning by adding on knowledge needed and not possessed by the organization) and congenitally (by drawing by previously possessed knowledge of the employees). In the case of learning from international technology out-licensing, firms essentially acquire a vicarious knowledge, or they learn by observing other organizations (De Clercq et al. 2012). In vicarious learning, organizations may learn from the performance of others, usually by imitating actions that seem successful and trying to avoid actions that appear unsuccessful (Levitt & March 1988; Haunschild & Miner 1997; Kraatz 1998). This is aligned with the argument form (Pentland 1992), who defined organizational knowledge as the capacity of an organization to act competently. This type of learning may be addressed as learning-by-being-done-by-someone-else, because licensors learn *from* and imitate *how* international licensees implement their technologies in their products and which particular products that are based on licensors' innovations are more successful in terms of commercialization. Previous research also presents other alternatives to the learning-by-doing concept (Lane & Lubatkin 1998), like learning-by-doing-something-else (Schilling et al. 2003). As

[5] Organizational learning may also be defined as "organizations' encoding inferences from history into routines that guide the behavior" (Levitt and March 1988, p. 319). However, for better clarity of this research we apply the definition of organizational learning given by Argote & Miron-Spektor (2011).

mentioned before, learning is intangible by itself and it is problematic to measure weather it occurred. In this paper we measure the changes in performance through the increase of volume of firm's product sales internationally, as an indication that organizational learning commenced (Argote et al. 1990). By following the performance change we capture both tacit and explicit knowledge (Nonaka & von Krogh 2009), of which both are necessary for performance improvement (Argote & Miron-Spektor 2011).

We explore a particular type of learning, which is achieved by organization's observation and imitation of the superior products that are developed by the licensee enterprise, and are based on the technologies out-licensed by the licensor. Although firms also learn how to enter, behave and operate in international markets through their entry experience in foreign markets (Johanson & Vahlne 1977; Barkema & Drogendijk 2007; Gao & Pan 2010), our point of analysis is on a firm level learning about superior product realizations of their technologies in the global market in general. So, we are not discussing any of the market-specific knowledge, but more the technology-implementation specific knowledge, that is abstracted from any particular market. As Mansfield (1985) argues, any knowledge that is embedded in products is transferred more readily than knowledge embedded in processes or organizational practices and routines. This especially valid if the firm is an owner and developer of a certain technology that is the integral part of that product, because companies actually possess the tacit and thorough understanding of their own technologies (Nonaka & von Krogh 2009; Argote & Miron-Spektor 2011). We do not develop approach this research by hypothesis development, as we cannot hypothesize whether learning occurs after lag 1, 2, or 3 years. This approach is also applied in a similar study explaining organizational learning in the international context by Salomon & Shaver (2005).

4.2.1. Technology management and learning through technology out-licensing abroad

Let us say that company (licensor) out-licenses its technologies to one or more companies in foreign markets. Each of the companies that in-license these technologies (licensees) employs them in their own products. Since the out-licensing process is composed of a strong control phase that follows the technology transfer (Sikimic et al. 2013; Chiaroni et al. 2010), licensor closely monitors whether the licensee companies respect the licensing contract and how profitable are the products implementing the technology they have out-licensed. So, the learning outcomes are actually twofold. First, when offering their technologies by out-licensing to other firms internationally, licensors may observe the variety of product implementations that apply their technologies. Second, by controlling the use, application and commercialization of out-licensed technologies in the marketed products, licensors learn which potential product realization shows superior sales performance in the market. This enables licensor companies to combine its innovations differently and learn how to deliver and commercialize superior products from the technologies they already have available. All this knowledge is notably meaningful, because aside from

having the superior technologies, companies need to learn how to shape these technologies into their products and to understand which product implementations relying on their technologies lead towards superior product sales (Zahra et al. 2000; Danneels 2007).

Firms should align their product development and licensing activities as an integral parts of their technology exploitation strategy and closely coordinate their NPD and licensing processes (Bianchi et al. 2013). It has been empirically demonstrated that this alignment has a positive effect on financial performance (Lichtenthaler & Frishammar 2011). This perspective enriched the licensing dilemma idea that views the decision of firms to out-license depending on the balance of rent-appropriation (as financial incomes from out-licensed technologies) and profit-dissipation effects (as potential profits decrease caused when licensees take over firm's technology to compete in the same market) (Fosfuri 2006; Arora et al. 2013). When out-licensing for the purpose of learning about superior ways to shape the technologies in their own products, companies pursue a "keep and sell" strategy (Lichtenthaler & Frishammar 2011), where they both appropriate licensing rents and increase profits in their product sales in international market. The fungible nature of technologies (Penrose, 1959), allows unrestricted reuse of technologies and suitable shaping of it in wide range of market applications (Bianchi et al. 2010). But delivering all the potential applications and serving all the markets simultaneously is costly (Danneels 2007), which makes licensing as a good alternative to actually exploit the licensee companies and their effort and resources to develop the products for the market (Patel & Pavitt 1997). By offering their technologies to licensees, licensor provides itself with an opportunity to rely on the effort of product development efforts of licensees. This can be lead to a sort of an indirect involvement of the customers, through beta testing or collaboration with lead users that are of high value for adequate product development outcomes (Robert 1985; Lilien et al. 2002).

Link between firm's success in international product sale and international out-licensing presents an intersection between market and technology strategic orientation. Market orientation is recognized through the extent of firm's focus towards the need of their customers (Slater & Narver 1998), by providing products that fit their needs (George 1994) and by continuously delivering more value for them (Narver & Slater 1990). Technology orientation is in essence characterized by the capability and willingness of firms to create strong technological background and to implement it in their commercializing of new products (Song & Parry 1997). Following our reasoning, international out-licensing provides learning that is both relevant for its market and technology strategic orientation. Mu & Di Benedetto (2011) find the positive relation between strategic orientations and new product commercialization, and more importantly they present that pairing of different strategic orientations (like market and technology) actually supports the impacts of them on the performance of new product

commercialization. So, companies that out-license abroad get insights in the adequate ways to leverage their technologies in more successful products (Danneels 2007; Athreye & Cantwell 2007).

4.2.2. International business and learning through technology out-licensing abroad

Different entry modes present a sort of repositories for the embedded knowledge in foreign markets. When companies engage in international market entry modes, they gather, accumulate and transfer this knowledge to the home organization (Barkema et al. 1996; Shaver et al. 1997). Before there is any significant flow of knowledge between organizations, they have to be in some form of a strategic alliance (e.g. licensing) (Easterby-Smith et al. 2008), which affects how they interact and transfer knowledge (Hagedoorn & Narula 1996). Barkema and Drogendijk (2007) show that learning is stronger when firms initiate operating over-border with non-equity based entry modes (like technology out-licensing), and that non-equity entry modes are relevant for later performance in international markets. By out-licensing abroad enterprises reduce the level of liability of foreignness, as well as a high level of uncertainty caused by different cultural and institutional settings (Zaheer 1995). To overcome the liability of foreignness and achieve competitive advantage, ventures need to offer superior products in the foreign market (Caves, 1982). Technology out-licensing abroad provides organizations with an opportunity to figure out which products that implement their technologies are exactly those superior product. Although the firm's absorptive ability to recognize, assimilate, and apply these external information helps firms achieve more efficient learning (Cohen & Levinthal 1990), we do not explore it in this study, but focus solely on discovering if the effect of learning is present.

There are several implications for the reasoning for the positive relation of international product sales and learning by out-licensing. Firstly, within internationalization process companies strongly rely on strategic out-licensing to gain knowledge that makes them superior in foreign markets (Johanson & Vahlne 1977; Arora & Fosfuri 2000). Nerkar and Roberts (2004) investigate venture's gains from having a diverse experience base, and find that firms with more diverse market experience produce new products of higher quality. Similarly Bruneel et al. (2010) consider the lack of knowledge about international operations as a key obstacle of international expansion, which can be overcome mainly by operating abroad. Secondly, as Cohen and Levinthal (1990, p.136) note, organizations are limited by its prior knowledge that permits them to "predict more accurately the nature and commercial potential of technological advances". So, by technology licensing abroad companies observe how their technologies are embodied in products and which from this variety of applications achieves better customer acceptance and higher sales. Thirdly, our approach to internationalization process is aligned with the research on international expansion, explaining that internationalization process is optimally organized in steps (Johanson & Wiedersheim-Paul 1975). These steps should not initiate with high-commitment entry modes

(like FDI), but should preferably start with low-commitment entry mode (like out-licensing), as thereby they diminish important exploration of international environments and decrease the potential for international business success (Barkema & Drogendijk 2007). Surprisingly, only a few studies actually explored the relation between international experience and learning effect facilitated by any of market entry modes (Barkema & Drogendijk 2007; Clarke et al. 2013; Zahra et al. 2000). So, we try to identify that the learning effect from technology out-licensing abroad positively influences the international product sales, and proceed with the empirical analysis in the next section.

4.3. Data

We employ the data from a survey on a representative sample of Spanish firms from the database Encuesta Sobre Estrategias Empresariales (Survey on Business Strategies, ESEE), collected by a public institution that is financed by the Spanish Ministry of Industry. The ESEE survey was designed to ensure that the dataset includes a representative sample of Spanish manufacturing sector. For this reason, in the sample the companies with more than 200 employees were surveyed, but also the smaller companies with more than 10 employees were randomly chosen and included to achieve stratified sampling. Approximately 70% of the selected organizations actually completed the survey. The focus on the manufacturing sector is particularly valuable in the context of our research, as we explore learning funneled through technology out-licensing. We find reason for this in the argument that the manufacturing firms are those who might use licensing strategically and not necessary use it just as the main source of income, because manufacturing firms would rather combine licensing benefits with its product commercialization (Lichtenthaler 2007). Moreover, manufacturing firms are forced to rely on innovation because of the short life-cycle and fast obsolescence of products (Tushman & Anderson 1986), so technology trade should find an important role in their strategy. Similarly, pioneering in terms of new products has seen as more risky, but also more significant for manufacturing firms than for service firms, so our study on the data sample of manufacturing firms has higher relevance in terms of relation between product development strategy and licensing strategy (Song et al. 1999). This database has already been used in the studies dealing with organizational learning in the international context (Salomon & Jin 2010; Salomon & Shaver 2005) and with technology trade (Bianchi et al. 2013; Kotlar et al. 2013). Initially our data contained 4.475 companies and 49.225 firm-year observations followed in the period of 1997-2007. As we tend to explore the learning effect on product sales abroad, we have excluded from the sample all the companies who do not commercialize their products internationally in any of the years. After this our sample was left with 2.486 enterprises and 27.346 firm-years observations. In the Table 4.1 we present the industry breakdown of the firms in our sample. The number of observations by industry ranges from

sector of fabricated metal products (sector number 1), which includes a total of 295 firms, to the sector of computer, electronic and optical products (sector number 20), which contains 40 firms. In the empirical approach that will be presented later, we use the lagged values of technology out-licensing for some analysis, so the size of our usable sample changes.

Table 4.1. Industry breakdown of the companies from the sample

Industry	Number of Firms	Percentage of Total
1. Fabricated metal products	295	11.87%
2. Food and tobacco	216	8.69%
3. Textiles and clothing	211	8.49%
4. Nonmetal mineral products	181	7,28%
5. Agricultural and industrial machinery and equipment	179	7,20%
6. Chemicals and pharmaceuticals	164	6,60%
7. Electric materials and accessories	151	6,07%
8. Plastic and rubber products	132	5,31%
9. Printing	128	5,15%
10. Furniture	120	4,83%
11. Vehicles and accessories	116	4,67%
12. Timber	90	3,62%
13. Basic metal products	76	3,06%
14. Paper	75	3,02%
15. Meat products	72	2,90%
16. Leather, fur and footwear	71	2,85%
17. Other transport equipment	60	2,41%
18. Other manufacturing	57	2,29%
19. Beverage	52	2,09%
20. Computer products, electronics and optical	40	1,61%
TOTAL	2.486	100%

We also implement the data on inflation from the Spanish National Institute for Statistics (INE), which we use to take into account the annual inflation from December previous year to December of the current year (as also the data given in the sample relate to the December of the observed year), for the

period of 1997-2007. Thus, we convert the nominal values of the variables into deflated values, by taking the first year as the reference year. Similar inflation-adjustment was seen in other panel data studies (Arellano & Bond 1991). By considering inflation we strengthen our model, as the value of one unit of variable in the first year of our sample (1997) weights around 36% more when used to observe the relation with one unit of the variable in the last year of our sample (2007).

4.3.1. Dependent Variables

We described in the introduction of the paper that we use the volume of venture's international product sales as a dependent variable. Organizational learning is intangible by itself, and it is problematic to measure weather it actually occurred. In order to circumvent this issue, some authors observe if the organizational learning took place by following the changes in practices and routines in the company (Levitt & March 1988) or changes in products and services (Helfat & Raubitschek 2000). In our study we measure the changes in performance through the increase of volume of firms' product sales globally, as an indication that organizational learning commenced (Argote et al. 1990). We consider this approach suitable as it allows us to capture tacit and explicit knowledge (Nonaka & von Krogh 2009), both needed to achieve higher performance (Argote & Miron-Spektor 2011). The values of product sales abroad are given in Euro (in terms of the incomes that company receives for their product sales abroad) and are highly skewed, so we add one to the value of product sales abroad and take the natural logarithm of it. We name this variable ***Product Commercialization Abroad Volume*$_{(t)}$ - PCAV$_{(i,\ t)}$**, and use it to demonstrate the natural logarithm of firms product sales volume internationally.

5.3.2. Independent Variable

The survey reports the volume of technology out-licensing of firms abroad. We use this variable to test the direct learning effect of it on the improvements of product commercialization in foreign markets. Because knowledge needs some time to be incorporated in the focal firm, we use different variations of the lag of technology out-licensing volume that is common in the organizational learning research (Eggers 2012; Salomon & Shaver 2005; Argote 2011). Initially, from the volume of technology out-licensing of firms abroad, we derive the following dummy variables:

- ***Out-Licensing Abroad in any previous year*$_{(t)}$ – OLAapy$_{(i,\ t)}$**: this variable takes value 1 if firm has out-licensed in any of the previous years, excluding the current year, otherwise it takes value zero;
- ***Out-Licensing Abroad*$_{(t-1)}$, *Out-Licensing Abroad*$_{(t-2)}$ and *Out-Licensing Abroad*$_{(t-3)}$ – OLA$_{(i,\ t-1)}$, OLA$_{(i,\ t-2)}$** and **OLA$_{(i,\ t-3)}$**: these variables take value 1 if firm has out-licensed in lag 1 year, lag 2 year and lag 3 year respectively, otherwise it takes value zero.

Further we employ variables that consider the volume of technology out-licensing internationally. Again, as a result of high skewness of technology out-licensing volume, we take the natural logarithm of one plus the observed variable. All the following variables are given as the natural logarithms, although we do not stress that for each of them:

- ***Out-Licensing Abroad Volume Average of all previous years*** $_{(t)}$ – **OLAVapy**$_{(i,\ t)}$: this variable is formed as a moving average of all naturally logged income volumes of out-licensing abroad in the previous years, excluding the current one;
- ***Out-Licensing Abroad Volume*** $_{(t-1)}$, ***Out-Licensing Abroad Volume*** $_{(t-2)}$ and ***Out-Licensing Abroad Volume*** $_{(t-3)}$ – **OLAV**$_{(i,\ t-1)}$, **OLAV**$_{(i,\ t-2)}$ and **OLAV**$_{(i,\ t-3)}$: these variables present the logged value of international out-licensing in lag 1 year, lag 2 year and lag 3 year respectively.

The lags 1, 2 and 3 are chosen based on the length of our panel (11 years) and similar prior research (Salomon & Shaver 2005). Moreover, our later analysis indicates that when performing the system GMM estimator we use on average 3 observations per group, so by actually applying up to 3 lags we optimally exploit the explanatory strength of our dataset.

4.3.3. Control Variable

We control for firms R&D intensity in the current year, measured by the firm's relative investment in R&D as the percentage of firm's total sales. This variable is defined as R&D expenditures divided by total sales, and expressed in percentage - ***R&D Intensity*** $_{(t)}$ (**RnDI**$_{(i\ ,\ t)}$).The R&D intensity is relevant here because it dictates how fast and efficient may firm react to organizational learning (Cohen & Levinthal 1990; Lane & Lubatkin 1998). It also demonstrates the ability of a company to leverage their technologies and be more successful in developing their products (Lichtenthaler & Muethel 2012; Steensma 1996; Schilling & Hill 1998). Similarly R&D intensity may be viewed as an alternative measure of size in the innovation context. It is commonly used in the technology management and international business literature (Ceccagnoli & Jiang 2012; Arregle et al. 2006).

When observing the product sales or customer and market orientation in general, the effort that a company inputs into its advertising cannot be neglected. We develop a measure of advertising intensity, given as the percentage of total sales that company invests in its marketing activities. Again, it is calculated as advertising expenditures in the present year divided by total sales of the company and is expressed in percentage - ***Advertising Intensity*** $_{(t)}$ (**AdvI**$_{(i\ ,\ t)}$)**.**. We favor the intensity measure here, related to total sales amount. This is an indirect way to consider the total sales volume in the model, as we do not control for it because the values of both the international licensing and product sales are contained in it. Another point is that comprehensive marketing activates may directly be responsible for firms over-border product sales (Zhao et al. 2004; Brouthers & Hennart 2007).

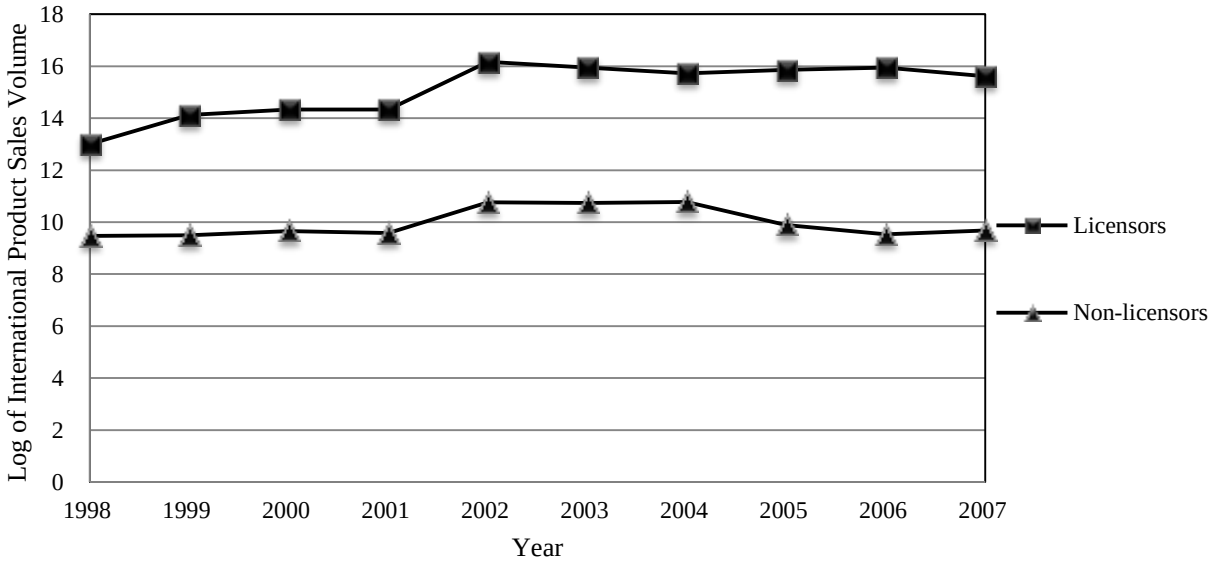
The control measure for the size of the company presents the total number of employees of the firm in the current year - $\boldsymbol{Size_{(t)(}}$ ($\mathbf{Size_{(i,\ t)}}$). Companies who are more active in the international market tend to be larger in size, so we control for it. We avoid using the total sales as the size measure, because of the expected reverse causality between out-licensing, product sales abroad and overall sales.

Firm's age is another control measure that we build by counting the number years since the year of foundation of the company. Although firms can be born globally today (Blomstermo et al. 2006; Buckley & Casson 1998), older firms might be longer in the market and have already a strong reputation and international presence. So, we input in our model the variable that informs about the age of the observed venture in the present time moment - $\boldsymbol{Age_{(t)}}$ ($\mathbf{Age_{(i,\ t)}}$).

4.3.4. Descriptive results

We initiate with a straightforward comparison of the sample average international product sales volume between the firms who engage and the firms who do not engage in out-licensing abroad (Figure 4.1). The licensing companies consistently achieve greater product commercialization abroad, which is consistent with our arguments that organizations learn through their technology out-licensing abroad. However, by this we do not tackle the direction in which the causality runs, whether it runs from licensing to product commercialization, or in the opposite direction, or in both directions. Moreover, although showing that licensors achieve higher product commercialization amounts, we do not control for the relevant effects that also might drive this relation. Thus we proceed with multivariate type of statistical analysis.

Figure 4.1. International Product Commercialization by International Out-Licensing status



In the next table (Table 4.2) the product moment correlations on the total sample are given, along with the summary statistics of the variables used further on. The difference between really low values of means and really high values of the maximum amount of the variables that either present the moving average of out-licensing volume in all the previous years, or the out-licensing amount in the lag 1, 2 or 3 years, drawn our attention. So, we have gone back to the data set and check if this difference (e.g., mean value of 0.27 to the maximum value of 17.23 of the variable that takes the natural logarithm of the volume) is caused by the wrong and misleading values presented in our sample. We found that this was caused by the small number of firms that actually out-license abroad (95 companies from total 2.486, which is around 4%), so no observations were excluded, since this is really a representative sample of firms international out-licensing activities and their out-licensing volume abroad is highly dispersed. This is aligned with the previous out-licensing literature that explains that most of the companies are not seriously engaged in proactive out-licensing and that some companies achieve high success in out-licensing while others do not (Granstrand 2004; Arora & Fosfuri 2003a; Arora et al. 2013; Fosfuri 2006; Bianchi et al. 2010). However, the correlations still do not suggest some major dependencies among variables of interests that might help us understand the learning effect of out-licensing on product sales abroad.

Table 4.2. Product Moment Correlations and the Summary Statistics

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Product Commercialization Abroad Volume$_{(t)}$	1												
2. Out-Licensing Abroad in any previous year$_{(t)}$	0.15	1											
3. Out-Licensing Abroad Volume Average of all previous years$_{(t)}$	0.13	0.85	1										
4. Out-Licensing Abroad$_{(t-1)}$	0.12	0.78	0.85	1									
5. Out-Licensing Abroad$_{(t-2)}$	0.12	0.74	0.87	0.77	1								
6. Out-Licensing Abroad$_{(t-3)}$	0.11	0.71	0.87	0.63	0.78	1							
7. Out-Licensing Abroad Volume$_{(t-1)}$	0.12	0.77	0.86	0.98	0.76	0.64	1						
8. Out-Licensing Abroad Volume$_{(t-2)}$	0.12	0.72	0.88	0.76	0.98	0.77	0.77	1					
9. Out-Licensing Abroad Volume$_{(t-3)}$	0.12	0.70	0.89	0.64	0.77	0.98	0.66	0.79	1				
10. R&D Intensity$_{(t)}$	0.15	0.19	0.22	0.18	0.19	0.20	0.20	0.21	0.23	1			
11. Advertising Intensity$_{(t)}$	0.11	0.12	0.15	0.12	0.12	0.13	0.12	0.12	0.13	0.06	1		
12. Size$_{(t)}$	0.30	0.13	0.14	0.12	0.12	0.12	0.13	0.13	0.14	0.10	0.9	1	
13. Age$_{(t)}$	0.29	0.14	0.15	0.13	0.13	0.13	0.12	0.13	0.13	0.09	0.23	0.17	1
Number of observations	13315	11510	12845	11510	9673	7949	11510	9673	7949	13310	7539	15640	13629
Mean	10.12	0.04	0.25	0.02	0.02	0.02	0.27	0.27	0.27	0.57	1.26	285.46	27.58
Standard error	6.69	0.19	1.51	0.15	0.15	0.15	1.78	1.78	1.77	2.03	2.96	834.75	21.16
Minimum	0	0	0	0	0	0	0	0	0	0	0	1	0
Maximum	22.44	1	16.27	1	1	1	17.23	16.32	16.32	98.92	45.9	15003	172

Note that industry and year dummies are included in our analysis , but are not presented in the correlation matrix

Therefore we proceed one step further and match the companies who out-license abroad (threated) with the companies of the similar characteristics who do not license out their technologies outside their home market (untreated). We use matching in order to test if the insights from the Figure 4.1 hold, if we compare the international product commercialization of out-licensing and non-out-licensing ventures that are matched by some predominant firm features (like proposed by Rosenbaum and Rubin (1983)). Mahalanobis distance matching has been applied to match companies that out-license and companies that do not out-license, and how this treatment (licensing or not) reflects on the product sales abroad. We considered the following control characteristic of the firms that have been already described above: *R&D Intensity*$_{(t)}$*, Advertising Intensity*$_{(t)}$*, Size*$_{(t)}$ and *Age*$_{(t).}$ Matchnig has been similarly applied also in other studies in the context of capturing the treatment effects of licensing (Leone & Reichstein 2012). We have included the year and the industry dummies for a more reliable matching (Czarnitzki & Thorwarth 2012). As a result we find again that firms that out-license abraod attain higher volumes of product commercialization internationally. Our matching results show that organizations that are out-licensing abroad (treated) achieve an average volume of product sales internationaly of around 15.79 (represented in as a transformed natural logarithm of the product commercialization abroad volume in Euro), while the matched companies that do not out-license (untreated) achieve much lower amount of around 10.49 (again given as the natural logarithm of the product commercialization abroad volume in Euro). However to test the significance of the relation we apply the Dynamic Panel Data modeling explained in the following section.

4.4. Statistical approach

To explore our research questions if the learning from international out-licensing occurs ("If the technology out-licensing in foreign market has a positive impact on international product sales?") and in what time lag does this learning demonstrate its effect ("If there is an exact time lagged effect between the moment firms out-licenses abroad and international product sales improve?"), we employ the panel nature of our dataset. In this section we will explain the exact statistical procedure applied. The dependent variable examined presents the natural logarithm of international product commercialization amounts in the current time moment (*Product Commercialization Abroad Volume*$_{(t)}$). This variable manifests a high value of heterogeneity between different organizations, since the sales abroad are also influenced by other variables aside from technology out-licensing activities. However, we have carefully chosen our control valuables for the regression, in order to isolate more efficiently the effect of learning by out-licensing on product sales internationally.

Another important choice in making our analysis meaningful is the selection of suitable estimation procedure. We use the Dynamic Panel Data approach and the system GMM estimation presented by Roodman (2009). We justify our choice of this type of statistical estimation because of multiple reasons. First, our dataset is characterized with the "small *T*, large *N*", meaning that we have a short year frame of observations and a large number of entities followed (in our case $T = 11$ and $N = 2.486$). Second, a linear functional relationship is assumed in our models. Third, we have a dependent variable that is dynamic, meaning that it highly depends on its past realizations. In our case, the dependent variable depicts the product commercialization abroad in the current year, which is a "sales type" variable and dependent with its previous realizations (Salomon & Shaver 2005; Bobillo et al. 2006; Arellano & Bond 1991). Fourth, the variables from the model are not strictly exogenous, and could be in correlation with past or current realization of the error. Fifth, our data surely has some fixed individual effects, and heteroscedasticity and autocorrelation only within the individuals.

In the next section we will discuss the results from the system GMM estimation of the four different models. In all the models the dependent variable is *Product Commercialization Abroad Volume*$_{(t)}$, and the right side of the equation contains the lagged value of the dependent variable, in our case it is *Product Commercialization Abroad Volume*$_{(t-1)}$. All the above mentioned control variables are included in all four models, along with the two dummy variables (one marking the industry of the firms and the other marking the currently observed year). Below we are illustrating models, considering that the dependent variables change in Model 1, 2, 3 and 4.

- **Model 1** uses the *Out-Licensing Abroad in any previous year*$_{(t)}$ as the independent variable:

$$PCAV_{(i,\,t)} = \alpha + \beta_1 * PCAV_{(i,t-1)} + \beta_2 * OLAapy_{(i,\,t)} + \gamma_1 * RnDI_{(i,\,t)} + \gamma_2 * AdvI_{(i,\,t)} + \gamma_3 * Size_{(i,\,t)} + \gamma_4 * Age_{(i,\,t)} + \eta_{(i)} + \varepsilon_{(i,\,t)}$$

- **Model 2** uses the *Out-Licensing Abroad Volume Average in all previous years*$_{(t)}$ as the independent variable:

$$PCAV_{(i,\,t)} = \alpha + \beta_1 * PCAV_{(i,t-1)} + \beta_2 * OLAVapy_{(i,\,t)} + \gamma_1 * RnDI_{(i,\,t)} + \gamma_2 * AdvI_{(i,\,t)} + \gamma_3 * Size_{(i,\,t)} + \gamma_4 * Age_{(i,\,t)} + \eta_{(i)} + \varepsilon_{(i,\,t)}$$

- **Model 3** uses the *Out-Licensing Abroad*$_{(t-1)}$, *Out-Licensing Abroad*$_{(t-2)}$ and *Out-Licensing Abroad*$_{(t-3)}$ as independent variables:

$$PCAV_{(i,\,t)} = \alpha + \beta_1 * PCAV_{(i,t-1)} + \beta_2 * OLA_{(i,\,t-1)} + \beta_3 * OLA_{(i,\,t-2)} + \beta_4 * OLA_{(i,\,t-3)} + \gamma_1 * RnDI_{(i,\,t)} + \gamma_2 * AdvI_{(i,\,t)} + \\ + \gamma_3 * Size_{(i,\,t)} + \gamma_4 * Age_{(i,\,t)} + \eta_{(i)} + \varepsilon_{(i,\,t)}$$

- **Model 4** uses the *Out-Licensing Abroad Volume*$_{(t-1)}$, *Out-Licensing Abroad Volume*$_{(t-2)}$ and *Out-Licensing Abroad Volume*$_{(t-3)}$ as independent variables:

$$PCAV_{(i,\,t)} = \alpha + \beta_1 * PCAV_{(i,t-1)} + \beta_2 * OLAV_{(i,\,t-1)} + \beta_3 * OLAV_{(i,\,t-2)} + \beta_4 * OLAV_{(i,\,t-3)} + \gamma_1 * RnDI_{(i,\,t)} + \\ + \gamma_2 * AdvI_{(i,\,t)} + \gamma_3 * Size_{(i,\,t)} + \gamma_4 * Age_{(i,\,t)} + \eta_{(i)} + \varepsilon_{(i,\,t)}$$

Where the subscripts *i* and *t* refer to firm and time (yearly) respectively; α presents the constant term; β_1, β_2 and β_3 are the regression coefficients of the corresponding independent variables; γ_1, γ_2, γ_3 and γ_4 are the

regression coefficients of the corresponding control variables; $\eta_{(i)}$ presents an unobserved individual specific effect; and $\varepsilon_{(i,\,t)}$ is the error term of the *i*-th cross-sectional unit. The dependent, independent and control variables have already been described before.

In regards of the choice of instrumental variables, we include all the regressors in the instrument matrix, as suggested by Roodman (2009). We assume that all the regressors, except firm age variable, and industry and year dummies, are endogenous and use their lags from 2 to 5 as instruments. Only for the lag value of dependent variable, used as the GMM-style instrument, we consider the lags 2 to 6[6]. The GMM-style instruments were used both in the differenced and level equations. We have not applied the collapse function, since we have already solved the issues around overindetification by limiting the number of lags used as instruments. Variables that mark firm's age, industry and year dummies, were assumed to be endogenous, and for this reason treated as the IV-style in their unchanged state. Finally, our model is using the one-step estimation, which is asymptotically more efficient, as the two-step can be severely biased (Arellano & Bond 1991). Finally, the finite-sample correction given by Windmeijer (2005) is being used in our models, making standard error estimates consistent in the presence of any pattern of heteroscedasticity and autocorrelation within panels.

4.5. Results

Table 4.3 reports the results from the Dynamic Panel Data regression, applying the system-GMM estimation. The results from all the models (Model 1, Model 2, Model 3 and Model 3) are given. For all the models the same dependent and control variables were included, only the independent variables change. Moreover, all the specifications include the industry and year dummy variables, but are not presented in our table, since they are not the focus of our study. We present the Hansen test p-values, which we rely upon to test the over-identifying restrictions--of whether the instruments, as a group, appear exogenous (Roodman 2009a). As Roodman (2009b) proposes, we consider the Hansen test p-values higher than 0.25 as acceptable. We also report the test for residual serial autocorrelation. First-order autocorrelation is expected in the first-difference, but it is important not to have the second-order autocorrelation if we chose the instruments from the second lag of the observed variable. This is relevant because autocorrelation indicates if the lags of the dependent variable are being endogenous, making them

[6] We have tried different choices of lag lengths, but by considering the overidentification problems and the results from the Hansen test we have chosen the optimal count of regressor lags to be used in the instrument matrix (Roodman 2009a). Only the results coming from the optimal choice of lags is presented in this paper.

improper instruments (but also of any other not strictly exogenous variable used in instrument matrix). If there is no second-order autocorrelation, we can consider the lag 2 of the variables as instruments.

Table 4.3. Results from the System GMM regression

Dependent Variable: Product Commercialization Abroad$_{(t)}$	**Model 1** (out-licensed in any previous years)	**Model 2** (value of average out-licensing volume in all previous years)	**Model 3** (out-licensed in lag 1, 2 and 3 years)	**Model 4** (value of out-licensing volume in lag 1, 2 and 3 years)
Out-Licensing Abroad in any of previous years$_{(t)}$ (*binary variable*)	0.805 (1.51)			
Out-Licensing Abroad Volume Average of all previous years$_{(t)}$ (*continuous variable*)		0.147 (0.97)		
Out-Licensing Abroad$_{(t-1)}$ (*binary variable*)			4.689** (2.08)	
Out-Licensing Abroad$_{(t-2)}$ (*binary variable*)			-2.235 (-1.49)	
Out-Licensing Abroad$_{(t-3)}$ (*binary variable*)			0.702 (0.55)	
Out-Licensing Abroad Volume$_{(t-1)}$ (*continuous variable*)				0.338* (1.94)
Out-Licensing Abroad Volume$_{(t-2)}$ (*continuous variable*)				-0.149 (-1.64)
Out-Licensing Abroad Volume$_{(t-3)}$ (*continuous variable*)				0.060 (0.64)
R&D Intensity$_{(t)}$	0.156** (2.55)	0.120** (2.19)	0.153* (1.96)	0.162 (2.14)
Advertising Intensity$_{(t)}$	-0.171 (-0.64)	-0.081 (-0.26)	-0.420 (-1.08)	-0.334 (-0.89)
Size$_{(t)}$	0.000 (0.55)	0.000 (0.12)	0.000 (-0.01)	0.000 (0.08)
Age$_{(t)}$	0.016* (1.66)	0.013 (1.24)	0.020 (1.63)	0.017 (1.40)
Constant	Dropped due collinearity	Dropped due collinearity	2.147** (2.03)	2.022* (1.92)
Product Commercialization Abroad$_{(t-1)}$ (*lagged dependent variable*)	0.791*** (11.94)	0.800*** (12.27)	0.788*** (10.61)	0.796*** (10.99)
N	4796	4796	3432	3432
Number of instruments	95	95	93	93
Number of groups	1914	1914	1060	1060
Average number of observations per group	2.51	2.51	3.24	3.24
Hansen test (*p*-value)	0.541	0.392	0.478	0.332
First-order autocorrelation (*p*-value)	0.000	0.000	0.000	0.000
Second-order autocorrelation (*p*-value)	0.904	0.931	0. 857	0.842
Year effects (Year dummies)	Included	Included	Included	Included
Industry effects (Industry dummies)	Included	Included	Included	Included

t-values in parenthesis below coefficient estimates.

*** *p*-value < 0.01, ** *p*-value < 0.05, * *p*-value < 0.1

In Model 1, we model the relation between firm's international product sales volume and the binary variable marked 1 if the company has out-licensed abroad in any of the previous years (excluding the current year). We model this relation to see if there is significant influence of out-licensing abroad in any of the previous time lags, on the volume of product commercialization internationally. Similarly, in Model 2, we examine the same relation, but instead of just viewing if the company out-licensed abroad in any previous years, we resolve the influence of the average magnitude of all the yearly out-licensing amounts (naturally logged) in the previous years (excluding the current year). We apply Model 1 to understand if any previous out-licensing affects the current product sales, and Model 2 to understand if the magnitude of average previous out-licensing volume impacts the current product sales abroad. In both models we attain good results of the Hansen test (p-value for Model 1 of around 0.541 and of Model 2 of around 0.392). The serial first-order autocorrelation is present but diminishes in the second-order for both models (second-order autocorrelation p-value for Model 1 of around 0.904 and for Model 2 of around 0.931). In both models the xtabond2 realization of our estimation drops the constant term due to collinearity, which does not have any significant indications for our research interest. Although the above tests propose the valid specification of our model, we do not find any significant influence (though positive coefficients stand in front of independent variables: 0.805 for the Model 1 and 0.147 for the Model 2) of either out-licensing in any of the previous years or average out-licensing in the previous years in our models.

In Model 3, we aim to analyze if the learning effect appears when the company licenses out abroad in the lag 1, lag 2 or lag 3 year. The dependent variables are binary and take value 1 if the company out-licenses outside its home market in the lagged year, otherwise they take value 0. In this manner, we can view if there is an actual time effect relation between the moment when firms licensed-out and the moment when organizational learning reflects on the amount of product commercialization internationally. Similarly, the Model 4 concentrates on the effect of the amount of the out-licensing that firm achieved in the lag 1, lag 2 or lag 3 year. This model enables us to detect how the magnitude of out-licensing abroad in the lagged years is manifested on the firm's product commercialization internationally. In the previous studies on the organizational learning in the international context different models that include the binary or continuous depictions of the similar explanatory variables were similarly employed (Salomon & Shaver 2005; Salomon & Jin 2010). Again, both Model 3 and Model 4 are here well specified with the fitting choice of the instrumental variables (Hansen test p-value of 0.478 for the Model 3 and 0.332 for the Model 4). Further, the serial autocorrelations of first-order is again present in both models, but in the second-order it perishes as indicated by the second-order autocorrelation p-values of 0.857 in the Model 3 and of 0.842 in Model 4. Interestingly, we find significant and positive influence of the international out-licensing only in the previous year, on the product sales magnitude in the current year. This result stands for both the variable indicating if the firm licensed or not (significant at $p < 0.05$, t value

of 2.08; coefficient positive and equals 4.689) and the variable that seizes the total value of the out-licensing by the firm (significant at $p < 0.10$, t value of 1.94; coefficient positive and equals 0.338). This is an intriguing finding that suggests that firms should also carefully consider the time dimension in managing their strategic learning by out-licensing.

4.6. Discussion and conclusion

Although the previous research demonstrates that out-licensing internationally facilitates organizational learning, there are no studies that explore the direct effect of this learning on the venture's product commercialization internationally, as one of the most important factors driving companies overall success (Morschett et al. 2010; Tang & Yu 1990; Pan & Tse 2000). We say that this learning mechanism is actually enabled as licensors may observe how their technologies are embodied in different products and which of these products deliver higher market sales. Out-licensing enables this specific type of vicarious learning, learning by observing and imitating (Argote 2011; Argote & Miron-Spektor 2011; Huber 1991), as the out-licensing process contains a strong control phase that comes after the technology transfer. During this phase licensor closely monitors the performance of the applications of its technologies, and learns how to improve its own products that will consequently achieve higher commercialization success abroad. For this reason, in this paper we want to draw the research attention on two questions: "Do companies learn through international out-licensing to improve their product sales abroad?" and "Is there a particular time lagged influence of this learning?". In the empirical analysis the Dynamic Panel Data modeling is applied on the sample of the firms from the Spanish manufacturing sectors.

We found several evidences indicating that companies do learn from out-licensing abroad and that this learning is reflected in the higher magnitude of companies' international product sales. Initially, we have simply compared the average volume of the international product sales between firms who out-license in any of the previous years and firms who do not. The results presented in the Figure 1 suggest that out-licensors are continuously (throughout all the years) are more successful in commercializing their products abroad. We interpret these results as the effect of organizational learning caused by international out-licensing. However, by taking the average amount of product sales abroad for all the companies we might draw misleading and not generalizable results, especially if the out-licensing companies in our sample are not comparably similar with the non-licensing companies.

So, we proceeded one step further to understand if this learning effect and product sales increase also stand when we compare out-licensing and non out-licensing firms of similar characteristics. For this purpose for each firm in the sample that out-licenses abroad we have found the "nearest neighbor" in the

control sample (the sample of firms that do not out-license abroad) by considering the closeness in accordance to the control variables described above and by applying the Mahalanobis distance matching. After matching these companies, we have again found the convincing difference of the naturally logged volume of product sales outside the home market of licensors (average volume of 15.79) in comparison with non- licensors (average volume of 10.49). This finding again proves our assumption that companies learn by out-licensing abroad.

Further on, we exploit the panel nature of our sample and model the relation between product commercialization amounts abroad with the organization's engagement in technology out-licensing. The modeling employs the system-GMM estimation that pinpoints on a significant and positive impact of out-licensing abroad in the year one lag, but not in the lag two or lag three year. Up to three years lag was chosen because of the limitation of our data sample (11 years of observation in total), the average number of observations per group in the model (which was around 3) and the insights from the previous studies exploring the organizational learning (Salomon & Shaver 2005; Salomon & Jin 2010). This presents an interesting finding that can be explained in more ways. First, through out-licensing companies commend their technologies to other firms and in a sense hand over a part of their competitive advantage (Kline 2003b; Arora et al. 2013; Arora & Fosfuri 2003a). So, firms must use this gained knowledge rapidly, before licensees take over the technology advantage. The tacit nature of the knowledge might give the licensor this short term advantage before the licensees employ this knowledge adequately (Nonaka & von Krogh 2009). Second, the lifecycle of product is becoming shorter, which is especially noticeable in the manufacturing sector (Tushman & Anderson 1986), making the knowledge about proper application of technologies in products obsolete fast. In other words, the knowledge that company attains about the optimal products, which stem from its technologies, needs to be implemented and marketed in a time efficient manner. Third, the out-licensing contracts vary in their duration. The initial period after the knowledge transfer, the control phase of the licensing process (Chiaroni et al. 2010; Sikimic et al. 2013), is characterized with the closer monitoring of the licensee and licensees' use of the licensed technologies. For this reason, it may be assumed that organization's learning from licensees is the strongest in the short term and has the most significant influence on product sales outside the home market right after out-licensing took place.

The theoretical implications of our study suggest that out-licensing may be viewed through the organizational learning perspective. This perspective enables researchers to discuss and explore other benefits of strategic out-licensing. Moreover, the findings presented stress the importance of inspecting the time lagged relation of out-licensing activities to other processes inside the firm. Some managerial conclusions might also be withdrawn from our results. For example, firms need to be aware of all the potential benefits endowed by out-licensing abroad and to align their product development strategy with

licensing strategy (Kim 2009; Bianchi et al. 2013; Bianchi et al. 2011; Lin 2011; Lichtenthaler 2011). Since the learning effect from out-licensing is maximized in the short time lag window, companies should constantly monitor and invest in this activity, but also efficiently manage the knowledge that was intaken.

This study also has several limitations. Our dataset does not provide us with enough information so we could also control for the length of the licensing-deal, and explore how it relates to the learning outcomes. Moreover, the nature of the technologies out-licensed was not considered here. The peculiarity of technologies out-licensed may effect differently on the configuration of benefits coming from out-licensing. Then, our focus was on the manufacturing sector and it would be interesting to break down this sector and to test if the time lagged effect of learning from out-licensing varies along industries. Finally, as we suggest that the learning effect originates from observing the most successful implementations of the licensed technologies in the products, we do not know if the product sales increase is more driven by the incremental changes of the already available products or delivering of the new ones to the market. In any sense, this study opens up new venues for out-licensing research and should contribute to the better understanding and management of it.

4.7. Summary of the Chapter

The research article reported in this Chapter shows that out-licensing abroad empowers the organizational learning that is reflected in the higher product sales internationally. Learning effect is accomplished as a result of a specific configuration of technology out-licensing itself, which enables licensors to monitor the technologies that it out-licensed globally. This setting permits the vicarious type of organizational learning to be achieved by the licensor company, or learning by observing and imitating the licensees that apply these technologies in their own products. In this way, licensor firms become capable to identify and clearly distinguish the optimal product resulting from the product development implementing its out-licensed technologies by licensee organizations. Interestingly, we have found that the window of time lag between out-licensing and the demonstrated learning effect is also relevant. Our study shows the particular importance of the international technology out-licensing in really recent time lag.

The theoretical implications of our study suggest that technology out-licensing may be viewed through the organizational learning perspective that could be combined with other theories (like Dynamic Capability Framework, Transaction Cost Theory or Resource Based View), by making an intersection of different theories in relation to out-licensing. Further theories can try to explain more in-depth the time lagged effect of out-licensing activities to other processes inside the firm. Regarding the propositions for managers, this paper points out that enterprises should be aware of all the potential benefits endowed by out-licensing abroad and the need to carefully align their product development and licensing strategies.

Moreover, firms need to find ways to maximize the learning effect of technology out-licensing abroad in the short time window, meaning that they are suggested to constantly monitor, manage and invest in this activity.

These findings are relevant in the context of the framework of this thesis, and add on the bulk of research that deals with the strategic outcomes resulting from international technology out-licensing. Findings presented here help theoreticians and practitioners to understand more fully the nature and mechanism of strategic outcomes form technology out-licensing abroad.

CHAPTER 5:

Conclusions and Implications

The purpose of this Chapter is to summarize the overall research results developed and reported in the doctoral dissertation. Here the main implications for the research and practitioner community will be presented, some limitations of the study will be indicated, and the possible directions for future research will be proposed.

5.1. Rationale of the work and research approach

This research was motivated by the increasing growth of international technology out-licensing demonstrated in previous studies (Aulakh et al. 2010; Marshall et al. 2007; Jiang et al. 2008). Growth recognized has directly been reflected on the spread and importance increase of the market for technology (Arora et al. 2002; Arora et al. 2013). Firms ranging from small, "serial innovators" (Hicks & Hegde 2005) to large and established corporation, such as such as Texas Instruments, Dow Chemical, Hitachi, Kodak, Eli Lilly, Procter & Gamble or IBM (Arora & Fosfuri 2003a; Fosfuri 2006; Arora et al. 2013), are both draining multiple benefits by engagement in over-border technology out-licensing.

Although the growth is evident, out-licensing technologies abroad is a particularly complex business activity (Mottner & Johnson 2000). This complexnes is caused both by the specific nature of technoologies as the good traded (Teece 1986), but also by the high-risk features of international business itself (Mottner & Johnson 2000). In this light, there appear large discreppancies between some firms that practice technology out-licensing abroad with a positive outcome and the others that do not do so (Razgaitis 2004). In order to reduce these discreppancies and explian closer the international technology out-licensing as a relevant business activity of the modern firm, in this PhD dissertation we have built the holistic view of technology out-licensing internationally. Primarely, we aimed to do so by jointly integrating the two relevant research streams from technology management reseach and international business research. By doing so, a more comprehensive and structured research framework of the technology out-liensing abroad phenomenon was created. This framework allowed us to precisely target the most importatnt research questions that were identified in both of the literature streams.

We present the rational behind our research framework by posing that in order to fully understand and disatengle the management of international technology out-licensing, we need to study the main elements covering this activity. These elements should be cautiously managed by the practicing firm, and

they range from the international out-licensing antecedent (*antecedent construct*), over the international out-licensing process (*process construct*) and towards the desired outcomes of technology out-licensing internationally (*outcome construct*). For the purpose of structurally studying the theoretical framework, we have organized it through the series of three propositions:

Proposition 1: Technology out-licensing internationally is influenced by technology in-licensing from abroad as its antecedent.

Proposition 2: International technology out-licensing management can adopt a process based view.

Proposition 3: International technology out-licensing inhibits organizational learning as its strategic outcome.

Our research project attempted to empirically asses the propositions listed above. So, the empirical analysis was articulated into three research articles that are separately focusing on a certain part of the overall framework of this research. The propositions were approached by raising the specific research questions in relation to them. All three studies are integrated throughout this dissertation to form a logical and unified flow of relevant results, leading from one research point of interest to another. In order to ensure the continuity of the thesis, the short explanations and summaries were given before and after each of the chapters. They were predominantly used to link the chapters together in a consistent collection of papers on the topic of international technology out-licensing.

Chapter 2 contains the research paper with a title "Antecedent of International Technology Out-Licensing Volume: Does Technology In-Licensing from Abroad Help?". This research work analyzes the volume of technology in-licensing from abroad as an antecedent of international technology out-licensing volume. Here we empirically assess the Proposition 1, and test it on a panel data sample from the Spanish manufacturing industry. We have answered the following research questions:

RQ.1.a: "How does the volume of technology in-licensing from abroad affect the volume of international out-licensing?"

RQ.1.b: "Does internal R&D intensity moderate the relation between international in-licensing and out-licensing volume magnitude?"

In Chapter 3 we have presented an article titled "Managing International Technology Out-Licensing: A Process Based View and Dynamic Capabilities Development". Here we apply the process based view perspective for the purpose of studying management of international technology out-licensing. The study

presented in this Chapter shows that along the management of the international out-licensing process firm's Dynamic Capabilities are developed. Methodologically we approach this study through a multiple case study of the leading Italian pharmaceutical and chemical companies. So, this study tackles with the Propositions 2, and answers to the following research questions:

RQ.2.a: "What are the stages of international out-licensing process?"

RQ.2.b: "Do companies develop Dynamic Capabilities by out-licensing abroad?"

Finally in the Chapter 4, the study titled "Learning through Technology Out-Licensing Internationally: Organizational Learning and Influence on the Product Commercialization" is reported. It focuses on the specifically important and valuable strategic outcomes that may be achieved by technology out-licensing worldwide. Our study observes how international technology out-licensing affects product commercialization success abroad. In terms of methodology, we use panel data set of firm-level observations in the Spanish manufacturing sectors. Importantly, this is the study that directly links the performance of the company (product sales abroad) and the phenomenon of interest (technology out-licensing abroad). Therefore, this paper empirically assesses the Proposition 3 and proposes answers to the following research questions:

RQ.3.a: "Do companies learn through international out-licensing to improve their product sales abroad?"

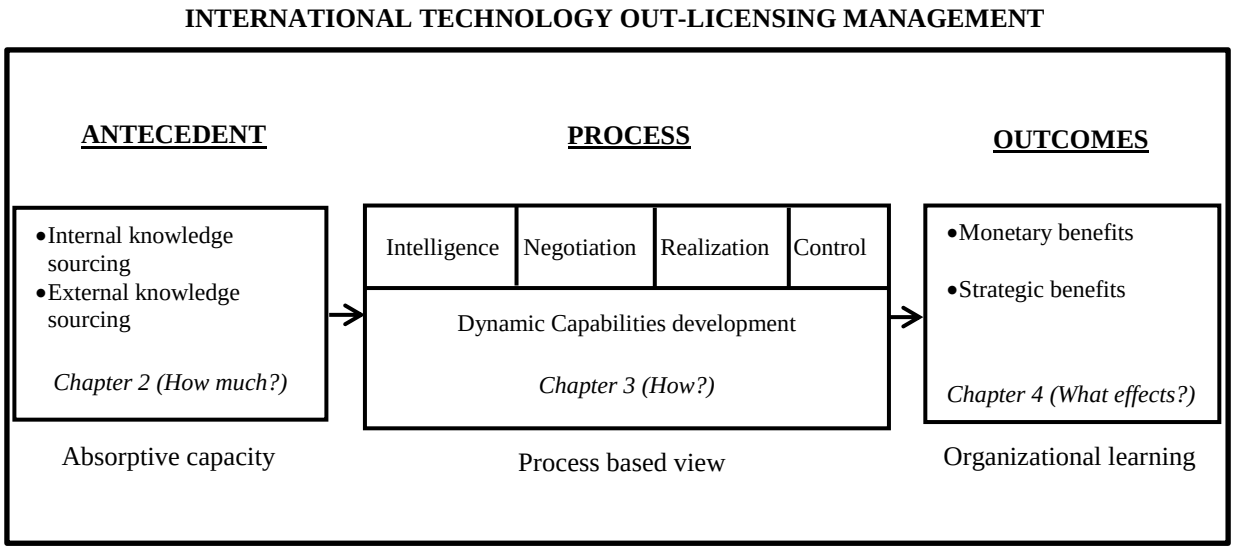
RQ.3.b: "Is there a particular time lagged influence of this learning?"

5.2. Emerging holistic view of international technology out-licensing

As the goal of this dissertation is to offer a holistic perspective of international technology out-licensing that will facilitate its adequate management by linking together the technology management and the international business research, we have developed a structured research framework. In Figure 5.1 we have summarized the schematic representation of the research framework, indicating the main aspects that have been discussed in the thesis. The dissertation follows a logical sequence of the points that are relevant to study in order to build a holistic view of international technology out-licensing. In Chapter 2 we look at the enablers of international technology out-licensing. When able to understand what drives the higher volume of technology out-licensing abroad, we proceed to an in-depth analysis and focus on the international technology out-licensing process itself (given in Chapter 3). The results of Chapter 3 provide our holistic view with an important link between the question on the international out-licensing antecedent

and strategic outcomes that come after the conclusion of the out-licensing deal. So, in Chapter 4 we shift our focus on the output of this process, seen through the benefits it enables to the practicing firms.

Figure 5.1. Schematic representation of research framework



It is important to recall here that the study articles presented in each of the chapters are applying different methodologies and theoretical perspectives, which were recognized as the most fitting from the previous technology management and international business research. Therefore the reader should take into account the different stages of development of this research project through the three given studies.

In summary, the research findings combined in the thesis advance the holistic understanding of the technology out-licensing phenomenon in general. This comprehensive view initiates by studying the **international technology out-licensing antecedent** that leads towards more international technology out-licensing, viewed through the magnitude of volume of international out-licensing. The size of the out-licensing volume abroad is triggered by the overall amount of in-licensing from foreign markets. This relation is moderated by the firm-level absorptive capacity (captured through the intensity of internal R&D investment), defined as ability to acquire, assimilate, transform and exploit the external knowledge (Zahra & George 2002). Further, we propose analyzing the process behind the over-border technology out-licensing (**international technology out-licensing process**), along all the process stages and by marking the relevant managerial questions. By adopting the process perspective we were able to recognize the Dynamic Capabilities that were developed along this process. In the end, after the process management we explore the strategic outcomes (**international technology out-licensing strategic**

outcomes). We approach to the outcome analysis by looking at the organizational learning taking place when firms out-license their technologies, and their effect on the product sales commercialization abroad.

This study expands several perspectives of international technology out-licensing research by combining technology management and international business literature. By having this unified approach, we strengthen the explanatory power of both the international out-licensing and this dissertation. As previous works were limited on either technology management, like in Madeuf (1984) or Reddy & Zhao (1990), or international business perspective, like in Contractor (1984) or in Morschett et al. (2010a), we expand our knowledge on the phenomenon by tackling both streams together. Our research empirically demonstrates that important concepts from both literature streams could be combined together for the purpose of building a solid understanding of international technology out-licensing as a whole. These concepts are: absorptive capacity and Dynamic Capability (given in Chapter 2 and 3) with a technology management emphasis; and organizational learning (discussed in Chapter 4) with a more international business research background.

All of the concepts described above are used to explore one particular segment of the holistic international technology out-licensing framework. We deal with **international technology out-licensing antecedent**, by studying the effect of in-licensing from abroad (external sourcing of knowledge) on the out-licensing internationally (external exploitation of knowledge). The volume of in-licensing and the effect it has on the volume of out-licensing were questioned in Chapter 3. Absorptive capacity as concept from both technology management literature and international business literature (Cohen & Levinthal 1990; Zahra & George 2002; Brown et al. 2003) was applied to explain the acquiring, assimilating, transforming and exploiting of the external knowledge. In the framework of the doctoral dissertation, we rely on it to put together an understanding how the in-licensed technologies from foreign markets enlarge the volume of over-border technology out-licensing. So, in this part of the research we focus on the "how much" question. Management of the **international out-licensing process** itself (from planning, over transfer to control) is discussed in the Chapter 3. Along this structured process for management of the international technology out-licensing activities the Dynamic Capabilities are developed within the organization. The final focus is on the results and outcomes for the licensor firm after the international out-licensing process closure. Here we put our interest point on the post-licensing benefits and present it in Chapter 4. We show that there is an organizational learning benefit reflected on the improvement of product commercialization abroad and triggered by international out-licensing. We mark this specific organizational learning effect as the concept of **international technology out-licensing strategic outcomes**. Technology markets are characterized with many lacks, like the problems with its inefficiencies or limited transparency that is mostly caused by the intangible nature of the good traded (Arora et al. 2013), so the high quality and innovative technologies owned by the companies do not

straightforward guarantee their full exploitation or maximum profit extraction in these markets. For this reason, this dissertation has been written in order to enable academics and managers to fully explore and comprehend the international technology out-licensing as an evidently present and relevant phenomenon.

Our theory advances all three of the concepts as it wraps them up in a new joint approach of an already studied topic, but in comparison with previous studies here we merge together the technology management and international business perspectives. In Chapter 2 we suggest several issues relevant for the antecedent of international technology out-licensing volume:

- The external technology sourcing and external technology exploiting should be strategically managed jointly.
- The volume of external technologies firms import from companies abroad by technology in-licensing (as an input) affects the volume of international technology out-licensing (as an output).
- The level of absorptive capacity companies develop and nourish through their intensive investment in internal R&D has a moderating effect on the relation between international out-licensing volume and in-licensing from abroad volume.
- The internal R&D should not be neglected even when firms heavily rely on the external sourcing of knowledge.

In regards to the implementation itself of technology out-licensing in a global market, the critical aspects of its management where presented in Chapter 3:

- The process based view of international technology out-licensing is fitting for the management of its implementation.
- Each phase has its distinctive role in the development of Dynamic Capabilities of the firm along the process.
- This process consists of well-defined sequences of activities that drive the post-licensing outcomes.

The essential abstract nature of technology out-licensing may be viewed as an enabler for other entities (licensee firms) to apply the technologies from licensor firms in their own product development and commercialization. This setting allows licensor companies to learn about potential application of their technologies in the products and about the market success of these products. So, we looked at the organizational learning outcomes from international technology out-licensing and concluded that (Chapter 4):

- By out-licensing abroad and offering their technologies to companies in foreign countries licensors are enabled to strategically benefit from it.

- The organizational learning takes place because out-licensing firms observe and imitate how their technologies are shaped in products internationally and which of those products achieve superior performance in the market. This results in positive influence on product commercialization abroad.
- Strategic out-licensing abroad for the purpose of organizational learning should be effectively and constantly followed, as its effect is maximized in the short time lag window.

In conclusion, our theory posits that by linking and intervening technology management research and international business research, technology out-licensing abroad receives a more comprehensive understanding and in that sense more advanced insights for its proper management. The framework we proposed for structuring the relevant elements of the holistic view of international out-licensing, going from antecedent of its volume, process itself and strategic outcomes that result from it, presents a good foundation for analysis and should be further developed.

5.3. Limitations and future research

The research framework presented in this PhD dissertation presents a basic foundation that might be used for further structuring of the related research dealing with the international technology out-licensing management. All the elements in the framework could be further extended and some other theoretical perspectives might also be implemented within it, such as the real options approach that has already found its application in terms of international licensing studies (Ziedonis 2007; Jiang et al. 2008). Each of the elements can be subdivide in more in-depth segments. For example, aside from the licensing antecedent of the international out-licensing volume, the antecedent of the number and characteristics of the countries where firms out-license could be looked into, but also the peculiarities of the technologies that are out-licensed. This approach would certainly reinforce the whole framework.

Although the studies from Chapters and 4 perform statistical analysis on the whole manufacturing sector, in Chapter 4 the international out-licensing process is explored only in the chemical and pharmaceutical companies. Chemical and pharmaceutical industries have already demonstrated in previous study the extensive use of out-licensing (Arora et al. 2002; Arora & Fosfuri 2000) and in that sense the finding resulting from these industries might not be fully representative. The focus on more and broader industry segment should be considered in the future.

Each of the chapters is concentrated on the firm level evidence only from one country (Spain in Chapter 2 and 4 and Italy in Chapter 3). On one side, both Spain and Italy are the members of the

European Patent Office (EPO)[7]. EPO was established as a result of the European Patent Convention (EPC) of Munich in October 1973, and in the year 2007 it already governed the patent applications and grants in 33 European countries[8]. The companies from the countries that are members of EPO have aligned national patent laws with prevailing European laws, so it might be assumed that the innovation and technology related trade has a good deal of similarities. In that sense, both the focus on Spanish and Italian firms offers to us a broad generalizability. On the other side, as the strategic choice decisions differ among countries (Song et al. 2002) and as the out-licensing abroad of the firms in our sample is limited on the European companies, in order to extend and achieve higher generalizability of our results, companies from other countries operating in the international market for technologies should be similarly examined.

It would be interesting to have a multi-country analysis of the international out-licensing of firms. Moreover, a comparison of technologically advanced and technologically undeveloped countries and the effect of international out-licensing could be examined. International out-licensing activities and outcomes from both the developed and underdeveloped markets or companies could be compared, like it was similarly done in the Salomon & Shaver (2005) study. The propagation of technologies along the international markets would be interesting to follow, as technology out-licensing enables the underdeveloped markets to learn and catch the pace of developed countries that out-license their knowledge (Arora et al. 2002).

Our analysis is predominantly focused on the technology related aspects of explored phenomenon, while the market related issues or certain policy related issues are not taken in consideration. As proposed in the review from Ortt & Duin (2008) studying innovation management requires a contextual approach by considering the type of innovation, type of organization, type of industry and the type of country/culture to be studied. In that sense, it would be useful to extend this research direction on certain policy related aspects of countries, like IPR and need for technologies, or some market specific insights, such as competitive intensity. However, the data we have available doesn't offer sufficient information to perform this analysis.

Finally, the configuration and the nature of the empirical data set that we have used in this dissertation have not allowed us to study the technology out-licensing on the licensing-deal-level like it was done in the recent works from Walter (2012) or Somaya et al. (2010), but on the firm-level. Further studies could look at different features and characteristics of technologies on the licensing-deal-level and by that expand the proposed framework. In general, our theoretical framework can be used as guidance for any further upgrade of the research on international technology out-licensing.

[7] Italy is the member of EPO since 1978 and Spain since1986 (EPO 2007).
[8] In the year 2012, when the case studies were collected for the Chapter 2, EPO already had 38 member states.

5.4. Implications for research

First, higher ability for explaining and understanding international technology licensing out is achieved when threating this phenomenon as an intersection of the technology management and international business research. Though certain concepts and theories overlap (e.g. transaction cost view), there are distinct contributions form one research stream that have only found minor reflection in the other research (e.g. organizational learning is more common for the international business research). So, when combining together perspectives, concepts and theories from both streams a more comprehensive aspect for studying technology out-licensing abroad is built.

Second, as proposed in previous works, out-licensing should not be treated as an isolated strategy in the firm. For its optimal management researchers should view it jointly with the new product development strategy (Frishammar et al. 2012; Bianchi et al. 2013), internationalization strategy (Bruneel et al. 2010; Barkema & Drogendijk 2007; Morschett et al. 2010) and innovation strategy (Berkhout et al. 2006). By doing so, its use in both the product and technology markets would be clearer and more structured for understanding.

In Chapter 2, a bidirectional relationship and importance of the relation between external technology exploration and exploitation was discussed. So, this dissertation contributes to the strategic technology management research that stresses the importance of association between different exploitation and exploration activities (Fang et al. 2009; Stettner & Lavie 2013; Bianchi et al. 2013; Hoang & Rothaermel 2010). This Chapter inputs the absorptive capacity idea in the research and extends on the absorptive capacity literature by looking at it as a valid moderator of this link.

Through Chapters 3 and 4 we have elaborated and validated the monetary and strategic enabling nature of technology licensing. In that sense, our findings add on the literature exploring potential returns on innovation investments (Laursen & Salter 2006; Chiaroni et al. 2010; Enkel et al. 2009; Ceccagnoli & Rothaermel 2008). In Chapter 3 we presented straightforward and structured process for managing international technology out-licensing that facilitates the maximization of these benefits by the enterprise, while in Chapter 4 we have grasped on the potential strategic outcomes from it.

Further on, the insights from Chapter 4 point out on the importance for researchers to inspect the time lagged relation of out-licensing activities on other processes inside the firm. If the strategic benefits are aimed to be captured, not only in the short-term but also in the long-term, the time lagged analysis is needed and could be used to explore various other potential outcomes of technology out-licensing abroad.

Finally, we believe that these considerations will help academics to recognize the importance and potential of international technology out-licensing. Some of the critical issues surrounding this business

activity have been raised in this PhD dissertation, which is a first step towards providing a solid and holistic overview of international technology out-licensing.

5.5. Implications for managers

The most relevant managerial implication that we want to put forward by this PhD dissertation is that practitioners and managers need to be educated in a manner so that the benefits from international technology out-licensing are clearly presented to them (Alexy et al. 2009). In many cases the potential strategic outcomes that could be positively extracted from innovations by out-licensing are totally ignored, solely because of the managerial incomprehension. So, aside from the complexities along the technology licensing activities itself, faster development of market for technologies might be decelerated and limited if the practitioners attenuate the importance and value contained in the over-border technology out-licensing only because of their negligence.

Collection of the studies in this PhD thesis continuously show that close fitting of all the technology related strategies leads towards optimal extraction of the innovation investment and firm's resources. In this sense, corporations need to repeatedly look into the ways to combine external and internal sources of knowledge and external and internal means for their exploitation. In particular, the contribution of our research is seen in the novel view of strategic fitting of firm's processes around the input of technologies in the firm, their transformation and development, and eventually the out-licensing of new technologies as an output. This view can be used as the managerial guidance for international technology out-licensing management.

The insights form the case studies in Chapter 3 have again showed that an active international licensing has become a strategy strongly exploited within the pharmaceutical and chemical sector. But the process and structured approach given in this Chapter is flexible and can be modified for the conditions in any other industry. We thus propose that managers can rely on the process model presented in Chapter 3, shape it and integrate in the manner that suits the best their application needs.

The results from the panel data analysis in Chapter 4 demonstrate the organizational learning benefits endowed by out-licensing abroad, which should be aligned to organization's product development strategy. Since the learning effect from out-licensing is maximized in the short time lag window, companies are advised to constantly monitor and invest in out-licensing abroad, and efficiently manage the knowledge that was intaken.

We also believe that this research project holds valuable implications for managers, especially in the current business environment where knowledge presents the leading competitive advantage. In fact, technology out-licensing has been repeatedly emphasized as a valuable strategy to achieve the higher profit, either financial or strategic, from company's technological assets. This dissertation provides a

number of managerial solutions (e.g. learning from out-licensing abroad or relying on external technologies to accomplish higher volume of out-licensing internationally) that suggest some proficient ways to carry out technology out-licensing activities internationally. Novel and important consequences at the macro-economic and societal level could be enabled through technology exchange in the global markets (e.g. development of underdeveloped countries by active out-licensing from more technologically advanced companies), all alluding on the importance for further studies and attention to be given to this topic.

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