The Relationship between Intellectual Property and Innovation: A Mexican SMEs Perspective

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Abstract

Market globalization and uncertainty that currently prevail in businesses brings as a consequence toughest requirements to organizations, especially to Small and Medium-Sized Enterprises (SMEs), in terms of their level of innovation. Hence organizations in order to survive and to remain in the market not only have to constantly create innovations in products, but also to implement legal measurements that allow these to protect intellectual property rights for innovations, this mainly because it will allow these to stimulate and enhance innovation activities. Therefore, in this research a sample of 125 manufacturing SMEs in the Aguascalientes state, México, was obtained in order to identify the relationships between intellectual property and innovation. The results obtained show that registration of patents, trademarks and image investment, as well as intellectual property have a positive and significant influence on innovation.

Keywords: Intellectual property, innovation, small and medium-sized enterprises

1. Introduction

The relevance of innovation for companies' growth and development, especially in Small and Medium-sized Enterprises (SMEs) is a current topic with a growing interest from researchers, academics, professionals and entrepreneurs from the sciences of administration. Also, there is an especial boom in the publication of articles in specialized literature (Qiu & Yu, 2010). However, since 1980 several countries had already implemented a series of legal measurements to protect intellectual property rights, with the essential objective of stimulating and strengthening organizations' innovation (Qiu & Yu, 2010). In this sense, the literature presents several theories that consider that Intellectual Property (IP) has a positive significant impact on innovation, because this protection encourages the adoption and implementation of innovation in companies, by generating high profits and reducing costs in activities of research and development, even when some theories state totally the opposite (Jaffe & Lerner, 2004; Bessen & Maskin, 2009). Therefore, the debate about the existing relationship between intellectual property and innovation activities have been orientated in demonstrating empirical evidence, unfortunately the current published evidences have been incomplete (Qiu & Yu, 2010).

Jaffe (1999) came to the conclusion that there is little empirical evidence demonstrating that intellectual property has significant positive effects on innovation activities, while Hall and Ziedonis (2001) came to the same conclusion when considering that there is little evidence on the effects that intellectual property has on companies on an environment of fast technological changes. At the same time, Sakakibara and Branstetter (2001) consider that the implemented reforms in Japan, by the end of 80's, have low response rate in terms of innovation activities increment in manufacturing companies. However, Evenson and Kanwar (2001) and Chen and Puttitanum (2005), in their corresponding researches, found sufficient empirical evidence that show a positive and significant relationship between intellectual property and innovation activities in companies. Similarly, Mansfield (1994) came to the conclusion in his research that various multinational companies in United States prefer to be located in countries offering more facilities for the innovation development and intellectual property protection, than on those that have more rigid laws on both intellectual property protection and innovation.

Similar effects were found in technology transfer in companies, because companies carried out more technology transfers when these were located in countries with less rigid laws (Branstetter *et al.*, 2006), as these found more attractive such type of countries for greater and direct foreign investment (Branstetter *et al.*, 2007). Similarly, based on a small sample and applying interviews on SMEs in India, Lanjouw (1998), Lanjouw and Cockburn (2000) concluded that protection of intellectual property existing in the majority of developing countries can be one of the most important causes inducing companies to implement its ideas through a greater number of innovations, than in developed countries. In addition, the legal reforms carried out in different developing countries to protect intellectual property can substantially increase innovation (Qiu & Yu, 2010). Thus, few published research in the literature analysing the relationship between intellectual property and innovation have been carried out in developed countries (Mondal & Gupta, 2006; Maskus, 2008; Crampes & Langinier, 2009; Qiu & Yu, 2010; Roy & Sivakumar, 2011), and only some studies have been applied in implemented in emerging countries (Lanjouw, 1998; Lanjouw & Cockburn, 2000; Cozzi, 2009). In this context, the main contribution of this empirical research is the analysis of intellectual property in SMEs in a developing country, such as México. Another contribution of this research is the methodology employed, since the structural equations are used to test the theoretical model of intellectual property. The rest of the work has been organized in the following order; in the second section the theoretical framework and previous empirical studies and the hypotheses are established; in the third section the research methodology, sampling and variables used are explained; in the fourth section the results obtained are presented. The last section presents conclusions and discussion.

2. Literature Review

In the current literature in the field of Economics and Management various authors, such as Gilbert and Shapiro (1990), Scotchmer and Green (1990), consider that the relationship between intellectual property and innovation activities is ambiguous. In addition, several researchers recognize that protection of intellectual property rights is a crucial element of market policy, which significantly affects the nature, and speed of innovation activities in the economy of any country (Lerner, 2009). Therefore, it should not surprise that deep changes that have developed systems for the protection of intellectual property rights at a global level during the last 25 years have increased attention to the existing relationship between intellectual property and innovation activities in companies (Lerner, 2009). In this sense, several empirical researches, published in the current literature, have been oriented in the analysis and discussion about the impact on intellectual property in innovation activities, such as the study case on patents in Japanese companies (Sakakibara & Branstetter, 2001), the establishment of the intellectual property rights of the companies in the appealing courts of the Federal circuits of the United States (Hall & Ziedonis, 2001), the decision of patents protection in the global fair of exhibitions (Moser, 2005), the analysis of consequences of policies changes in terms of patents in foreign and direct investment (Branstetter *et al.*, 2006), the analysis of changes at a global level to protect patents in the pharmaceutical industry (Qian, 2007), intellectual property protection in multinational companies in United States (Qiu & Yu, 2010) and intellectual property management in outsourcing globalization (Roy & Sivakumar, 2011).

Similarly, several researches in the literature about industrial management have also been focused on demonstrating the existing effects between policy reforms on patents protection and innovation (Lanjouw, 1998; Kortum & Lerner, 1998; Hall & Ziedonis, 2001; Sakakibara & Branstetter, 2001). In addition, some researches on international commerce consider important the analysis and discussion of effect that has reforms on intellectual property rights in various countries in terms of innovation activities in international commerce (Markus, 2000; Branstetter *et al.*, 2007). On the other hand, Lerner (2002) analyse the impact of 177 protection policies in innovation in 60 countries in the last 50 years, identifying that a strong protection of intellectual property has a low and positive effect in innovation activities. Equally, other researchers have been oriented to the existing relationship between intellectual property and innovation of new products (Teece *et al.*, 1997; Malewicki & Sivakumar, 2004), the intellectual property rights and innovation activities (Glass & Saggi, 2002) that can generate competitive advantages in companies greater than its competitors (Markus & Penubarti, 1995). Therefore, with the current economy globalization and market alliances and the close relationships among companies, which are totally necessary to participate in the global market (Hagedoorn, 201), mainly because globalization generates a greater protection of intellectual property and positive and significant influence in the generation of both radical and incremental innovation (Roy & Sivakumar, 2011).

For this reason, several companies have developed and implemented various activities that allow improving both intellectual property rights and innovation activities (Crampes & Langinier, 2009), since different models of patents protection, published in the literature, consider that the elimination of companies uncertainty can improve its identity and innovation activities (Reinganum, 1989). However, Crampes and Langinier (2009) in their research study did not consider uncertainty and came up to the conclusion that patents protection improves companies' innovation. Thus, several researchers, academics and professionals on managerial sciences have recognized the need to reform both the patents system to a global level and protection of intellectual property rights in companies (Gallini, 2002; Bessen & Meurer, 2008), mainly because according to Boldrin and Levine (2005, 2008), the ideas market is not different in products and services, and as consequence it is also necessary the protection of intellectual property. Hence, intellectual property management in several companies, independently of its size and sector; involve three essential activities that are closely interrelated: the access to intellectual property, the use of intellectual property rights and defence of intellectual property (Zander & Kogut, 1995; Kogut & Zander, 1996; Contractor, 2000). The access to intellectual property describe a process through which companies obtain its intellectual property from its innovation activities, without the need of support or control from suppliers, since the access to intellectual property is similar to value generation strategy (Lepak *et al.*, 2007), in this sense the relationship producer – supplier can generate a quick access to intellectual property that generate a greater value for both organizations (Roy & Sivakumar, 2011). In terms of intellectual property usage, the relationship between companies can also significantly increase the level of innovation and value creation for customers (March, 1991).

Moreover, the intellectual property utilisation can be considered a process by means of which companies develop and commercialise its suppliers' intellectual property, its own intellectual property or such intellectual property from any relationship producer – supplier, or even generated from clear marketing objectives or by registering rights of both companies. The defence of intellectual property rights is the process on which the companies secure its intellectual property rights, both from its usage without authorization and piracy that may exist of its innovation from other company activities (Brown & Duguid, 2001; Hannah, 2005, 2006). On the one hand, Contractor (2000) considers that essential elements of intellectual property that can be registered as patents, trademarks, copyright and industrial secrets, which he called "first elements of intellectual property". The "second elements" of industrial property include those values that cannot be registered but can be codified as part of intellectual property and can be tailored software, databases, formulas, recipes and market secrets (Hannah, 2005, 2006). The "third elements" of intellectual property are all those values that commonly are created from interactions between sellers and buyers (Roy *et al.*, 2004). Hence, from the previous theories it is possible to formulate the following hypotheses:

H1: The higher level of patents use, the higher level of innovation
H2: The higher the level of trademarks use, the higher level of innovation
H3: The higher level of image investment, the higher level of innovation

On the other hand, the literature implicitly considers that there is a close relationship between intellectual property and innovation, since innovation generated inside companies usually encourages organizations to take legal regimes to protect intellectual property rights (Helpman, 1993; Teece, 1998; Roy & Sivakumar, 2011). Also, in the literature it is considered that companies are the main promoters of intellectual property rights' defence, since marketing flows outside companies precisely provoke that companies are the ones that defend its intellectual property more than individuals or people (Glass & Saggi, 2002). In consequence, several researchers and academics consider that there is a close relationship between intellectual property and innovation activities in companies (Lanjouw, 1998; Lanjouw & Cockburn, 2000; Mondal & Gupta, 2006; Maskus, 2008; Crampes & Langinier, 2009; Lerner, 2009; Qiu & Yu, 2010; Roy & Sivakumar, 2011). Thus, it is also possible to formulate the last research hypothesis:

H4: The higher level of intellectual property use, the higher level of innovation

3. Methodology

In order to test the formulated hypothesis regarding the theoretical model of intellectual property and innovation, an empirical study was carried out in 130 Manufacturing SMEs in the Aguascalientes region, in Mexico. This was considering as a theoretical framework the System of Mexican Businesses Information Directory of the Aguascalientes region, which had 130 SMEs registered from 20 to 250 workers.

Since this directory was very small, it was consider pertinent to carry out a census of all SMEs selected having a confidence level of 99% and a sample error of ±1%. Similarly, the data collection instrument was designed to be completed by SMEs managers or owners, and it was applied through a personal interview to 130 companies, from which 125 surveys were validated, getting a 96% as response rate; the 5 remaining surveys were eliminated because these were not totally completed. Table 1 presents a summary of the more important aspects of the research.

Table 1: Research Design

Characteristics	Research
Population	130 Small and medium enterprises
Geographical area	Aguascalientes, México
Sample	SMEs from 20 to 250 workers
Data collection method	Personal interviews
Sampling method	Random sampling
Sample size	125 Manufacturing SMEs
Sample error	+/- 1% error, confidence level 99% (p=q=0.5)

Additionally, to measure the intellectual property of manufacturing SMEs, managers were asked to indicate if its company had developed any type of patent, distinctive signs registration or investment to improve the image on its company or products (1 = Si, 0 = No), and those that answered yes were asked to measure the importance level of such improvement, through a Likert 5 scale (where 1= less important and 5=very important as limits). Moreover, three factors were employed to measure intellectual property, which were adapted from WIPO (2003), Jensen and Webster (2006): *1) Patents* measured by a 4 items scale; *2) Trademarks* a measured by a 4 items scale; *3) Image investment* measured by a 9 items scale. In the same way, to measure innovation in SMEs, managers were requested to indicate if their companies during the last two years had developed innovation activities (1= yes, 0=no) and companies that answered yes were asked to evaluate the importance level of such activities through a 5-Likert scale (as limits: 1=not important, 5=very important), products innovation, processes innovation and management systems innovation (Zahra & Covin, 1993; Kalantaridis & Pheby, 1999; Frishammar & Hörte, 2005; Madrid-Guijarro *et al.*, 2009). Likewise, innovation variable was measured by three factors: *1) Products innovation* measured by a scale of 2 items; *2) Process innovation* measured by a scale of 2 items; *3) Management systems innovation* measured by a scale of 3 items, which were adapted from AECA (1995, 2005) and Madrid-Guijarro *et al.* (2009). On the other hand, in order to evaluate reliability and validity of scales used in this research, a Confirmatory Factor Analysis (CFA) was carried out, this by employing the Maximum Likelihood method in the EQS 6.1 software (Bentler, 2005; Brown, 2006; Byrne, 2006), and the scale reliability, of the theoretical model on intellectual property and innovation, was evaluated through the Cronbach alpha and the Composite Reliability Index (CRI) (Bagozzi & Yi, 1988). Moreover, the recommendations made by Bentler and Satorra (1991), de Hu, Bentler and Kano (1992) regarding statistics correction, from the theoretical model, where they considers that data normalization is possible by using robust statistics to provide a better data adjustment (Satorra & Bentler, 1988).

Furthermore, the adjustment indexes used were the Normed Fit Index (NFI), the Non-Normed Fit (NNFI), the Incremental Fit Index (IFI), Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) (Bentler & Bonnet, 1980; Byrne, 1989; Bentler, 1990; Hair *et al.*, 1995; Chau, 1997; Heck, 1998). Hence, Segars and Grover (1993) define that if the NFI, NNFI and CFI have on average a value between 0.80 and 0.89 it is considered that the theoretical model fits. On the other hand, if the average of these rates is equal or higher than 0.90 then there is a reasonable evidence of an excellent fit of the theoretical model (Jöreskog & Sörbom, 1986; Byrne, 1989; Papke-Shields *et al.*, 2002). Moreover, when the RMSEA value is below 0.08 the model fit is considered acceptable (Jöreskog & Sörbom, 1986, Hair *et al.*, 1995). Table 2 presents the results obtained from the CFA that indicate that the theoretical model on intellectual property and innovation has good fit ($S\text{-}BX^2$ = 188.756; *df* = 120; p = 0.000; *NFI* = 0.943; *NNFI* = 0.972; *CFI* = 0.978; *RMSEA* = 0.068), all items from the related factors are significant ($p < 0.01$), the size of all standardized factor loads exceed 0.60 (Bagozzi & Yi, 1988), Cronbach's and IFC have a greater value of 0.70, and extracted variance index (EVI) has a value greater than 0.50 (Fornell & Larcker, 1981). Therefore, these values indicate that there is sufficient evidence of reliability and convergent validity that justifies internal reliability of the scale used (Nunally & Bernstein, 1994; Hair *et al.*, 1995).

Table 2: Internal Consistency and Convergent Validity of the Theoretical Model

Variable	Indicator	Factor Weight	Robust value t	Average of factor weight	Cronbach Alpha	CFI	EVI
Patents	PA1	0.725***	1.000[a]	0.737	0.774	0.784	0.550
	PA2	0.650***	5.171				
	PA3	0.837***	7.347				
Trademarks	RM1	0.821***	1.000[a]	0.734	0.701	0.704	0.547
	RM2	0.647***	3.687				
Image investment	II1	0.892***	1.000[a]	0.828	0.913	0.918	0.631
	II2	0.943***	22.990				
	II3	0.901***	20.411				
	II4	0.672***	10.142				
	II5	0.688***	9.520				
	II8	0.601***	8.636				
Products innovation	IP1	0.836***	1.000[a]	0.798	0.777	0.779	0.639
	IP2	0.760***	8.149				
Process innovation	IR1	0.926***	1.000[a]	0.928	0.925	0.925	0.861
	IR2	0.930***	23.884				
Management systems innovation	IG1	0.834***	1.000[a]	0.911	0.935	0.937	0.832
	IG2	0.935***	10.353				
	IG3	0.963***	12.341				
$S\text{-}BX^2$ (df = 120) = 188.756; p < 0.000; NFI = 0.943; NNFI = 0.972; CFI = 0.978; RMSEA = 0.068							

[a] = Parameters fixed to this value in the identification process
*** = p < 0.01

In relation to discriminant validity of the intellectual property and innovation theoretical model, evidence is provided in two ways, which is presented in table 3. First of all, it presents the interval of confidence test proposed by Anderson and Gerbing (1988) that establishes confidentiality range of 95% none of the individual elements from the latent factors correlation matrix has value of 1.0. Secondly, arises the extracted variance test proposed by Fornell and Larcker (1981), which establish that the extracted variance between each pair of constructs is higher than their corresponding EVI. Therefore, according to the results obtained from both tests it is possible to conclude that both measurements present sufficient evidence of discriminant validity of the theoretical model.

Table 3: Discriminant Validity of the Theoretical Model

Variables	1	2	3	4	5	6
1. Patents	**0.550**	0.051	0.051	0.059	0.065	0.066
2. Trademarks	0.091 - 0.359	**0.547**	0.093	0.065	0.058	0.061
3. Image investment	0.094 - 0.358	0.163 - 0.447	**0.631**	0.057	0.078	0.047
4. Products innovation	0.107 - 0.379	0.101 - 0.409	0.087 - 0.391	**0.639**	0.585	0.314
5. Process innovation	0.117 - 0.393	0.084 - 0.396	0.127 - 0.431	0.693 - 0.837	**0.861**	0.424
6. Management systems innovation	0.134 - 0.378	0.106 - 0.386	0.082 - 0.350	0.460 - 0.660	0.565 - 0.737	**0.823**

The diagonal represents the Extracted Variance Index (EVI) while above diagonal the variance part is shown. Below diagonal is the correlation estimation of factors with a confidence interval of 95%.

4. Results

In order to answer the hypotheses stated in relation to the theoretical model of intellectual property and innovation, a model of structural equations was applied, using EQS 6.1 software with same variables used in the AFC (Bentler, 2005; Byrne, 2006; Brown, 2006), which examined the nomological validity of the theoretical model through the test of the Chi Squared Test, which consists on comparing results obtained between the theoretical model and the measurement model, where results indicate that differences between models are not significant, which allows to define an explanation about the relationships between the latent constructs (Anderson & Gerbing, 1988; Hatcher, 1994). Table 4 shows these results in detail. Table 4 presents results of the structural equation model application, and in regards to hypothesis H1, $\beta = 0.144$, $p < 0.01$, which indicate that the use of patents has significant and positive effects on innovation activities, in manufacturing SMEs in Aguascalientes state, Mexico. In regards to hypothesis H2, $\beta = 0.124$, $p < 0.01$ that indicates that trademarks use has a significant and positive impact on innovation. Whereas, hypothesis H3, according to results obtained, $\beta = 0.178$, $p < 0.01$, establish that an image investment has a significant and positive impact on innovation activities. Finally, hypothesis H4, $\beta = 0.389$, $p < 0.01$, indicate that intellectual property use has a significant and positive impact on innovation, in manufacturing SMEs.

Table 4: Results of the Structural Equations Model

Hypothesis	Structural relationship	Standardized coefficient	Robust value t
H1: The higher level of patents use, the higher level of innovation	Patents registration → Innovation	0.144***	6.259
H2: The higher level of trademarks use, the higher innovation	Trademarks → Innovation	0.124***	3.687
H3: The higher level of image investment, the higher level of innovation	Image investment → Innovation	0.178***	14.339
H4: The higher level of intellectual property, higher level of innovation.	Intellectual property → Innovation	0.389***	22.990
$S\text{-}BX^2$ (df = 107) = 168.308; p < 0.000; NFI = 0.949; NNFI = 0.972; CFI = 0.981; RMSEA = 0.068			

*** = P < 0.01

5. Conclusions Y Discussion

According to the results obtained in this research, it is possible to conclude that the use of patents, trademarks and image investments in manufacturing SMEs facilitate the adoption and implementation of innovation activities in companies. This is mainly because the patents registration brings with it a legal impediment so that other companies can use or imitate new products created by SMEs and even those that are in a development phase. At the same time, trademarks offer commercial exploitation of products generated by businesses, and protect intellectual property of innovations done in products, processes and management systems. Lastly, image investment facilitates positioning both current and future products in SMEs inside the customers mind, as well as the image and market positioning in the company. Moreover, it is possible to conclude that the intellectual property stimulates innovation in products, processes and management systems in manufacturing SMEs, since companies having rights of intellectual property, exploitation and commercialization of innovations, will allow and increment of innovation activities focused on new products development. Therefore, intellectual property is considered, in the current literature, by several researchers, academics and professionals in the field of management sciences, as one of the business strategies that facilitate and stimulate the adoption and implementation of innovation activities in products and processes, as well as in management systems.

In this sense, manufacturing SMEs not only have to register patents but also to increase activities that revamp such creations, mainly because it will allow them to have a significant increment on innovation activities in companies. Therefore, patents play a fundamental role, not only as a legal protection measurement in companies, but also as a variable that significantly impact the adoption and implementation of innovation activities in products, processes and management systems in manufacturing SMEs, which can bring as a result, apart from a higher level of growth, a better economical development to the company.

Similarly, also manufacturing SMEs would have to look for a better way to register trademarks of its various products, because it would not only legally protect its trademark that gives them a distinction of its products, but also commercialization of such trademarks on both national and international market. Hence, it is essential that companies have intellectual property of brands, since it will allow SMEs to increase its innovation activities in products, processes and management systems, even it can generate higher level of new products development, which can be translate into a better positioning of market products in companies. Apart from the two variables previously mentioned, manufacturing SMEs also have to make greater investments on image to its products and company itself, because not only would have significant and positive effects on intellectual property, but it will also significantly impact on innovation activities. Likewise, image investment made by manufacturing SMEs will be also revealed, firstly, on an improvement of products positioning on the mind of clients and costumers; and secondly, on the possible success obtained from introducing new products and services in the business. Besides, it is necessary to present the main limitation of this empirical research. The first limitation is regarding the use of scales to measure both intellectual property and innovation, because only three dimension or factors were considered to measure each of these topics. For this reason, in future research it would be useful to incorporate other factors or dimensions to corroborate this research results.

A second limitation is the data collection process because only qualitative variables were considered to measure intellectual property and innovation, so in future it would be convenient to use quantitative to verify if same results can be obtained. A third limitation is that surveys were applied only to managers or owners of the manufacturing SMEs selected, for that reason the results can differ if a different sample is used, so in future research it would be useful to apply surveys also on clients and suppliers to corroborate results obtained. A fourth limitation is that only were considered manufacturing SMEs in Aguascalientes that have from 20 to 250 employees. Thus, in future research it would be suitable to consider companies with less than 20 workers, equally to verify present results. A last limitation is that most of the manufacturing SMEs considered that information requested was confidential; subsequently results presented may not necessarily reflect companies' reality. Finally, it is important to go beyond results obtained and to discuss in greater depth, for instance, what would be the effects on manufacturing SMEs from the use of more quantitative scales to measure intellectual properties and innovation?, what results can be obtained from innovation in manufacturing SMEs if an alternative method is used to measure intellectual property?, which specific innovation activities have higher impact on intellectual property? These and other questions that can possibly arise can be studied in future research.

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