

Innovation Protection Mechanisms: The Influence of National Culture[†]

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[†] This research was supported by the Social Sciences and Humanities Research Council of Canada (SSHRC) at the Centre for Intellectual Property Policy at McGill University (*The International Expert Group on Biotechnology, Innovation and Intellectual Property*).

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Abstract

The purpose of this study is to analyse the extent to which national culture values influence the choices that firms make among different protection mechanisms (formal mechanisms and informal mechanisms). It presents the results of a survey administered across 13 countries that examines innovation protection mechanisms by adopting Hofstede's national cultural framework. We test the hypotheses in a sample of 148 biotechnology firms. The findings illustrate that national culture values do influence the choice and the relative importance of secrecy.

Key words: national culture values; innovation protection mechanisms; secrecy; biotechnology

Innovation Protection Mechanisms: The Influence of National Culture

Firms innovate and try to create new knowledge to improve and develop new products and/or production processes in the hope of enhancing their future profits. Consequently, the capacity of an innovative firm to get returns on its R&D investments is at the core of its business. According to Schneider (2002), a biotechnology company has its foundation in its intellectual property: *protection* increases the technology and the firm's value. McEvily et al. (2004) define *protection* as the process by which firms sustain the uniqueness and value of their technological competencies. The types of intellectual property protection can be grouped into two categories: (1) formal protection such as patents and other legal mechanisms, (2) strategic protection such as secrecy, and lead time (Harabi, 1995; Bönnte and Keilbach, 2005). Several studies have shown a strong difference of absolute numbers of patent applications between small firms and large firms (Thumm, 2001; Hanel, 2004). In a study of Swiss biotechnology companies, Thumm (2003) found that secrecy is almost as important as patenting as a protection measure when used together with lead-time advantages. Although surprising in the biotechnology field, this finding is also confirmed by some practitioners (Heuss, 2006). In Europe, results suggest that small biotechnology firms seem to use secrecy more often than larger firms (Thumm, 2001). Data from the third European Community Innovation Survey (CIS3) for R&D-performing firms shows that in most countries, strategic protection is more frequently used than formal protection, and within this category lead time and secrecy are most common. Nevertheless, some exceptions are found: formal protection appears to be relatively more frequent in France, Denmark, Sweden, and Greece (Jaumotte and Pain, 2005). Secrecy rates are 15% for the United Kingdom and 22% for Italy (Thumm, 2001). Moreover, a comparative study in new European countries (Estonia, Slovenia, Slovequia, etc.) shows that patents, secrecy and lead time are used differently in small innovative firms in each of these countries (Eurostat, 2004; 2007). Consequently, the use of patenting and the

relative importance of lead time advantages and secrecy vary among countries (Thumm, 2001). The difference in use of intellectual property protection mechanisms may come about as a result of differences in national jurisdictions. Another possibility explaining the difference in use is that intellectual property protection mechanisms are impacted by differences in national culture. While there have been noticed differences among countries, there is little discussion as to the underlying reasons for these differences.

Consequently, the research question in this study investigates whether differences in intellectual property protection mechanisms can be attributed to national cultural differences. For some authors, the importance of considering national culture is paramount. Consequently, the notion of national culture has received a great deal of attention in international business literature. Almost 10% of the articles published in thirteen major business journals in the last five years have used culture as an explanatory variable (Lenartowicz and Roth, 2004). Managers socialized in their respective national cultures are likely to maintain distinct frames of reference (Westwood and Posner, 1997). As well, different interpretations trigger different decision processes and different behaviours.

In cross-cultural research, the country (or the nation) can be defined as the unit of analysis because national boundaries delineate the legal, political, and social environments within organizations. In other words, cross-cultural comparisons can be based on an analysis of the similarities and differences between countries. Nevertheless, clusters of countries are often based on Hofstede's cultural dimensions (Ronen and Shenkar, 1985). In order to avoid culture being a purely residual black box, Redding (1994) considers that it is necessary to identify the cultural characteristics of a country that are considered, *a priori*, to explain organizational differences. In this research study, we therefore empirically examine the effect of Hofstede's national culture dimensions on the use of intellectual property protection mechanisms in the context of biotechnological innovations. We suggest that national culture values affect the

choice of protection mechanisms being used. We test the hypotheses in a sample of small and medium biotechnology firms and discuss implications for intellectual property protection strategies. Thus, this paper aims to better understand the necessary conditions for successful management of innovation through analyzing innovation protection mechanisms.

The structure of the paper is as follows: section 1 reviews the existing literature and formulates the hypotheses; section 2 presents the empirical analysis; and section 3 presents the empirical findings. The final section of the paper discusses the policy implications related to the findings.

Theory and Hypotheses

Innovation protection mechanisms

From a managerial point of view, the goal in managing intellectual assets should not be the maximization of protection, i.e., the strongest possible appropriability regime, but rather the most efficient appropriability regime created in order to maximize the value of intellectual property, and to optimize appropriation of R&D investments (Shapiro and Varian, 1999).

Appropriability mechanisms can be represented along a continuum categorising different practices according to their legal formality. The appropriability conditions are usually represented by two groups of mechanisms (Harabi, 1995; Bönnte and Keilbach, 2005). The first group comprises formal protection mechanisms: patents, brand names, trademark and copyright. Formal protection practices entail the creation of legal rights and sanctions for their infringement. The second group comprises strategic protection such as secrecy, complexity, lead time, or complementarity. Strategic protection does not directly entail the creation of legal rights and sanctions but rather attempts to restrict the possibility of having to resort to the law (Kitching and Blackburn, 1998).

Formal protection mechanisms: Patents

The literature well documents the use of patents and formal mechanisms to leverage the intellectual assets value (McEvily et al., 2004). A patent grants a property right to an inventor. It is “the right to exclude others from making, using, offering for sale, or selling the invention” (title 35 USC, section 154). A patent can lead to a proprietary technological advantage when the firm offers a new product or implements a new process technology before its competitors. In fact, the patent increases the firm’s capacity to hoard higher returns on its R&D investments. Patents are clearly related to pure economic aspects (Thumm, 2001).

Nevertheless, some intellectual assets are hard to protect even through legal mechanisms. Legal means of protection are more efficient when the degree of codification of knowledge is high (Nieto and Perez-Cano, 2004). Studies report that legal mechanisms such as patents are not always effective (Lanjouw and Schankerman, 2001). Patents offer protection to their holder at the high indirect cost of revealing important technical information. The disclosure of critical information is found to be the most important reason why patents are not always efficient at protecting innovation rents (Levin et al, 1987; Schotchmer and Green, 1990). To protect tacit knowledge, which is essentially impossible to patent, it is often necessary to use alternative protection mechanisms (Mansfield, 1986; Levin et al., 1987; Kitching and Blackburn, 1998; Bönte and Keilbach, 2005; Cohen et al., 2000). Amongst these mechanisms, the relative importance of secrecy and lead time advantages in comparison with patents for earning competitive advantages has been shown (Thumm, 2001).

Strategic protection: Secrecy, Lead time

Secrecy

“Keeping technological knowledge secret” means preventing any essential element of that knowledge from spilling over outside the firm (Hannah, 2005). “[Secrecy] is an option only for innovations that can in fact be kept secret: the holder of a trade secret cannot exclude anyone who independently discovers it or who legally acquires the secret by such means as

accidental disclosure or reverse engineering (von Hippel, 1988, p. 54). The promotion of internal sources of information in R&D processes favours secrecy. Secrecy is effective in protecting processes which can be “hidden” inside the firm (Cuello de Oro and Lopez-Cozar, 2007; Argyres and Silverman, 2004) and is often used during the premarket development phase. Trade secret protection is incomplete. Secrecy can be achieved in a number of ways and maintained through actions generally classified as either administrative or physical protection (Liebeskind, 1997). Gray (1988, p. 8) describes the accounting value of secrecy as “a preference for confidentiality and the restriction of disclosure of information about the business.” Secrecy manifests itself through a tendency to restrict the disclosure of information available to outsiders (Doupnik and Riccio, 2006). Secrecy generally separates individuals, because secrecy means keeping knowledge for oneself and keeping others in ignorance.

Lead time

Lieberman and Montgomery (1988) define “first-mover advantages” in terms of the ability of pioneering firms to earn positive economic profits (i.e. profits in excess of the cost of capital). Lead time allows firms to have a technological edge over competition for a period of time. This strategy consists of innovating more quickly than rivals. According to Harabi (1995), lead time is considered to be the most effective means of capturing and protecting competitive advantages of process innovations. Technologies that are difficult to observe and that are complex are easy to protect by alternative means of protection, such as taking advantage of lead time (Nieto and Perez-Cano, 2004).

Relevance of national culture

National culture is the collective programming of the human mind and the core issue of organization science. National culture is defined as the values and beliefs that distinguish one group of people from another (Hofstede, 1983). It is the shared way groups understand and interpret the world, rather than their visible behaviour (Flynn and Saladin, 2006).

Steensma et al. (2000) have shown that differing views and assumptions embedded in national culture are reflected in managerial attitudes and beliefs. Smith et al. (2001) demonstrated the effect of national culture on organizational practices and individual work behaviours and perceptions. Newman and Nollen (1996) stress the “fit” between national culture and managerial practices. National cultural values affect the decisions that executives make about innovation, risk, and the urgency of changing (Geletkanycz, 1997), the propensity to create (Guerrero-Cusumano and McGuire, 2001), the innovation rate (Sirmon and Lane, 2004) and the development of new products (Nakata and Sivakumar, 1996). National culture plays an important role in the development and management of innovation. To what extent does national culture also influence the innovation protection mechanisms?

For the purpose of this research study, the values approach elaborated by Hofstede (1983, 1991) identifies the four empirical dimensions that were used in this research. Several studies are based on Hofstede’s cultural dimensions (Geletkanycz, 1997; Steensma et al., 2000; Drogendijk and Slangen, 2006) including individualism/collectivism, power distance, uncertainty avoidance, and masculinity/femininity. It has been shown that the four Hofstede dimensions are correlated with Trompenaars cultural national dimensions (Hofstede, 1996). Moreover, Hofstede’s taxonomy and measurements were actually employed rather than subjective measurements because cultural values are society-level phenomenon and are most accurately captured at the society level (Geletkanycz, 1997). Nevertheless, it is important to note that other cultural taxonomies should prove equally useful in the study of organizational phenomena.

Hypotheses development

Relation to hierarchy and risk. Uncertainty avoidance and power distance are the decisive dimensions of culture in organizations. Organizations are mechanisms that distribute power

and also serve to avoid uncertainty (Hofstede, 1983). These dimensions deal with the “relation to hierarchy and risk” (Doney et al., 1998).

Uncertainty avoidance

Uncertainty avoidance is the degree to which a nation deals with uncertainty and risk. Thus, it involves the extent to which people are intolerant of ambiguity and rely on rules to deal with unknown situations (Hofstede, 1980). Societies with high uncertainty avoidance feel more threatened by uncertain or ambiguous situations. They often are risk averse and tend to make choices with certain outcomes rather than take a risk to optimize gains. Individuals and organizations within a country characterized by a low degree of uncertainty avoidance, take risk more easily (Hofstede, 1983). Organizations in countries characterized by high uncertainty avoidance tend to respond to uncertainty in the environment by building up a system of high formalization and hierarchy. National cultures that are higher in uncertainty avoidance, such as Germany, have an “emotional need” for rules (Hofstede, 1980), creating institutions to promote security and minimize risk. National cultures that score low in uncertainty avoidance dislike formal rules, setting them only when it is necessary (Flynn and Saladin, 2006).

Moreover, uncertainty avoidance is the cultural variable that, by definition, is the least likely to lead to creative or innovative outcomes (Guerrero-Cusumano and McGuire, 2001). A low uncertainty avoidance culture may make it easier for organizational leaders to provide innovators with freedom and a “garage-like atmosphere” (Guerrero-Cusumano and McGuire, 2001). Individuals from uncertainty avoidance cultures will tend to avoid uncertainty by relying more heavily on social norms and bureaucratic practices (House et al., 2004). In uncertainty avoidance cultures, there is a more active effort to control unpredictable events.

Consequently, one can suggest that a preference for formal protection mechanisms such as patents rather than strategic protection such as secrecy or lead time is consistent with strong uncertainty avoidance. The discussion above leads to:

Hypothesis 1a:

The greater the uncertainty avoidance values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under patents.

Hypothesis 1b:

The lower the uncertainty avoidance values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under secrecy.

Hypothesis 1c:

The lower the uncertainty avoidance values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under lead time.

Power distance

Power distance represents the extent to which the members of a society expect power to be distributed equally in organizations and institutions (Hofstede, 1980). Power distance measures the “interpersonal power or influence between boss and a subordinate as perceived by the less powerful of the two” (Ronen and Shenkar, 1985, p. 446).

High power distance is often associated with a preference for control through rules. Hence, one can suggest that high power distance may be associated with formal protection mechanisms such as patents.

Members of small power distance cultures “do not necessarily accept superiors’ orders at face value, they want to know why they should follow them” (Gudykunst, 1997, p. 333). Power distance may negatively predict economic creativity (Shane, 1994; Guerrero-Cusumano and McGuire, 2001), and may be negatively linked to the relative importance of lead time advantages.

Hofstede (1980) found that the dimension of power distance also represents societal trust. He argues that power distant societies exhibit low interpersonal trust and a great need for controls on the behaviour of individuals. “A smaller power distance leads to the feasibility of control systems based on trust in subordinates, in larger power distance countries, such trust is missing” (Hofstede, 1980, p. 384). Trust influences how parties in social exchange relationships think and act. Some alternative protection mechanisms are closely linked to trust such as secrecy. Indeed, it has been shown that when employees see themselves as being in high-trust relationships with their employers, they are more likely to have psychological contracts that include high levels of personal obligations. Consequently, they are more likely to respect secrecy in organization (Hannah, 2005). One can suggest that the relative importance of secrecy will be higher in low power distance culture.

These notions are summarized in the following hypotheses:

Hypothesis 2a: The greater the power distance value associated with firms’ national culture, the more firms will tend to protect innovation and intellectual assets under patents.

Hypothesis 2b: The smaller the power distance value associated with firms’ national culture, the more firms will tend to protect innovation and intellectual assets under secrecy.

Hypothesis 2c: The smaller the power distance value associated with firms’ national culture, the more firms will tend to protect innovation and intellectual assets under lead time.

Relation to self. Individualism/collectivism and masculinity/femininity deal with the “relation to self” (Doney et al., 1998). The “relation to self” reflects concerns with the notion of self and personality. Hence, they are dimensions for which culture differences concern interpersonal relations. Norms and values associated with individualism/collectivism reflect the way people interact, and norms and values associated with masculinity/femininity, reflect objectives people research through interactions.

Individualism/collectivism

Individualism - collectivism is the degree to which individuals are integrated into groups and look after each other (Hofstede, 1980). Individualism - collectivism is “positively related to variables such as personal time, freedom, challenge, and negatively related to the use of skills, physical conditions, and training” (Ronen and Shenkar, 1985, p. 446). In individualistic societies, identity resides within the individual rather than from an association to a group. Individualism is characterized by personal goals that support competitiveness and individual decision making. It is fair to suggest that individualists favour mainly exclusive property rights (including patent).

Individualists are more likely to champion new ideas (Shane et al., 1995). Individualism facilitates the emergence of champion roles that facilitate innovation (Howell and Higgins, 1990). Individualism positively affects economic creativity and innovation implementation (Guerrero-Cusumano and McGuire, 2001; Sirmon and Lane, 2004). Hence, one can suggest that individualism is positively linked with the relative importance of lead time advantages.

In collectivist societies, individuals are more motivated by a group interests. In these societies, individuals view themselves as part of a group where members contribute to the greater good. Cooperation is more likely to occur. Radelbaugh and Gray (2002) suggest that secrecy is consistent with a preference for collectivism, as opposed to individualism, in that its concern is for the interests of those most closely involved with the firm rather than external parties. This hypothesis is consistent with the postulate that the cultural dimension that is considered most relevant for employees' tendency to trust their management as well as managers' propensity to engage in trust-building processes is individualism rather than collectivism: in collectivist cultures, a trustful interpersonal relationship is a precondition of smooth and successful activities (eg. Huang and Van de Vliert, 2006). Since trust is a

necessary condition to develop and maintain secret, the positive link between collectivism and secrecy may be relevant.

The discussion above leads to the following hypotheses.

Hypothesis 3a: The greater the individualistic values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under patents.

Hypothesis 3b: The lower the individualistic values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under secrecy.

Hypothesis 3c: The greater the individualistic values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under lead time.

Masculinity/femininity

Masculine societies are characterized by doing and acquiring rather than thinking and observing (Newman and Nollen, 1996). Masculine countries include Japan, US and Germanic countries. Feminine countries are typified by Nordic countries such as Denmark, Norway, Finland and Sweden.

Masculine societies are aggressive, task and performance oriented. It has been shown that a country with high masculinity is associated with more innovative activities, more specifically high masculinity positively contributes to the implementation of the new idea (Nakata and Sivakumar, 1996). Moreover, entrepreneurs, compared to managers, have higher masculinity values (McGrath et al., 1992; Hayton et al., 2002). Consequently, in masculine societies, individuals are used to take risks and are more likely to be leaders and pioneers: masculine societies are more likely to deal with the relative importance of lead time advantages.

Furthermore, in masculine societies, there will be a greater tendency to publicize achievements and success (Radebaugh and Gray, 2002). By publishing the intellectual property rights, in the form of patents, the holders of these rights can diffuse their technological knowledge to a wider public (Thumm, 2004). Consequently, masculine

societies may have a preference for patent strategy rather than strategic protection that does not allow diffusing and communicating technological success.

Nevertheless, feminine societies frown upon opportunistic behavior (Doney et al., 1998). It has been suggested that opportunism and trust are negatively linked (Delerue and Berard, 2007). Based on the premise that a secrecy strategy is closely linked to trust, one can suggest that the relative importance of secrecy will be lower in masculine culture.

The discussion above leads to the following hypotheses.

Hypothesis 4a: The greater the masculine values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under patents.

Hypothesis 4b: The lower the masculine values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under secrecy.

Hypothesis 4c: The greater the masculine values associated with firms' national culture, the more firms will tend to protect innovation and intellectual assets under lead time.

Research Methods

Data collection: Context and sample

The sample is comprised of biotechnology companies with fewer than 250 employees. A questionnaire was sent to managers of the 790 small health biotechnology enterprises included in the *BioScan* database. These enterprises are independent companies, located in 24 countries. Given that top managers have the best vantage point for viewing the entire organizational system (Snow and Hrebiniak, 1980), especially when firms are small, a single key informant design was used, as is the case in similar studies (eg. Parkhe, 1993). The managers' names were listed either on their firm's Internet website or in the *bioscan* database. Nevertheless, 20% of the 790 managers never received the questionnaire because of address errors in the database or disappearance of the firm. Out of the 627 managers who received the

questionnaire, 148 took part in the study. The response rate of 23.6 % percent compares favourably with the rate of 15–24 % found in similar studies (eg. Parkhe, 1993).

We relied on extant literature to select individual items for our scales. We conducted pretest interviews with a small group of managers from different companies before sending out the final version. Pretesting helped us identify any problems with question wording and questionnaire layout. A preliminary version of the questionnaire was also reviewed by business scholars to ensure face validity.

The main problem with mailed surveys is the possibility of bias resulting from low response rates. We tested for non-response bias by comparing the respondents and the non-respondents in terms of the size of their affiliated firm. We also compared early and late respondents (Armstrong and Overton, 1977). A one-way analysis of variance (ANOVA) for firm size across early and late respondents yielded an insignificant *F*-value of 0.64 (n.s.).

Measures

Multi-item scales were used to collect data on the key constructs. There was little empirical research available to develop the measures used in the questionnaire; thus the definition of individual items for the scales drew heavily on the existing literature. Table 1 provides details of individual items used to measure each construct: secrecy, lead time, and patent strategy. The Cronbach alpha reliability value for each construct is also reported. We also evaluate each construct for unidimensionality using exploratory factor analysis.

Table 1. Measurements

Label	Items	Alpha
	<i>Secrecy</i>	.803
SE1	1. We maintain secrecy regarding product and process technology.	
SE2	2. We use confidentiality clauses in all our contracts (clients, suppliers, partners).	
SE3	3. It is important to limit publicity about new inventions to a restricted circle until the patent application has been filed.	
	<i>Lead time</i>	.873
LT1	1. We increase the speed of product delivery to the customer faster than the competition.	
LT2	2. Our R&D efforts are led by timelines.	
	<i>Formal protection</i>	
GEN1	1. It is preferable to accumulate related patents	.700

National culture values

Respondents were assigned their country national value score for individualism, uncertainty avoidance, masculinity, and power distance as provided in Hofstede (1991). Long-term orientation dimension is not included in this study because of the characteristics of the sample. Long-term orientation is the fifth dimension of Hofstede which was added after the original four to try to distinguish the difference in thinking between the East and West. Our sample is only composed of firms from countries in the west.

Cultural dimensions are dichotomized at theoretically meaningful points, based on the analysis reported by Hofstede (1980). A summary of country scores and the dichotomies for each culture dimension are presented in Table 2.

Table 2. Sampled Countries' scores along Hofstede's cultural dimensions^a

	Number of firms	Uncertainty avoidance	Power Distance	Individualism	Masculinity
Australia	15	51	36	90	61
Canada	23	48	39	80	52
Denmark	4	23	18	74	16
Finland	5	59	33	63	26
France	14	86	68	71	43
Germany	8	65	35	67	66
Italy	3	75	50	76	70
New Zealand	2	49	22	79	58
Switzerland	6	63	50	66	63
The Netherlands	2	48	39	80	50
United Kingdom	23	35	35	89	66
United States	33	46	40	91	62
	n = 148	High \geq 65 Low < 65	High \geq 50 Low < 50	High \geq 71 Low < 71	High \geq 57 Low < 57

^a Adapted from Hofstede (1991), scores represent each country's relative position along an approximate 100-point scale (ranging low to high, 0-100). Scores come from a survey data about the values of people in over 50 countries around the world. These people worked in the local subsidiaries of one large multinational corporation – IBM.

Analysis and Results

Table 3 presents descriptive statistics and correlations. Normality of variables and equality of variances were assessed with the help of a Q–Q plot, the Kolmogorov–Smirnov test and Barlett's test of sphericity. The Kolmogorov–Smirnov test indicated that the assumption of normality was only marginally satisfied in some of the measurements. Hence, we performed a

series of nonparametric Kruskal–Wallis tests on the data in order to test the hypotheses, while at the same time also running an ANOVA analysis. The results did not differ and thus we retained the nonparametric Kruskal–Wallis test. The results are described and are discussed below. Table 4 lists the results of the analysis.

Table 3. Descriptive statistics and zero-order correlation constructs

	Mean	S.D	Patent strategy	Secrecy	Lead time
Patent strategy	7,5	1,57	1		
Secrecy	12.97	1.97	,105	1	
Lead time	7.41	1.70	,002	-,007	1

N = 148 **p*<0.05

Table 4. Innovation protection mechanisms by national cultural values

		Formal mechanisms	Strategic protection	
		Patent strategy	Secrecy	Lead time
Uncertainty avoidance	Weak uncertainty avoidance	73.46 ^a	82.09	71.76
	Strong uncertainty avoidance	78.95	41.98	86.25
	Khi-squared	.534 (n.s)	20,715***	2.694 (n.s)
Power distance	Small power distance	73.91	81.84	72.22
	Large power distance	77.27	40.06	85.21
	Khi-squared	.137 (n.s)	21.225***	2.045 (n.s)
Individualism	Low individualism	64.82	84.11	77.26
	High Individualism	77,96	47.76	73.51
	Khi-squared	2.817 ⁺	21.691***	.227 (n.s)
Femininity/masculinity	Feminine	80.13	72.32	85.00
	Masculine	70.77	75.94	67.54
	Khi-squared	1.764 (n.s)	.264 (n.s)	6.113 *

⁺ *p*<.010, **p*<0.05, ** *p*<0.01, *** *p*<0.001

41% of the enterprises are North American, 47% are European and 15% are from the Pacific zone (Australia and New Zealand). The average number of salaried employees is 31. 30% of enterprises have fewer than 20 employees and 6% have over 150 employees.

Our hypotheses predict a relationship between national culture values and innovation protection mechanisms. Hypotheses 1a, 1b and 1c predict a relationship between uncertainty avoidance values and innovation protection mechanisms. Only hypothesis 1b concerning secrecy is strongly supported. According to hypotheses 2a, 2b, and 2c, there may be a relationship between power distance values and innovation protection mechanisms. Only hypothesis 1b concerning secrecy is strongly supported. Hypotheses 3a, 3b and 3c predict a

relationship between the individualism-collectivism dimension and innovation protection mechanisms. Hypothesis 3b concerning secrecy is strongly supported and hypothesis 3a concerning patent strategy is supported at $p < .10$. Hypotheses 4a, 4b and 4c predict a relationship between masculine-feminine values and innovation protection mechanisms. These hypotheses are not supported except for lead time strategy ($p < .05$).

Our results show that national culture values do not influence the relative importance of patent strategy of the firm except for individualism-collectivism values, and do not influence the relative perceived importance of lead time advantages except for feminine-masculine values.

National culture values mainly impact the choice and the relative importance of secrecy. Firms in a low uncertainty avoidance environment use more secrecy as a means of appropriation and protection. Low power distance is found to be associated with a greater degree of secrecy. Collectivism may also facilitate secrecy mechanisms.

Discussion

Understanding organizational behaviour in different cultural contexts raises a number of new challenges. Variation in organizational practices within and across cultures has been a topic of wide interest (Aycan, 2000). Our empirical research have analysed in the context of biotechnology firms, the influence of Hofstede's national culture dimensions on the innovation protection mechanisms choice. The results show that national culture values do not influence patent strategy, even if individualistic values may improve protection under patent. These results have to be interpreted with caution given that the companies in our sample are located in western countries. Individualism is a characteristic of western countries. Numerous factors may explain firms' patent strategy such as the legal and institutional system, firms' size, or patent costs, for instance. For example, Lanjouw and Schankerman (2004) found that small firms are handicapped in using patents to protect international property as a result of

costly litigation processes. Likewise, Chen and McDermott (1998) suggest that the legal framework related to the patentability of life forms, the relevance of social considerations to patent decisions, and the protection of plant inventions, vary considerably between the US, Europe and Japan. Therefore, national patent laws differ in many aspects regarding biotechnological innovations, and can considerably affect the protection mechanisms choice.

Our results also suggest that the relative importance of lead time advantages is not related to the national culture, except for one dimension (masculine/feminine dimension). This result is not surprising. Previous research shows that masculinity may either favour or inhibit economic creativity and innovation (Guerrero-Cusumano and McGuire, 2001).

Our results provide strong evidence of a national culture effect in the use and choice of secrecy. Our findings are not consistent with Radebaugh and Gray's suggestion. Radebaugh and Gray (2002) argue that a preference for secrecy is consistent with strong uncertainty avoidance because the latter stems from the need to restrict the disclosure of information to outsiders to avoid conflict and competition and to preserve security. Nevertheless, secrecy is closely linked to trust. Trust is defined as "an increasing one's vulnerability to the risk of opportunistic behavior" (Chiles et McMakin, 1996, p. 85). Societies with high uncertainty avoidance feel more threatened by uncertain or ambiguous situations. They often are risk averse and tend to make choices with certain outcomes rather than take a risk to optimize gains. It is not surprising that the level of secrecy is higher in low uncertainty avoidance societies than in high uncertainty avoidance societies. In principle, trade secret laws require a trusted employee with a trade secret to keep it and not to reveal it to another firm. In practice, trade secret protection is incomplete. Human resource management is one way to manage secrecy. Comparative research show that managers from different national cultures hold different assumptions, which shape different value systems and get translated into different management and organizational practices. Among these practices, "human resource

management practices are likely to be the most sensitive to cultural diversity” (Laurent, 1986, p. 97). For example, Laurent (1986) argues that: (1) American managers held an instrumental view of the organization where positions are defined in terms of tasks and functions and where authority is functionally based; (2) French managers perceive the organization as an authority network where the power to organize and control the actors stems from their positioning in the hierarchy; (3) German managers view the organization as a coordinated network of individuals who make appropriate decisions based on their professional competence and knowledge; (4) British managers view the organization primarily as a network of relationships between individuals who get things done by influencing each other through communicating and negotiating. On the same subject, it has been demonstrated that clear power and status differentials between hierarchical levels tend to be expected more in France than in Germany or Great Britain; and that the delineation of the bounds of authority is more appreciated in Germany than in Great Britain (e.g. Gerpott and Bloch, 1992). Therefore, national cultures have implications for human resource policies (Schneider, 1988; Gerhart and Fang, 2005). Consequently, secrecy strategies are embedded in both human resource management policies and work values that are affected by national cultures.

Conclusion

The main contribution of this paper is to bring empirical support to the topic of innovation protection mechanisms choice within and across cultures.

Nevertheless, several potential limitations should be noted. First, the interest of the research was in the SMEs managers’ perception of innovation protection mechanisms. Thus, the findings may not be generalizable to executives of large corporations such as pharmaceutical companies. A second limitation is the sample. The focus is on a set of western countries. However, individualism prevails in developed and Western countries, whereas collectivism prevails in less developed and Eastern countries. Finally, it may be required to adopt, in such

cross-cultural research, a more multidisciplinary and holistic perspective (e.g. for example, Fischer et al., 2005; Aycan, 2000) to examine the complex dynamics between secrecy and national culture.

The present study is therefore only an opening chapter in the story of cross-cultural differences in intellectual property management and protection. Its main importance lies in the demonstration of the fact that cultural values have a differing effect on innovation protection mechanisms. Its results may suggest two further research areas. First, the missing links between national culture and two of the three studied protection mechanisms (patent and lead time) reveal that other issues could have more influence on the use of innovation protection mechanisms than culture, such as national innovation systems. A national innovation system can be perceived as “a historically grown subsystem of the national economy in which various organizations and institutions interact with and influence one another in the carrying out of innovative activity” (Balzat and Hanusch, 2004, p. 197). Second, the particularities of biotechnology sectors present specificities which go beyond national culture: the vast majority of biotechnology firms are managed by scientists (Fischer, 1996) and one could suggest that scientific managers have their own specific cultural attitudes that erode the effect of national culture. Consequently, other sectors might be analyzed.

This study raises some implications for practitioners. It demonstrates that in international working relations, cultural values have an effect on behaviours. More specifically it can help managers in the choice of their innovation protection mechanisms, specifically secrecy in the context of internationalization of R&D through decentralization or partnership.

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