TECHNICAL STRATEGIC ALLIANCES AND PERFORMANCES: THE MEDIATING EFFECT OF KNOWLEDGE-BASED COMPETENCIES

César Camisón, Montserrat Boronat and Ana Villar*

WP-EC 2007-11

Corresponding author: Montserrat Boronat. Universitat Jaume I, Facultad de Ciencias Jurídicas y Económicas, Depto. Administración de Empresas y Marketing, Avda. Vicent Sos Baynat, s/n, 12071 Castellón. E-mail: mboronat@emp.uji.es.

Editor: Instituto Valenciano de Investigaciones Económicas, S.A.

Primera Edición Octubre 2007

Depósito Legal: V-4643-2007

* Universitat Jaume I.

TECHNICAL STRATEGIC ALLIANCES AND PERFORMANCE:
THE MEDIATING EFFECT OF KNOWLEDGE –BASED COMPETENCIES

César Camisón, Montserrat Boronat and Ana Villar

ABSTRACT

This study provides an empirical evidence of the relationship that exists between participation in technological strategic alliances and business performance by considering the knowledge-based distinctive competencies that the alliance is capable of generating as a mediating variable. The generation of knowledge in technological strategic alliances explains the contradictory results that emerge from the direct effect of strategic alliances on economic performance. The study uses a sample of Spanish industrial firms. The results findings prove that the relationship between R&D and innovation strategic alliances, and performance is mediated by the generation of knowledge-based distinctive competencies; and that the contribution of the participation in alliances to the growth of the firm's knowledge stock depends on its creation of innovation competencies. R&D managers should enhance the development of this kind of competencies in order to achieve superior performance.

Keywords: Strategic alliances, technological cooperation, knowledge-based and innovation competencies, performance

RESUMEN

El presente trabajo provee evidencia empírica de la relación existente entre la participación en alianzas estratégicas tecnológicas y el desempeño organizativo, introduciendo como variable mediadora las competencias distintivas basadas en conocimiento que la alianza es capaz de generar. En la literatura existen resultados contradictorios en cuanto al efecto directo de las alianzas estratégicas en el desempeño organizativo. La generación de conocimiento en las alianzas estratégicas tecnológicas explica estos resultados contradictorios. A través de una muestra compuesta por empresas industriales españolas, nuestros resultados demuestran que la relación entre alianzas estratégicas en I+D y el desempeño, está mediada por la generación de competencias distintivas basadas en conocimiento; y que la contribución de la participación en las alianzas en el crecimiento del stock de conocimiento de la empresa depende de la creación de competencias en innovación. Los directivos de I+D deben alentar el desarrollo de este tipo de competencias para conseguir un desempeño organizativo superior.

Palabras clave: Alianzas estratégicas, cooperación tecnológica, competencias basadas en conocimiento e innovación, desempeño organizativo.

1. Introduction

This study demonstrates how the distinctive knowledge-based competencies that the partners can accumulate in the alliance mediate a positive effect of technological strategic alliances on performance. The study considers the Knowledge-Based View (KBV) model to distinguish between competencies in the knowledge flows and stock, and to explore the mediating effect of the two types of competencies. The study explores the relationships between technological strategic alliances and economic performance that some specific knowledge emerging from the interaction of alliance partners explains.

The relationship between strategic alliances and firm performance is not new to research, although prior research confirming the existence of a positive direct relationship between performance and alliances is relatively scarce (Stuart, 2000). Furthermore, empirical evidence in this respect is controversial. Methodological reasons (e.g., studies in different contexts using different variables or techniques, and the examination of different types of alliances) could explain empirical diversity. However, theoretical reasons may also explain empirical diversity.

Strategic alliances can be an important source of assets (distinctive competencies) that are the root of competitive advantages (Ireland, Hitt & Vaidyanath, 2002). The Knowledge-Based Approach (KBA) has acquired particular weight in strategic alliance research. This approach has highlighted knowledge and learning capabilities as the most valuable assets that partners can obtain or create through strategic alliances. The specialized literature has also generally accepted that distinctive competencies in knowledge creation and learning through strategic alliances have a positive effect on business performance (Emden, Yaprak & Cavusgil, 2005; George et al., 2001; Shrader, 2001; Dyer & Singh, 1998; Simonin, 1997; Powell, Koput & Smith-Doerr, 1996). But the empirical study of the mediating effect of distinctive knowledge-based competencies that partners can achieve by participating in strategic alliances on value creation is still scarce.

The main aim of this study is to provide empirical evidence of the relationship between participation in strategic alliances and business performance, taking the distinctive knowledge-based competencies that the alliance is capable of generating as a mediating variable. The focus is placed on technological strategic alliances, specifically those centered on R&D and innovation, since each type of alliance will have different effects on performance. The authors take the two knowledge-based competence types identified by Bontis, Crossan & Hulland (2002) as a starting point on the basis of the work by Dierickx &

Cool (1989): the knowledge stock an organization has at a given moment in time, and its flow over time that leads to innovation in products, processes or technologies.

2. Theoretical Framework

A broad stream of research claims that cooperation is an interesting organizational model, regardless of the conditions of the industry and the environment (Perry, Sengupta & Krapfel, 2004) find a positive, significant relationship between participation in strategic alliances and business performance. Tebrani (2003) concludes that using strategic alliances improves performance regardless of the type of competitive strategy used, the country of origin, or the industry in which the alliances are established. The conviction surrounding this line of thought was so prevalent for so long that empirical analysis of the relationship between strategic alliances and performance received little attention (Stuart, 2000).

But the establishment of strategic alliances is a complicated, delicate process, as the high failure rate and dissatisfaction with their performance show (Reuer & Zollo, 2005). Therefore, other studies usually find no direct effect (Hagedoorn & Schakenraad, 1994; Cravens, Shipp & Cravens, 1993) or a relationship depending on the performance indicator used (Shrader, 2001). Cooperation presents considerable problems (Teece, 1986), and is not free of specific cost. There are the costs of the functional integration of autonomous structures used for operating with different cultures and styles, problems of controlling the strategic alliance (Powell, Kogut & Smith-Doerr, 1996), and problems if cooperation allows a competitor to learn more than the firm or if the safeguard of internal knowledge is not enough (Hamel, Doz & Prahalad, 1989).

The RBV is based on the persistent differences in intra-industry business performance that lie in internal characteristics of the organization, specifically the resources and capabilities this theoretical framework is endowed with. However, not all resources and capabilities are equally valuable from a strategic perspective. Distinctive competencies are an organization's distinctive resources or capabilities that allow the organization to substantially outperform its competitors (Selznick, 1957).

From among the various approaches within the RBV, the KBA has acquired particular weight. This approach underlines the importance of knowledge as a source of competitive advantages (Teece, Pisano & Shuen, 1997; Grant, 1996a,b; Nonaka, 1994). Dynamic capabilities are basically knowledge-based skills that facilitate the search for new combinations of resources and capabilities (renovation of stock) and innovation (Eisenhardt & Martin, 2000; Teece, Pisano & Shuen, 1997).

The aim of strategic alliances can be to develop jointly necessary resources or capabilities or to gain access to them when other partners have complementary, valuable assets (Hamel, Doz & Prahalad, 1989; Buckley & Casson, 1988). Access to certain resources or capabilities lacking in the cooperating companies is an important underlying factor in the establishment of strategic alliances (Ireland, Hitt & Vaidyanath, 2002; Harrison et al., 2001; Rothaermel, 2001; Das & Teng, 2000; Gulati, 1999; Dyer & Singh, 1998; Madhok & Tallman, 1998; Eisenhardt & Schoonhoven, 1996; Glaister & Buckley, 1996; Grant, 1996b; Mitchell and Singh, 1996; Crossan and Inkpen, 1994). Firms can decide to form part of strategic alliances when they find themselves in a vulnerable strategic position because they need resources or capabilities that cannot be developed internally at a reasonable cost in a reasonable time (Das & Teng, 2000), or cannot be achieved through an exchange on the market (Eisenhardt & Schoonhoven, 1996) because there are no organized markets in which they can be acquired), or can be learned or assimilated through cooperation (Ireland, Hitt & Vaidyanath, 2002; Cohen & Levinthal, 1990). Companies that need particular assets which they cannot efficiently transfer on markets or develop internally will seek alternative means of obtaining them. Strategic alliances appear especially attractive as they are a fast, flexible method and also involve a much lower commitment in terms of cost and resources than other possible options.

All types of strategic alliances are not equally beneficial to improve a company's knowledge base. Some types of alliance, such as cooperation in logistic aspects, are suitable for sharing tangible resources in the development of certain operations; other types of a commercial nature may be useful to enter new markets or to increase market penetration. The most suitable strategic alliances for the generation and absorption of knowledge are those centered on R&D and innovation projects. The authors call these two alliances technological strategic alliances. Environmental uncertainty in today's markets and rapidly changing technologies need quick responses, which are more easily achieved through the establishment of strategic alliances than through isolation (Dodgson, 1993). R&D collaboration allows firms to share the risks of high-cost new technology development (Dodgson, 1992). Technological strategic alliances are formed as a powerful source for creating and exploiting knowledge (Inkpen, 1996; Grant & Baden-Fuller, 2004), and for developing new technologies and innovative products (Powell & Grodal, 2005; Rothaermel & Deeds, 2004; Cohen & Levinthal, 1990). The establishment of alliances in R&D or innovation projects can encourage access to new knowledge-based assets or knowledge-based assets of associated companies that would be unattainable without participation in the agreement (Inkpen and Dinur, 1998; Powell, Koput & Smith-Doerr, 1996). However, the effect of technological strategic alliances on different types of competencies on knowledge remains to be studied.

The structure of knowledge based competencies can be understood through the two-fold explanation put forward by Bontis, Crossan & Hulland (2002), on the basis of the ideas by Dierickx & Cool (1989) allows us to understand the structure of knowledge. These authors argue that, on the one hand, considering the knowledge stock the organization has at a given moment in time (Huber, 1991) and, on the other hand, its flow over time leading to product, process or technological applications—in other words, innovations—(Connor & Prahalad, 1996) can resolve the conceptual confusion in the literature. Knowledge competencies thus refer to both the firm's knowledge stock and its capacity to build up this stock through the competency of applying new knowledge for commercial purposes.

The firm's capacity to manage and increase knowledge lies in its innovative competencies. Innovative competencies represent the skills necessary for the processes of knowledge capture, creation, storage, distribution and interpretation to be carried out in such a way that they generate innovations in products, processes or technologies. The capacity for innovation is embedded in specific organizational routines and processes that constitute internal mechanisms for knowledge transfer and facilitate the widespread effective application of the knowledge that the organization already has. Technological strategic alliances may represent a tool by which an organization can access both the internalization of certain routines from the firms the organization cooperates with, and in conjunction with its partners, refine and configure new routines that will enable the organization to boost the generation of innovative competencies. The following hypothesis may therefore be put forward:

Hypothesis 1 (H1). There is a positive direct relationship between the firm's participation in technological strategic alliances and its innovation competencies.

Cooperation across strategic alliances is an organizational learning process through which companies can internalize competencies from their partners (Kale, Singh & Permutter, 2000) or configure new knowledge together. To take part in technological strategic alliances only to gain access to their partners' knowledge but without attempting to integrate this knowledge into their own operations is not unusual for companies.

With the exception of a few cases however, participation in a strategic alliance does not lead directly to the appropriation of partners' knowledge because they are aware of the risk of strengthening a competitor by cooperating. The partners of these alliances frequently protect their core competencies, their internal knowledge, in order to maintain their competitive advantage (Hamel, Doz & Prahalad, 1989). Therefore, participation in technological strategic alliances does not usually contribute directly to the knowledge stock accumulated by the organization.

Furthermore, real learning takes place when partners seek to combine their knowledge in the context of the alliance (Doz & Hamel, 1998). Partners must internalize the knowledge learned so that they can apply this knowledge to generate value in other areas (Simonin, 1997; Inkpen & Crossan, 1995). Therefore, the learning process within a strategic technological alliance will make an indirect contribution to the stock of knowledge accumulated by the organization, conditioned by the degree to which the organization triggers the development of the partners' innovative capabilities. The capacity of technological strategic alliances to stimulate the production or the absorption of knowledge will determine their value regarding the growth of the firm's knowledge-based assets stock. Therefore:

Hypothesis 2 (H2). The positive effect of a firm's participation in technological strategic alliances on the growth of its knowledge stock will depend on its ability to generate innovation competencies through cooperation.

A firm would be able to create value through a strategic alliance that the firm could not create on its own (Boris & Jemison, 1989). To measure this effect, a concept of performance must be specified that reflects the creation of value. A company can create value by reducing costs. Some types of strategic alliances (for example, in logistics, purchasing or administrative services) can have direct effects on economic results because they usually produce cost savings through synergies. Nevertheless, the most widely used criterion in economics and strategy to measure firm performance is to adopt some financial indicators which estimate the contribution to the shareholder wealth; and these are approaches for measuring the firm's ex-post competitiveness, that is, a proxy for the supranormal income associated with competitive advantages. A firm has a superior economic performance when it is above the industry average in the long term; in other words, its economic performance remains superior over time (Ruefli & Wiggins, 2000; McGahan & Porter, 1999).

Alliance results must be transformed into sustainable competitive advantages if the agreement contributes directly to the achievement of superior economic performance. Thus, the contribution of technological strategic alliances to growth or improvement of knowledge-based competencies determines their contribution to superior economic performance (defined as above). The use of technological strategic alliances produces sustainable competitive advantages only if the partners are capable of internalizing, appropriating or developing knowledge-based capabilities they previously lacked and which meet the strategic asset requirements mentioned above.

Consequently, considering the effect of participation in technological strategic alliances on the firm's competencies in innovation and the knowledge stock is necessary to

formulate predictions of the impact on value creation. Through the extension and combination of the partners firm's assets, partner firms in technological strategic alliances can create knowledge or learning by establishing valuable assets that can lead to sustainable competitive advantages, and therefore to economic income (Ireland, Hitt & Vaidyanath, 2002; George et al., 2001; Shrader, 2001; Dyer & Singh, 1998; Simonin, 1997; Powell, Koput & Smith-Doerr, 1996). In this way, companies can create greater value through technological cooperation than that which they could generate by acting independently. Based on the above, the third hypothesis establishes that:

Hypothesis 3 (H3). The positive effect on economic performance of the firm's participation in technological strategic alliances will depend on its ability to generate innovation competencies through cooperation.

Knowledge integrated and stocked by the firm can be turned into a powerful factor in the creation of new distinctive competencies that improve its competitive position. The organization's innovative capabilities will feed the growth of this knowledge stock. Therefore, the impact on the firm's economic performance after its integration into technological strategic alliances will therefore also depend on its contribution to the expansion of its knowledge stock that is generated and which the expansion of its innovative capability encourages. Thus:

Hypothesis 4 (H4). The positive effect on economic performance of a firm's participation in strategic alliances will depend on its ability to encourage the growth of the knowledge stock by generating innovation competencies through cooperation.

3. Methodology

3.1. Measurement of variables

Technological strategic alliances (ALLIANCES). This variable gathers the total number of strategic alliances the firm has developed in R&D, innovation and staff training in new technologies over the previous 10 years. This variable was operationalized by summing the various agreements the firm had developed. Since the impact of alliances on firm performance should be assessed after they have ended, the authors only measured the alliances that had finished at the time of the survey.

The variables termed CONIN and STOCK are both constructs that cannot be observed directly, and measuring them is only possible from the dimensions in which they are represented. They must be estimated by means of the covariance of their dimensions

through confirmatory factor analysis. A set of items that constitute the observable variables of the measurement model (multi-item scales) is used to measure each dimension, and the the variance-covariance matrix serves to estimate the latent construct (Law, Wonk & Mobley, 1998).

Distinctive competencies in innovation (CONIN). This construct evaluated company skill in generating innovation and new technological competencies. Eleven items make up the scale, which the authors developed on the basis of previous research that defines the construct in a similar way (Kogut & Zander, 1992). The authors defined this variable as a latent construct inferred from attitudinal indicators that are observable variables. They measured these items on an incremental 5-point Likert-type scale that gathered managerial perception of the strength of the company in each skill as compared to its competitors.

Distinctive competencies in knowledge stock (STOCK). The nucleus of knowledge-based distinctive competencies is a stock of knowledge (Nelson and Winter, 1982) whose variety, depth and availability open new horizons of ideas. To measure the degree to which a firm possesses valuable knowledge, the authors built a scale of 13 attitudinal items selected from the literature. This variable is also defined as a latent structure that is inferred from these indicators, conceived of as observable variables. The authors used an incremental 5-point Likert-type scale with the same focus as the previous construct.

Control variables. The sample for the empirical study is multi-sectorial and it predominantly comprises small- and medium-sized companies. In order to control the effect of how the sample characteristics influence the research results, the authors introduced two control variables: company size and the industry to which the company belongs. The number of employees allowed us to measure organizational size. The general sector to which the company belongs allowed us to measure industry (from 18 sectors identified to two SIC digits).

Economic performance (PERFORMANCE). To measure superior economic performance, the authors utilized a three-item scale: return on assets (ROA), sales growth and increase in market share. The literature commonly uses these indicators to measure changes in knowledge, competencies and learning, and less frequently to measure results from alliance participation. Shrader (2001) and Stuart (2000), among others, have adopted sales growth; Goerzen and Beamish (2005), ROA; and Dussauge, Garrette & Mitchell (2004), increase in market share. The average of the three indicators which are the observable variables serves to measure economic performance.

To measure the items, the authors used an incremental 5-point Likert-type scale that gathers managerial perception of the firm average performance as compared to its

competitors over the previous five years. To measure superior economic performance, this would have to be above the long-term industry average value (McGahan & Porter, 1999). Following Ruefli & Wiggins (2000), the authors established five years as a sufficient period to test the persistence of the economic income in time. On the other hand, self-evaluation is well established in the previous literature from works like those by Venkatraman and Ramanujam (1987). This self-evaluation procedure also has important precedents in the literature on the subject, and Geringer & Hebert (1991) find a significant, positive correlation between objective and subjective measures of strategic alliance performance.

3.2. Database

The population studied was the universe of Valencian –a Spanish region- industrial companies, excluding the energy sector and micro-businesses (companies with fewer than 10 workers). The authors selected the sample from the ARDAN database, which has a total of 3,394 companies registered. The final size of the sample was 401 companies, with a confidence interval of ± 95% and level of ± 5%. The population of the ARDAN database, selected at random, made up the sample; this was a stratified sample proportional to the industry and to size. An interview with the top manager (general manager or CEO) in the companies, using a structured questionnaire, provided the data. The fieldwork took place during November and December 1998. The sample includes firms from 18 industrial sectors (SIC to two digits). The sample structure, both in distribution by size and industry, maintains a high level of correlation with the structure of the population under research.

The number of companies with technological strategic alliances meeting the established conditions was 100 (24.9%), which had entered into a total of 182 agreements. Therefore, the average number of alliances per company with agreements was 1.82 (standard deviation = 0.821). The predominant alliances were those with the objective of developing product or process innovations (75), followed by those that reported personnel training or refresher courses in new technologies as their main aim (66). The third group consisted of R&D motivated alliances (41). The period considered for the development of alliances was the previous 10 years. All these strategic alliances had finished in the three years prior to the empirical study, so their results had taken full effect and could still be noticed in the organization.

3. 3. Statistical techniques

A series of two-stage structural equation models (SEM) (Hair et al., 1998: 612) served to test the theoretical model proposed. The purpose of these models is to

simultaneously integrate a series of different multiple regression equations that are interdependent at the same time. This methodology seeks to minimize the difference between the covariances of the sample and the predicted covariances of the model. The main advantage of this multiple analysis is, in addition to the direct structural effects (that assimilate the regression coefficients into the classic multiple regression models), that an estimation of the indirect effects the mediating variables generate and the total effects define as the sum of the direct and indirect is possible. The use of this methodology is also appropriate because they allow us to calculate the measurement error by simultaneously estimating all the coefficients, and by evaluating the adjustment of the model with the information.

The authors used the EQS 5.7b statistical package for this purpose. In order to avoid problems of normality, they used the maximum likelihood estimation method with robust standard estimators (Satorra & Bentler, 2001). The Annex offers the measurement scales for all variables, defined as required in the questionnaire. Table 1 provides an analysis of the descriptive statistics and correlations of the variables.

Table 1. Means, standard deviations and correlations between the variables

	Variable	Mean	Std. Deviation	1	2	3	4	5
1	Technological strategic alliances (ALLIANCES)	0.4	0.88	1.00				
2	Distinctive competencies in innovation (CONIN)	3.3	0.61	0.21**	1.00			
3	Distinctive competencies in organizational memory (MEMOR)	3.3	0.61	0.11*	0.46**	1.00		
4	Organizational size (SIZE)	48.8	58.65	0.18**	0.123**	0.14**	1.00	
5	Industry (INDUSTRY)	---	---	0.03	0.05	0.04	-0.06	1.00
6	Economic performance (PERFORMANCE)	3.4	0.59	0.15**	0.35**	0.32**	0.14**	0.03

* $p < .05$ ** $p < .01$

4. Results

4.1. Validation of the measurement scales

The initial phase of the data analysis consisted of developing a measurement model through the specification of factorial models, using confirmatory factor analysis. The

authors first verified the goodness of fit of the estimated factorial models, using the estimation of the various indicators as proposed by Hair et al. (1998). They also verified the goodness of the absolute, incremental and parsimonious fits by means of the GFI (Goodness of Fit Index), AGFI (Adjusted Goodness of Fit Index) and NC (Normed Chi-Square), which evaluate each of the above-mentioned goodness-of-fit dimensions respectively. The authors also carried out analyses of dimensionality, reliability and validity for all the scales using confirmatory factor analysis (Bagozzi, 1981). Joint reliability served to measure the dimensions. The evaluation of internal validity was used three methods: the Adjusted Goodness of Fit Index (AGFI), the loading value (≥ 1), and the statistical significance of the factor loadings ($t \geq 1.96$, $\alpha = 0.05$).

Distinctive competencies in innovation (CONIN). The recommendations of the *LMTEST* led us to eliminate 5 items from the initial scale (ID2, ID3, ID4, ID8 and ID10). The goodness of fit validates the uni-dimensionality of the first-order factor model (GFI = 0.96, AGFI = 0.92 > 0.9; NC = 3.98 ≤ 5). All the standardized factor loadings show values greater than the recommended minimum level of 0.5. All the estimated parameters are statistically significant at a level $p < 0.001$. The joint reliability of the construct (0.77) is greater than the recommended minimum value of 0.70. The statistical significance, the value of the factor loadings and the Adjusted Goodness of Fit Index (AGFI) allowed us to verify international validity.

Distinctive competencies in knowledge stock (STOCK). The recommendations of the *LMTEST* led us to eliminate 9 items from the initial scale, leaving a final scale of 4 indicators (SC1, SC2, SC3 and SC5). The goodness of fit validates the uni-dimensionality of the first-order factor model (GFI = 0.99, AGFI = 0.99 > 0.9; NC = 1.06 ≤ 5). The standardized factor loadings show values greater than the minimum level of 0.5, with the exception of SC5, although this indicator presents an acceptable value to not further deteriorate the definition of the construct and was therefore retained. All the estimated parameters are statistically significant at a level $p < 0.001$. The joint reliability (0.67) is very close to the recommended value. The significance and value of the factor loadings, and the Adjusted Goodness of Fit Index (AGFI) served to verify internal validity.

Economic performance (PERFORMANCE). The authors are warned of the possible implicit bias in managerial perceptions of the economic performance in their organizations. Caution is necessary when evaluating the risk of variance of common methods, as the data come from the same source. To verify the convergent validity of the objective and subjective measures is therefore important, to test whether the scales used truly measure the construct for which they were designed. The correlation coefficients from the self-evaluation, with objective measures exogenous to the company of two indicators that make up the scale, namely, ROA (0.18, $p < 0.05$) and sales growth (0.16, $p < 0.1$), allowed us to verify the convergent

validity of the performance measure. The SABI (Iberian Balance Sheet Analysis System) database, which gives information on the annual accounts of over 480,000 Spanish firms over the last 10 years, provided us with the exogenous indicators. In the present study, the exogenous performance indicators refer to 241 companies, the number of firms from the sample which the database includes information on.

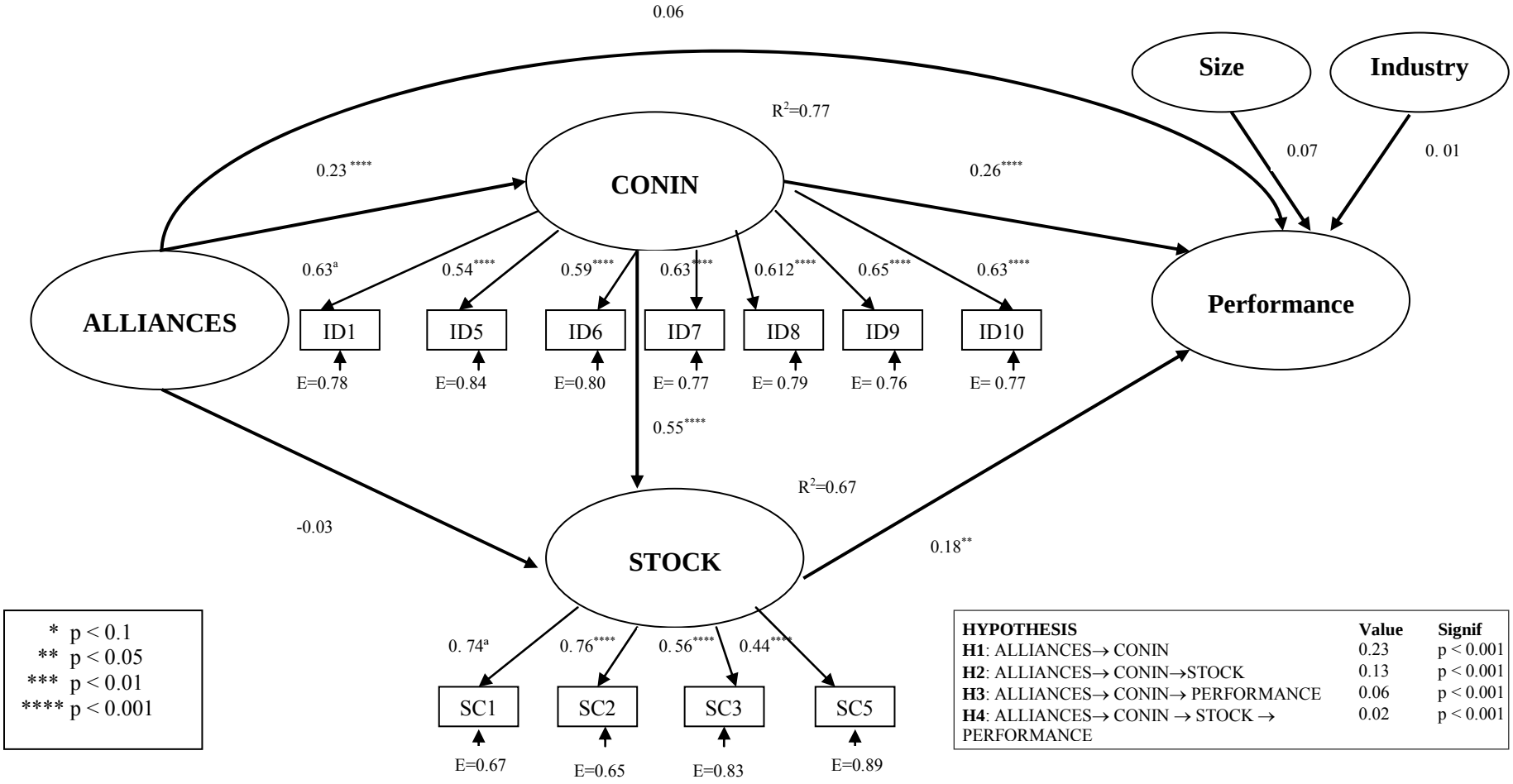
4.2. Empirical validation of the hypotheses

Having confirmed the measurement model, the authors now analyze the relationships amongst the variables. To do so, they follow the usual phases of specification, identification, estimation and interpretation. The specification phase consists of establishing relationships of dependency amongst variables, in line with the theoretical reasoning. Figure 1 shows the complete model.

The estimation of the structural model offers adequate fit indexes (GFI = 0.95; AGFI = 0.92; NC = 2.15). The proposed structural model has a significant explanatory capacity (R^2 = 0.30). Results of the model provide empirical evidence of the positive effects of participation in technological strategic alliances on competencies in innovation (ß = 0.23, p < 0.001). Therefore, H1 is confirmed. Moreover, a company's involvement in technological strategic alliances does not show any direct effects on the organization's knowledge stock (ß = - 0.03, n.s.), and their contribution to this stock is mediated by innovative capacity (ß = 0.13, p <0.001). Then H2 too is confirmed.

Participation in technological strategic alliances *per se* is not associated with greater organizational performance. In the structural equation of the model, the direct effect of the alliances variable on performance obtains a positive, but not significant coefficient (ß = 0.06, n.s.). The firm's ability to create competencies in innovation and knowledge mediates the relationship between the alliances variable and performance. The third hypothesis predicted that a firm's ability to generate innovation competencies would be a mediating variable in the relationship between participation in technological strategic alliances and organizational performance. This indirect effect is positive and significant (ß = 0.06, p < 0.001). H3 is therefore also confirmed. Finally, the fourth hypothesis predicted that the effect of participation in technological strategic alliances on performance would be influenced by the firm's capacity to encourage growth of knowledge stock generating innovation competencies through cooperation. The results from the model once again support this association. This indirect effect is positive and significant (ß = 0.02, p < 0.001). H4 is therefore also confirmed.

Figure 1. Diagram of the structural model



HYPOTHESIS	Value	Signif
H1: ALLIANCES→ CONIN	0.23	p < 0.001
H2: ALLIANCES→ CONIN→STOCK	0.13	p < 0.001
H3: ALLIANCES→ CONIN→ PERFORMANCE	0.06	p < 0.001
H4: ALLIANCES→ CONIN → STOCK → PERFORMANCE	0.02	p < 0.001

Finally, the authors can also observe that the effect of both competencies on innovation and knowledge stock effect on economic performance is positive and significant. Competencies in knowledge stock have a direct and positive effect ($ß = 0.18$, $p < 0.05$). Furthermore, competencies in innovation have a direct and positive effect ($ß = 0.26$, $p < 0.001$) and a further indirect and positive effect through their contribution to the growth of knowledge stock ($ß = 0.01$, $p < 0.01$).

The empirical research aimed to avoid any influence of sample characteristics such as size and the multisectorial nature on the results. Neither the size nor the sector to which the company belongs had significant effects on the variability of performance.

5. Conclusion

The lack of empirical consensus when setting out to determine the effect that alliance participation has on organizational performance characterizes the literature on the relationship between strategic alliances and business results. This study began with the basic aim of underlining the importance of generating knowledge-based distinctive competencies by creating technological strategic alliances, so that alliance participation should have a positive effect on business performance.

Firstly, empirical evidence shows that the mere integration of a firm in a technological strategic alliance does not produce a positive effect on its performance, as some previous studies had already anticipated (Shrader, 2001; Hagedoorn & Schakenraad, 1994; Cravens, Shipp & Cravens, 1993). The theoretical basis in the RBV, and particularly in the KBV, allow us to predict that if the collaborating companies do not manage to increase the knowledge they already possess through the cooperation agreement, this will not produce the desired effect on its competitiveness. The results of the empirical study have shown the subordination of the success of the technological strategic alliance to progress in knowledge. The relationship between technological strategic alliances and performance is mediated by the generation of two types of knowledge-based distinctive competencies: competencies in innovation and those related to knowledge stock.

The empirical results of the study corroborate the long-standing idea in the strategic alliance literature that the aim of accessing new intangible assets (Ireland, Hitt & Vaidyanath, 2002; Glaister & Buckley, 1996), particularly assets based on knowledge and innovation capabilities (Yasuda & Ijima, 2005; Grant & Baden-Fuller, 2004; Das & Teng, 2000), chiefly justifies the advantages of technological cooperation agreements. Through the development of these innovative competencies, companies that participate in

technological strategic alliances are able to enrich their valuable stock of knowledge on markets and clients, competitors and suppliers.

The strong explanatory power of firm performance associated directly with competencies deriving from the knowledge stock and skills in innovation is a point of major consequence. This empirical evidence reinforces the central postulations of the KBV, lending empirical support to this body of literature (Grant, 1996b; Nonaka, 1994). However, caution is advisable when generalizing these results. Knowledge stock and flow might not always have the same positive effects on organizational performance. In particular, knowledge stock can enhance or inhibit the capacity of a firm to acquire new knowledge and innovative competencies.

The research has interesting practical implications. When designing a technological strategic alliance, management should analyze potential partners' presumed endowments of knowledge competencies in order to select those offering the best knowledge stock profile (in depth and diversity). The alliance governance structure must incorporate as a criterion the propensity and capacity to learn from partners, together with disposition towards knowledge transfer and the classic contract-type variables already indicated in the literature. In the same way, the objectives pursued in establishing the alliance may also condition learning by the partner companies.

The previous literature points to the importance of how companies in strategic alliances take care to protect their competencies because of the risk of opportunist behavior by partners (Das & Teng, 2000). However, the lack of a direct statistically significant relationship between participation in technological strategic alliances and knowledge stock indicates that the risks of adoption of knowledge by an opportunist partner are not clear. In fact, they cannot easily be reflected in persistent economic performance. The most promising direction to emerge from the empirical results is the development of the capacity to acquire knowledge within the alliance that could have applications in other areas, thus promoting the development of new knowledge.

The authors would like to admit certain limitations of this study. Firstly, the measure of one of the constructs of the theoretical model is not as solid as desirable. Specifically, the measure of distinctive competencies in knowledge stock could clearly be improved: the elimination of a high number of indicators from the initial scale was inevitable in order to achieve an acceptable fit of the measurement model. In this research, the remaining items were related to clients, markets, potential competitors and suppliers, and they seem to indicate that participation in technological strategic alliances has indirect effects on the knowledge stock related to competition only. Secondly, the authors have not attempted to measure the amount of performance that can be attributed to alliance participation, but

rather the superior economic performance the company achieves as a result of the sustainable competitive advantages the company gains from participating in the alliance. A final limitation concerns the cross-sectional nature of the analysis, as the benefits of the experience gained through cooperation will in fact only accrue palpable effects once firms have absorbed new knowledge competencies after a certain period of time has passed. The way the variables are measured may mitigate this limitation. Although the authors measured the firm experience in strategic alliances from its creation to the time they undertook the field work, they measured knowledge-based distinctive competencies with respect to the date the questionnaire was completed. Therefore these competencies had supposedly already incorporated all the knowledge accumulated by the organization as a result of its history of learning through strategic alliances.

SEM models distinguish between measurement models and causal models of relationships between variables. Obviously, the model detects a relationship between variables but does not prove the existence of a cause-effect relationship between them. This is a general limitation of cross-section statistical studies which try to explain changes that take place in one characteristic due to changes that take place in other variables. Explaining the variability of a certain variable does not necessarily imply that the reasons that produce or modify the variable must be known. Nevertheless, an association between variables, as the authors found in the empirical data, should lead us to suspect the existence of causal relations when robust theoretical reasonings that explain the covariation between variables have supported this association. In this research the authors have taken care to theoretically justify how a group of variables relative to both alliance participation and knowledge-based competition affect the behavior of economic performance.

ANNEX

Measurement scales

DISTINCTIVE COMPETENCIES IN INNOVATION (CONIN)

Item	Description
ID1	Capacity for obtaining information on the state of and advancements in relevant science and technologies through prospection and technological vigilance systems
ID2	Availability and efficiency of relevant, continuous and up-to-date systems for gathering information on competitors by means of competitive intelligence systems
ID3	Competency in the firm to carefully analyze emerging tendencies and to select those with proven potential
ID4	Capacity to develop incremental changes in products
ID5	Capacity to develop incremental changes in processes
ID6	Capacity to develop new products
ID7	Capacity to develop new processes
ID8	Capacity to generate advanced process technologies
ID9	Efficiency in setting up programs oriented towards the internal development of technological competencies or absorption of technologies, whether through R&D centers, suppliers or clients
ID10	Ability to be an original innovator by introducing new products onto the market
ID11	Skill in the development of knowledge applied to the creation of a diversified product portfolio

DISTINCTIVE COMPETENCIES IN KNOWLEDGE STOCK (STOCK)

Item	Description
SC1	Valuable knowledge available on current clients and markets
SC2	Valuable knowledge available on the best clients by profitability and size, and by their consumer profile
SC3	Valuable knowledge available on current and potential competitors
SC4	Anticipated knowledge on future tendencies in the area of business
SC5	Valuable knowledge available on suppliers and providers
SC6	Valuable knowledge available to develop new products
SC7	Valuable knowledge available to innovate in processes and technologies
SC8	Valuable knowledge on the best processes and systems for work organization
SC9	Valuable tacit knowledge accumulated by the company's employees
SC10	Valuable technological knowledge as shown through product and process patents
SC11	Degree of definition and documentation of knowledge on organizational procedures and processes (manuals, quality standards, quality and productivity norms, protocols, etc.)
SC12	Degree of diversity in R&D&I lines developed by the company
SC13	The organization's degree of experience in technological and business fields prioritized in the company strategy that enable it to remain at the technological forefront in its business

ORGANIZATIONAL PERFORMANCE (PERFORMANCE)

Item	Description
D1	Mean economic profitability (pre-tax and pre-interest profits/ total net assets, average 1993-1997)
D2	Average annual sales growth 1992-1997
D3	Market share gain (increase in share of total sales in the industry, 1992-1997)

References

Bagozzi, R.P. (1981) Evaluating structural equations models with unobservable variables and measurement error. A comment. *Journal of Marketing Research*, 18, 375-381.

Bontis, N., Crossan, M.M., and Hulland, J. (2002) Managing an organizational learning system by aligning stocks and flows. *Journal of Management Studies*, 39 (4), 438-469.

Buckley, P.J. and Casson, M. (1988) A theory of cooperation in international business. In, Contractor, F.J. and Lorange, P., editors. *Cooperative strategies in international business*. Lexington: Lexington Books, 31-54.

Cohen, W.M. and Levinthal, D.A. (1990) Absorptive capacity, a new perspective on learning and innovation. *Administrative Science Quarterly*, 35 (1), 128-152.

Connor, K.R. and Prahalad, C.K. (1996) A resource-based theory of the firm, knowledge versus opportunism. Organization Science, 7 (5), 477-501.

Contractor F.J. and Lorange P. (1988) Why should firms cooperate? The strategy and economics basis for cooperative ventures. In, Contractor FJ, Lorange P, editors. *Cooperative strategies in international business.* Lexington: Lexington Books.

Cravens, D.W., Shipp, S., and Cravens, K.S. (1993) Analysis of cooperative interorganizational relationships, strategic alliance formation, and strategic alliance effectiveness. *Journal of Strategic Marketing*, 1, 55-70.

Crossan, M.M. and Inkpen, A.C. (1994) Promise and reality of learning through alliances. *The International Executive*, 36 (3), 263-274.

Das, T.K. and Teng, B. (2000) A resource-based theory of strategic alliances. *Journal of Management*, 26 (1), 31-61.

Dierickx, I. and Cool, K. (1989) Asset stock accumulation and sustainability of competitive advantage. *Management Science*, 35 (12), 1504-1513.

Doz, Y.L. and Hamel, G. (1998) *Alliance Advantage, The Art of Creating Value Through Partnering*. Boston: Harvard Business Scholl Press.

Dussauge, P., Garrette, B., and Mitchell, W. (2004) Asymmetric performance, The market share impact of scale and link alliances in the global auto industry. *Strategic Management Journal*, 25, 701-711.

Dyer, J.H. and Singh, H. (1998) The relational view, Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review,* 23 (4), 660-679.

Eisenhardt, K.M. and Schoonhoven, C.B. (1996) Resource-based view of strategic alliance formation, Strategic and social effects entrepreneurial firms. *Organization Science*, 7 (2), 136-150.

Eisenhardt, K.M. and Martin, J.A. (2000) Dynamic capabilities, What are they? *Strategic Management Journal*, 21, 1105-1121.

Emden, Z., Yaprak, A., and Cavusgil, S.T. (1998) Learning from experience in international alliances, antecedents and firm performance implications. *Journal of Business Research*, 58 (7), 883-892.

George, G., Zahra, S.A., Wheatley, K.K., and Khan, R. (2001) The effects of alliance portfolio characteristics and absortive capacity on performance. A study of biotechnology firms. *Journal of High Technology*, 12, 208-226.

Geringer, J.M. and Hebert, L. (1991) Control and performance of international joint ventures. *Journal of International Business Studies*, 22 (2), 249-263.

Glaister, K.W. and Buckley, P.J. (1996) Strategic motives for international alliance formation. *Journal of Management Studies*, 33 (3), 301-332.

Goerzen, A. and Beamish, P.W. (2005) The effect of alliance network diversity on multinational enterprise performance. *Strategic Management Journal*, 26, 333-354.

Grant, R.M. (1996a) Prospering in dynamically-competitive environments, organizational capability as knowledge integration. *Organization Science*, 7 (4), 375-387.

Grant, R.M. (1996b) Toward a knowledge-based theory of the firm. *Strategic Management Journal*, 17 (Winter Special Issue), 109-122.

Grant. R.M. and Baden-Fuller, C. (2004) A knowledge assessing theory of strategic alliances. *Journal of Management Studies*, 41(1), 61-85.

Gulati, R. (1999) Network location and learning, the influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal*, 20, 397-420.

Hagedoorn, J. and Schakenraad, J. (1994) The effect of strategic technology alliances on company performance. *Strategic Management Journal*, 15, 291-309.

Hair, J., Andersson, R., Tatham, R., and Black, W. (1998) *Multivariate Data Analysis*. Homewood: Prentice Hall.

Hamel, G., Doz, Y.L., and Prahalad, C.K. (1989) Collaborate with your competitors and win. *Harvard Business Review,* 67 (1), 133-139.

Harrison, J.S., Hitt, M.A., Hoskisson, R.E., and Ireland, R.D. (2001) Resource complementarity in business combinations, extending the logic to organizational alliances. *Journal of Management,* 27, 679-690.

Huber, G.P. (1991) Organizational learning, the contributing processes and the literatures. *Organization Science*, 2, 88-115.

Inkpen, A.C. and Crossan, M.M. (1995) Believing is seeing, Joint ventures and organizational learning. *Journal of Management Studies*, 32 (5), 595-618.

Inkpen, A.C. (1996) Creating knowledge trough collaboration. *California Management Review*, 39 (1), 123-140.

Inkpen, A.C. and Dinur, A. (1998) Knowledge management processes and international joint ventures. *Organization Science*, 9 (4), 454-468.

Ireland, R.D., Hitt, M.A., and Vaidyanath, D. (2002) Alliance management as a source of competitive advantage. *Journal of Management*, 28 (3), 413-446.

Kale, P., Singh, H., and Perlmutter, H. (2000) Learning and protection of proprietary assets in strategic alliances, Building relational capital. *Strategic Management Journal*, 21, 217-237.

Kogut, B. and Zander, U. (1992) Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3 (3), 383-397.

Law, K.S., Wonk, C., and Mobley, W.H. (1998) Towards a taxonomy of multidimensional constructs. *Academy of Management Review*, 23 (4), 741-755.

Madhok, A. and Tallman, S. (1998) Resources, transactions and rents, managing value through interfirm collaborative relationships. *Organization Science*, 9 (3), 326-339.

McGahan, A., Porter, M.E. (1999) The persistence of shocks to profitability. *Review of Economics and Statistics*, 81 (1), 143-153.

Mitchell, W. and Singh, K. (1996) Survival of business using collaborative relationships to commercialize complex goods. *Strategic Management Journal*, 17, 169-195.

Nelson, R.R. and Winter, S.G. (1982) *An evolutionay theory of economic change*. Boston: Harvard University Press.

Nonaka, I. (1994) A dynamic theory of organizational knowledge creation. *Organization Science*, 5 (1), 14-37.

Perry, M.L., Sengupta. S., and Krapfel, R. (2004) Effectiveness of horizontal strategic alliances in technologically uncertain environments, are trust and commitment enough? *Journal of Business Research*, 57, 951-956.

Powell, W.W., Koput K.W., and Smith-Doerr, L. (1996) Interorganizational collaboration and the locus of innovation, networks of learning in biotechnology. *Administrative Science Quarterly*, 41 (1), 116-145.

Powell, W.W. and Grodal, S. (2005) Networks of innovators. In, Fagerberg, J., Mowery, D.C., and Nelson, R.R., editors. *The Oxford handbook of innovation*. Cambridge: Oxford University Press, 56-85.

Reuer, J.J. and Zollo, M. (2005) Termination outcomes of research alliances. *Research Policy*, 34, 101-115.

Rothaermel, F.T. (2001) Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal*, 22, 687-699.

Rothaermel, F.T. and Deeds, D. (2004) Exploration and exploitation alliances in biotechnology, a system of new product development. *Strategic Management Journal*, 25, 201-221.

Ruefli, T.W. and Wiggins, R.R. (2000) Longitudinal performance stratification. An iterated Kolmogorov-Smirnov approach. *Management Science*, 5, 685-692.

Satorra, A. and Bentler, P.M. (2001) A scales difference chi-square test statistic for moment structures analysis, *Psychometrika*, 66, 507-514.

Selznick, P. (1957) *Leadership in administration. A sociological interpretation*. New York: Harper & Row Publishers.

Shrader, R.C. (2001) Collaboration and performance in foreign markets, the case of young high-technology manufacturing firms. *Academy of Management Journal*, 44 (3), 45-60.

Simonin, B.L. (1997) The importance of collaborative know-how, an empirical test of the learning organization. *Academy of Management Journal,* 4 (5), 1150.

Stuart, T.E. (2000) Interorganizational alliances and the performance of firms, a study of growth and innovation rates in a high-technology industry. *Strategic Management Journal*, 21, 791-811.

Tebrani, M. (2003) Competitive strategies, strategic alliances, and performance in international high-tech industries, a cross-cultural study. *Journal of American Academy of Business*, 2 (2), 610-617.

Teece, D.J. (1986) Transaction costs economics and the multinational enterprise. *Journal of Economic Behaviour and Organization*, 7, 21-45.

Teece, D.J., Pisano, G., and Shuen, A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal*, 18 (7), 509-533.

Venkatraman, N. and Ramanujam, V. (1987) Measurement of business economic performance, An examination of method convergence. *Journal of Management*, 13 (1), 109-122.

Yasuda, H. and Iijima, J. (2005) Linkage between strategic alliances and firm's business strategy, the case of semiconductor industry. *Technovation*, 25 (5), 513-521.