INFLUENCE OF INNOVATION AND COOPERATION ON BUSINESS COMPETITIVENESS IN THE ANDALUSIAN METAL-MECHANIC SECTOR

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ABSTRACT:

This paper explores the relationship between innovative outcomes, cooperation and competitiveness in the Andalusian metal-mechanic sector. In order to achieve this objective, we develop a structural equation model that directly relates quality management, knowledge and financial resources to innovative outcomes. The model also examines the influence of cooperation on innovative outcomes and of both factors on firm competitiveness. The empirical study has validated the assumptions made in a peripheral region of Europe characterized by the dominance of traditional services and a low R&D activity. Such contexts have been less studied in empirical research on innovation and competitiveness.

1. INTRODUCTION

Competitiveness is fundamental in the European Union. In March 2000, the Lisbon Council established the well-known objective of turning Europe into the most competitive and dynamic knowledge-based economy in the world. Following the evaluation carried out in 2005, which affirmed that the European economy had not reached the predicted outcomes, the so-called program for innovation and competitiveness was developed. This plan supports measures for increasing competitiveness and proposes a coherent framework for improving competitiveness and innovative potential within the European Union. Different countries and territories of the European Union need to articulate methods aimed at increasing competitiveness. In this context, it is essential to determine what factors positively influence competitiveness.

Competitiveness, meaning the capacity to compete, has been a highly relevant concept which can refer to territories, industrial sectors and firms, although in this last sense there are discordant opinions such as that of Krugman (1994). This Nobel prize winner affirmed that competitiveness may be a dangerous, compulsive and meaningless obsession. His criticism focuses on the concept of competitiveness of territories or of nations, and he argues that between countries, unlike between firms, the competitive game is not zero-sum, and that countries are not subject to the bottom line which so importantly affects the decisions of many business organizations.

The work we present studies competitiveness in firms in the Andalusian metal-mechanic sector, such that it is not fitting to apply the objections described. The choice of the firm as a unit of analysis, shall permit us to study firm competitiveness and shall increase knowledge on bases of competitiveness of this industry, without determining the level of competitiveness of the sector nor providing any aggregated measurements for competitiveness.

The micro-level focus we have chosen centers on studying some factors that potentially affect competitiveness of firms in this sector, answering two specific questions: (1) Does innovation significantly impact the competitiveness of firms in this sector?, and (2) Does cooperation significantly affect competitiveness?

To this end, a model of structural equations shall be proposed in order to: 1) analyze the relationship between innovation and firm competitiveness in the Andalusian metal-mechanic sector, 2) study the influence on quality management, knowledge and financial resources on innovation, and 3) observe the potential influence of cooperation on innovation and competitiveness.

Following this introduction, we shall proceed to describe and justify the model. In the second epigraph, we shall describe the concept of competitiveness employed, justify the inclusion of the rest of the supravariables and propose the conceptual model. The third epigraph shall reveal the fundamental characteristics of the empirical study, and the fourth epigraph shall show the results and discuss them. Lastly, in the fifth epigraph, we shall lay out schematically the main conclusions of the work.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

In this epigraph, we will justify the relationships between the proposed conceptual model's supravariables and we will propose the fundamental hypotheses. Subepigraph 2.7 will graphically represent the complete conceptual model.

2.1. Competitiveness

There are many ways to determine business-level competitiveness. Thus, for example, the European commission states that competitiveness depends on the capacity to adapt quickly to changes, take advantage of innovative potential and develop quality products" (DOUE, 2006: 17). The importance of this concept is unquestionable within economy and management, such that it is widely applied in the specialized literature. However, the variety of uses it is given would lead us to doubt whether the word has any specific meaning (Connor, 2003).

Competitive firms must be profitable (Caridi, 1997). This supposition is also valid for SMEs, such that profitability and competitiveness are related variables in small and medium firms (Oksanen & Rilla, 2009; Chew, Yan & Cheah, 2008). We should also consider the very different cases in which profitability alone is not enough to define a firm as competitive, because sometimes firms may reject benefits in order to take advantage of opportunities (Tangen, 2003) or they may even force the obtainment of short-term benefits, sacrificing future profitability (Blaine, 1993). When defining the competitiveness of a business organization it is important to consider an additional variable.

"Competitiveness refers to the firm's ability to grow and prosper among other firms in the marketplace" (Han, Chen y Ebrahimpour, 2007: 5). Competitive firms increase their market quota and seek new markets (Oksanen & Rilla, 2009). International markets offer opportunities for firms to become competitive (Loyka & Powers, 2003, Hitt, Keats & DeMarie, 1998). Growth in sales serves as a measure of the competitiveness of SMEs (Chew, Yan & Cheah, 2008). Competitive firms grow and extend their markets. It is not unusual that

growth has been considered a fundamental objective of the firm contributing to competitiveness (Correa, Acosta, González & Medina, 2003).

It is probably true that the definition of a term such as this one is never true or false in an absolute sense and must be adjusted to each specific research project and problem (Ketels, 2006). We shall thus try to clarify its meaning it as well as possible in order to study it. For the purposes of this study, a competitive firm shall be one which grows in the market, and which obtains benefits. Thus, we define competitiveness as a construct formed by two variables: extension of the market, measured according to level of internationalization of products, and firm profitability measured evaluated on an ordinal scale.

1.2. Quality management

It is interesting to research the relationship between innovative outcomes and quality management. Quality management contributes to developing innovative capability in organizations (Perdomo-Ortiz; González-Benito & Galende, 2006; Gobeli & Brown, 1993). The establishment of standards correlates with the success of inserting new products into the market (Cho & Pucik, 2005; Cooper & Kleinschmidt, 1987). Quality management seems to have a strong impact on innovative results (Martínez-Román, Gamero & Tamayo, 2011; Satish & Srinivasan, 2010).

For these reasons, it may be interesting to propose this first hypothesis:

Hypothesis 1: Quality management exerts a positive impact on innovative outcomes.

2.3. Knowledge

Creativity, R&D activities and acquisition of technology exert a clear influence on innovation as sources of internal knowledge. The related literature frequently considers that R&D may be used as a measure of internal efforts to develop technological knowledge (Bertrand, 2009; Hull & Covin, 2010; Quintana & Benavides, 2008; Romijn & Albaladejo, 2002; Subramaniam & Youndt, 2005).

Cooperation can contribute to generating knowledge. Organizations increase their capacity to develop and implant innovations through collaboration with partners who have complementary abilities and knowledge bases (Hitt, Keats y DeMarie, 1998).

In a general manner, we can propose the following hypothesis:

Hypothesis 2: Knowledge exerts a positive impact on innovative outcomes.

2.4. Financial resources

The specialized literature indicates the importance of financial resources in the innovative activity of firms (Furman et al., 2002). Studies exist relating innovative outcomes and internal funding (Kamien & Schwartz, 1982). Results have been more debatable in regard to outside funding, depending on factors such as the type of innovation (Galende & De la Fuente, 2003), the firm life cycle and the characteristics of the credit market (Giudici & Paleari, 2000). In general terms, the influence of outside financing is more complex to evaluate. We must also consider the difficulties inherent to the small firm in accessing outside funding. Small and young firms tend to have greater difficulty in getting bank loans even in a context without credit restrictions (Levenson & Willard, 2000).

Therefore it is interesting to prove the following hypothesis:

Hypothesis 3: Financial Resources exert a positive impact on innovative outcomes.

2.5. Cooperation

Cooperation is an important variable with a lot of interrelations with innovative outcomes. At the moment of product design, the relationships with distributors and customers become quite relevant. A close relationship with suppliers and customers provides firms with a key source of innovation (von Hippel, 1986). Trust and long term relationship are foundations of cooperation that facilitate the sharing of information. Cooperation can have positive effect on new product development (Enright & Roberts, 2001). Moreover, a common policy's goal is to believe that it is possible to foster innovation by stimulating cooperation (Falck, Heblich, & Kipar, 2010).

Therefore, there are enough reasons to propose the following hypothesis:

Hypothesis 4: Cooperation exerts a positive impact on innovative outcomes.

On the other hand, cooperation is a factor that affects SMEs' success (Chittithaworn, Islam, Keawchana & Yusuf, 2011). It can increase competitiveness (Enright & Roberts, 2001) and contributes to success in the global marketplace (Thoumrungroje & Tansuhaj, 2004). Inter-firm cooperation is an efficient way of improving the competitiveness of firms (Chen & Karami, 2010), because it is a source of competitive strength (Jarillo, 1988).

For these motives we proposed the following hypothesis:

Hypothesis 5: Cooperation exerts a positive impact on firm competitiveness.

2.6. Innovative outcomes

Numerous investigations have shown the existing relationship between innovation and competitiveness in firms (Guan & Ma, 2003; Hernández-Espallardo et al., 2011), such that

innovation is considered a source of competitive advantage for internationalized firms both large and small (McAdam et al., 2010). The regional analysis of innovation and economic growth confirms the scarce connection between both concepts, clearly revealing that in the EU there is a significant positive relationship between innovative activity, economic outcomes and economic growth in the current context of the economic crisis (European Commission, 2009). The empirical research backs measures for fostering technological knowledge and innovation in the territory, especially in peripheral and less developed regions (Tödtling & Tripll, 2005), after confirming that regional investment in R&D, technological development and innovation are associated significantly with productivity, growth and sustained international competitiveness (Hewitt-Dundas & Roper, 2011).

For these reasons, we propose the following hypothesis:

Hypothesis 6: Innovative outcomes exert a positive impact on competitiveness.

2.7. Complete model

In the conceptual model shown in Figure 1, we can observe the supravariables or constructs and their relationships, which can be specified in the six hypotheses formulated earlier. The supravariable of innovative outcomes plays a central role in the model and concentrates the majority of the potential relationships.
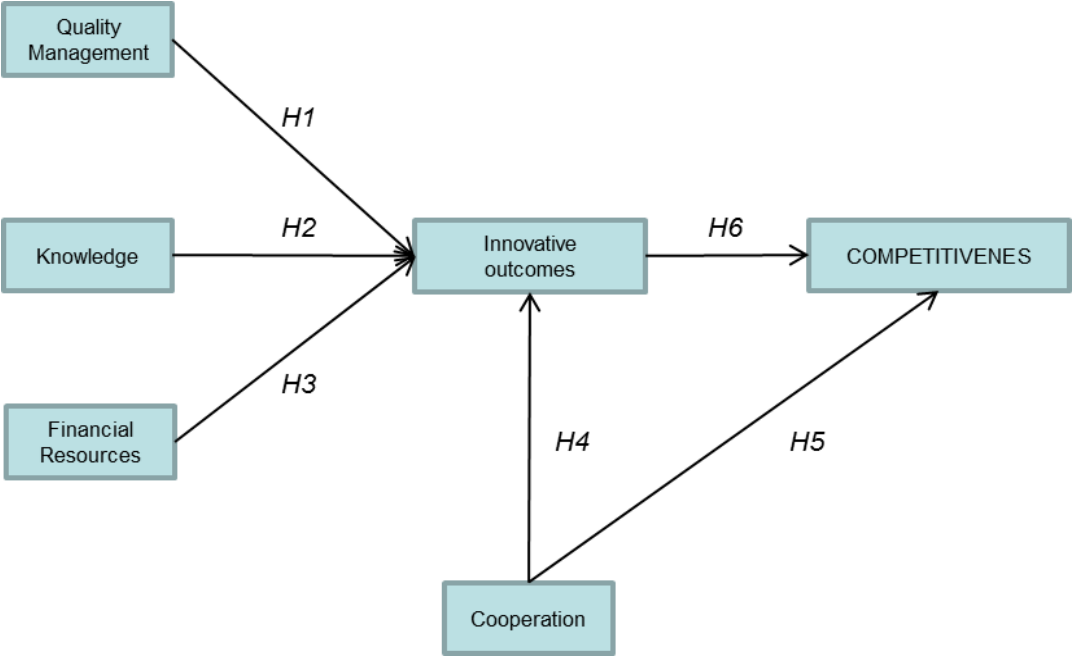

Figure 1. Innovation, cooperation and competitiveness: the mediating role of innovative outcomes.

3. EMPIRICAL RESEARCH

The study was carried out with 80 firms in the Andalusian metal-mechanic sector. The firms were selected by experts from the Instituto Andaluz de Tecnología (IAT) with the intention of obtaining a sample of the most representative firms in the sector[1]. We can observe in Table 1 the distribution of firm sizes selected. The average size of the firms, measured by the number of employees in 2010, is 36.8. Table 2 shows the location of the firms in the different provinces of Andalusia. The data from the study were obtained by two alternative means: 1) through personal interviews with the managers and owners of the firms selected, according to a questionnaire, and 2) going to the Trade Register to obtain information about the profitability and benefits of the firms.

Size	Number of Employees
<20	43
[20-50)	26
[50-150)	7
[150-250)	3
>250	1
Total	80

Table 1. Size of firms in the sample.

Province	Number of Firms
Seville	22
Málaga	12
Huelva	4
Cádiz	10
Córdoba	13
Jaén	9
Almería	4
Granada	6
Total	80

Table 2. Distribution of firms by provinces.

For the analysis of the relationships and the validation of the hypotheses, we shall employ a model of structural equations with the PLS technique. The proposed model will lay out various simultaneous relationships between supravariables or constructs which can be correctly treated with SEM (Hair, Tatham & Black, 1999). The choice of PLS is justified as it allows for the estimation of SEM without requiring a large sample size nor any suppositions about the residual distributions (Sohna, Joob & Han, 2007).

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[1] Data were obtained thanks to Program 0752/0356, established between the Instituto Andaluz de Tecnología (IAT) and the authors of this paper in their capacity as professors of the University of Seville.

In general, in order to determine the sample size with this technique one must use Cohen's power tables (1988) or the approximations given by Green (1991). In our case, in order to detect effects of medium size in the final model, we would need a minimum sample size of n=76. Certainly, given the demands of the PLS method, the sample size of 80 allows us to follow the usual heuristic rules of thumb for sample selection.

The table provided in Appendix shows the variables included in the model. All of the variables in the model were evaluated in ordinal scales, with dichotomous variables or with numerical scales.

4. RESULTS AND DISCUSSION

In the model of measurement initially proposed, some indicators are reflective–Quality Management, Knowledge and Cooperation- while others are formative –Financial Resources, Innovative Outcomes and Competitiveness-. The measurement model fulfills the standard criteria for validity and reliability. Thus, the reliability of the items and the composite reliability of the constructs of reflective indicators are correct because they exceed the standard minimum values. This is also true of convergent validity–measured through Forner and Larcker's average variance extracted, or AVE (1981) - and of the discriminant validity of the variables. It can be observed that the correlations between the constructs that they measure are weak.

A high multi-colinearity was not observed between indicators of the same formative construct, as the values of variance inflation factors (VIF) were clearly less than 3. The formative constructs selected have a relevant theoretical meaning, such that considerations related to the significance of formative items are especially interesting. Thus, the lack of significance of outside financing in the construct of financial resources may be directly linked to the crisis in which we are immersed. When innovating, firms in this sector must resort almost exclusively to self-financing. Finally, the discriminating validity of the formative constructs can also be considered acceptable.

The most relevant results of the work imply the general evaluation of the structural model, evaluating the weight and magnitude of the relationships between the different variables. In order to test the hypotheses proposed in the model, the bootstrapping technique shall be used. With a 5% level of significance and a critical value of t=1.6479, the hypotheses whose experimental t values exceed the critical t values will not be rejected. Table 3 features a summary of the model's hypotheses, with the suggested effects, the path coefficients obtained, and the experimental t values. The last column indicates if the values are rejected or not with a significance level of 5%.

Hypothesis	Suggested effects	Path coefficients	T-value (bootstrap)	Supported (Y/N)
H1:Quality Management-> Innovative outcomes	+	0.213	1.7680	Y
H2:Knowledge-> Innovative outcomes	+	0.244	1.8686	Y
H3:Financial Resources-> Innovative outcomes	+	0.288	2.2729	Y
H4:Cooperation->Innovative outcomes	+	0.099	0.6703	N
H5: Cooperation->Competitiveness	+	0.390	2.9778	Y
H6: Innovation->Competitiveness	+	0.359	2.9869	Y

Table 3. Path coefficients y T-values (bootstrap)

As may be observed, hypothesis H4 is rejected. From a theoretical point of view, this lack of relationship between cooperation and innovation is not easily justifiable. In reality, it may stem from the lack of trust of the organizational managers of innovative organizations in cooperative relationships. Although the behavior of firms in the metal-mechanic sector seems exceptional, it may not be entirely unusual. Cooperation appears to harm levels of innovation in small and medium firms in the province of Seville (Martínez-Román, Gamero & Tamayo, 2011). "The most innovative SMEs in the province do not cooperate with other firms, perhaps in order to preserve the confidentiality of their own knowledge (uncontrolled transfer of information and qualified personnel, industrial espionage, etc.). These culturally influenced decisions deserve a more in-depth analysis in future research" (Martínez-Román, Gamero & Tamayo, 2011).

Although the objective initially pursued in the model was to explore possible relationships between the variables, the value of the Stone-Geisser test gives a value of $Q^2=0.0933$ for the construct of competitiveness, which would indicate that the model may be considered to have predictive capacity.

Lastly, it may be noted that two constructs–innovative outcomes and cooperation- explain 34.9% of the variance of the competitiveness construct. This fact may be useful to private firm managers as well as those individuals in charge of creating public policies. Managers may seek improvements in profitability and market expansion through innovation and cooperation with organizations along the channel of distribution, as well as with other firms belonging to national and international networks. Managers can increase innovation by implanting systems of quality management, developing and acquiring technology and knowledge and overcoming the financial obstacles inherent to innovation.

Those responsible for economic policies could improve the level of competitiveness of the firms in the sector, attempting to increase their level of innovation and facilitating the development of conditions that favor establishing cooperative relationships with other organizations of their value system. As the strange lack of relationship between cooperation and innovation could indirectly harm the level of competitiveness of the firms, it would seem logical to provide incentives for behaviors that reduce opportunistic behaviors by organizations seeking cooperation in Andalusia. This would imply protecting the interests of

collaborators and reducing opportunistic behavior with fast-working arbitration systems which contribute to solving potential disputes between parties, at the lowest possible cost. In any case, the lack of relationship between cooperation and innovation is relevant enough to require more attention from researchers. If the lack of relationship between cooperation and innovative outcomes were due to motives of a cultural nature, it would be necessary to act in order to increase the culture of cooperation between firm owners most interested in innovation. The complexity implied by all types of cultural changes will require the participation of widely diverse institutions such as the Andalusian Confederation of Businessmen and Women and Andalusian Universities which, in collaboration with public administrations, may play a useful role in society.

5. CONCLUSIONS

In this work we have proposed a parsimonious model of equations which allows us to understand a significant part of the building blocks of competitiveness in firms belonging to the Andalusian metal-mechanic sector. The use of the PLS technique has shown the importance of innovative outcomes and cooperation with distributors and networks of domestic and foreign firms in the promotion of firm competitiveness.

The four main conclusions which may be drawn from the observation of the results are:

First: Quality management, Knowledge and Financial resources exert a positive impact on innovative outcomes.

Second: Cooperation and innovative outcomes exert a positive impact on competitiveness and explain practically 35% of the competitiveness of companies in the metal-mechanic sector.

Third: In these difficult economic times, firms have to rely exclusively on their internal funding for innovation.

Fourth: Cooperation does not significantly influence innovative outcomes in this sector.

In sum, within the Andalusian metal-mechanic sector, composed of SMEs, competitiveness depends in large measure on innovative results and cooperation. Existing relationships between both supravariables and competitiveness justify actions taken by managers in the interest of market expansion and internationalization.

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7. APPENDIX:

Initial variable or construct	Description	Scales
CUALITY MANAGEMENT	• Does the firm include a certified system of quality management?	Dichotomous
TEAMS	• Are specialized teams created for the analysis and solution of problems?	Dichotomous
CREATIVITY AND INTERNAL R&D	• Level of effort in R+D: Level of financial, human and material resources which are dedicated to R+D in the firm	Ordinal (1-6)
	• The value of managerial creativity in the firm	Ordinal (1-6)
	• The value of non-managerial creativity in the firm	Ordinal (1-6)
	• Importance of creativity in the firm's innovation-related activities	Ordinal (1-6)
TECHNOLOGICAL ACQUISITION	• Frequency of access to the technology market	Ordinal (1-6)
R&D COLLABORATION	• Intensity of R+D collaboration with Technological Centers and Universities	Ordinal (1-6)
	• Intensity of R+D collaboration with firms	Ordinal (1-6)
EXTERNAL FUNDING	• Facility of short-term financing	Ordinal (1-6)
	• Facility of mid-term financing	Ordinal (1-6)
	• Facility of long-term financing	Ordinal (1-6)
	• Assessment of the cost of outside funding	Ordinal (1-6)
INTERNAL FUNDING	• Importance of self-financing in the firm	Ordinal (1-6)
DISTRIBUTOR COLLABORATION	• Level of collaboration with distributors	Ordinal (1-6)
NATIONAL NETWORKS	• Level of integration in networks of collaboration composed of Spanish firms	Ordinal (1-6)
EXTERNAL NETWORKS	• Level of integration in networks of collaboration on an international level	Ordinal (1-6)
PRESENT INNOVATION OF PRODUCT	• Level of radicality in product innovations during the last 2 years (2008-2010)	Ordinal (1-5)
FUTURE INNOVATION OF PRODUCT	• Level of radicality in product innovations predicted for the next 2 years	Ordinal (1-5)
PERFORMANCE	• Trajectory of profitability: Arithmetic mean of the profitability in the two periods of 2004-2007 and 2008-2009	Average values of ordinal scales (1-6)
MARKET EXTENSION	• Market extension: 2 x (Percentage of sales corresponding to the international market) + (Percentage of sales corresponding to the national)	Numerical

Table 4: Description of variables.