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Absorptive Capability and Knowledge Tacitness in the Transfer of Knowledge in the Agrifood Cluster of the Southeast of Spain[1]

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1 Introduction

The OECD (1997) conceives a national innovation system (NIS) as "technology and information among people, enterprises and institutions are key to the innovative process" (p. 7). Innovation is conceived as the result of complex set of relationships among actors in the system, which includes companies, universities and research centres. In actual knowledge-based economies, industry-links are essential for economic development and progress (Ahrweiler et al., 2011). They are essential for building up networks of relationships that are necessary for any firm to innovate (Freeman 1987, 1992). In particular, many influential studies have identified the links between firm innovation and competitive advantage at the national level (Porter, 1990). Lundvall (1992) describes characteristics of NIS, emphasizing the importance or learning and how small countries, with limited public budgets and few large corporations, have selected areas of innovation strength and are able to absorb knowledge and innovations from elsewhere (Cooke *et al.*, 1997). Thus, the vision of a NSI is just beyond the technological advances, "but is more broadly on the factors influencing national technological capabilities" (Nelson & Rosenberg, 1993: 4).

The evolution of regions in terms of political, economic and cultural forces has led to develop specific skills that differ from the state and other regions. The region has become an institutional context with own normal, values, routines and processes. , Differential institutional settings are likely to give rise to distinctive competencies, emerging the regional innovation systems (RIS) (Cooke *et al.*, 1997). Researchers adopt a perspective of NIS for RIS to analyse firm innovation in the context of the set of organizations that affect innovation activities (OECD, 1999, Yam *et al.*, 2011).

These systems, in a geographical context, are named as regional innovation clusters (Yu & Jackson, 2011), as a consequence of the so-call 'network paradimg' (Morgan, 2007). Evidences show that industries participating in strong clusters, achieve higher level of growth, innovation and development (Delgado *et al.*, 2012). Operations of innovation systems depend on the knowledge flows, both tacit and codified (OECD, 1997), among constituents, RICs offer important advantages. In particular, the intensity of interactions between private companies and Universities and other public research institutions is particularly relevant for firm efficiency (Fritsch & Slavtchev, 2011). Also, this cooperation often means an important benefit for the economic and technological environment (Breznitz *et al.*, 2008).

Frequently, that activity is located in the same geographical area, known as geographical cluster (Becattini, 1990). This cluster is considered particularly attractive generating knowledge and innovation in the agri-food industry (Phillips *et al.*, 2013). Knowledge creation is a key factor for innovation and success in the agrifood industry. However, SME and firms in traditional industries dispose of low levels of absorptive capacity, need external assistance from research centres (Spithoven *et al.*, 2011). Farmers, manufacturing firms and retail distribution companies benefit from collaboration with knowledge

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creation and diffusion organizations such as R&D groups. This is usually adopted by SMEs as the best way to generate innovation and economic growth through the development of social and knowledge links (Rodriguez-Pose and Comptour, 2013).

Cooperation and business networking has been emphasized for its implications for innovation (Pitaway *et al.*, 2004). Also, behavioural perspectives provide useful explanations for the disposition of firms to innovate. At firm level, the resource based theory (RBT) (Barney, 1991, Grant 1996) examines how firm's resources and capabilities affect the development of competitive advantages. In particular, the knowledge view (KV) (Grant, 1996: 114) defines knowledge as the most strategically significant resource of a firm. KV emphasizes have the highest potential for competitive advantage potential (Eisenhardt & Martin, 2000, Grant, 1996; Winter, 2000). Capacities are usually protected by various mechanisms of isolation that hinder imitation (Spender & Grant, 1996). Since protection of capabilities is determined by the causal ambiguity (Reed & DeFillipi, 1990), transfer between partners is negatively affected by knowledge ambiguity (Simonin, 1999).

In this context, absorptive capacity (Cohen & Levinthal, 1990) is a proper concept to identify, assimilate and exploit external knowledge that R&D groups obtained from agriculture firms including links between absorptive capacity and performance (Lane *et al.*, 2001). However, the mere possession of knowledge by research groups and specialized firms does not by itself guarantee that a firm will be able to exploit the sources of this advantage. Thus, Grant (1996: 114) argues that "if most of the knowledge relevant to production is tacit, then transfer of knowledge between organizational members is exceptionally difficult".

A distinction can be drawn between tacit and explicit knowledge (Polanyi, 1966). Explicit knowledge is codified and transmittable whilst most of the body of knowledge is made of tacit knowledge. Knowledge-based literature concludes that the tacitness of such knowledge may constrain the use and scope of this knowledge among firms (Martin & Salomom, 2003).

With this background, the structure of the Spanish business with a strong presence of SMEs makes it particularly interesting collaboration between companies. The study pays attention to the relationships between research groups and firms members of an agro-industrial cluster. In particular, this paper focuses on the South East Spanish auxiliary industry auxiliary industry horticultural firms of the Southeast of Spain that is considered as an industrial agri-food cluster (Galdeano & Cespedes, 2008, Pallares-Barbera, 2002). Thus, this research examines empirically the effect of absorptive capability of research groups on its capacity to create products and knowledge for agriculture moderated by the level of knowledge tacitness.

The paper analyzes the effects of the research group's absorptive capacity on project performance for both group and contracting firm. Besides direct effects, we aim to test if the characteristic of the knowledge transferred (i.e., tacitness) moderates the influence of absorptive capacity on project performance. Also, we aspire to assess if there differences between both part of the exchange.

2 Background and Hypotheses

According to Carlsson *et al.* (2002), a system of innovation owns several dimensions, such as geographical, sectorial, technological or temporal. Relationships, as one of the most important components of the system, involve technology transfer or acquisition.
Knowledge-intensive industries (Yam *et al.*, 2011), product modularity or knowledge distributed along organizations are external determinants of the need to collaborate with other firms (Baldwin & Clark, 2003; Pittaway *et al.*, 2004). Discoveries and innovations are no longer located in a specific firm (Powell et al., 1996) and cooperation to innovate is a typical practice (Stremersch & Van Dyck, 2009).

Knowledge creation is a key factor for innovation and success in the agrifood industry. Frequently, la actividad agroibusiness is located in a same geographical area, known as geographical cluster or marshallian industrial district (Becattini, 1990). This cluster are considered particularly attractive to generate knowledge and innovation in general (Maskell, 2001, Maskell & Malmberg, 2007), and in thre agrifood industry in particular (Phillips *et al.*, 2013). Farmers, auxiliary industry firms (seeds, machinery, …) and retail distribution companies benefits from collaboration with knowledge creating and diffusing

organizations, such as R&D groups. This territorial framework is usually adopted by SME as the best way to generate innovation and economic growth through an embedeness of social and knowledge links (Molina-Morales and Martinez-Fernandez, 2010, Rodriguez-Pose & Comptour, 2013).

Colaboration with research centres and even individuals of any size and kind are become an increasing pattern for fostering innovations (Huston & Sakkab, 2006). Companies may improve their performance by exploiting university-owned knowledge and technologies (George *et al.*, 2002). Cooperation between companies and universities is positive for their success, with a high impact on product innovation (Un *et al.*, 2010). The case of Southeast Spain horticultural system, offer a high concentration of horticulture greenhouses and an important auxiliary system (Figure 1). Both constitute a complex horticultural cluster system, with a continuous transfer of knowledge and technology between the industry and the academy (Pérez-Mesa & Galdeano-Gómez, 2010).

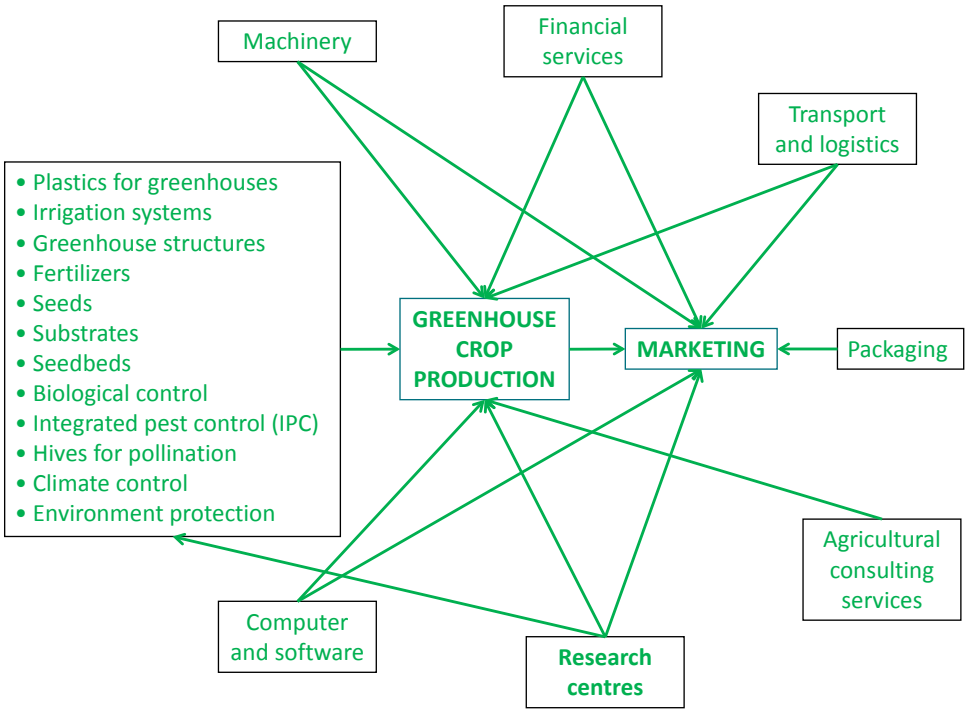

Figure 1. Southeast Spain horticultural cluster system (greenhouse crop production)

Researchers gather skills, knowledge and relationships to participate in future research projects (Bozeman & Corley, 2004). Our argument is that knowledge accumulation initially increases the absorptive capacity of the research group, and is more likely to get a better performance of the research project. However, academic researchers frequently are subjected to a path dependence that induces a particular curriculum development (Ambos et al., 2008). This makes academic researchers focus mainly on studies with quantitative outputs which can offer more on the 'how' and 'why' aspects of a theory and higher rank journals (Rothaermel *et al.*, 2007)

Then, academic careers are affected by a path dependence that reinforces academic publication patterns and orientation (Ambos et al., 2008). Even, more senior researchers may prefer not to change the 'system' (Markides, 2007). An undesireable consequence is that academic may be a limited and "prefer keeping the main jobs in academics" (Clarysee & Moray, 2004: 55). Evidences about commercialization of academic knowledge show that more academic researchers are less likely to be industrial activities and get a commercial output from the project (Ambos et al. 2008). Also, in general, earnings are not valid incentive for a university entrepreneurship (Åstebro *et al.*, 2013).

Absorptive capacity is the "ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990: 128). A particular characteristic of absorptive capacity is

the path dependence it induces through generation of knew knowledge (Cohen & Levinthal, 1990): "prior knowledge permits the assimilation and exploitation of new knowledge" (p. 136). Research groups that possess valuable knowledge of certain technologies can generate new ideas and products. Research groups with higher levels of absorptive capacity are more likely to harness knowledge from other fields to their. They must have the capacity to absorb inputs in order to generate outputs (Tsai, 2001), being the lack of this capability a major barrier to transfer knowledge from one unit to another (Szulanski, 1996).

Since a firm may pursue different goals simultaneously or sequentially, reactions to performance feedback differ depending on the absorptive capacity configuration (Be-Oz & Greve, 2012).

The cumulativeness of knowledge permits the organization to predict more accurately environmental changes and, in turn, influence the innovative performance of organizations. As Cohen & Levinthal (1990: 137) note: "organizations with higher levels of absorptive capacity will tend to be more proactive, exploiting opportunities present in the environment, independent of current performance".

> H_{1a}: There is a positive relationship between absorptive capacity and firm's R&D project performance.
> H_{1b}: There is a positive relationship between absorptive capacity and research group's R&D project performance

Though the explicit knowledge is codified and transmittable, is only the "iceberg of the entire body of knowledge" (Nonaka *et al.*, 1994). Polanyi points out that most of the body of knowledge is made of tacit knowledge. Knowledge-based literature concludes that the tacitness of such a knowledge may constrain the use and scope of this knowledge among firms (Martin & Salomom, 2003). Thus, tacitness can hinder the knowledge transfer between R&D activities and agrifood firms. We posit the following hypotheses:

> H_{2a}: There is a negative relationship between knowledge tacitness and firm's R&D project performance.
> H_{2b}: There is a negative relationship between knowledge tacitness and research group's R&D project performance.

Derived from these arguments, we also posit that if the level of tacitness is high enough, the positive effects of absorptive capacity may be offset. The, we posit the following hypotheses:

> H_{3a}: When the tacitness of knowledge to transfer is high (low), there is a negative (positive) effect of absorptive capacity on firm's R&D project performance.
> H_{3b}: When the tacitness of knowledge to transfer is high (low), there is a negative (positive) relationship of absorptive capacity on research group's R&D project performance.

A competing hypothesis is that absorptive capacity and performance have a nonlinear relationship. A problem with H1 is that it implies that performance always will increase with higher absorptive capacity levels. However, this implication may fail to recognize that though a research groups and firm that cooperate in a R&D project should share the same goals about the project, the research group may also have other goals related their research outcomes (Ambos *et al.*, 2008). In fact, absorptive capacity affects expectation formation, and these condition the incentive to invest in absorptive capacity, creating a self-reinforcing cycle (Cohen & Levinthal, 1990). And the self-reinforce nature of learning makes it attractive for an individual or organization to sustain current focus. Increased familiarity with an existing operational domain increases organizational absorptive and may lead to a 'familiarity trap' that makes the adoption of different activities less attractive (Levinthal & March, 1993). In the interplay between academic and industry trajectories, research groups may need to cut efforts in industry/academic research to benefit academic/industry goals. This argument has been considered in literature about market orientation, predicting a inverted U-shape relationship with performance (Atuahene-Gima *et al.*, 2005).

Academic and industry have different preferences settings provide different access to resources and infrastructures, and academic researchers differ from industry researchers in terms of propensity to incentives, not being economics incentives for research groups very significant (Agarwal & Ohyama, 2012). Tensions arise related with the dissemination of results, knowledge property (Clancy & Moschini, 2013) or conflicts between firm's commercial ends and research group's publications goals. Also, problems of fairness perception may prevent cooperation between research groups and companies (Burg *et al.*, 2013). Furthermore, academic researchers present a higher 'taste for nonpecuniary returns' (Agarwal & Ohyama, 2012). In fact, not always scientific knowledge leads to valuable innovation and practice (Gittelman & Kogut, 2003).

Thus, though there is a positive effect of absorptive capacity on performance, ever-increasing absorptive capacity would lead to an unwanted distance of academic goals. We propose a curvilinear shaped relationship between absorptive capacity and performance for the firms' research goals:

> H_{4a}: There is a curvilinear, concave down relationship between absorptive capability and firm's R&D project performance.
>
> H_{4b}: There is a curvilinear, concave down relationship between absorptive capability and research group's R&D project performance.

3 Methods

3.1 Data and measures

The empirical setting of the study is the Spanish Southeast area (provinces of Almeria and Murcia), the world's largest concentration of horticulture greenhouses in the world. In the province of Almeria, surface under greenhouse is 28,576 Ha, representing a total production of 3,051,027 Tm (campaing 2012-2013). In Murcia there are 4,410 Ha of greenhouses with a total irrigated horticulture surface of 48.733 Ha, achieving a total production of 1,504,684 Tm (campaing 2010-2011) (Fundacion Cajamar, 2012, 2013). From the production point of view, this area makes up an industrial agri-food system characterized by the intensive use of resources and knowledge (Aznar-Sánchez & Galdeano-Gómez, Sánchez-Pérez et al., 2001). It is a highly internationalized industry, with most production exported to Europe. The greenhouse cultivation offers high levels of production, horticultural type.

Data were collected from 143 R&D projects between agrifood firms and academic research groups. Projects were previously identified through the records of the Research Results Transfer Office of the research centres of the area, that is, universities of Almeria, Murcia and Politecnica de Cartagena and IMIDA. In order to assess the performance of each project, all projects had to be finished. After calls and meetings to with the principal investigators, it was agreed upon that they could fill out an electronic questionnaire (published on a secured website). Academic literature has used previously data based on Research Council-funded projects, using perceptions of their principal investigators to test the likelihood to commercialize academic research (Ambos et al., 2008).

Scales for the measurement of variables are detailed in the Appendix. Absorptive capacity is adapted from Jimenez-Barrionuevo *et al.* (2011). Performance of the project was obtained with different measures for the research group and the firm. Para el caso de los resultados sobre el grupo de investigación, conscientes de la diversidad de dimensiones consideradas se han utilizado escalas multi-ítem. Each ítem is expected to measured a dimension with satisfactory levels of predictive validity (Bergkvist & Rossiter, 2007; Drolet & Morrison, 2001; Wanous et al., 1997). Items were measured in a 0 (strongly disagree) to 10 (strongly agree) scale. In the case of the tacitness variables, we switched to a 7-point scale, with 1 signifying ''In a written form' (not tacit at all) and 7 signifying 'Completely tacit' to introduce variations in the potential dynamics of the interviewee that could lead to a common-method bias (Podsakoff *et al.*, 2003).

3.2 Data Analysis and results

As suggested by Aiken & West (1991), independent variables were mean-centered to minimize the threat of multicollinearity in equations where we created interaction terms. For testing H3a and H3b, with included the absorptive capacity term as both lineal and quadratic in the regression model. Table 1 reports the result of the estimation.

Table 1.
Regression analysis for the effects of absorptive capacity and tacitness on firm and research group performances, with quadratic and interactive effects

Variable	Value for the firm (f)		Value for the research group (g)	
	Unstand. coefficient	*t*-value	Unstand. coefficient	*t*-value
Constant	0.106	1.002	0.168	1.393
Absorptive capability	0.293	4.040*	0.310	3.739*
Tacitness	-0.053	-1.114	-0.004	-0.073
Absorptive capability^2	-0.078	-1.499	-0.173	-2.143**
Absorptive_capability X Tacitness	0.114	3.037*	0.068	1.584
R^2 (adj. R^2)	0.225 (0.202)		0.178 (0.154)	
F^{prob}	$10.001^{0.000}$		$7.478^{0.000}$	
* p<0.01; **p<0.05				

Results show that H_{1a} and H_{1b} are supported, as absorptive capacity significantly project performance for both partners (β_{1f}=0.293, p<0.01, β_{1g}=0.310, p<0.01). For the case of tacitness, there is no empirical support to the negative effects, rejecting both H_{2a} and H_{2b}. Support for H_{3b} (β_{3g}=0.173, p<0.05) indicates that at higher levels of absorptive capacity, the relationship between absorptive capacity and research group's performance becomes negative. There is not support for such an effect in the case of firm performance. Finally, β_{4f}=0.114 (p<0.05) is significant but with the opposite sign expected, which suggests that the negative effects of tacitness can not offset the positive absorptive effects on firm's R&D project performance. There is any support for H_{4g}.

4 Conclusions

First of all, results show that R&D groups may have different goals, related to the project of the agricultural firms who demanded the research, but also related to others aims such a provide basic knowledge to the field, their own scientific score, or the image of the researchers. But, more in deep, estimation indicate the positive effect of the absortive capacity of the R&D group to obtain good outcomes.

Differences in performance of a research project for the R&D group than for the firm. Positive effect of absorptive capacity for both firm and researchers. Knowledge tacitness effects are offset with absorptive capacity. Absorptive capacity has a concave-down -shape effect on research group's project performance.

The results differ depending on whether one considers the benefits for the company or research group. A related outcome of this paper is how the positive effects of research group's absorptive capacity turn

negative when it reached higher levels. However, high levels of absorptive capacity can overcome the negative effect of tacitness.

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Appendix

Measurement scales

Dependent variables

Performance for the firm

1. Achieving the intended objective of the research project report
2. Creating a product, process or technology that improves the competitiveness of the agri-food sector

Performance for the research group

1. Economic and financial outcomes for members of the research group
2. Patents obtained
3. Results applied in successful new products, processes or business

Independent variables

Absortive capacity

• Adquisition

There is close personal interaction between the two organizations.

A continuous exchange of information and knowledge is produced

The relation between the two organizations is characterized by mutual trust.

The relationship between the two organizations is characterized by a high level of reciprocity

• Assimilation

The members of the two organizations share their own common language.

There is high complementarity between the resources and capabilities of the two organizations.

The organizational cultures of the two organizations are compatible.

The operating and management styles of the two organizations are compatible.

• Transformation

The whole team had access to company information

The utility that the new knowledge from the firm brought to the knowledge of the group was identified quickly

The implications of the new knowledge from the firm had on the evolution of the project were systematically analyzed

• Exploitation

The project was quickly modified in the light of information from the firm

There was a large ability to exploit information and knowledge from the firm

The knowledge from the firm was applied to new ideas for this project

The knowledge from the firm has been applied in other projects

Tacitness

Form of transfer of technology or project results from the research group the company

In written form ----------In tacit form

100/0	80/20	60/40	50/50	40/60	20/80	0/100
1	2	3	4	5	6	7