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# ABSORPTIVE CAPACITY AS A CONFOUNDER OF THE PROCESS OF SUPPLY CHAIN INTEGRATION<sup>1</sup>

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## ABSTRACT

**Purpose** – The purpose of this research is to explore and advance on existing knowledge regarding supply chain integration and absorptive capacity. On the one hand, new elements, such as high-performance human resource practices and internal integration are proposed to foster absorptive capacity within the supply chain. On the other hand, the study proposes a model and hypotheses to analyze the moderating effect of absorptive capacity on the relationship between external supply chain integration and performance.

**Design/methodology/approach** – Four hypotheses are formulated based on relevant literature. Data was collected from the horticultural marketing sector, using two different sources, a survey, and archival data. A total of 99 responses were analysed. Hierarchical multiple regressions were carried out to test the proposed hypotheses.

**Findings** – The results confirm that high-performance human resource practices are a crucial element when trying to increase the level of absorptive capacity. In addition, the results show that absorptive capacity has a moderating effect on the relationship between supply chain integration and performance (both economic and financial). Absorptive capacity moderates the relationship between customer integration and economic performance.

**Originality/value** – This study examines the potential causes for the differences that exist in a firm's ability to develop absorptive capacity. Thus, on the one hand, high-performance human resource practices and internal integration are proposed as triggers of absorptive capacity, and on the other, absorptive capacity is proposed as a moderator in the relationship between supply chain integration and performance.

**Keywords** Supply chain integration, internal integration, human resources, absorptive capacity, performance

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# **ABSORPTIVE CAPACITY AS A CONFOUNDER OF THE PROCESS OF SUPPLY CHAIN INTEGRATION**

## **1. Introduction**

In the 21<sup>st</sup> century, the importance of coordination between members of a supply chain has become indispensable for survival. Businesses compete as supply chains rather than as stand-alone companies (Christopher, 2016). Subsequently, Supply Chain Integration (SCI) has been widely acknowledged in the literature as a critical factor with a positive effect on firm performance (Devaraj *et al.*, 2007; Flynn *et al.*, 2010; Rosenzweig *et al.*, 2003; Swink *et al.*, 2007). According to Chen *et al.* (2009), SCI involves restructuring activities used to link and simplify processes to help firms allocate, align, and utilize both internal and external resources. Even, some authors have recognized its role as one of the “best practices” for improving performance (Miri-Lavassani and Movahedi, 2018; Sousa and Voss, 2008), highlighting its potential as a source of competitive advantage. In addition, Tarifa-Fernandez and de-Burgos-Jimenez (2017) state that once this value is supported by empirical evidence, research should shift from the justification of its worth to the understanding of the contextual conditions under which it is more effective.

In this regard, the literature reflects a great variety of factors that can intervene by moderating the effect of SCI on performance, such as environmental uncertainty (Bonn-itt and Wong, 2011; Koufteros *et al.*, 2005; Wong *et al.*, 2011), demand uncertainty (Germain *et al.*, 2008; Iyer *et al.*, 2009), the strategy followed by the firm (Huo *et al.*, 2014; Liu *et al.*, 2013) and, recently, the existence of specific strategic competencies or capabilities (Li, 2015; Wiengarten *et al.*, 2014). Strategic capabilities affect the management and utilization of organizational processes as they are embedded in organizational routines and can be achieved through cooperation and coordination (Grant, 1991). They are based on the sharing of resources between the parties involved and form the bedrock upon which firms build their competitive advantage (Barney, 1991), and they, therefore, have the ability to compromise the effect of SCI on performance. However, they have received less attention as moderators, even though they are closely linked with organizational processes (Day, 1994).

Little research has analyzed the role of Absorptive Capacity (AC) as a dynamic capability, in the context of the supply chain management processes (Dobrzykowski *et al.* 2015). AC can be considered as a firm’s ability to recognize the value of new, external knowledge, assimilate, and apply it to commercial ends (Cohen and Levinthal, 1990). It is based on learning

mechanisms and arises because of the cumulative effect of continuous learning. As a dynamic capability, AC could improve other capabilities that facilitate the process of applying the knowledge to achieve the firm's goals (Agostini *et al.*, 2017). Consequently, it may have a critical influence on the development of supply chain external integration (with both suppliers and customers).

Customer integration (CI) and Supplier integration (SI) are key factors in gaining the information needed to improve performance (Azadegan, 2011). However, performance is not only driven by obtaining information and knowledge but also by how effectively information and knowledge are assimilated and applied in decision-making and business processes (Malhotra *et al.*, 2005). In other words, to exploit CI and SI, firms need to develop their AC.

Due to the important role of AC in attaining competitive advantage, firms have to consider the elements that favor its development. The antecedents of AC had been extensively studied and can be categorized into three groups: managerial, intra-organizational, and inter-organizational (Volberda *et al.*, 2010). However, only a few studies have explicitly considered supply chain orientation (Dobrzykowski *et al.*, 2015). From a supply chain perspective, internal integration (II) allows firms to understand and develop the internal dissemination of information through the interconnection of departments. Analogously, to transform and assimilate information and knowledge, firms need to count on well-developed human resources through specific practices (e.g., high-performance human resource practices –HPHRP; Derely and Doty, 1996). This is because decision-makers at various points along the supply chain do not usually make perfect decisions, and their decisions are also influenced by employee reward systems (McGuffog and Wadsley, 1999). Consequently, II and HPHRP should be considered as enablers of AC. There are scarcely any studies relating to AC and supply chain integration explaining the generation of competitive advantage in this context, despite the importance of the issue. (Dobrzykowski *et al.* 2015).

This study tries to shed light on those actions that strategically improve relationships with supply chain partners. The main contribution of this study is twofold. On the one hand, it analyses the relationship between AC and its antecedents (e.g., HPHRP and II), a link mostly unexplored (Roy, 2015). On the other hand, it studies the moderating role of AC, to better explain the relationship between strategic capabilities (e.g., CI and SI) and performance in the context of the supply chain, an issue requiring further analysis and new evidence (Tarifa-Fernandez and de-Burgos-Jimenez, 2017).

The remainder of the study is structured as follows. In Section 2, a literature review and theoretical explanations are provided. In Section 3, the research method, including the model,

variable definitions and measurements, and the data sources utilized in this study, are introduced. Section 4 presents data analysis and the main results whereas Section 5 sets out the discussion points, including limitations and extensions, and Section 6 draws conclusions.

## **2. Theoretical background and research hypotheses**

Drawing on the resource-based view of the firm (Barney, 1991) and the notion of complementary resources (Teece, 1986; Black and Boal, 1994), this study analyzes the relationships between different resources and capabilities, which are required to gain a competitive advantage in supply chains. The theoretical model identifies two sets of practices and assets related to the development of AC. Firms with this complementary capability enhance performance through external supply chain integration. Thus, this study adopts a contingent model to explain how SCI and AC affect firm performance: when the value of AC increases, the positive relationships between both SI and CI and firm performance also increase. Figure 1 shows these relationships.

[Figure 1 over here]

### **2.1. Supply chain integration and performance**

Firms need to consider other participants beyond their boundaries aligning strategies if their objective is to be more responsive to their environment, and therefore remain competitive (Richey *et al.*, 2009). Thus, it has been demonstrated that the most successful organizations are those that link their internal processes with suppliers and external customers within a single supply chain (Frohlich and Westbrook, 2001; Zailani and Rajagopal, 2005). SCI can be understood to be the degree to which a firm strategically collaborates with partners within its supply chain and collaboratively manages internal and external processes (Flynn *et al.*, 2010). Consequently, research about SCI needs to consider both internal and external integration (Narasimhan and Kim, 2002; Koufteros *et al.*, 2005; Swink *et al.*, 2007; Flynn *et al.*, 2010). Although there have been concerns about the balance between internal and external integration, the importance of II has been highlighted in some studies that have focused on this rather than on external integration (Pagell, 2004; Swink and Song, 2007). Some authors regard it as the first step toward achieving SCI (Frohlich and Westbrook, 2001; Morash and Clinton, 1998), considering it the foundation upon which external integration is built (Flynn *et al.*, 2010; Kim, 2013).

Internal Integration has been defined as the degree to which a firm structures its own organizational strategies, practices, and processes into collaborative and synchronized processes (Huo, 2012; Zhao *et al.*, 2011). Although different practices can represent the process in II, some of them are used more generally. Working together leads to the pooling of goals and interests, as well as sharing costs, risks, and benefits. Practices like decision synchronization and incentive alignment help departments to optimize their joint performance (Cao and Zhang, 2011; Simatupang and Sridharan, 2008). II, therefore, generates a better understanding among departments, resulting in joint knowledge creation (Cao and Zhang, 2011). At the same time, departments must maintain both constant and fluid information sharing in order actually to build relationships among them beyond simple interactions.

External integration refers to the efforts of a firm to integrate with external partners. Although they can be considered separately from the theoretical point of view (with suppliers and customers), in practice they are related. This is because SCI requires that companies be simultaneously integrated upstream and downstream in order to achieve significant benefits (Danese and Romano, 2011). Fabbe-Costes and Jahre (2008) also state that stronger links and higher degrees of integration across organizational boundaries lead firms and their supply network to improved performance.

Integration with customers and suppliers can shape the structure of the supply chain and condition behavior. Supply chain members may reduce the level of information asymmetries between them by promoting information sharing. This reduced information asymmetry should decrease the likelihood of opportunism and diminish transaction costs. The new structure can, therefore, improve critical elements such as reliability, speed, and the coordinative efficiency of supply chain members. It also contributes to support external processes that collect accurate demand and supply information essential for the coordination of essential tasks such as marketing, procurement, production or logistics (Stank *et al.*, 1999). With a low level of supplier and customer integration, firms are more likely to receive inaccurate or distorted supply and demand information, which eventually may result in poor production plans, high levels of inventory and/or poor delivery reliability.

Establishing a strategic relationship with suppliers and customers creates mutual understanding and facilitates task coordination, which helps to reduce wastage and misuse of resources in managing supply chain activities across partner firms (Swink *et al.*, 2007). External integration improves process flexibility by allowing supply chain partners to better anticipate and coordinate supply and demand (Flynn *et al.*, 2010). This is important to improve trust and commitment across the supply chain and to help partners delegate decision making (Lee and

Whang, 2000). As a result, SCI represents a new way of understanding firms based on the processes they perform rather than on the functional units, divisions or departments they are divided into (Trkman et al., 2007).

## **2.2. Absorptive capacity**

AC is a concept based on the ability of firms to identify, absorb, assimilate, transform and exploit external knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002; Lane *et al.*, 2006). It has been analyzed both theoretically and empirically, having been approached from different perspectives, including people (Park *et al.*, 2007), individual firms (Zahra and George, 2002; Hervas-Olivier *et al.*, 2011), interorganizational relationships (Lane *et al.*, 2001; Lane and Lubatkin, 1998), interorganizational networks (Newey and Shulman, 2004), or industrial clusters (Volberda *et al.*, 2001). The concept of AC has been developed around organizational learning and has two different facets: intraorganizational and interorganizational learning. On the one hand, the former tries to cover gaps in relation to how the different levels of knowledge between receiver and receiving entities affect internal learning (Apriliyanti and Alon, 2017). It tries to analyze how the firm can learn, capture and exploit the value of external knowledge, paying special attention to a variety of antecedents that influence AC at the organizational level (Apriliyanti and Alon, 2017).

On the other hand, the latter seeks to go deeper regarding the influence of organizational change on knowledge search (Apriliyanti and Alon, 2017). This leads to a double perspective: learning in dyadic and multiple interorganizational relationships. Concerning dyadic relationships, Lane and Lubatkin (1998) change the traditional perspective and analyze AC between firms. It is shown that the decision of a firm to select another in a strategic alliance depends on the degree of relative absorptive capacity between the two. Therefore, AC is determined by the motivation of a firm to establish sociological interactions with others and common characteristics among them. In relation to multiple interorganizational relationships, Caloghirou *et al.* (2004) establish that AC is essential to increase innovation performance when acquiring external knowledge from their broad networks. That is, the more extensive their network, the better their performance as firms can make use of embedded knowledge. Thus, Dyer and Singh (1998) understand AC as an interactive exchange process with benefits, mainly shown as relational rents, that derive from the interaction and collaborative processes between partners from different firms.

Zahra and George (2002) focus on the distribution and integration of internal knowledge as critical elements in creating AC. Greater importance is given to dynamic capabilities, which are

geared towards achieving or sustaining competitive advantages (Zollo and Winter, 2002; Eisenhardt and Martin, 2000). They established that the continuous process of absorbing knowledge could be divided into two subsets: potential and realized AC. In this way, the potential AC makes the firm receptive to acquiring and assimilating external knowledge (Lane and Lubatkin, 1998). Firms with higher potential AC are more flexible and able to reconfigure their resources and develop capabilities with a low economic and temporary cost because they tend to sustain a competitive advantage.

Actual AC reflects the firm's capacity to leverage the knowledge that has been absorbed. In this manner, firms with a higher AC have more likelihood of achieving a competitive advantage through the development of new products and processes. Despite having been considered separately, they coexist at all times and fulfill a necessary but insufficient condition to improve performance. This means that firms vary in their ability to create value from their knowledge base because of variations in their capabilities to transform and exploit knowledge. Therefore, firms that maintain a balance between their ability to capture knowledge and their ability to transform this knowledge are positioned to increase their performance.

The role of AC as a moderator in the relationships between external and internal factors and performance has been recognized in the literature. This point of view has been approached considering external relationships, and their effects on diverse types of performance. Thus, Azadegan (2011) postulated that a firm can enhance the value it obtains from its suppliers' operational innovativeness by focusing on learning from suppliers (e.g., through AC). The lack of AC generates little improvement in a firm's performance derived from said relationships. Likewise, Shin *et al.* (2016) stated that in the biotechnology industry it is not always easy to obtain the knowledge that firms need from their external relationships. AC helps to improve the alignment between the technologies acquired and those already operating in the firm. This happens because AC acts as a catalyst maximizing the mutual advantages of both sides. Otherwise, the establishment of external relationships can be detrimental due to the lack of consensus among them. In both cases, AC moderates the effect of external relationships on performance.

In the context of supply chains, AC gains importance because the most relevant information for a firm resides outside its boundaries, which not only makes information acquisition more difficult but requires effective dissemination and application of that information (Lane and Lubatkin, 1998). AC allows a firm to increase its familiarity with the knowledge that both suppliers and customers can provide. As such, AC allows an enhancement of firms' ability to leverage their external relationships by redesigning and improving organizational processes and



routines in the relationship (Dyer and Singh, 1998). Likewise, the acquisition of new specialized knowledge is often the motivation for establishing inter-organizational collaboration (Hamel, 1991).

Organizations with a high level of AC are able to recognize the value of external information and process it, which helps them to coordinate and deploy knowledge resources through both their internal and external interactions (Argote, 1999). Therefore, firms will have faster access to critical information that will give them the opportunity to predict more accurately the nature of environmental changes (Cohen and Levinthal, 1990). They can also use that advantage to create new knowledge and integrate it with existing capabilities in the firms. The ability to assimilate and reconfigure internal and external competencies will facilitate the exploitation of opportunities derived from environmental uncertainties (Jin-Xing *et al.*, 2011). In essence, AC provides firms with a greater range of mechanisms to identify, transform, and assimilate both internal and external knowledge, leading to an increase in performance.

### **2.2.1. Internal integration and absorptive capacity**

Firms can gain access to diverse sources of information; however, Zahra and George (2002) suggest that firms do this in mainly two ways: prior relevant knowledge, which forms the content of a firm's AC; and external sources, which allow firms to capture any available knowledge in their external environment and integrate it. Consequently, firms with an adequate base of prior knowledge have the ability to envisage future changes, which eventually improves AC proactively. In this way, firms with limited prior knowledge may be uncertain about market trends and they may be discouraged from exploring new ones. However, Fiol (1996) states that firms are like sponges that have different capacities for attracting new knowledge and practices. Thus, they can have a limited accumulation of prior knowledge, or even reach a point where they can no longer absorb any more. To manage this internal diffusion of new knowledge and make it more stable, firms may use networks of formal and informal communication links (Jones and Craven, 2001).

The objective of firms would be to strengthen these communication links in order to attain the broadest possible diffusion of information. In this sense, when a firm is internally integrated its departments share information, ideas, and knowledge with fluidity. As a result, the firm achieves a certain level of overall harmonization in its internal processes (Narayanan *et al.*, 2011). This is because integration can remove functional barriers, enabling cooperation across internal functions (Flynn *et al.*, 2010). When this happens, different areas within the firm can work together as a team and develop a mutual understanding of responsibilities. The

information sharing serves as a platform through which parties can engage in coordination, joint action and problem-solving (Prajogo and Olhager, 2012).

Knowledge exploitation requires the sharing of relevant knowledge among members of the firm (Spender, 1996) in order to promote mutual understanding (Garvin, 1993). Integration mechanisms can facilitate the sharing and eventual exploitation of knowledge. This integration contributes to knowledge assimilation, occurring either informally or formally. So, while informal mechanisms are useful for the exchange of ideas, formal ones facilitate the distribution of information within the firm as well as the interpretation and identification of trends.

According to Carlile and Reberich (2003), the ability to put information to beneficial use depends on how effectively the information is organized. Therefore, information must be accessible and exchanged within an organization before information from external sources can amend it. This means that all members of a firm should have access to it in an orderly manner according to the mechanisms in II. This makes firms acquire and assimilate new knowledge faster than under other conditions, ensuring that it is accurate and reliable. Thus, II serves as a driver to make the prior knowledge of the firm available to all members. In the opposite sense, when there is a lack of II, different areas and people may be working at cross-purposes and this results in redundancy of efforts and waste of resources (Pagell, 2004). They may, therefore, have the information and knowledge but not the mechanisms to properly share and disseminate it. This, in turn, leads to the following hypothesis:

*Hypothesis 1: Internal integration will be associated with a higher absorptive capacity level.*

### **2.2.2. High-performance human resources practices and absorptive capacity**

In recent years there has been an important increase in studies that analyse the relationship between HPHRP and AC. So, whereas Foss *et al.*, (2009) highlight the relationship between job design and knowledge sharing, Collins and Smith (2006) and Chen *et al.*, (2011) focus on the study of different HPHRP as being the main factors for change in firms' AC. In the same way, as firms need to be aware of having access to their existing knowledge, they also need to know how to manage it properly. Hence, employees are ultimately responsible for the treatment of information, determining what information and knowledge will be acquired and stored within the firm (Walsh and Ungson, 1991). The beneficial use of knowledge can, therefore, be considered to be based on the learning skills of the individual members that firms need to assimilate and exploit (Nicolini and Mezner, 1995). Subsequently, HPHRP could play an

essential role in understanding the abilities, motivation, and opportunities of employees (Tu *et al.*, 2006).

Through ability-enhancing practices, employees can increase their expertise, helping them perform searches that are more effective or environmental scanning. The information obtained because of their dexterity tends to be more comprehensive, reliable, and accurate than that obtained by their counterparts with narrower expertise (Gong, 2003). In addition, employees with a more advanced range of abilities are more likely to possess a common base between their own knowledge and the knowledge found in the external environment. This knowledge overlap facilitates the acquisition and mastery of knowledge at the firm level (Jansen *et al.*, 2005; Lane *et al.*, 2001).

However, in order to take advantage of these synergies, employees need to be sufficiently encouraged to engage in knowledge sharing. Thus, motivation-enhancing practices such as dialogue or discussion (e.g., involving them in the decision-making process or making them familiar with the firm's goals), may provoke a pooling of information and knowledge in order to improve the firm's knowledge-base (Nonaka, 2007). Eventually, this improvement in the firm's knowledge can help the firm to further understand and assimilate new external knowledge (Chan *et al.*, 2012). Likewise, reward systems, trying to link personnel incentives and the firm's performance measures, create shared accountability and trust among knowledge employees, which in turn facilitates the integration and exploitation of new external knowledge into firm-specific expertise (Jansen *et al.*, 2005).

Redeployment and reconfiguration of existing human resources can act as opportunity-enhancing practices because they give employees the chance to experiment in different areas. This increases the probability of interaction among employees with different knowledge meaning they can express themselves and provide useful information. Ultimately, this facilitates the integration and combinations of the knowledge employees have acquired (Jansen *et al.*, 2005). Therefore, HPHRP contribute to having the more skilled personnel, with more and specific knowledge and aligns their objectives with the firm's strategy. In the end, HPHRP will contribute to developing personnel willing to be updated more frequently, using it to improve the management of information and knowledge exchange and acquisition. This leads to the following hypothesis:

*Hypothesis 2: High-performance human resources practices will be associated with a higher absorptive capacity level.*

### **2.2.3. Absorptive capacity as a moderating variable**

Some studies suggest that a firm's internal resources, such as AC, might improve its exploitation of external resources (e.g., suppliers' and customers' knowledge), enhancing its performance (Presutti *et al.*, 2017). Malhotra *et al.* (2005) proposed a set of AC configurations in order to drive effective information exchange in conjunction with partners, which influence knowledge creation and emphasize a fit to environmental contingencies in order to integrate them. In this way, although AC is increasingly regarded as a moderating factor, evidence suggesting that the moderating role of AC as an internal factor in the relationship between different dimensions of SCI and firms' performance is nearly non-existent (Najafi Tavani *et al.* 2014).

Because of the external interactions maintained both with suppliers and customers, companies are close enough to understand the objective and the unobservable components of each part. The interorganizational relationship can be highlighted as one of the main ways of interacting with the purpose of knowledge acquisition (Zahra and George, 2002). These relationships can be more appealing in order to make use of the knowledge of other firms as it helps to develop a set of resources and capabilities not previously owned. Firms engaged in interorganizational relationships can access external resources without losing control and ownership of what they are sharing. It can also foster both information and knowledge exchange with a common purpose, as they are less demanding regarding the degree of involvement.

In this sense, AC plays a relevant role in stimulating the consequences derived from supply chain integration. In the presence of a high level of AC, firms could create and exploit links with other firms (Caloghirou *et al.*, 2004), which would be a requirement for effective learning from external relationships (Lane *et al.*, 2001). A higher level of AC may provide firms with stronger organizational learning mechanisms. This gives them the opportunity to develop a more productive and stable communication with suppliers and customers in the process of knowledge exchange. This process generates different ideas and solutions that make firms more likely to recognize their value and eventually try to integrate them into their knowledge-base. AC prepares firms to address any challenging situation when developing external relationships such as supply chain integration, be it with customers or suppliers. This makes them learn about difficulties in learning and knowledge acquisition. Firms are therefore more likely to select carefully the firms they want to relate to by optimizing their efforts. AC makes firms more conscious of what they have and what they need. So, firms can decide if a particular relationship has to be terminated or if it has to be developed. In the end, AC enables firms to choose the best

partner according to their common purposes. This will improve the benefits these relationships will generate.

Conversely, a lack of AC can lead to the value of their relationships being overlooked, not knowing how to properly select customers/suppliers or even develop an appropriate relationship with them. Accordingly, those firms with a lower AC may have difficulties in recognizing the worth of new ideas that arise from collaboration. Also, they may have no special ability to integrate those new ideas into their knowledge base. In this way, all the efforts firms make to develop supplier and customer integration may be a waste of resources to the detriment of its performance. Thus, the establishment of close relationships with customers and suppliers might be harmful and have a negative effect on performance (Tsai, 2009).

Although AC may influence the effect of both supplier and customer integration on performance, there are slight differences in these relationships. On the one hand, customers usually have the bargaining power within the supply chain, which could be an obstacle for firms to obtain their joint objective as it may increase transaction costs (Zhao *et al.*, 2008). However, the presence of AC can help firms to understand their customers' needs better and act accordingly while strengthening their relationships. Otherwise, firms can misunderstand the information they are receiving and not be able to develop healthy negotiations with customers and attend appropriately to their needs.

Customer integration may provide relevant information about the product (design, delivery, quality). However, this information has to be translated into valuable products. The knowledge provided by key customers usually requires complex interactions in a process in which both parties develop a process of learning (Presutti *et al.*, 2017). Only if the firm has a high level of AC, will it be able to incorporate this knowledge into the product. This "adjusted" product is a crucial element to increase performance (e.g., sales, profitability, and customer satisfaction). For instance, the environmental performance of the product throughout its life cycle is essential for the customer, but it generates complex information from several sources (e.g., package, transport, mix with another product, waste management systems). Abareshi and Molla (2013) found that addressing environmental concerns requires a process in which environmental information, through a wide range of channels and practices, is acquired, assimilated, transformed, and exploited. Although the focal firm has integrated environmental information about customer demands, it requires an extra level of AC to effectively transform this information into product specifications (knowledge) that increase the value of the product. This leads to the following hypothesis:

*Hypothesis 3: The greater the absorptive capacity, the stronger the relationship between customer integration and performance.*

Supplier integration can usually provide relevant information regarding the technical details of the raw materials and components, which can be incorporated in turn into the focal firm's new product or process specifications (e.g., more efficient, environmentally responsive, or safer). However, this information can only be transformed into knowledge and used by the focal firm for their products and processes when a minimum level of AC is present. Thus, Azadegan (2013) posited that AC allows a manufacturer to understand a technology, method or system better and to predict its future application, increasing its ability to recognize, understand and internalize supplier innovations. He found that AC moderates the association between a firm's supplier operational innovativeness and a firm's operational performance. Similar arguments may be applied in other contexts. For example, horticultural marketing firms have to plan their product-mix using complex technical information (e.g., a variety of crops, seeds, biological pest control or packaging). As suppliers might provide this information, horticultural firms have to interact with them in order to assimilate information and knowledge and transform it into valuable products. Thus, only firms with a relatively high level of AC are able to increase their performance through SI. This leads to our final hypothesis:

*Hypothesis 4: The greater the absorptive capacity, the stronger the relationship between supplier integration and performance.*

### **3. Methods**

#### **3.1. Sample and data collection**

To test these hypotheses, data was collected from Spanish agri-food marketing firms. The literature recommends selecting a sample of firms located in a relatively homogeneous geographical, cultural, legal and political space to minimize the impact of other variables that cannot be controlled in empirical research (Adler, 1983). In particular, this research has focused on the intensive agri-food sector in Southern Spain, which has been an example of success and growth for the past forty years. This is due to its productive specialization, which is based on three main pillars: (a) close ties between production, manufacture, and commercialization; (b) the regular introduction of new product varieties and other crops innovations; and (c) the introduction of quality systems that ensures the traceability of their products.

We identified a population of agri-food firms in two geographical areas, one of them specialized in horticultural products (e.g., peppers, tomatoes, cucumbers) and the other specialized in soft fruits (e.g., strawberries, blueberries, raspberries). Firms in these two areas rely on similar production technologies and compete in similar markets, and this represents an advantage when considering them jointly. In order to collect data, two different sources were used. First, a questionnaire was carried out. Secondly, archival data from *Sistemas de Análisis de Balances Ibéricos (SABI)* database for financial and economic performance was considered.

The questionnaire's design and implementation were carried out in three stages. The first comprised the development of the questionnaire based on the literature and review by academic experts in both the supply chain and agri-food sector. Secondly, the questionnaire was modified to accommodate the academic experts' comments and suggestions. This updated version was pretested on five firms from the sample, which were personally visited to conduct the discussions. Thirdly, the final version was designed drawing on their feedback and sent out to the rest of the firms in the sample.

The survey was managed by a computer-assisted telephone interview system (CATI), which enabled researchers to improve the quality of the responses (Couper, 2011). The initial population was made up of 210 firms located in the South of Spain. This sample was selected from a list of firms classified under the Statistical Classification of Economic Activities in the European Community (NACE) Rev. 2 business code 46.31 (wholesale of fruit and vegetables). For each firm selected, a key point of contact was identified, typically bearing the title of manager, chairman or director, and with knowledge of the firm's internal and external processes. Given the focus of this study, the appropriate respondents were those horticultural marketing firms involved in the entire productive process, from production and transformation to distribution.

Of the initial sample of 210, 35 of them were impossible to locate because their contact information was not up-to-date, 30 refused to participate, and 45 were unavailable due to their work commitment. A total of 99 questionnaires were finally completed and included in this study. Respondents were mainly CEOs (71%), operations managers (20%) and others, such as quality or sales manager (9%). The average length of experience in their position was 12 years. One of the most frequent sources of common method variance is the use of a single survey respondent for obtaining both the independent and dependent variables (Podsakoff *et al.*, 2003). To mitigate this concern, we collected information from different sources, using primary and secondary data. We also performed an exploratory factor analysis with all primary data to assess common method bias. The results showed four factors with eigenvalues above 1.0

accounting for 80.54% of total variance. The first factor explained 24.52 % of the variance. This suggests that the common method bias does not appear to be a serious concern in this study.

To assess potential late response bias, a test was conducted using the extrapolation method suggested by Armstrong and Overton (1977). According to these authors, people responding late can be assumed to be similar to people who do not respond. Thus, the sample was divided into two groups: the first and the second half of the respondents. Following that, the demographic characteristics of assets, annual sales, and the number of employees of early and late responses were compared. At the same time, five items in the questionnaire were randomly selected and also compared. No significant differences were found between early and late responses. Accordingly, non-response bias is unlikely to be a significant concern in this study.

### **3.2. Measures**

The questionnaire was based on previously validated measures. The literature was surveyed to identify valid measures for related constructs and adapted existing scales. Thus, the variables used in this research were developed according to the following description (see Table 1):

Dependent variables:

According to Ataseven and Nair (2017), the association between internal and external integration and performance considers several measures such as growing sales, return on investment and the profit margin on sales and overall business performance. In this study, it is considered relevant to measure performance in two different approaches: financial and economic. Following Rothaermel and Alexandre (2009) and Zahra and Hayton (2008), when studying absorptive capacity, the return on equity (ROE) becomes a good proxy of financial performance because it assesses how efficiently a firm uses its resources. Analogously, Li and Xu (2016) and Michelino *et al.* (2014) consider that Earnings Before Interest and Tax (EBIT) shows higher reliability and objectivity when determining economic performance. Both values were reported in the SABI database. In order to correct the size effect, the economic performance was measured as the ratio between EBIT and the number of employees.

Independent variables:

SCI was measured according to its dimensions: internal integration practices (Flynn *et al.*, 2010) and external integration practices (Flynn *et al.*, 2010; Narasimhan and Kim, 2002). Regarding external integration, this research follows those studies that have kept the supplier and customer elements of integration separate, with the purpose of analyzing their potentially distinct relationships with performance (Narasimhan and Kim, 2002; Shah *et al.*, 2002). Thus,



respondents were asked to rate the extent to which statements regarding information exchange and involvement with both suppliers and customers applied to their firm. We included in our survey four items to measure II, adapted from Flynn *et al.* (2010). We used another four items to measure SI, adapted from Flynn *et al.* (2010) and Narasimhan and Kim (2002). Finally, we adapted four items used by Flynn *et al.* (2010) and Narasimhan and Kim (2002) to measure CI. These authors consider the exchange of information and the frequency of the interaction as the more relevant processes to be included in their measures. The items are listed in Table 2. The three dimensions of SCI were considered on a 5-point Likert-scale, where 1 indicates “strongly disagree” and 5 “strongly agree”.

The HPHRP measure was adapted from Derely and Doty (1996) and Collins and Smith (2006). This measure comprises ability-enhancing practices such as training programmes; motivation-enhancing practices such as incentives based on results; and opportunity-enhancing practices such as information sharing. Derely and Doty (1996) identify seven human resource practices, naming them: intensive training, internal career opportunities, employment security, performance appraisals, job descriptions, profit sharing, and participation. Our scale includes at least one item representing said practices. Finally, two of the items were not considered as their factor loadings fall below the 0.50 threshold (see Table 2).

AC has been measured in various ways ranging from proxies such as R&D investment (Cohen and Levinthal, 1990; Stock *et al.*, 2001) to more behavioral measures (Gluch *et al.*, 2009; Azadegan, 2011). In this study, the AC measure was adapted from Azadegan (2011) in order to include prior relevant knowledge and communication network and climate (Tu *et al.*, 2006). Initially, this scale uses five items, however, one of them was excluded as it is directly related to internal integration (in this study internal integration is considered a separate construct). Both HPHRP and AC were considered on a 5-point Likert-scale, where 1 indicates “strongly disagree” and 5 “strongly agree”.

Control variables:

Additionally, three different control variables were considered. First, age was considered as a proxy for the firms’ accumulated knowledge base, being measured with the natural logarithm of the number of years elapsed since the firm’s foundation. Second, firm size was chosen because it may affect performance as it is supposed that larger firms possess greater and more heterogeneous resources for learning (Wagner, 2010). This is measured according to the number of employees, calculated as the natural logarithm of said number. A third control variable was considered because of the characteristics of the sector. The horticultural sector is internationalized so that firms usually obtain significant revenue from international markets.

So, the natural logarithm of the total amount of revenue coming from international markets was used.

[Table 1 over here]

#### 4. Results

A confirmatory factor analysis (CFA) was conducted to assess convergent and discriminant validity. The CFA results suggested that the model provided a good fit for the data. The ratio of  $\chi^2$  (217.57) to degrees of freedom (157) is less than the recommended value of 3.0 for a satisfactory fit of a model to data (Hair *et al.*, 1998). All individual items in the measurement model had standardized coefficients that were significant ( $p < 0.001$ ), indicating that the constructs exhibited convergent validity. Collectively, these results provided evidence of convergent and discriminant validity (see Table 2). The Cronbach's alpha reliability coefficient was computed, which ranged between 0.70 and 0.91. The values of composite reliability (CR) were also computed, which ranged from 0.71 to 0.92, and the values of average variance explained (AVE), ranging from 0.50 to 0.74. Table 3 shows the correlation matrix, means, and standard deviation of the construct used in the research model.

[Table 2 over here]

[Table 3 over here]

To examine whether HPHRP and II have a positive and significant effect on AC, ordinary least squares (OLS) regression was used to test hypotheses 1 and 2. To test the moderating effects (hypotheses 3 and 4), two hierarchical regressions were carried out. As two dependent variables are considered in the research model (financial and economic performance), a hierarchical regression analysis was performed for each dependent variable separately. Thus, control variables and CI, SI, II and AC variables were first entered in a baseline model (model 1 and 4). The interaction terms between CI and AC (hypothesis 3), and between SI and AC (hypothesis 4) were then entered into the model separately (model 2 and 3 for economic performance and model 5 and 6 for financial performance). As the cross-product (interaction) term might be highly correlated with their constituent parts, the variables used in the interaction terms were mean centered (Aiken and West, 1991) to increase the possibility of interpreting interactions and to avoid multicollinearity. In both models, variance inflation factors were under 3, which are well below the generally accepted threshold of 10 (Cohen *et al.*, 2013).

[Table 4 over here]

The results in Table 4 indicate that the relationship between II and AC although positive is not statistically significant. This result does not support hypothesis 1 ( $\beta=0.035$ ,  $p>0.01$ ). However, the estimated coefficient of HPHRP is positive and significant, which supports hypothesis 2 ( $\beta=0.3788$ ,  $p<0.001$ ). Table 5 shows the relationship between AC, SCI, the interaction terms, and performance. The results indicate that AC positively moderates the relationship between CI and performance both when economic performance ( $\beta=3.0423$ ,  $p<0.05$ ; model 2) and financial performance ( $\beta=0.1586$ ,  $p<0.05$ ; model 5) are considered. These results fully support hypothesis 3.

The fourth hypothesis states that AC positively moderates the relationship between SI and performance. In the case of economic performance, results yield support for hypothesis 4 ( $\beta=1.8875$ ,  $p<0.05$ ; model 3), which indicates that high levels of AC increase the effect of SI on the economic performance. Meanwhile, when financial performance is considered, hypothesis 4 is not supported ( $\beta=0.1228$ ,  $p>0.10$ , model 6). Together, these results partially support hypothesis 4.

[Table 5 over here]

The predicted relationships between CI and performance at different levels of AC are plotted in Figure 2 (economic performance) and Figure 3 (financial performance). Figure 2 illustrates that there is a much stronger positive relationship between CI and economic performance when AC is high. Likewise, under low levels of AC, an increase in CI is associated with lower levels of economic performance. When financial performance is considered (Figure 3), similar relationships are found. These results show the positive moderating effect of AC when considering the relationships between CI and both economic and financial performance.

[Figure 2 over here]

[Figure 3 over here]

Figures 4 and 5 highlight that for firms with high levels of AC, SI is associated with the greater positive impact on performance (economic and financial). In contrast, SI has a negative impact on a firm's economic performance or minimal impact on a firm's financial performance when

AC is low. These results show the positive moderating effect of AC on the relationship between SI and performance.

[Figure 4 over here]

[Figure 5 over here]

## **5. Discussion**

### **5.1. Discussion of results**

This study focuses specifically on two antecedents of AC in the context of supply chain management. First, our results provide support for previous findings (e.g., Minbaeva *et al.*, 2003) that some human resource management practices (e.g., HPHRP) promote firms AC development, by enhancing employees' abilities, motivation and opportunities. These relationships are aligned with previous arguments and findings that associate HPHRP with organizational learning (e.g., López *et al.*, 2006). Thus, these results suggest that human resource management practices favour the capacity of the firm to understand, exploit and disseminate critical external resources, such as information and knowledge (Jansen *et al.*, 2005). HPHRP may impact the ability and motivation of employees to seek, select and apply information. Employees with more experience and expertise ensure that the process of information absorption is enhanced and act in accordance with the firm's expectations.

Second, we have not found support for the notion that the internal dimension of SCI has a positive relationship with AC. This notion was based on the idea that when a firm prioritizes its internal integration processes, it obtains progressive AC derived from the establishment of routines and internal networks to manage both the acquisition and the transformation of information (Jones and Craven, 2001). Although II might include some formal mechanisms to share information among different areas within the firms effectively, higher levels of II are not associated with a higher AC in our sample. It may be explained by the fact that most internal integration activities are common practice. For example, information integration among internal functions or real-time integration among internal functions are usually accomplished through an ERP software which is extensively used in the sector. Additionally, this result may be attributed to the role of II as an enabler of external integration in the supply chain (Yu *et al.*, 2013).

In addition, this study incorporates the moderating role of AC between external SCI and performance, both financial and economic. Although both theoretical arguments and many empirical pieces of evidence support a positive and direct effect of SCI on performance (e.g.,

Liu *et al.*, 2013), this study has not found a positive relationship between CI, SI, and performance. It has found however that this relationship is moderated by AC. Other studies have analyzed the moderating role of AC to explain the performance of business processes (e.g., Agostini *et al.*, 2017). Our results provide additional evidence to support the importance of this role in the context of SCI.

## **5.2. Implications and contributions**

The theoretical and empirical analysis of AC in the ambit of supply chain integration management has several implications for both theory and practice. First, our arguments provide useful insights into the antecedents of AC. This study is one of the first to provide empirical evidence of the positive relationship between human resource management practices and AC in firms integrated into supply chains. In doing so, we extend existing theory by identifying additional factors that explain the development of AC. Second, this research offers an understanding of how AC can be exploited to enhance the positive effect of external integration on performance. Therefore, it contributes to the literature, which has analyzed the relationships between SCI and performance considering the firm's internal moderators (Tarifa-Fernandez and de-Burgos-Jimenez, 2017). The interpretation of these results suggests that only firms with high levels of AC are able to enhance economic and financial performance by obtaining the benefits associated with the external integration of the supply chain. Third, the process orientation requires the integration of customers and suppliers in the supply chain (Miri-Lavassani and Movahedi, 2018). Our results also suggest that the development of AC is essential for process orientation in order to achieve improved performance.

The moderating role of AC may be particularly important in industries where there are vast quantities of technical information from customers and suppliers, but environmental uncertainty is high, and the process of assimilation is relatively complex. For example, in the intensive agri-food sector, there is a high number of differentiated suppliers, and consumer trends are complicated to predict. Specific crises associated with food security and health concerns, complicate the integration of information and the creation of new knowledge. Suppliers and consumers sometimes launch contradictory messages, on matters that affect production and sales planning. Therefore, the mere integration of consumers and suppliers is not sufficient. Firms need to develop their AC to acquire and generate new valuable knowledge from external information sources in order to adopt new strategies and extend their sales and operations planning processes to include key customers and suppliers. It is possible that companies that do

not have a sufficient AC level invest excessively into tools to facilitate external integration may decrease their performance.

In short, this study enriches the current understanding of the relationships between SCI and performance and also helps explain why some firms achieve higher performance than others with the same level of integration. Some implications for practices can be identified in this study. The most significant is that firms should invest simultaneously in improving their AC and their levels of integration with customers and suppliers to obtain a competitive advantage. Higher investment in the implementation of HPHRP is crucial to improving a firm's AC while II has no apparent impact on AC.

### **5.3. Limitations and extensions**

Despite the contributions of this study, its findings should not be interpreted without recognizing its limitations. For example, the possibility of common method and survey non-response biases may be a concern. This work has applied some tests for analyzing common method bias and potential late response bias, but it is not possible to ascertain with certainty if these problems do not exist in our research. For example, although our sample seems to be representative of the population, respondents and non-respondents may differ on unmeasured variables. Also, this study does not control some variables (e.g., exploratory and exploitative learning processes) and some moderators (e.g., uncertainty and environmental complexity) that may influence the dependent variables (AC and performance) or moderate the relationship between AC and performance. Future research examining these antecedents and moderators will contribute to the SCI literature and expand the findings of this study.

The fact that the sample population used in this study is restricted to firms in a specific industry and geographical area may be a limitation, as it hinders the possibility of extrapolating its results. Future research may extend this study to a broader population of firms in the manufacturing or service sectors to detect potential differential effects. For example, the characteristics of the industry determine a direct or indirect effect of SCI on firm performance, the antecedents of AC, and the role of AC as a mediator in the relationship between external integration and firm performance could be analysed.

## **6. Conclusions**

The primary objective of this study was to investigate the role of AC in the process of SCI. This study has considered II and HPHRP as antecedents of AC, and, in turn, AC as a moderating variable in the relationship between external integration and performance. In short, the

empirical results suggested that only HPHRP are directly related to the development of AC within a firm. In addition, this study provides evidence that AC positively moderates the relationship between CI and SI and performance. Firms with higher levels of AC enhance the positive effects of supply chain external integration on financial and economic performance. In a context of growing uncertainty, firms have to integrate customers, key suppliers, and partners into their internal supply chain business processes. This study stresses the importance of simultaneously evaluating investment in tools and processes (e.g., information technologies) that facilitate external integration in the supply chain, and the investment necessary to develop AC. Both external integration and AC are necessary to gain a competitive advantage. Our study emphasizes the central role of AC in the process of generating and applying knowledge, which highlights the improvement in the set of business processes that constitute the SCI, thus contributing to the increase of the individual performance at firm level as well as the general performance of the supply chain.

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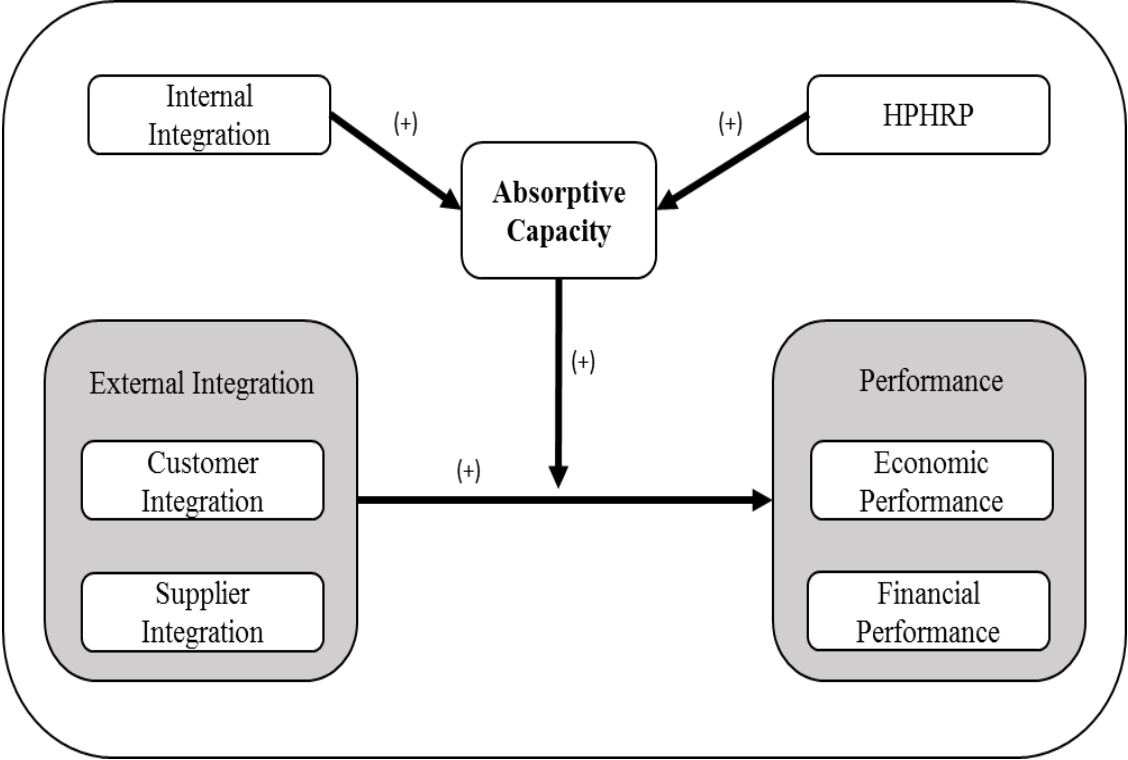
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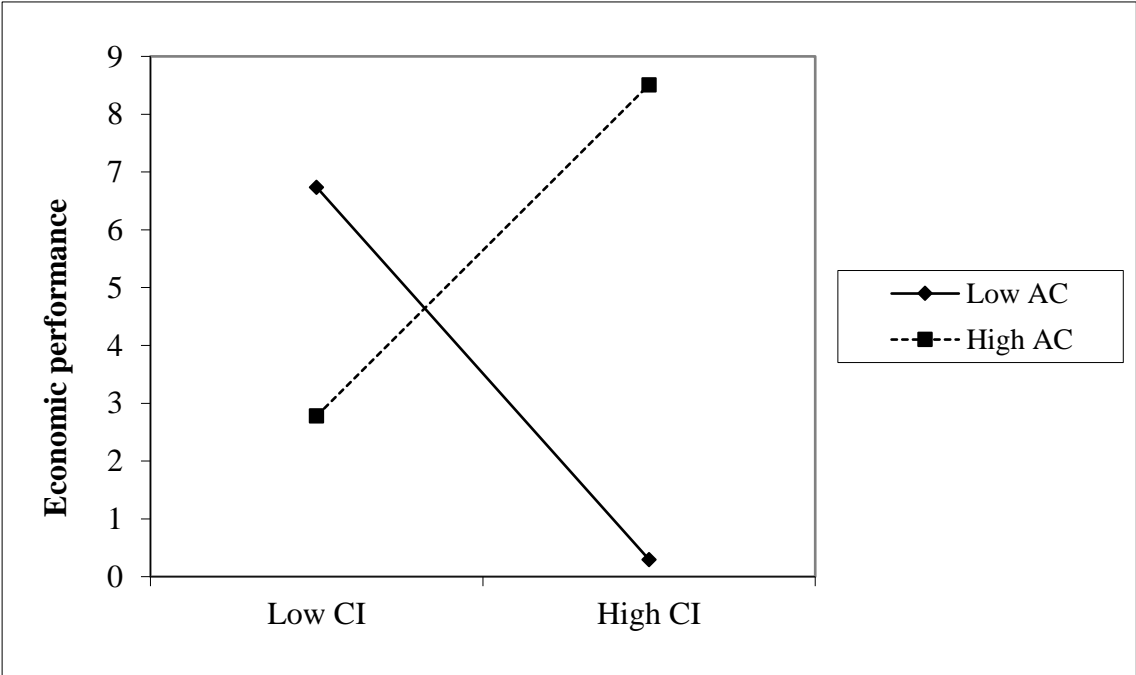
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**Figure 1. Research framework**

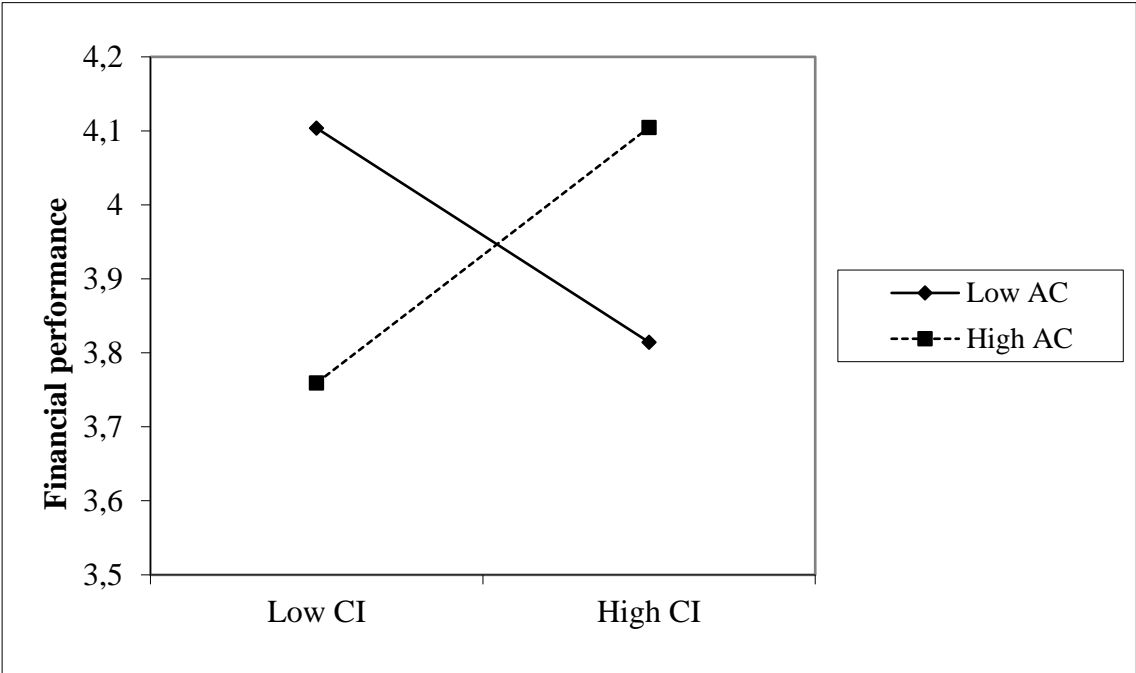


**Figure 2. Moderating effect of AC over CI and economic performance**

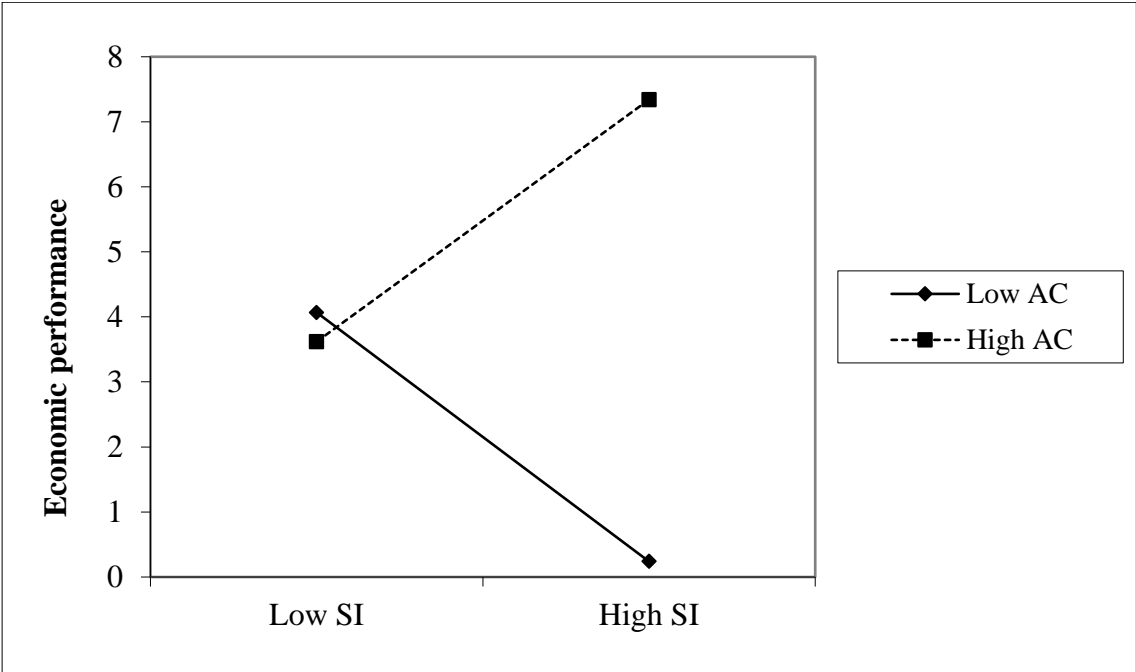




**Figure 3. Moderating effect of AC over CI and financial performance**



**Figure 4. Moderating effect of AC over SI and economic performance**



**Figure 5. Moderating effect of AC over SI and financial performance**

