

The Mediator Effect of Supply Chain Agility for Firm Performance

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Abstract

We use data from 231 Spanish firms to find that supply chain agility mediates the relationship between absorptive capacity and firm performance. According to our results, supply chain agility may contribute to explain why absorptive capacity improves firm performance; firms with supply chains more agile may benefit more from their efforts in absorptive capacity to improve firm performance.

Introduction

The current business environment is characterized by growing global competition which makes more difficult to achieve sustainable competitive advantages. Several scholars point out that individual businesses no longer compete as solely autonomous entities, but rather as supply chains (Zimmermann et al., 2016; MacCarthy et al., 2016). A supply chain in its most basic form is the firm, its suppliers and customers. There is a growing need for firms and their supply chains to respond quickly to market changes as well as to keep updated their technology and knowledge portfolio, either through in-house R&D or by managing adequately the use of external knowledge. Two very important dynamic capabilities that become sources of sustainable competitive advantages are absorptive capacity and supply chain agility.

On the one hand, absorptive capacity is relevant because it assesses the firm's ability to identify, assimilate, transform, and apply valuable external knowledge to their own processes or operations in order to obtain a competitive advantage. Consequently this capacity allows the company to keep technologically updated and adapted to market changes from the perspective of knowledge and innovation. On the other hand, supply chain agility is the firm's ability to respond quickly to unexpected market changes which is very important in highly dynamic environments (Swafford et al. 2008; Fayezi et al., 2015). Both agility and absorptive capacities may influence positively firm performance. Considering today's constantly changing environment and the shift of competition to a supply chain level, an organization's absorptive capacity (AC) and supply chain agility (SCA) becomes critical elements affecting its global competitiveness (Lee, 2004; Swafford et al. 2006).

However the relationship between both dynamic capabilities and their impact on firm performance is very little studied. This relationship is important because of the need of creating dynamic capabilities to compete in a global economy. Since innovation is increasingly open and multidisciplinary, firms must create synergies among different dynamic capabilities to focus more on intangibles to improve performance.

Therefore these two dynamic capabilities may explain much better firm performance if they could be jointly analyzed. On the one hand, AC is a fundamental capability to track market changes by in-house learning from past experiences and by assimilating external knowledge. AC is also relevant to establish relationships with other agents in the supply chain because the diffusion of good practices is a frequent goal for supply chains. Within this framework of analysis, SCA may contribute to respond quickly to environmental changes as well as to improve firm performance by making absorptive knowledge more productive throughout the supply chain. There are quite a few empirical evidences in the literature about the positive relationship between AC and firm performance (i.e., Lane et al. 2006; Dobrzykowski et al. 2015) but this relationship has been less studied within a supply chain framework. There is also less research about the causal mechanisms which could explain that relationship.

Then, the main purpose of this paper is to analyse whether SCA mediates the relationship between AC and firm performance. By proving this mediator effect we could propose SCA as a causal mechanism that explains how AC improves firm performance. If we could demonstrate that SCA is a mediator there would be important managerial implications to justify, for instance, the need of seeking synergies between both dynamic capabilities which is much desirable but little tested.

The paper is structured as follows. First we review the literature and develop the research hypothesis. Then we explain the methodology of the empirical study followed by the results and their discussion with managerial implications. Finally we end with conclusions and limitations.

Theoretical foundation and hypothesis development

The resource-based view of the firm and the dynamic capabilities perspective

To theoretically develop our arguments we rely on the resource-based view of the firm (RBV) augmented with the dynamic capabilities perspective, since both perspectives contribute to explain the competitive implications of AC and SCA. On the one hand, the basic premise of the RBV is that a firm's competitive advantage lies primarily in the application of bundles of resources that are valuable, rare, in-imitable and non-substitutable (Barney, 1991). The RBV has received considerable attention by scholars in business management but its popularity has also been increasing in the field of production and supply chain management research. For example, Hsu et al. (2011) utilise the RBV to establish the link between entrepreneurial supply chain management competence, supply chain management strategies and firm performance.

On the other hand, the dynamic capabilities perspective considers that accumulating resources is not enough. To be competitive firms need capabilities to integrate, reconfigure, develop and apply resources (Teece et al. 1997). Effective dynamic capabilities contribute to a firm's competitive advantage by enabling a series of temporary advantages, which allow a firm to stay ahead of competitors and maintain a competitive advantage (Teece, 2007).

Absorptive Capacity

The concept of absorptive capacity (AC) was initially proposed by Cohen and Levinthal (1990): they showed that companies cannot benefit from external flows of knowledge, simply by being exposed to them; instead, companies must develop the ability to recognize the value of external knowledge to assimilate and use it afterwards for commercial purposes. The initial typology of three dimensions (identify, assimilate and exploit knowledge) was later expanded by other scholars. For instance, Zahra and

George (2002) proposed four dimensions that have been used by several scholars thereafter: acquisition, assimilation, transformation and exploitation of new knowledge. In this typology of dimensions, the phase of acquisition refers to the identification of new knowledge and how it is transferred from one firm to another; the assimilation indicates the firm's ability to use its resources, skills and routines to assimilate the acquired knowledge; the transformation implies the combination of external and in-house knowledge to suit the firm's needs; and finally, the exploitation means to achieve firm goals that compensate the effort and resources invested in the previous phases.

AC becomes a firm's dynamic capability that it is valuable and difficult to imitate by competitors because it depends heavily on the trajectory and prior knowledge of each firm (Volberda et al. 2010). This capability becomes then something scarce, difficult to imitate and replace that contributes to obtain competitive advantages ahead of competitors. The four dimensions of AC coexist and reinforce each other to make AC a dynamic capability that encourages innovation and improves performance (Patterson and Ambrosini, 2015).

Supply Chain Agility

Supply chains are configurations of firms that work together in the network which constantly needs to improve their operations and capacity, either by suppliers or customers. Supply chain agility (SCA) can be considered a dynamic capability that enables firms to adapt to changes and provide quick responses throughout the entire supply chain (Lee, 2004; Lin et al. 2006; Swafford et al. 2006). Like AC, SCA is also a broad and multi-dimensional concept bridging many disciplines. As the positive impact of agility has gained recognition, researchers have offered different conceptualizations of agility, and put forth a variety of normative frameworks to suggest relationships among variables of interest within the domain of agility. For the purpose of our study we focus on frameworks that seek to identify the "across firms" enablers of agility or the characteristics that a supply chain must have to be agile because other frameworks that have an internal, single-firm focus are not so theoretically useful to establish links between AC and SCA. We used the framework introduced by Christopher et al., (2004) and also adapted by Agarwal et al., (2006) and Ngai et al., (2010). This framework considers market sensitivity, process integration, network based and virtual to be the main characteristics of an agile supply chain.

First, thanks to the dimension of market sensitivity, supply chains may respond to real demand and anticipate better the market's opportunities and threats. Virtual supply chains refer to supply chains based on information rather than inventory which can be achieved through the use of information technology to share data online between buyers and suppliers. Similarly, agile supply chains create collaborative networks among members, because only firms with a high level of collaboration are able to respond quickly and effectively to market changes. Finally, the process integration means working collaboratively between buyers and suppliers, joint product development, common systems and shared information. Supply chains with these characteristics are able to adapt faster to market changes and be more competitive (Yusuf et al. 2014; Tse et al. 2016).

The mediating effect of SCA in the relation between AC and firm performance

The firm's knowledge has always been considered by the RBV as a key resource to obtain competitive advantages over competitors, However, there is a lack of studies that explain how knowledge flows between supply chain members, or how new knowledge influences the management of supply chains (Yang, 2014; Gligor et al. 2015). Within this framework of analysis we want to study if SCA mediates the

relationship between AC and firm performance. This analysis is important because it would suggest that AC can be transformed via SCA into superior performance. Firms with a higher AC are initially better positioned to obtain superior performance due to all the new knowledge that is acquired, assimilated, transformed and applied, but the question remains if this improvement may be greater where conditions of SCA are more favourable.

SCA has been analysed as a mediating effect in a few studies. For example, Vickery et al. (2010) tested the mediating role of agility in the relationship between antecedents (supply chain information technology and supply chain organisational initiatives) and firm performance. Agility also was posited by Swafford et al. (2008) as a mediator linking the effect of information technology integration to competitive business performance. Similarly, Blome et al. (2013) found a mediating effect in the relationship between supply- and demand-side competence and performance, and Danese and Romano (2013) found that a fast supply network structure influences the relationship between customer integration and efficiency performance. In our paper we suggest that SCA is the capability that enables AC to adapt to the changing environment and ultimately lead to elevated performance.

Greater AC allows firms to have more updated knowledge and of their entire supply chain (Whitehead et al., 2016). First, firms with a greater AC are more able to adapt to their customer needs and to identify market changes more quickly. Second, thanks to this updated knowledge firms may understand more precisely all the processes and interactions between supply chain members. Thus, firms may be in a better position to improve the effectiveness and efficiency of internal processes, and also to improve their timing and relationships along the supply chain. Additionally, new knowledge should enable firms to remain constantly at the technological forefront which is most relevant for SCA. Therefore we propose:

Hypothesis: SCA mediates the relationship between AC and firm performance.

Methodology

We first reviewed the literature to elaborate a web questionnaire that was addressed to the company's CEO or Supply Chain Manager from a selected population of 1,450 Spanish firms included in the SABI (*Sistema de Análisis de Balances Ibéricos*) database. The selected population includes firms involved in the manufacturing of automotive products, machinery, electronic and other electrical equipment, pharmaceutical and health products, food & beverages, textiles, footwear, paper, furniture, storage and activities connected to goods transportation. We purposefully included these industries with the expectation of them possessing needs of AC and SCA, as well as being situated in a dynamic environment.

Data were collected by a web platform where selected users accessed privately to fill out the questionnaire online. This way we could check if the persons who answered the survey were the most knowledgeable people about this subject. In order to increase response rate, participants were offered an executive summary of the research findings. Close monitoring of survey from May to December 2013 was conducted by a letter invitation from our University about the purpose and objectives of the study followed by three personalised reminder e-mails and a phone call to the selected managers.

The population of study involves 1,450 firms from the SABI database. In total 416 firms returned the questionnaire but we eliminated 174 firms due to partial responses and another 11 firms due to inconsistencies or mistakes not clarified.

Therefore, the final sample for our empirical study was 231 firms with a response rate of 15.93%, which is similar to other empirical studies of SCA (e.g., Blome et al. 2013). The distribution of responses by firm size indicates that 32.9% are small firms (less than 50 employees), 32.03% are medium sized firms and 35.06% are large firms (more than 250 employees).

We elaborated the questionnaire after a thorough review of the literature. The two theoretical constructs of our research model constitute latent variables requiring indirect measures. *Absorptive capacity* (AC) was operationalised using survey items from Camisón and Fores (2010) scale and *Supply Chain Agility* (SCA) from Lin et al. (2006) scale. AC includes four dimensions: acquisition (4 items), assimilation (6 items), transformation (5 items) and exploitation (4 items). SCA involves four dimensions as well: market sensitivity (4 items), process integration (5 items), network based (8 items), and virtual (4 items). Finally, firm performance is operationalised by items indicating a firm's competitive position in terms of return on sales, return on assets and market share. Questionnaire items were reviewed by five independent experts: 2 researchers and 3 supply chain industry professionals to ensure proper understanding and content validity. These experts knew the scope and purpose of our study and as such they were helpful to tailor the measurement items with their feedback. A seven-point rating scale ranging from 'strongly disagree' (value=1) to 'strongly agree' (value=7) was used to assess the respondent's degree of agreement with the measurement items.

Cronbach's Coefficient Alpha exceeds 0.90 for all constructs and dimensions which indicates satisfactory simple reliability. Composite reliability (CR) also exceeds the suggested minimum of 0.7. Construct validity was examined through the adequacy of the model's fit and both convergent validity and discriminant validity. To test the mediating effect of SCA in the relationship between AC and firm performance, we used the methodology proposed by Baron and Kenny (1986) with a focus of structural equations modelling (SEM), in which a structural equation model is adjusted in four successive steps. We use firm size, industry and R&D effort as control variables because other studies have found to be them relevant for both AC and SCA.

Results

Table 1 shows the test results of the SCA mediating effect in the relationship between AC and firm performance, according to the four-step methodology explained in the previous section. We find in the first step that the relationship between AC and firm performance is statistically significant and positive ($\beta=0.42$ $p<0.01$), which means that the higher the AC of the firm the greater its firm performance. Similarly, the step 2 model is also significant and demonstrates that SCA and firm performance are positively related ($\beta=0.52$ $p<0.01$). AC and SCA are positively related in step 3 model as well ($\beta=0.85$ $p<0.01$). Finally the step 4 tests the mediating effect with a SEM model with all three constructs: SCA, AC and firm performance. The results indicate there is a mediating effect and this effect is total and not partial because the relations between AC and SCA ($\beta=0.85$ $p<0.01$) and between SCA and performance ($\beta=0.4$ $p<0.01$) are statistically significant but the relationship between AC and performance is not. All goodness of fit indicators (CFI>0.9, RMSEA<0.05) show scores above recommendation values which validate our research hypothesis. Then SCA is a capability that makes AC to improve firm performance. AC contributes to firm performance on its own but this improvement is also further obtained if AC contributes positively to SCA. The control variables are not statistically significant which indicates that the mediating effect is independent of firm size, industry, and R&D effort.

Discussion

Our main result is that SCA may contribute to explain why AC is positively related to firm performance. The interchange of knowledge is a key issue for a supply chain's success but is necessary to analyse how knowledge is created and evolves through the relations within the supply chain members. It is also important to clarify the influence of new knowledge in different topics of supply chain management. Our research proposes SCA as a potential mechanism to transform AC efforts in greater firm performance.

Firms with higher levels of AC may be in an advantageous position thanks to new knowledge acquired, assimilated, transformed and applied in areas that benefit SCA. For example, firms with higher levels of AC may be able to identify market changes more quickly, because they should be more sensitive to capture new customer needs, anticipate competitor's moves, new business areas, etc. Similarly, more knowledge related to areas such as demand's information processing, should allow firms to focus more effectively on customers, by increasing the SCA's market sensitivity.

AC may be a key element to contribute positively to supply chain relationships. Due to the assimilation, transformation and exploitation of the most relevant and updated external acquired knowledge, firms may understand much better their customers or suppliers by using this knowledge to improve synchronization with suppliers, to align and coordinate resources along the supply chain, as well as to improve the quick and efficient management of the entire supply chain. AC may also contribute to integrate information because firms can keep updated about information and communication technologies that are used to interchange information along the supply chain with customers, suppliers and other firms. Thus we consider SCA as a mechanism that enables AC to improve firm performance as our research indicates.

This research also suggests several managerial implications. First, managers must think carefully about the importance of updating the flows and stock of knowledge within the company. This renewal, either through the knowledge from their own employees, suppliers, customers, and even competitors, is essential to keep the company adapted to environmental changes. AC is a useful dynamic capability for this purpose. Therefore, managers should pay special attention in promoting this capability, as well as in investing enough resources because enhancing AC increases firm performance.

These resources should aim to improve different aspects of the company; the first one is to have the adequate number of specialists, skilled technicians, scientists and engineers in order to enhance the firm's level of basic knowledge; something related is to dedicate enough resources to employees' training and skills improvement, as well as to promote an innovative and learning culture that facilitates the interchange of information between departments. It is also very important to benefit from the know-how of supply chain members in order to enhance processes' synchronization and efficiency that can improve the understanding of the supply chain and the relationships between its agents.

The second and even more important feature because of the mediator effect we have found is that firms should highlight the importance of SCA. This agility is a real competitive advantage to improve firm's competitiveness in a sustainable way. Nevertheless achieving an adequate level of agility is not an easy task and requires a bundle of plans, actions and efforts. Firms should use agility dimensions in a comprehensive way because they can obtain more synergies and save costs in comparison to implement them separately.

For instance, it is important to allocate resources to improve information flows in the supply chain because supply chain's operations and decisions largely depend upon them. Therefore, increasing supply chain's visibility should be a priority action for any firm. This action's success largely requires collaboration between supply chain members because effective and on-time flows of information are needed. Increasing supply chain's visibility beyond traceability also contributes to enhance collaboration between supply chain members because it is easier to identify key indicators in order to implement strategies and systems of incentives that facilitate and operationalize such collaboration.

Finally, firms must acknowledge that dedicate technology or production resources to the supply chain does not guarantee a sustainable competitive advantage because there are many influential factors such as market dynamism. It is precisely here where the other dynamic capability analysed in this paper, AC, plays a key role. AC enables firms to stay adapted to market and environmental changes that, in turn, facilitate to regenerate their base knowledge in order to use it for new operations and innovation activities. At this point it is necessary to coordinate strategically both capabilities: SCA and AC. This paper demonstrates that they are directly related to firm performance but that there is also a mediator effect of SCA in the positive relationship between AC and performance. This effect should be taken into account by managers in order to find the best way to coordinate and integrate both capabilities to improve firm performance even further. The improvement of AC would positively influence SCA dimensions that in turn would additionally improve firm performance.

Conclusions, limitations and future research

This research has analysed the mediator effect of supply chain agility in the relationship between absorptive capacity and firm performance, and found that this mediator effect is total and not partial. The empirical evidence contributes to the study of supply chain competitiveness because it arouses the need to leverage both dynamic capabilities (SCA and AC) in order to look for further synergies upon the improvement of firm performance. Our data suggest that AC can be transformed via SCA into superior performance.

The article discusses implications for industrial management but they should be considered in relation to our main research limitations: cross-sectional analysis and constructs (SCA and AC) measured by managerial perceptions would require replications with real measures and longitudinal data. This is also a single-country study but we believe that supply chains are increasingly globalized and therefore the presence of multinational and international suppliers in our sample seems to suggest that the results for Spanish firms may not be so different from other countries.

Future research could incorporate new variables in the study of the relationships between AC and firm performance, SCA and firm performance or the mediator effect of SCA between AC and firm performance. Some of these variables could be related to the company itself, for example, firm's corporate culture or organizational structure, in order to answer questions that were suggested by our results such as: Do companies with certain corporate culture have higher AC? Does AC influence more positively performance on those firms? Are some firms more agile according to their type of organizational structure? Do firms perform better when they coordinate more their AC and SCA capabilities? Getting answers to these questions would be a useful source of information to improve supply chain management in this global context where knowledge management is increasingly important.

Acknowledgement

This research was supported by the grant ECO2014-56912-R from the Spanish Ministry of Economics & Innovation.

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Table 1. SEM models

Step 1: Absorptive Capacity (AC) → Firm performance		
Variable	Firm performance	
Absorptive capacity	0.42**	
Fit	Chi-Square= 1752.94, d.f.= 276, NNFI= 0.912, RMSEA= 0.045 CFI= 0.924, IFI= 0.925 *p<0.05; **p<0.01	
Step2: Supply chain agility (SCA) → Firm performance		
Variable	Firm performance	
Supply chain agility	0.52**	
Fit	Chi-Square= 2954.4, d.f.= 465, NNFI= 0.906, RMSEA= 0.047 CFI= 0.915, IFI= 0.916 *p<0.05; **p<0.01	
Step3: Absorptive capacity (AC) → Supply chain agility (SCA)		
Variable	Supply chain agility (SCA)	
Absorptive capacity	0.85**	
Fit	Chi-Square= 1100.52, d.f.= 193, NNFI= 0.922, RMSEA= 0.046 CFI= 0.934, IFI= 0.935 *p<0.05; **p<0.01	
Step4: SCA mediating effect in the relationship AC → Firm performance		
Variable	Absorptive capacity (AC)	Firm performance
Absorptive capacity	-	0.08
Supply chain agility	0.85**	0.48**
Fit	Chi-Square= 1654.94, d.f.= 199, NNFI= 0.919, RMSEA= 0.047 CFI= 0.93, IFI= 0.931 *p<0.05; **p<0.01	