The relationship between ambidexterity, supply flexibility and supply chain performance: an empirical analysis

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Abstract

The purpose of this paper is to examine the relationship between Supply Chain (SC) ambidexterity, Supply Flexibility (SF), and SC performance, and to analyze the combination of SC exploration and exploitation associated with the different levels (low and high) of SF. The proposed research models and hypotheses are tested using cross-sectional survey data from a sample of 302 Spanish manufacturing firms. Our results suggest that the deployment of SC ambidexterity has a positive impact on performance through SF when the company has a high level of SF.

Keywords: Supply chain management, supply flexibility, ambidexterity.

Introduction

Ambidexterity is the ability of companies to explore new and to exploit existing competences simultaneously (Raisch et al., 2009). Recent studies argue the increasing importance of ambidexterity in achieving a sustainable competitive advantage in the long term. However, the results from studying the relationship between ambidexterity and performance have been mixed. A need thus remains to re-examine this relationship (Tamayo-Torres et al., 2017). Junni et al. (2013) suggest the presence of mediators in the exploration and exploitation - performance relationship.

Supply flexibility is defined as achieving availability of materials and services of the necessary quality, and the ability to acquire them effectively in response to changes in the requirements (Moon et al., 2012). Adler et al. (2009) conclude that the combination of exploration and exploitation activities leads to improvement in flexibility. Other studies propose that the effects of SC flexibility on the SC itself be evaluated

(Stevenson and Spring, 2009; Blome et al., 2013). The purpose of this paper is to examine the relationship between Supply Chain (SC) ambidexterity, Supply Flexibility (SF), and SC performance.

Although ambidexterity theory has been applied to SC management, little attention has been paid to the possibilities of balancing and combining exploratory and exploitative practices to improve firms' competitiveness (Gualandris et al., 2018). This need becomes more important because the effect of flexibility on SC performance is controversial (Pujawan, 2004; He et al., 2012). There is also a need to determine the correct combination or balance of both SC ambidexterity practices to enhance SC. The literature review shows how the construct of ambidexterity has been operationalized independently of balance (He and Wong, 2004) or combination of exploration and exploitation practices (Gibson and Birkinshaw, 2004). Very diverse and even contradictory results have been obtained for the impact of ambidexterity on performance and other organizational variables. This study thus also seeks to analyze the differences between balance and combination of ambidexterity practices, and their impact on SC performance based on whether the firm has high or low SF.

Literature review and hypotheses

Ambidexterity and Supply Flexibility

Ambidexterity is the ability of organizations simultaneously to combine the strategic options of knowledge exploration and exploitation. Exploitation includes activities to implement and refine existing knowledge, whereas exploration refers to the experimentation with and discovery of new possibilities (March, 1991; Cao et al., 2009). SC ambidexterity can be defined as the strategy that seeks to develop practices of knowledge exploration and exploitation simultaneously in the SC (Kristal et al., 2010). The prior literature shows that ambidexterity improves the ability to adapt to the environment due to the learning acquired through exploration and exploitation (O'Reilly and Tushman, 2013; Santos-Vijande et al., 2012). Adler et al. (2009) conclude that the combination of exploration and exploitation leads to improved flexibility in the long term. Rojo et al. (2016) analyze the impact of ambidexterity in the SC and how the combination of exploration and exploitation practices facilitates SC flexibility fit.

In Operations Management, flexibility is defined as the ability to change or react to environmental uncertainty with little penalty in time, effort, cost, or performance (Upton, 1994). In the context of the SC, SF has been understood as a measure of the "elasticity" of buyer-supplier relationships to uncertainties in demand and supply conditions (Das and Abdel-Malek, 2003). SF is defined as achieving availability of materials and services of the necessary quality, and the ability to acquire them effectively in response to changes in requirements (Moon et al., 2012). SF permits the firm, on the one hand, to minimize the risk associated with production when it must seek new suppliers rapidly. SF also attempts to adapt continuously the quality requirements of the materials supplied to the changing needs of the environment. According to March (1991), exploration practices enable the search for alternative paths and new modes of performing processes, facilitating the search for new suppliers, generating new forms of collaboration with existing suppliers, and adopting different logistics strategies to obtain a component from a supplier. On the other hand, exploitation practices in the SC permit the flow of components acquired to maintain the level of quality required and reduce uncertainty between the parties (Lummus et al., 2003; Swafford et al., 2006). We thus propose that:

H1: SC ambidexterity has a positive and direct impact on SF.

Supply Flexibility and Supply Chain Performance

The literature review has shown that SC performance is related to various "competitive priorities" (Hult et al., 2006): *Speed* is the ability to deliver on time, according to a set schedule. *Quality* focuses on improving SC processes to increase product reliability and customer satisfaction. *Cost* seeks cost efficiency without losing value for the consumer. Finally, *flexibility* refers to SC agility, adaptability, and responsiveness to the needs of its users. Qrunfleh and Tarafdar (2014) suggest that SC performance should be evaluated in terms of flexibility, integration, and customer responsiveness. The more flexible the relationship with suppliers, the greater the SC performance. Supply flexibility involves a collaborative relationship with suppliers, using continuous improvement techniques to improve the quality of the parties, reduce delivery times, and minimize inventory. As a result, SC performance is enhanced (Wang et al., 2004; Qi et al., 2009). We thus propose that:

H2: SF has a positive and direct impact on SC performance.

Ambidexterity, Supply Flexibility, and Supply Chain Performance

SC exploration is about search and discovery; SC exploitation tasks focus on reducing redundancies in the operational processes. SC ambidexterity improves operational reliability and SC performance in terms of efficiency, agility, quality, or speed (Kristal et al., 2010). According to March (1991), although an ambidextrous SC strategy is expected to impact performance positively, there are difficulties associated with achieving and maintaining the right balance between exploration and exploitation practices. We must thus analyze the benefits of ambidextrous strategy in the form of competitive capabilities to achieve superior performance (Kristal et al., 2010). Along these lines, Junni et al. (2013) suggested the presence of mediators in the exploration and exploitation - performance relationship.

Prior studies conclude that ambidexterity improves the firm's ability to adapt to the environment and to survive (Gupta et al., 2006; Santos-Vijande et al., 2012), and adaptation to the environment requires flexibility. We thus propose that:

H3: SF mediates the relationship between SC ambidexterity and SC performance.

The effect of flexibility on SC performance is controversial, since investment in flexibility has a cost and involves assuming risks (Pujawan, 2004; He et al., 2012). Researchers have proposed the need to study how to achieve the right mix of ambidexterity practices by analyzing the best combination of SC exploration and SC exploitation for each level of flexibility (high or low SF), extending the results of other studies in Operations Management, such as Herzallah et al. (2017) and Chandrasekaran et al. (2012).

Duncan (1976) determines that exploration and exploitation alone are insufficient to sustain competitiveness in a hypercompetitive and dynamic environment. Gualandris et al. (2018) conclude that singular, isolated adoptions of exploratory or exploitative activities do not bring much value; rather, the ability to pursue these activities simultaneously becomes an essential determinant of competitiveness. The literature review thus shows that the construct of ambidexterity has been operationalized independently of whether it is conceived as balance (He and Wong, 2004) or as combination of exploration and exploitation practices (Gibson and Birkinshaw, 2004), obtaining very diverse and even contradictory results for the impact of ambidexterity on performance and other organizational variables. Wang and Li (2008) and Marino et al.

(2015) also suggest that the advantages of the balance dimension of ambidexterity vary under different levels of environmental dynamism. Based on the foregoing, we propose that it is necessary to expand and refine operationalization of SC exploration and SC exploitation, and their impact on different levels of SF and SC performance.

H4: There are statistically significant differences in the relationship between SC ambidexterity (balancing and combining practices) and SC performance, depending on SF level.

Methodology

The hypotheses were tested based on a survey study. The sample of firms was randomly selected from the SABI database, which is composed of 45,166 firms. The data were obtained through computer-assisted telephone interviews (CATI) performed in May 2014. A total of 302 valid questionnaires was obtained, a response rate of 12%.

Measurement items were adapted from existing scales to guarantee their validity and reliability. SC ambidexterity is measured multi-dimensionally through knowledge exploration and exploitation in the SC, according to the scales proposed by Kristal et al. (2010). SF is measured with the scale proposed by Moon et al. (2012). Finally, SC performance was measured using the scale proposed by Qrunfleh and Tarafdar (2014).

Reliability and exploratory factor analysis were performed with SPSS v.22. For confirmatory factor analysis and Structural Equation Modeling (SEM), EQS Multivariate Software version 6.3 was used. The validity and reliability of the scales are presented in Table 1. Additional statistical analyses were applied to the combinations of exploration and exploitation for each SF level.

Table 1 – Factor loading and reliability analysis

Construct	Loadings	t-values	R^2	Scale reliability
SC Exploration				
SCER1	0.764	a[1]	0.584	Composite reliability: 0.895
SCER2	0.810	14.620	0.655	AVE: 0.683
SCER3	0.807	14.567	0.651	Cronbach's alpha: 0.863
SCER4	0.918	16.491	0.843	
SC Exploitation				
SCET1	0.915	a[1]	0.837	
SCET2	0.915	26.890	0.837	Composite reliability: 0.958
SCET3	0.951	30.182	0.903	AVE: 0.852
SCET4	0.912	24.525	0.832	Cronbach's alpha: 0.958
Supply Flexibility				
SF1	0.821	a[1]	0.674	Composite reliability: 0.884
SF1	0.834	15.993	0.696	AVE: 0.717
SF3	0.884	16.584	0.782	Cronbach's alpha: 0.816
SC Performance				
SCP1	0.677	a[1]	0.458	
SCP2	0.828	12.677	0.685	
SCP3	0.785	12.125	0.616	
SCP4	0.784	12.119	0.615	Composite reliability: 0.901
SCP5	0.766	11.870	0.586	AVE: 0.568
SCP6	0.720	11.248	0.519	Cronbach's alpha: 0.901
SCP7	0.703	11.005	0.494	
FCA of second-order constructs	Standardized parameters	t-values	R^2	Scale Reliability
SC Ambidexterity				Composite reliability: 0.940
SC Exploitation	0.918	a[1]	0.844	AVE: 0.887
SC Exploration	0.965	21.001	0.931	Cronbach's alpha: 0.901

CFI 0.964; NFI 0.957; IFI 0.964; GFI 0.921; AGFI 0.842; RMSEA 0.05
[1] a indicates that the parameter was set at 1.0. If a different parameter is set at 1.0, however, the indicator of the scale is also statistically significant

Findings and Discussion

To test our hypothesis, three SEM models were estimated. First, a global model was estimated, which comprises the 302 observations of our sample. The results show a significant and positive relationship between SC ambidexterity and SF (β=0.290; t=12.227; p <0.05), empirically confirming our Hypothesis 1. These results are consistent with those in the prior literature showing that ambidexterity both encourages development of flexibility (Adler et al., 2009) and, when analyzed in relation to the SC context, facilitates flexibility fit (Rojo et al., 2016). Knowledge exploration and exploitation practices in the SC thus permit the rapid search for new suppliers and establish relationships of cooperation between firm and supplier, while also facilitating adaptation of the quality requirements for materials to the changing conditions of the environment.

The results also show a positive and significant relationship between SF and SC performance (β=0.217; t=6.860; p<0.05), and provide empirical evidence to confirm Hypothesis 2. These results are consistent with prior research (Wang et al., 2004; Qi et al., 2009).

Hypothesis 3 states that SF mediates the relationship between SC ambidexterity and SC performance. To test this hypothesis, we followed the procedure of Zhao et al. (2010). The results of their analysis show that the direct relationship between SC ambidexterity and SC performance is significant (β=0.466; t=20.628; p<0.05), as is the indirect relationship, through SF (β=0.163; t=3.229; p<0.05). Thus, SF partially mediates the relationship between SC ambidexterity and SC performance. This can be classified as complementary mediation (Zhao et al., 2010), since the direct and indirect effects have the same sign.

Given the existence of a direct and positive relationship between SC ambidexterity and SF, we analyze the combination of levels of development of SC exploration and exploitation practices that correspond to different levels of SF. To divide the sample into two groups, companies with higher levels of SF and companies with lower levels of SF, we used the average value of SF as the dividing point between the two groups (Chandrasekaran et al., 2012; Herzallah et al., 2017). To proceed with analysis of SC ambidexterity and the orientations of SC exploration and exploitation, we then constructed different measurement methods, some based on multiplication of SC exploration and SC exploitation (SCER x SCET), and others based on the absolute different between SCER and SCET (|SCER-SCET|). Figure 1 contrasts the levels of SCER and SCET for firms with high levels of SF and firms with low levels SF. Both figures show that firms with high levels of SF (represented by squares) are located in the top portion of both graphs, signifying that this group of firms generally develops its SCER and SCET orientations more fully than do firms with low levels of SF (represented by diamonds). On the other hand, the dispersion levels of both graphs are similar, for both the high- and low-level groups (squares and diamonds, respectively).

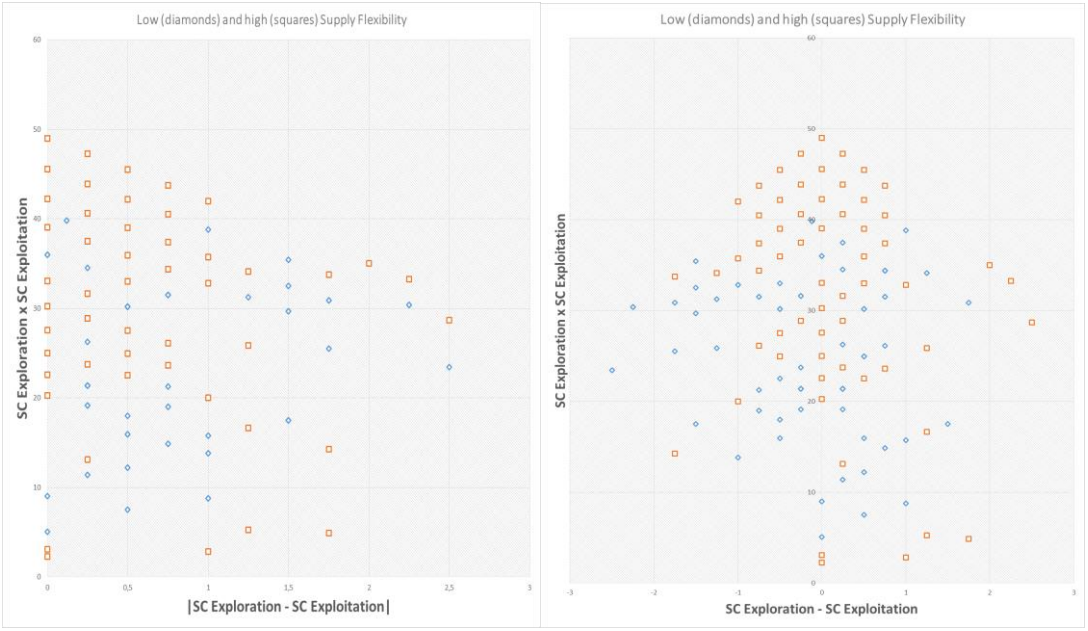

Figure 1 – SC exploration, SC exploitation, and SF measurement

Table 2, which includes the descriptive statistics of all of the variables, confirms these results.

Table 2 – Descriptive Statistics

Variable		Mean	SD	CV	Min	Max
SCER	High SF	6.10	1.05	0.17	1.50	7.00
	Low SF	5.46	0.96	0.17	2.25	7.00
SCET	High SF	6.09	1.15	0.19	1.25	7.00
	Low SF	5.58	1.03	0.18	2.25	7.00
SC Ambidexterity		5.98	0.85	0.14	2.29	7.00

Second, Table 3 shows the different percentages of firms for each of the groups, according to the SCER and SCET levels.

Table 3 – Proportions of firms, according to different levels of SCER and SCET

Group	SCER – SCET < 0	SCER – SCET = 0	SCER – SCET > 0
High SF	31.79	34.44	33.77
Low SF	41.72	20.53	37.75
Total	36.75	27.48	35.76

Finally, to confirm the foregoing results statistically, we performed a comparison of means for SCER and SCET for both groups (Table 4). The results show no significant differences between orientations to SCER and SCET for firms with high levels of SF (*t*-value=-0.027; *p*-value=0.821). Firms with low levels of SF, in contrast, show a significant difference between orientation to SCER and SCET (*t*-value=2.086; *p*-value=0.039), with higher levels of SCET than of SCER.

Table 4 – Mean difference t-tests

Variable 1 (Group)	Variable 2 (Group)	Difference of means	t-value	Sig.
SCER (High SF)	SCET (High SF)	-0.011	-0.027	0.821
SCER (Low SF)	SCET (Low SF)	0.120	2.086*	0.039
SCER (Entire sample)	SCET (Entire sample)	0.054	1.404	0.161

*p<0.05

In sum, a higher and balanced combination with similar levels of SC exploration and exploitation is found in companies with higher levels of SF, where an excess of exploitation over exploration is associated with lower levels of SF. These results are consistent with the prior literature, since prior studies link exploration practices to increase in flexibility and exploitation practices to the opposite effect (Miller et al., 2006).

Hypothesis 4 states that there are statistically significant differences in the relationship between SC ambidexterity and SC performance, depending on whether SF is high or low. To test this hypothesis, we first divided the sample into two groups, the first composed of firms with low SF (total of 151 firms) and the second of firms with high SF (total of 151 firms). We estimated one model for each group of firms to compare whether the relationship between SC ambidexterity and SC performance changes depending on whether the firm had high or low SF. Gualandris et al. (2018) conclude that a buying firm that faces rapidly changing policies and market expectations can achieve positive performance impacts when it engages more in exploration than exploitation.

Next, to analyze the combination of exploration and exploitation practices and their impact on the study variables, we analyzed the research model proposed separately, for each group, firms with high vs. low levels of SF. Figure 2 presents the results for the first group of firms. The global fit indices for the model (NFI=0.917, NNFI=0.966, CFI=0.970; IFI=0.970, GFI=0.954, AGFI=0.917, RMSEA=0.050) and the Chi-square value (258.378, p<0.001) indicate that the theoretical model fits the data well (Bollen, 1989). The results show that, whether the SF level is low or high, SF is not positively associated with SC performance. There is thus no indirect effect of SC ambidexterity on SC performance, but there is a direct effect.

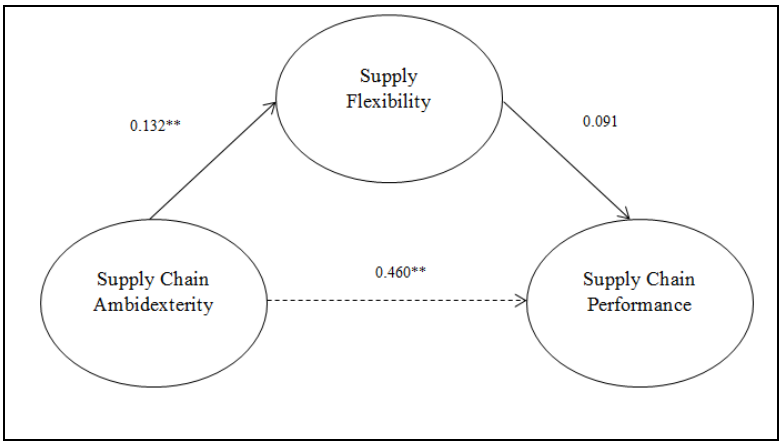

Figure 2 – Structural modelling for the relationships between the variables in low supply flexibility firms

Similarly, Figure 3 shows the results for firms with a high SF level. The global fit indices for the model (NFI=0.944, NNFI=0.947, CFI=0.953; IFI=0.954, GFI=0.929, AGFI=0.914, RMSEA=0.050) and the Chi-square value (338.012, p<0.001) indicate that the theoretical model fits the data well (Bollen, 1989). The results show that, for high levels of SF, there is no direct effect of SC ambidexterity on SC performance but there is indirect effect. For firms with high SF, therefore, SF fully mediates the

relationship between SC ambidexterity and SC performance. We thus obtain empirical evidence to support Hypothesis 4.

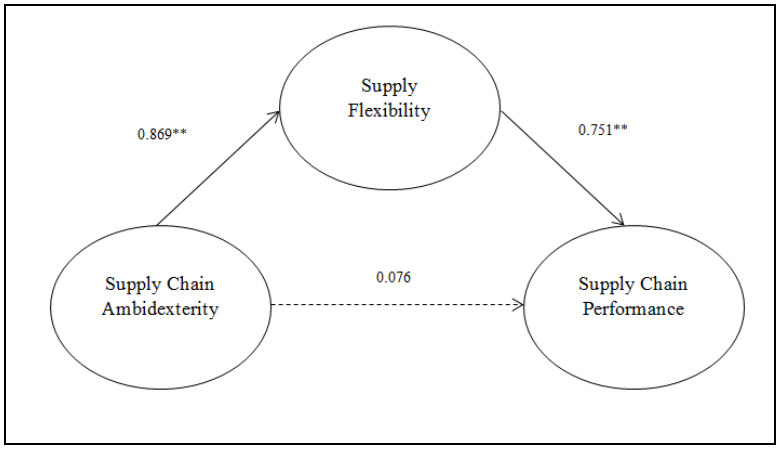

Figure 3 – Structural modelling for the relationships between the variables in high supply flexibility firms

Conclusion and limitations

This study makes significant theoretical contributions. First, it shows the need to conceptualize and operationalize SC ambidexterity as both a balance and a combination of exploration and exploitation practices to analyze the impact on different organizational variables and on performance (Gualandris et al., 2018). Further, these results can vary based on different organizational levels and on dynamism of the environment (Marino et al., 2015). Second, this study adds to the limited and controversial understanding of the relationship between ambidexterity and SC performance. Our results suggest that deployment of SC ambidexterity has a positive impact on performance through SF when the company has a high level of SF.

Managers must be aware that high-level SF firms develop SC ambidexterity capacity to a greater extent than low-level SF firms, and exploration and exploitation activities are developed in a balanced way. However, low-level SF firms are associated with a lower develop of ambidexterity and an excess of exploitation over exploration.

Our study does have some limitations. First, as the study is cross-sectional in nature, its results can only be generalized to Spanish firms. Second, since a single respondent was used to obtain the data, there is a risk of common method bias. Third, the research was not able to analyze the impact of ambidexterity on SF over time. Finally, SC ambidexterity, SF, and SC performance were evaluated from the perceptions of one manager from one of the firms composing the SC.

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