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LISTEN TO THE MARKET: DO ITS COMPLEXITY AND SIGNALS MAKE COMPANIES MORE INNOVATIVE?

Ana Pérez-Luño (Universidad "Pablo de Olavide")
Jesús J. Cambra Fierro (Universidad "Pablo de Olavide")

(anaperezluno@upo.es; jjcamfie@upo.es)

Universidad Pablo de Olavide Sevilla

DEPARTMENT OF BUSINESS ADMINISTRATION

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Ana Pérez-Luño
Dpto. Dirección de Empresas
Universidad "Pablo de Olavide"
Ctra. Utrera, km. 1
41.013-Sevilla
Phone: + 954 97 89 77, Fax: 954 34 83 53

Jesús J. Cambra Fierro
Universidad "Pablo de Olavide"

Abstract

This paper analyzes four modes of innovation that differ in their scope of newness – innovation generation and adoption–, and in their degree of change –radical and incremental innovations. Building a theoretical model based on the Market Orientation (MO) and contingency theory literatures and utilizing a unique sample of innovating firms, we find that MO positively influence the number incremental generation and adoption of innovations. We also find that environmental complexity moderates the relationship between MO and radical and incremental innovation generation and adoption. That is, we have found that high environmental complexity enhances the introduction of radical and incremental internally generated innovations and harms the introduction of incremental innovation adoptions for market oriented firm. These findings add to the innovation and MO literatures. Our results also have important implications for both commercial activities and R&D policies adopted by firms.taking place in this sector enhances its potential as a showcase for processes of anticipation and adaptation to the environment. In addition, the paper aims to shed some light on the question of whether strategy potentially moderates the MO-performance link. Finally, the principal implications of our findings are discussed.

Keywords: Market orientation, environmental complexity innovation

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1. Introduction

In an increasingly complex business environment, understanding how firms can adapt successfully to changing marketplaces through product and/or process innovation is of fundamental theoretical and managerial interest (De Luca et al., 2010; Jaw et al., 2010; Varela and Benito, 2005; Wei and Morgan, 2004).

From a marketing point of view, customers are the reference group. In this sense, market orientation (MO) has been the focus of much research, resulting in a large number of studies analyzing the construct, the concept, and its antecedents, consequences and potential moderating role. MO has been used to explain the attainment of sustainable competitive advantages (Langerak et al., 2004; Paladino, 2008); the MO–performance relationship has therefore received a great deal of attention (e.g., Kirka et al., 2005). Slater and Mohr (2006) recognize that the objective of market-oriented firms is to create superior value for customers. In this sense, MO is externally focused because, under this approach, the firms' primary center of attention is the satisfaction of market needs. However, as Paladino (2008) and Kahn (2001) note, firms also need to pay attention to internal processes, one of which is innovation.

Jaworski and Kohli (1996) highlight that innovation had in many cases been undeservedly excluded from MO models in the MO literature. Since then, several researchers (e.g., Baker and Sinkula, 2005; Deshpandé and Farley, 2004; Im and Workman, 2004; Salavou, 2004) have included this element in MO models and demonstrated the links between MO and innovation. Furthermore, the works of Dobni

(2008) and Aldas-Manzano et al. (2005) reveal that MO and innovation are not isolated fields and can therefore jointly support positive relationships with performance.

Previous studies have demonstrated a general relationship between market orientation and innovation. However, less is known about the nature of the innovation that MO enhances. That is, innovation has many dimensions and can manifest itself in many forms. Innovations can be internally generated or can be sourced externally (Damanpour and Wischnevsky, 2006; Grossman and Helpman, 1991; Mahmood and Rufin, 2005; Pérez-Luño et al., 2007a, forthcoming). Innovations can also vary in the extent to which they deviate from the existing state of the art, otherwise known as the degree of radicalness (Damanpour and Gopalakrishnan, 1998). Therefore, it could be interesting to analyze the nature of innovation that MO could potentiate.

Another important aspect related to innovation is the environment that companies face. Environmental conditions can vary because of the nature of competition in an industry, the stage of the life cycle of the industry, its pace of change, the resources available to the firms, and the degree of technological advancement and complexity in the core products and operational processes of an industry, among other factors (García et al., 2008; Jaworski and Kohli, 1993; Khandwalla, 1977; Palmberg, 2006; Pérez-Luño, 2009). Based on Hodgson and Knudsen (2006), this paper proposes that, of these environmental characteristics, complexity is the one that needs more attention in relation to innovation generation and adoption. Although it has been acknowledged that environmental complexity is related to innovation, we have not found previous studies explaining how environmental complexity and MO can jointly influence radical and incremental innovation generation and adoption. We consider this to be an important gap in the literature because each type of innovation could be developed depending on the complexity and the needs that MO has detected in the environment.

Based on the above discussion, the questions addressed in this paper are: How do MO and environmental complexity influence the nature of innovation developed by a firm? Is there a joint effect between them that enhances or harms different types of innovation? Hence, the purpose of the current study is to explain how an internal feature (MO) and an external one (environmental complexity) influence the generation and adoption of radical incremental innovations.

In so doing, we make contributions to both the literature and practice. These contributions are discussed at the end of the paper.

To achieve our research objective, this study uses a theoretical framework that—based on a thorough review of the literature—considers such basic concepts as innovation, MO and environmental complexity. In Section 2, the hypotheses for our empirical research are developed. The characteristics of our empirical study are presented in Section 3, while Section 4 presents the research findings. Section 5 discusses the more significant findings and their academic impact and implications, while Section 6 contains conclusions, limitations and proposals for future research.

2. Conceptual framework and hypotheses development

2.1. Radical and incremental innovation generation and adoption

The literature on innovation is varied. The concept has been defined to describe many things and therefore approaches and definitions vary depending on the context and the scope of the analysis (see, for instance, Damanpour and Wischnevsky, 2006; De Luca et al., 2010; Dobni, 2008; Ortt and van der Duin, 2008; Paladino, 2008; Percival and Cozzarin, 2008).

For the purposes of our research, we take as a reference one of the generally accepted definitions of innovation: "the introduction into the market of technologically **new** or improved products" (OECD Eurostat, 1997). "Newness" is a central element of innovation definitions, but the scope of newness has been conceptualized inconsistently in the literature. Whether an innovation is new to an individual adopter, to an organization, to most organizations in an organizational population, or to the entire world reflects substantially different scopes of newness. However, the literature has been unclear as to whether newness refers to one or several of these dimensions, or has assumed that newness to the organization is equivalent to newness to the world (Damanpour, 1991; Damanpour and Gopalakrishnan, 1998; Kimberly and Evanisko, 1981; Knight, 1967; Li and Atuahene-Gima, 2001). Indeed, lack of clarity of the newness concept has been suggested as a major reason why findings in the innovation literature are inconsistent and why models are characterized by limited explanatory power (Becheikh et al., 2005; Wolfe, 1994).

A fruitful way of addressing different scopes of newness in the innovation literature is suggested by Damanpour and Wischnevsky (2006). They differentiate between the generation and the adoption of innovations. As the terminology indicates, the generation of innovation refers to situations where a firm internally generates a product, process or technology that was previously unknown to the market in which the firm operates. If a firm adopts innovation, however, it assimilates knowledge and technologies that have been developed elsewhere and that are new to the organization only.

This distinction between innovation generation and adoption is akin to that made between exploration and exploitation in the organization learning literature (cf. March, 1991) or between innovation and imitation (cf. Brozen, 1951; Dell'Era and Verganti, 2007; Pérez-Luño et al., 2007a, 2007b; Schumpeter, 1961). We choose to rely on Damanpour and Wischnevsky's (2006) distinction and terminology because their definition makes two major contributions. The first is that it provides the vocabulary for a much needed distinction in the innovation literature depending on the scope of newness (new to the firm vs. new to the world). The second is that it puts both generation and adoption under the common rubric of innovation, viewing them as two means for firms to achieve market newness. The latter is relevant because previous research often confuses the scope of innovation (generation vs. adoption) with the scale of innovation, i.e., the degree of newness that the innovation leads to (radical vs. incremental) (cf. Pérez-Luño et al., 2007a). Therefore, using Damanpour and Wischnevsky's (2006) definition we can analyze the scope of innovation (generation vs. adoption) and determine whether the generation and/or adoption have different degrees of newness or radicalness.

Once we have defined innovation generation and adoption, we can consider the definition of innovation radicalness. Although there are different categories of innovation radicalness—for example, variation versus reorientation (Normann, 1971), ultimate and instrumental innovations (Grossman, 1970), incremental, architectural, modular and radical innovations (Henderson and Clark, 1990)—we use the most extended names for this classification: radical and incremental innovations (Damanpour, 1991; Damanpour and Gopalakrishnan, 1998; Kimberly and Evanisko, 1981; Knight, 1967; Tushman and Anderson, 1986). Radical innovation is characterized by being a novel contribution that is totally different to that which already exists, representing a revolutionary change in the technology, usually with a high investment cost for the innovator, and carrying a high degree of risk (Damanpour, 1991). When the innovation consists of substantial improvement to a product, service or process but, despite having a certain degree of novelty, does not break clearly with the ruling technology, it can be described as an incremental innovation. Such innovation takes an earlier original idea as the starting point and makes substantial improvements that represent minor changes from existing practice (Damanpour, 1991). It is important to highlight that a company that adopts a revolutionary change developed by another company would be adopting a radical innovation generated by the other company; the same could happen with incremental innovations.

2.2. Links between MO and innovation

MO reflects the ability of firms to internalize the marketing concept (Baker and Sinkula, 2005; García et al., 2008; Varela and Benito, 2005). The MO concept is based on work by Narver and Slater (1990) and Kohli and Jaworski (1990). Because these authors identified the antecedents and consequences of MO, the concept has received considerable attention from both researchers and practitioners, who have reached relative consensus regarding its meaning and operationalization.

Narver and Slater (1990) conceptualize MO as an organizational culture made up of three core dimensions: (1) customer orientation, (2) competitor orientation and (3) interfunctional coordination. The behavioral approach, proposed by Kohli and Jaworski, (1990), recognizes three dimensions related to (1) generation of information, (2) dissemination and (3) response. However, as Gao and Bradley (2007), Helfert et al.

(2002), Homburg and Pflesser (2000), Avlonitis and Gounaris (1997), or Cadogan and Diamontopoulos (1995) have acknowledged, these two approaches to MO are not rival but complementary.

Jaworski and Kohli (1996) recommend including innovation in MO models. This idea is of interest in today's highly competitive contexts. A business must be innovative in its approach to (1) learning about and tracking customer needs, (2) the development of new products or services that address those needs and (3) the development and implementation of internal processes that enhance customer-need understanding and product development.

Taking as reference the work of De Luca et al. (2010), we can justify different links between MO and innovation. First, MO positively influences innovation market performance, defined in terms of sales, market share, perceived product quality or customer acceptance of the innovation. Second, MO is related positively to innovation performance, defined in terms of profitability of the innovation (ROI, ROA). Third, MO is linked positively to the firm's ability to innovate, defined mainly in terms of number of innovations introduced by the firm and ranging from incremental modifications to breakthrough innovations. MO should be the foundation for a business's innovation efforts (Narver et al., 2004) because understanding consumer preferences and competitors' actions improves the market performance of innovations (Jaw et al., 2010). Therefore, the literature (e.g., Atuahene-Gima et al., 2005; De Luca et al., 2010; Jaw et al., 2010; Kok and Biemans, 2009) defends MO as an antecedent of innovation. Empirical findings converge in indicating a positive impact of MO on innovation and its outcomes and across different industrial settings. This may be because innovative firms are aware of the potential for certain products or managerial practices to become obsolete. However, the literature also suggests a firm may lose its position in industry leadership if it listens too carefully to its customers, thus innovating more slowly than its competitors. Maybe for that reason, Narver et al. (2004) conclude that a traditional MO approach, which addresses the expressed needs of customers, is not sufficient to guarantee the success of innovation. They propose complementing it with a proactive behavior approach, which addresses the latent needs of customers. However, this proactive behavior may be related to higher levels of risk because, under this approach, security about market trends is less important than under a traditional MO approach. In fact, this proactive behavior is related more to R&D and internal tasks than to customers. Therefore, if we translate previous findings relating MO to general innovation into a deeper relationship in which innovation can be radical and incremental and internally generated or adopted, we can propose that, because MO is generally related to existing customers and/or competitors' actions, it will be related positively to radical and incremental innovation adoptions and related negatively to innovation generation (both radically or incrementally). Therefore, we can establish our first hypothesis:

H1: Market orientation is associated:

H1a: positively with the number of radical innovations adopted by a firm.

H1b: positively with the number of incremental innovations adopted by a firm.

H1c: negatively with the number of radical innovations generated by a firm.

H1d: negatively with the number of incremental innovations generated by a firm.

2.3. The moderating effect of environmental complexity on the relationship: MO and radical and incremental innovation generation and adoption

The nature of the environment that organizations compete in is known to influence their innovative behavior (Palmberg, 2006; Subramaniam and Youndt, 2005). In this section, we analyze how the perception of one of the environmental dimensions, its complexity, influences the relationships between MO and radical and incremental generation and adoption of innovations. We have selected environmental complexity for analysis because, as Mintzberg (1979), among others, states, this dimension is related to the knowledge used in an industry. In this sense, we consider that such knowledge will moderate the MO–innovation relationship.

Environmental technological sophistication or complexity refers to the degree of technological advancement and complexity in the core products and operational processes of an industry (Jaworski and Kohli, 1993). An environment is technically complex when the information needed for making strategic decisions is technically very sophisticated (Khandwalla, 1977). The significance of this variable rests on the assumption that, because the technological complexity of a firm's industry has a direct impact on how an organization formulates its strategy and designs its structure (Covin and Slevin, 1989; King, 2007), it will have an important impact on the MO–innovation relationship.

Environmental complexity will have important implications for the relationships between MO and radical and incremental generation and adoption of innovations. This is because, generally, in complex environments, companies have to generate their knowledge internally and because rapid technological advancement makes it very difficult to wait to adopt what other firms launch into the market. However, in very complex environments, given the casual ambiguity associated with complex knowledge (Reed and DeFillippi, 1990) and the imitation barrier that complexity forms (Gopalakrishnan and Bierly, 2001; Nonaka, 1994; Rivkin, 2000), it is very difficult to adopt the knowledge generated by other companies. Therefore, we propose that environmental complexity will reduce the negative relationship between MO and radical and incremental innovation generation and will reduce the positive relationship between MO and radical and incremental innovation adoption. We therefore propose the following hypotheses:

H2: Environmental complexity moderates the relationship between market orientation and radical and incremental innovation generation and adoption as follows:

H2a: The greater the environmental complexity, the less will market orientation be associated positively with radical innovation adoption.

H2b: The greater the environmental complexity, the less will market orientation be associated positively with incremental innovation adoption.

H2c: The greater the environmental complexity, the less will market orientation be associated negatively with radical innovation generation.

H2d: The greater the environmental complexity, the less will market orientation be associated negatively with incremental innovation generation.

3. Research method

3.1. Research design and sample

Testing our hypotheses requires a sample comprised of firms that are involved in the launch of new products. We therefore start with a sampling frame covering Spanish firms from the industries most likely to exhibit innovative behaviors.[1] We use the SABI/AMADEUS database (the most comprehensive database of company information in Spain) to identify all companies in these industries. There is a total of 2942 firms having more than 10 workers in our target industries.

First, the 2942 firms were contacted by telephone and, shortly thereafter, all firms interviewed were sent a mail survey. Because the unit of analysis adopted in this study is the department where the innovation activity of the company is carried out, we spoke to the R&D manager. If the firm did not have an R&D manager, we instead spoke to the CEO. In total, 2765 firms responded to our phone calls (response rate of 94%). During the interview, we first ensured that the firm indeed belonged to the sample frame, i.e., that it operated within one of the target sectors and that it had more than 10 employees. Those firms with fewer than 10 employees (19), that do not belong to our target sectors (539), or that were duplicated or have no innovative activity (443) were excluded from our sample. We asked the remaining 1764 firms if we could send them our questionnaire. In total, 402 firms responded to this questionnaire, and of those, 386 responses were considered valid. This corresponds to a response rate of 21.88% of the firms in our target population. The questionnaire asked firms to state the number of products introduced during the past five years. All firms responded that they had

[1] The National Statistical Institute (INE) of Spain has identified five industries in the economy as containing the most "innovative" firms. These industries are: NACE 24, Chemical companies; NACE 32, Radio, TV and communication equipment; NACE 33, Medical, precision and optical instruments; NACE 34, Manufacture of motor vehicles, trailers and semitrailers; and NACE 35, Manufacture of other transport equipment. The definition of innovation, used by the INE, is based on the Oslo Manual (OECD/Eurostat, 1997), which identifies companies introducing new or improved products into the market. The Oslo Manual thus covers what we have labeled "innovation generations" as well as "innovation adoptions". This source assumes that technological innovation is produced when the company introduces technologically new or improved products into the market, but does not differentiate between products new to the company, new to the market or new to the world. For this reason, we consider that what they call innovation covers what we have defined as "innovation generation and adoption".

introduced at least one new product during this time frame, which supports the validity of our sample.

To check for nonresponse bias, we compared mean differences between respondents and nonrespondents for industry membership, number of employees and revenue. No significant differences were found, suggesting that nonresponse bias was not present.

3.2. Measures

Many of the constructs included in the study were measured using multi-item scales. We took several steps to ensure data validity and reliability. First, we pretested all measures in 25 interviews with R&D managers and asked them to closely review the survey, to ensure the clarity of the questions and to ascertain whether or not the scales captured the desired information. We then revised any potentially confusing items before submitting the questionnaire.

3.2.1. Dependent variables

Radical and incremental innovation generations and innovation adoptions (see the appendix): The questionnaire included a direct measure of the radical and incremental innovations introduced by the companies. The interviewees were requested to indicate the number of innovations obtained in the past five years that they had accomplished by reinforcing their existent products (incremental), and the number of innovations in the past five years accomplished by making obsolete their existent products (radical). Then, we asked them to indicate the percentage of these new products that were new to the world, new to their market and new to their company. To compute the number of radical innovations generated, we multiplied the total number of radical innovations by the percentage of products new to the world. Similarly, to compute the number of radical innovations adopted, we added together the percentages of products new to the company and products new to the market, and multiplied this sum by the total number of new products launched. To compute the number of incremental innovations generated, we multiplied the total number of incremental innovations by the percentage of products new to the world. Similarly, to compute the number of incremental innovations adopted, we added together the percentages of products new to the company and products new to the market and multiplied this sum by the total number of new products launched. Thus, the total number of innovations launched by each firm was separated first into radical and incremental and second into new to the world (radical and incremental innovation generation) and new to the market or the company (radical and incremental innovation adoption) innovations. This way, we avoided the possibility that an innovation could be counted in both categories.

Given the potential subjectivity associated with these types of measures, we took several steps to ensure content validity. First, we selected a random subsample of 50 R&D managers and asked them to describe each of the products launched during the past five years. In addition to their descriptions, we used documents or online information in which the products were described in detail. We then analyzed whether the products were new to the world (internal generation innovations), new to their focus market, or just new to their company (adopted innovations). Second, in the questionnaire, we also included Subramaniam and Youndt's (2005) scale to measure radical and incremental innovations. Furthermore, we developed a scale to measure internal generated and adopted innovations. For each of the firms in the random subsample, we then created two indexes reflecting the proportion of innovations launched and the proportion of radical innovations. The correlations between these indexes (transformed into a seven-point scale) and the scales were 0.38 ($p < 0.01$) and

0.403 ($p < 0.01$), respectively. When we corrected our scales for measurement error with the Cronbach's alpha value, as recommended in the literature (Cohen and Cohen, 1983), the correlation between the underlying constructs was 0.50, suggesting high convergent validity.[2] Because we used a random subsample, we can extrapolate this correlation to the target population. Finally, we also correlated our innovation generations and innovation adoptions measures with the number of patent documents presented in the Spanish and European Patent Offices. These data were directly obtained from the Spanish and the European Patent Offices. We obtained a correlation of 0.24 ($p < 0.01$) (0.32 for the underlying constructs). Taking into account that not all innovations are patented, this provides additional validation of the scale. Taken together, these extensive validations suggest that our measures are indeed valid.

Given that direct measures have many advantages when they can be understood as objective measures compared with subjective measures (Gopalakrishnan and Bierly, 2002), we have considered it appropriate to use these direct measures for the hypotheses tests. Nevertheless, before making this decision, we conducted our second test. This test was useful in demonstrating the existence of convergent external validity between the proposed scales and the direct measures.

3.2.2. Independent variables

Market orientation. We use Narver and Slater's (1990) scale to measure market orientation (see the appendix). The scale consists of 15 items (seven-point Likert scale).

[2] The consistency between different measures is typically tested using correlation coefficients (Loo, 2002), but it is difficult to specify a single threshold against which two measures can be considered to support concurrent validity. For correlation coefficients in general, Cohen (1988) argues that 0.1 is a small correlation, 0.3 a moderate correlation and 0.5 a large correlation. Based on this, we consider correlations between 0.3 and 0.49 to reflect moderate concurrent validity and correlations of 0.50 and above to reflect high concurrent validity.

The Cronbach's alpha of the scale was 0.934, suggesting high internal consistency and reliability (see the appendix).

Environmental complexity was measured using Khandwalla's (1977) scale. This scale has been used in several innovation studies. The scale consists of two opposite statements (seven-point opposite Likert scale). The Cronbach's alpha of the scale was 0.695 suggesting sufficient internal consistency and reliability (see the appendix).

3.2.3. Control variables

We controlled for organizational size, age, internal and external R&D expenditures, the company's industry and environmental dynamism and hostility. The variables *size*, *age*, *R&D expenditures* and *environmental dynamism and hostility* data were obtained from the questionnaire, and we obtained the industry data from the SABI database. *Size* was measured by the number of employees. Because of its dispersion, the variable was log-transformed. *Age* was computed using the difference between the actual date (2010) and the foundational date. *Internal R&D* expenditures were measured on internal R&D as the average percentage of the sales turnover of the company for the past five years. *External R&D* expenditures were measured on external R&D as the average percentage of the sales turnover of the company for the past five years. *Industry* effects were captured by dummy variables for each firm's main sector as indicated by their industry code (NACE code). Dummy variables were created for industries 24, 32, 33, 34 and 35. *Environmental dynamism and hostility* were measured using Khandwalla's (1977) scale (seven-point Likert scale). This scale has been used in several innovation studies. The scale consists of five opposite statements for environmental dynamism and three for environmental hostility. The Cronbach's alpha values of the scales were 0.669 and

0.743, respectively, suggesting sufficient internal consistency and reliability (see the appendix).

4. Analyses and results

Descriptive statistics and correlations for the relevant variables are displayed in Table 1. Over the past five years, the firms have generated an average of 0.5 radical innovation generations, 1.9 incremental innovation generations, 1.7 radical incremental adoptions and 8.7 incremental innovation adoptions. Skewness and kurtosis statistics fall well within the boundaries for normality, allowing parametric tests of significance. To ensure that multicollinearity was not an issue, value inflation factors were computed. None of them exceeded 2, indicating that we did not encounter multicollinearity.

Insert Table 1 about here

We tested our hypotheses using a hierarchical entry of independent variables in all the regressions, starting with the control variables in a base model and then entering the research variables in the next step and the interaction terms in the final step, because an interaction effect only exists if the interaction term gives a significant contribution over and above the direct effects of the independent variables. We conducted four Poisson regressions. The first one analyzes radical innovation generation, the second one analyzes incremental innovation generation, the third one analyzes radical innovation adoption and the fourth one analyzes incremental innovation adoption. The results are displayed in Tables 2, 3, 4 and 5. In all tables we have a base model, a main effects model and an interactions model.

Insert Table 2 about here

We first tested the hypotheses related to radical innovation generation (Table 2). Given that we have not hypothesized any relationship between environmental complexity and radical innovation generation, we included environmental complexity in this regression as a control variable only. The base model in Table 2 (control variables only) explains a statistically significant share of the variance in radical innovation generation (Pseudo $R^2 = 0.086$, $p < 0.001$). Examining the control variables entered in the base model, we find that internal R&D expenditures and the dummy variable for the Medical, precision, and optical instruments industry have a positive association with radical innovation generation. We then entered our research variable (MO). The main effects model makes a contribution over and above the base model (Delta $\chi^2 = 1.520$, $p > 0.1$). This improvement in model fit is not statistically significant, indicating MO has no influence on radical innovation generation. Therefore, our analyses do not support the hypothesis that MO has a negative association with radical innovation generation (H1c). The contingent model in the next column makes a significant contribution over and above the main effects model (Delta $\chi^2 = 68.040$, $p < 0.000$). The interaction between MO and environmental complexity makes a significant contribution over and above the main effects.

Insert Figure 1 about here

To determine the nature of the interaction, we plotted the effect of environmental complexity on the dependent variable for values of the MO set at one standard deviation above and below the mean, as suggested by Cohen and Cohen (1983). This plot is reported in Figure 1. The plot in this figure shows that the number of radical innovation generations increases with high levels of MO and environmental complexity. However, an increase in MO in low-complexity environments decreases the number of radical innovation generations. These findings support H2c stating that environmental complexity will reduce MO's negative effect on radical innovation generation. Furthermore, we find that in complex environments, MO is related positively to radical innovation generation.

Insert Table 3 about here

We then tested the hypotheses related to incremental innovation generation (Table 3). Again, given that we have not hypothesized any relationship between environmental complexity and incremental innovation generation, we included environmental complexity in this regression as a control variable only. The base model in Table 3 (control variables only) explains a statistically significant share of the variance in radical innovation generation (Pseudo $R^2 = 0.124$, $p < 0.001$). Examining the control variables entered in the base model, we find that age, internal and external R&D expenditures and environmental hostility and complexity have a positive association with incremental innovation generation. Furthermore, the dummy variable for the Medical, precision, and optical instruments industry has a negative association with incremental innovation generation. We then entered our research variable (MO). The main effects model makes a significant contribution over and above the base model (Delta $\chi^2 = 47.690$, $p < 0.001$). In this case, MO has a significant influence on the dependent variable. Therefore, our analyses do not support the hypothesis that MO has a negative association with incremental innovation generation (H1d). On the contrary, we find that MO is related positively to incremental innovation generation. The contingent model in the next column makes a significant contribution over and above the main effects model (Delta $\chi^2 = 21.620$, $p < 0.001$). The interaction between MO and environmental complexity makes a significant contribution over and above the main effects.

Insert Figure 2 about here

To determine the nature of the interaction, we plotted the effect of environmental complexity on the dependent variable for values of the MO set at one standard deviation above and below the mean, as suggested by Cohen and Cohen (1983). This plot is reported in Figure 2. The plot in this figure shows that the number of incremental innovation generations increases with high levels of MO and environmental complexity. We also find that an increase in MO in low-complexity environments increases the number of incremental innovation generations. However, the influence is higher for higher levels of environmental complexity. These findings support Hypothesis 2d stating that environmental complexity will reduce the negative effect that MO has on incremental innovation generation. Furthermore, we find that in both complex and simple environments, MO is related positively to incremental innovation generation. However, as expected, the effect is much stronger in complex environments.

Insert Table 4 about here

We then tested the hypotheses related to radical innovation adoption (Table 4). Again, given that we have not hypothesized any relationship between environmental complexity and radical innovation adoption, we included environmental complexity in this regression as a control variable only. The base model in Table 4 (control variables only) explains a statistically significant share of the variance in radical innovation adoption (Pseudo $R^2 = 0.05$, $p < 0.001$). Examining the control variables entered in the base model, we find that the dummy variable for the Chemical and for the Medical, precision, and optical instruments industries, the company's age and external R&D expenditures have positive associations with radical innovation adoption. We also find that environmental hostility negatively influences radical innovation adoption. We then entered our research variable (MO). The main effects model makes a contribution over and above the base model (Delta χ^2 = 1.080, $p > 0.1$). This improvement in model fit is not statistically significant, indicating that MO has no influence on radical innovation adoption. Therefore, our analyses do not support the hypothesis that MO has a positive association with radical innovation adoption (H1a). The contingent model in the next column makes an insignificant contribution over and above the main effects model (Delta χ^2 = 0.700, $p > 0.1$). Therefore, we have no support for Hypothesis 2a.

Insert Table 5 about here

We then tested the hypotheses related to incremental innovation adoption (Table 5). Again, given that we have not hypothesized any relationship between environmental complexity and incremental innovation adoption, we included environmental complexity in this regression as a control variable only. The base model in Table 5 (control variables only) explains a statistically significant share of the variance in radical innovation adoption (Pseudo R^2 = 0.134, $p < 0.001$). Examining the control variables entered in the base model, we find that the dummy variables for the Chemical, Radio, TV, and communication equipment and Medical, precision, and optical instruments industries, and environmental dynamism have a positive association with incremental innovation adoption. Furthermore, environmental hostility negatively influences incremental innovation adoption. We then entered our research variable (MO). The main effects model makes a significant contribution over and above the base model (Delta χ^2 = 9.340, $p < 0.01$). In this case, MO has a significant influence on the dependent variable. Therefore, our analyses support the hypothesis that MO has a positive association with incremental innovation adoption (H1b). The contingent model in the next column makes a significant contribution over and above the main effects model (Delta $\chi^2 = 15.450$, $p < 0.001$). The interaction between MO and environmental complexity makes a significant contribution over and above the main effects.

Insert Figure 3 about here

To determine the nature of the interaction, we plotted the effect of environmental complexity on the dependent variable for values of the MO set at one standard deviation above and below the mean, as suggested by Cohen and Cohen (1983). This plot is reported in Figure 3. The plot in this figure shows that incremental innovation adoption increases with high levels of MO and low levels of environmental complexity. We also find that an increase on MO in high-complexity environments decreases slightly the number of incremental innovation adoptions. These findings support Hypothesis 2b stating that the greater the environmental complexity, the less market orientation will be associated positively with incremental innovation adoption. That is, we find that we need low environmental complexity to enhance the relationship between MO and incremental innovation adoption.

5. Discussion

This paper has examined the nature of innovation and, more specifically, radical and incremental "new to the world" innovation generation and "new to the firm" innovation adoption. For the most part, the literature has viewed all new product launches homogeneously as "innovation". This general way of analyzing innovation has been the cause of many inconsistencies between studies (Pérez-Luño et al., forthcoming; Wolfe, 1994). To the extent that this paper has distinguished between different ways of achieving new market offerings (radical and incremental innovation generations and adoptions), it has been able to examine the MO–environmental complexity–innovation relationship in greater detail.

Kohli and Jaworski (1993) define a company's market orientation as a set of organizational behaviors and activities related to the generation, dissemination and response to intelligence from the market or the organizational environment. Although the traditional literature assumes that market orientation is centered exclusively on emphasizing the customer, more recent research associates this approach with a concern for the business environment in general (Deshpandé, 1999). Based on this definition, we understand that companies with this type of orientation will be disposed to adopt products, services and processes with the purpose of continually satisfying their customers' needs.

In line with Paladino (2008), our data suggest that MO does indeed impact incremental innovation (generation and adoption), whereby firms with a strong customer focus are able to learn about and anticipate customers' needs. This focus allows firms to continually innovate for the benefit of consumers and therefore to reinforce competitive advantages. This is because the firm's focus on the market and the provision of value affects the perception of quality and drives the organization to offer products of superior quality to those of competitors. Quinn (1979) observed a strong market orientation in the more innovative companies, and stated that this is because they were capable of responding continually to the changing needs of their clients (Narver and Slater, 1990). Those companies that best understand their customers' needs develop products that provide them with greater added value (Slater and Narver, 1995).

To be able to respond to customers' needs with continual improvements, consistent with our findings, it is reasonable to think that most of these companies will be constantly generating and/or adopting innovations that are incremental in character or with a low degree of radicalness. That is, our data, consistent with other studies (e.g., Camelo-Ordaz et al., 2009), reveal that MO is significantly and positively related to incremental innovation. This is consistent with the proposal by Narver et al. (2004), who also defend a proactive MO. In this sense, firms need to find a balance between reactive approaches to markets (i.e., adopting incremental innovations developed by competitors) and proactive approaches (generating incremental innovations) based on latent necessities and R&D efforts. This task is not, of course, easy. Managers need to assume some risks in R&D decisions, although market studies may help in decision making.

However, we have not been able to find any direct relationship between MO and radical generation or adoption of innovations. We believe that, generally speaking, the reason MO firms will not generate or adopt radical innovations is that, as these companies are trying to respond continually to the environment (Narver and Slater, 1990), they cannot invest the time that radical innovations, even adoptions, require.

It is very interesting to notice that environmental complexity enhances the relationship between MO and innovation generation both radically and incrementally. However, environmental simplicity harms innovation only when radically innovating. On the other hand, environmental complexity makes companies less disposed to invest in incremental innovation adoption.

These findings have many implications for both researchers and practitioners. First, we have examined and explained the mode and the amount/ intensity of innovation. The bulk of the innovation literature that has used models aimed at explaining variance in innovation has confounded innovation generation and adoption. That is, they have collectively estimated the extent to which firms generate and adopt innovations (Damanpour, 1991; Knight, 1967; Li and Atuahene-Gima, 2001; Pérez-Luño et al., 2010). We instead address explicitly whether new market offerings are the results of radical or incremental innovation adoption or generation and what drives such behaviors. Second, although the insight that firms can emphasize the adoption of existing radical and incremental innovations or generate their own is not completely new, we address it from a new vantage point. Our study builds on the notion that firms can simultaneously adopt and generate radical and incremental innovations and that the choice between them is a matter of degree rather than a binary choice between pure types of firms. We therefore explore the internal (MO) and external conditions (environmental complexity) that stimulate firms to increase their focus on each alternative.

6. Conclusions

This paper participated in the debate on the relationship between MO and innovation. We suggested that for a better understanding of the link, researchers may differentiate between radical and incremental innovation generation and adoption. The influence of environmental complexity is also of interest.

Our research findings suggest that, in the context studied, MO is associated positively with the number of incremental innovations adopted by a firm. However, we cannot support either positive links between MO and the number of radical innovations adopted by a firm or negative links between MO and innovations generated (incremental or radical) by a firm. The reasons may be related, as discussed in Section

5, to the effect of environmental complexity and to reactive/proactive approaches adopted by firms.

Our results have important implications for both commercial activities and R&D policies adopted by firms. However, despite the relevance of the results, this study is limited in several ways. First, the sample is based only on Spanish data; although most firms have an international focus, conclusions may not hold for other countries. However, the absence of previous studies similar to our research supports the value of the research presented here. This research may be taken as a reference for future international and multinational research. Finally, other constructs and variables could be taken into account to explain why we did not find evidence of some of the relationships.

For future research, we have already proposed examining other countries. We are also interested in seeing how each of the MO dimensions influences radical and incremental innovation generation and adoption. It is possible that such detailed analysis will enable us to better explain the proactive and reactive MO approaches. Finally, qualitative studies focusing on CEOs may also be of interest for a better understanding of the internal processes related to commercial and R&D practices in firms.

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FIGURE 1

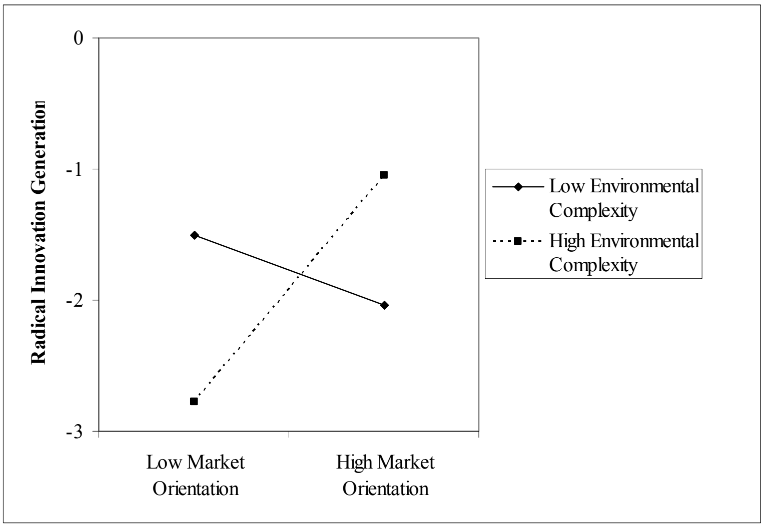

FIGURE 2

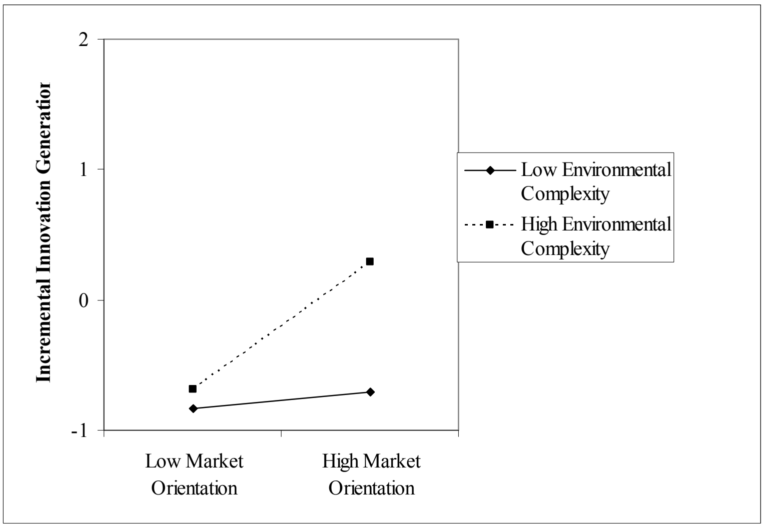

FIGURE 3

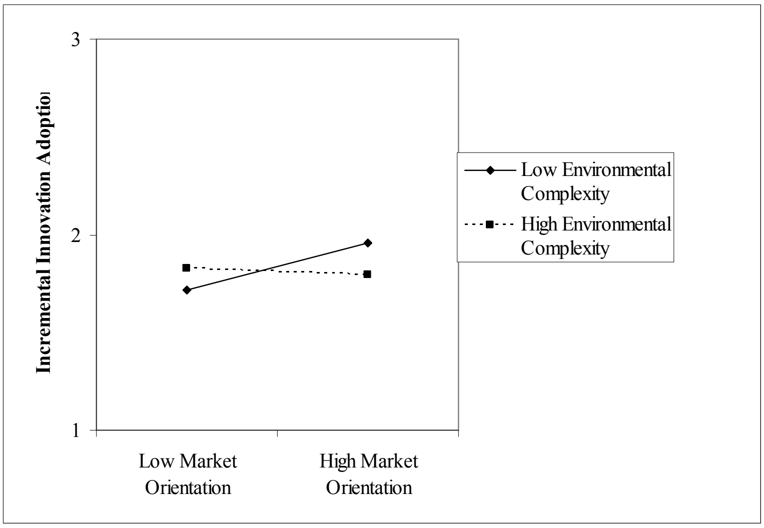

TABLE 1: Descriptive statistics and correlations

	Mean	S.D.	N	1	2	3	4	5	6	7	8	9	10	11	12
1. Radical Innovation Generation	0.436	1.650	388	1											
2. Incremental Innovation Generation	1.910	4.739	388	0.308	1										
3. Radical Innovation Adoption	1.657	4.075	388	0.229	0.009	1									
4. Incremental Innovation Adoption	8.686	9.466	388	-0.023	0.017	0.305	1								
5. Size	3.976	1.224	388	-0.059	0.079	-0.062	-0.009	1							
6. Age	54.399	198.237	388	-0.020	0.008	0.012	-0.025	0.014	1						
7. Internal R&D	9.767	14.538	387	0.167	0.238	0.069	0.082	-0.030	-0.020	1					
8. External R&D	2.543	6.847	387	0.081	0.176	0.066	0.026	-0.015	-0.008	0.285	1				
9. Environmental Dynamism	3.486	0.983	386	0.046	0.072	0.055	0.054	0.069	0.053	0.169	0.060	1			
10. Environmental hostility	4.217	1.075	386	-0.044	0.061	-0.066	-0.077	0.253	0.048	0.038	-0.091	0.283	1		
11. Environmental Complexity	4.597	1.459	386	0.045	0.196	0.051	0.023	0.245	0.108	0.337	0.146	0.285	0.176	1	
12. Market Orientation	5.700	0.931	386	0.036	0.130	-0.012	0.070	0.034	0.015	0.104	0.061	0.023	-0.029	0.166	1

$p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

TABLE 2: Hierarchical Poisson regression for Radical Innovation Generation

Dependent variables	Base Model β	Base Model SE	Independent Model β	Independent Model SE	Contingent Model β	Contingent Model SE
Control variables						
Industry 24	0.528	0.326	0.511	0.327	0.927 **	0.350
Industry 32	0.340	0.386	0.323	0.385	0.623	0.402
Industry 33	1.239 ***	0.359	1.241 **	0.360	1.653 ***	0.381
Industry 34	0.358	0.368	0.338	0.368	0.618	0.383
Size	-0.108	0.077	-0.107	0.078	-0.115	0.080
Age	-0.000	0.001	0.000	0.001	0.000	0.001
Internal R&D	0.023 ***	0.004	0.022 ***	0.004	0.020 ***	0.004
External R&D	0.011	0.008	0.010	0.008	0.004	0.010
Dynamism	0.145	0.087	0.141 *	0.087	0.148	0.088
Hostility	-0.135	0.079	-0.126	0.080	-0.121	0.078
Complexity	-0.063	0.067	-0.071	0.068	-2.424 ***	0.279
Main effect variables						
MO			0.112	0.093	-1.595 ***	0.196
Interactions						
MO * Complexity					0.416 ***	0.048
Model						
Log likelihood	-422.157		-421.396		-387.379	
χ^2	79.68***		81.20***		149.24***	
Delta χ^2			1.520		68.040***	
Pseudo R^2	0.086		0.088		0.162	

$p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

TABLE 3: Hierarchical Poisson regression for Incremental Innovation Generation

Dependent variables	Base Model			Independent Model			Contingent Model		
	β		SE	β		SE	β		SE
Control variables									
Industry 24	0.171		0.123	0.147		0.123	0.164		0.123
Industry 32	0.013		0.150	-0.016		0.149	-0.010		0.148
Industry 33	-0.371	*	0.172	-0.269		0.173	-0.211		0.173
Industry 34	-0.230		0.148	-0.269		0.148	-0.258		0.148
Size	0.066	*	0.031	0.070	*	0.032	0.075	*	0.032
Age	0.000		0.000	0.000		0.000	0.000		0.000
Internal R&D	0.013	***	0.002	0.013	***	0.002	0.014	***	0.002
External R&D	0.020	***	0.003	0.020	***	0.003	0.017	***	0.003
Dynamism	0.014		0.042	0.006		0.041	0.000		0.041
Hostility	0.080	*	0.037	0.100	**	0.038	0.092	***	0.038
Complexity	0.261	***	0.034	0.222	***	0.034	-0.691	***	0.186
Main effect variables									
MO				0.349	***	0.054	-0.420	**	0.157
Interactions									
MO * Internal R&D									
MO * Complexity							0.156	***	0.031
Model									
Log likelihood	-1176.247			-1152.401			-1141.587		
χ^2	332.550***			380.240***			401.860***		
Delta χ^2				47.690***			21.620***		
Pseudo R^2	0.124			0.142			0.150		

$p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

TABLE 4: Hierarchical Poisson regression for Radical Innovation Adoption

	Base Model		Independent Model		Contingent Model	
Dependent variables	**β**	**SE**	**β**	**SE**	**β**	**SE**
Control variables						
Industry 24	0.419 **	0.151	0.147	0.123	0.417 **	0.151
Industry 32	0.294	0.182	-0.016	0.149	0.294	0.183
Industry 33	1.015 ***	0.171	-0.269	0.173	0.981 ***	0.174
Industry 34	0.013	0.178	-0.269	0.148	0.017	0.178
Size	-0.062	0.039	0.070 *	0.032	-0.067	0.039
Age	0.000 *	0.000	0.000	0.000	0.000 *	0.000
Internal R&D	0.004	0.003	0.004	0.003	0.005	0.003
External R&D	0.009 *	0.005	0.020 ***	0.003	0.010 *	0.005
Dynamism	0.143 **	0.044	0.006	0.041	0.142 **	0.044
Hostility	-0.146 ***	0.040	0.100 **	0.038	-0.146 ***	0.040
Complexity	-0.001	0.034	0.003	0.034	0.124	0.148
Main effect variables						
MO			-0.043	0.041	0.062	0.133
Interactions						
MO * Complexity					-0.022	0.026
Model						
Log likelihood	-1084.999		-1084.461		-1084.107	
χ^2	128.970***		130.050***		130.750***	
Delta χ^2			1.080		0.700	
Pseudo R^2	0.056		0.057		0.057	

$p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

TABLE 5: Hierarchical Poisson regression for Incremental Innovation Adoption

	Base Model		Independent Model		Contingent Model	
Dependent variables	**β**	**SE**	**β**	**SE**	**β**	**SE**
Control variables						
Industry 24	0.470 ***	0.063	0.461 ***	0.063	0.450 ***	0.063
Industry 32	0.293 ***	0.077	0.282 ***	0.077	0.279 ***	0.077
Industry 33	0.163	0.084	0.177 *	0.084	0.127	0.085
Industry 34	0.203 **	0.071	0.197 **	0.071	0.200 **	0.071
Size	0.011	0.016	0.011	0.016	0.008	0.016
Age	0.000	0.000	0.000	0.000	0.000	0.000
Internal R&D	0.005	0.001	0.005 ***	0.001	0.005 ***	0.001
External R&D	-0.002	0.003	-0.003	0.003	-0.002	0.003
Dynamism	0.090 ***	0.019	0.090	0.019	0.090 ***	0.019
Hostility	-0.088 ***	0.018	-0.084 ***	0.018	-0.083 ***	0.018
Complexity	-0.003	0.015	-0.010	0.015	0.283 ***	0.076
Main effect variables						
MO			0.061 **	0.020	0.293 ***	0.064
Interactions						
MO * Complexity					-0.051 ***	0.013
Model						
Log likelihood	-2195.089		-2190.417		-2182.693	
χ^2	154.37***		163.710***		179.160***	
Delta χ^2			9.340**		15.450***	
Pseudo R^2	0.034		0.036		0.039	

$p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Appendix: Included measures

Dependent Variables

Radical Innovation generation: Number of "new to the world" radical products launched in the last 5 years

Radical Innovation adoptions: Number of "new to the company" radical products launched in the last 5 years
Incremental Innovation generation: Number of "new to the world" incremental products launched in the last 5 years
Incremental Innovation adoptions: Number of "new to the company" incremental products launched in the last 5 years
The questions included in the questionnaire were:

II1. The number of launched innovations that reinforce your prevailing products is: _____
Approximately what percentage of these innovations has been new to:

Just your organization _____%

For your organizational and market of reference _____%

For the World _____%

100%

II2. The number of launched innovations that make your prevailing products obsolete is: _____
Approximately what percentage of these innovations has been new to:

Just your organization _____%

For your organizational and market of reference _____%

For the World _____%

100%

Scales used to validate the Independent Variables

Inclination of firms to emphasize innovation or imitation (Cronbach's alpha = 0.746)

II1. Your company acquires other companies' innovations to develop its own (vs Your company develops its innovations based on its own ideas and knowledge without using ideas from other companies)
II2. Your company uses imitation as a common practice and is never the first launching products (vs Your company does not use imitation as a common practice and is always the first launching products)
II3. Your company responds to innovations produced by other companies in its market to copy them (vs Your company responds to its clients' needs generating products that are new to its reference market)

Radical Innovation (Subramaniam and Youndt, 2005) (Cronbach's alpha = 0.769)

You obtain innovations that
R1. Make your prevailing products obsolete
R2. Fundamentally change your prevailing products
R3. Make your existing expertise in prevailing products obsolete

Incremental Innovation (Subramaniam and Youndt, 2005) (Cronbach's alpha = 0.871)

You obtain innovations that
I1. Reinforce your prevailing products
I2. Reinforce your existing expertise in prevailing products
I3. Reinforce how you currently compete

Independent Variables

Environmental complexity (Khandwalla, 1977) (Cronbach's alpha = 0.743)

How would you characterize the external environment within which your firm functions?
S1. An environment demanding little in the way of technological sophistication (Vs. Technologically, a very sophisticated and complex environment)
How much research and development activity takes place within your firm's principal industry?
S2. Virtually no R&D in industry (Vs. Extremely R&D oriented industry)

Market Orientation (Narver and Slater, 1990) (Cronbach's alpha = 0.934)

MO1. Our firm is has a customer commitment
MO2. Our firm create customer value
MO3. Our firm understand customer needs
MO4. Our firm has customer satisfaction objectives
MO5. Our firm measures customer satisfaction
MO6. Our firm has alter-sales service
MO7. Salespeople share competitor information
MO8. Our firm respond rapidly to competitors' actions
MO9. Top managers discuss competitors' strategies
MO10. Our firm target opportunities for competitive advantage
MO11. Interfunctional customers calls
MO12. Information shared among functions

MO13. Functional integration in strategy MO14. All functions contribute to customer value MO15. Share resources with other business units
Control Variables
Size: LN. Workers
Age: 2008-year of the company's foundation
Internal R&D: expenditure on internal R&D as average %s of the sales turnover of the company for the last 5 years
Externall R&D: expenditure on external R&D as average %s of the sales turnover of the company for the last 5 years
Environmental dynamism (Khandwalla, 1977) (Cronbach's alpha = 0.671) D1. Our firm must rarely change its marketing practices to keep up with the market and competitors (vs. Our firm must change its marketing practices extremely frequently) D2. The rate at which products/services are becoming obsolete in the industry is very slow (vs. The rate of obsolescence is very high) D3. Actions of competitors are quite easy to predict (vs. Actions of competitors are unpredictable) D4. Demand and consumer tastes are fairly easy to forecast (vs. Demand and tastes are almost unpredictable) D5. The production/service technology is not subject to very much change and is well established (vs. The modes of production/service change often and in major ways)
Environmental hostility (Khandwalla, 1977) (Cronbach's alpha = 0.743)
How would you characterize the external environment within which your firm functions?
H1. Very safe, little threat to the survival and wellbeing of my firm (Vs. Very risky, a false step can mean my firm's undoing)
H2. Rich in investment and marketing opportunities (Vs. Very stressful, exacting, hostile; very hard to keep afloat)
H3. An environment that my firm can control and manipulate to its own advantage, such as a dominant firm has in an industry with little competition and few hindrances (Vs. A dominating environment in which my firm's initiatives count for very little against the tremendous competitive, political, or technological forces)
Industry: Dummy for industries 24, 32, 33, 34 and 35