Performance outcomes of interaction, balance and connectedness between exploration and exploitation in the technological innovation domain

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Eskuin-ezkerti izaeraz egindako aurreko ikerketan funtsezko gai bat eskuin-ezkerti kontzeptuaren operazionalizazioa da. Normalean, interakzio biderkatzailea (hau da, esplorazioan eta ustiapenean puntuazio altua erakustea) eta oreka dira kontuan hartu izan diren bi aurpegiak. Guk argudiatzen dugu hirugarren alderdi bat ere gehitu behar dela: konexutasuna, hau da, zein neurritaraino dauden elkar lotuta eta zenbateraino osatzen duten elkar esplorazioak eta ustiapenak.

Giltza-Hitzak: Eskuin-ezkerti izaera. Konexutasuna. Esplorazioa. Ustiapena. Enpresa-jarduna. Teknologia-berrikuntza.

Una cuestión clave en investigaciones anteriores sobre la ambidestreza es la operacionalización del propio concepto de ambidestreza. Por lo general, la interacción multiplicativa (es decir, la que muestra altas puntuaciones en cuanto a exploración y explotación) y el equilibrio son las dos facetas que se tienen en cuenta. Debería añadirse una tercera faceta: la conectividad, o la conexión o el contacto con otros, que se refiere a la extensión hasta la cual la exploración y explotación están realmente interrelacionadas y se complementan la una a la otra.

Palabras Clave: Ambidestreza. Conectividad. Exploración. Explotación. Rendimiento firme. Innovación tecnológica.

L'opérationnalisation de la notion d'ambidextrie constitue un point clé des recherches préalables sur l'ambidextrie. En général, les deux facettes étudiées sont l'interaction multiplicative (par exemple, de bons résultats en exploration et en exploitation) et l'équilibre. Nous pensons qu'une troisième facette devrait être considérée : la connexité, qui exprime l'étendue d'une véritable interconnexion et la complémentarité entre exploration et exploitation.

Mots-Clés : Ambidextrie. Connexité. Exploration. Exploitation. Rendement de l'entreprise. Innovation technologique.

1. INTRODUCTION AND RESEARCH PURPOSE

According to Tushman & O'Reilly (1997), the complexity and pace of change faced by many organizations in the current economy, together with the time needed to develop new products and services, requires that companies pursue exploitation and exploration simultaneously. In the field of technological innovation, "exploitation" refers to incremental innovation, whereas "exploration" is related to radical innovation. Along these lines, Benner & Tushman (2003) defined exploitative (i.e. incremental) innovations as the ones intended to meet the needs of existing customers or markets, and exploratory (i.e. radical) innovations as the ones focused on emerging customers or markets.

The ambidexterity premise establishes that firms capable of simultaneously pursuing exploitation and exploration are more likely to achieve superior performance than firms emphasizing one at the expense of the other (Tushman & O'Reilly, 1996). This premise has been tested in several studies (He & Wong, 2004; Gibson & Birkinshaw, 2004; Jansen, 2005; Lubatkin et al. 2006; Venkatraman, Lee, & Iyer, 2007), but empirical evidence still remains limited and mixed (Raisch & Birkinshaw, 2008). While some studies corroborate the ambidexterity premise (He & Wong, 2004; Gibson & Birkinshaw, 2004; Jansen, 2005; Lubatkin et al. 2006), others have found that time-paced sequence of exploration and exploitation has a superior effect on firm performance (Venkatraman, Lee, & Iyer, 2007).

A key point in previous studies is the operationalization of the ambidexterity concept. In their research, He & Wong (2004) operationalized ambidexterity in two ways. First, they considered a firm as ambidextrous when it scored high both on exploration and exploitation. Hence, the product of both scores was calculated (i.e. ambidexterity was considered the non-substitutable combination of exploration and exploitation) and the significance of this interaction effect on performance was tested. A similar approach can be found in Gibson & Birkinshaw (2004), Jansen (2005), Lubatkin et al. (2006), and Venkatraman, Lee, & Iyer (2007). Second, He & Wong considered balance between exploration and exploitation as another facet of the ambidexterity concept. Consequently, they calculated the absolute difference between exploration and exploitation scores and tested whether relative imbalance between them was negatively related to firm performance. This complementary approach was also considered by Jansen (2005), and Lubatkin et al. (2006). Additionally, the latter contemplated a third possibility: summing exploration and exploitation scores, even though this was done mainly from an "arithmetic" perspective, rather than from a conceptual point of view related to the meaning awarded to the ambidexterity concept.

However, in these attempts to operationalize the ambidexterity concept, a piece is missing: the degree of connectedness between exploration and exploitation activities. Considering that exploration and exploitation have to be recombined to create value (Eisenhardt & Martin, 2000; Teece, 2007; O'Reilly & Tushman, 2008), the mere coexistence of exploratory and exploitative activities is not enough: both exploration and exploitation should be complementary and mutually reinforcing. This being the case, multiplying exploration and exploitation

scores does not fully capture the extent to which both types of activity are interconnected. Multiplying both elements only allows testing whether the greater the exploitation effort, the greater the influence of exploration on performance (or vice versa). Therefore, we argue that, apart from the two angles reported in the ambidexterity literature, a third facet should be added: connectedness, which refers to the extent to which exploration and exploitation are really interrelated and complement each other.

Actually, incremental innovation represents the best way of extracting the maximum value from radical innovations carried out in the past. By providing small improvements, a company can sustain its product market share and profitability for a longer time, avoiding commoditization (Davila, Epstein, & Shelton, 2006). On the opposite side, discontinuity is often the result of unexpected conjunctions, which not necessarily constitute radical shifts at the technological or market frontier. Hence, recombinant innovation (i.e. packaging existing things up by making new connections between elements, or linking users' needs to technological means) can often be the trigger of radical innovation (Bessant & Tidd, 2007). Therefore, knowledge should flow smoothly between exploration and exploitation activities, and direct measures should be used to capture the degree of connectedness achieved.

Considering this, this paper adds to the growing body of research on the ambidexterity premise by analyzing the performance outcomes (profitability and growth) of interaction, balance, and connectedness between exploration and exploitation activities in the technological innovation domain. In particular, we will report preliminary results from a research in process in medium-high and high-technology firms from the Basque Region (Spain) showing that, unlike previous research, what it really matters for firm performance is to focus on radical innovation and to develop incremental innovations that really complement the former ("connectedness"). On the contrary, interaction and balance between both types of innovation do not show a significant influence on company performance. Specific measures to operationalize the connectedness construct are provided.

2. THEORETICAL BACKGROUND

Organizational ambidexterity is regarded as an emerging research paradigm in organizational theory (Raisch & Birkinshaw, 2008). Broadly speaking, it refers to an organization's ability to perform differing (and often competing) strategic acts at the same time (Simsek et al., 2009). For instance, trying to achieve both flexibility and efficiency (Burns & Stalker, 1961; Thompson, 1967), search and stability (Rivkin & Siggelkow, 2003), competence leveraging and competence building (Hamel & Prahalad, 1993; Sánchez, Heene, & Thomas, 1996), single-loop and double-loop learning (Argyris & Schön, 1978), incremental and radical innovation (Abernathy & Clark, 1985; Tushman & Anderson, 1986), to name but a few. Therefore, the study of organizational ambidexterity has been carried out from different perspectives, namely: organizational design, organizational adaptation, strategic management, organizational learning, and technological innovation (Raisch & Birkinshaw, 2008).

Central to the notion of organizational ambidexterity is the need to strike a balance between "exploration" and "exploitation". These two concepts were introduced by March in his landmark article of 1991, which has frequently been cited as the catalyst for the current interest in the field (Raisch & Birkinshaw, 2008). According to March (1991), exploration refers to notions such as "search, variation, experimentation, and discovery", whereas exploitation is associated with activities such as "refinement, efficiency, selection, and implementation" (p. 102). Successful firms "engage in enough exploitation to ensure the organization's current viability and engage in enough exploration to ensure future viability" (Levinthal & March, 1993: 105). Therefore, none of the activities should be performed at the expense of the other. Whereas too much focus on exploitation (to the exclusion of exploration) may enhance short-term performance, it can result in a "competence trap", since firms may not be able to respond adequately to environmental changes. Conversely, too much focus on exploration could lead to a "failure trap" in which organizations gain no returns from their knowledge (Levinthal & March, 1993).

Depending on the specific perspective from which ambidexterity is studied, the concepts of "exploration" and "exploitation" may have slightly different meanings. In the case of organizational adaptation, exploration and exploitation would refer to the need of implementing changes while maintaining daily operations (i.e. the need to strike a balance between continuity and change) (Meyer & Stensaker, 2006). In the field of strategic management, exploitation and exploration could refer to induced strategic processes (i.e. searching within the scope of the organization's current strategy) versus autonomous strategic processes (i.e. searching outside the scope of the firm's current strategy) (Burgelman, 1991, 2002). In the case of organizational learning, they could refer to the mere reuse of existing knowledge versus all instances of learning (Rosenkopf & Nerkar, 2001), or to learning gained through local search, experiential refinement, and selection and reuse of existing routines versus learning gained via processes of concerted variation, planned experimentation, and play (Baum, Li, & Usher, 2000). Finally, in the case of technological innovation (i.e. the perspective adopted in this paper), exploitation and exploration refer to the balance between incremental and discontinuous (i.e. radical) innovation (Tushman & Anderson, 1986; Benner & Tushman, 2003). Along these lines, Tushman & O'Reilly (1996) defined organizational ambidexterity as "the ability to simultaneously pursue both incremental and discontinuous innovation and change results from hosting multiple contradictory structures, processes, and cultures within the same firm" (p. 24). According to them, ambidextrous organizations are able to both compete in mature markets (where costs, efficiency, and incremental innovation are critical) and to develop new products and services for emerging markets (where experimentation, speed, and flexibility are key drivers).

Because exploitation and exploration may require fundamentally different organizational structures, strategies, and contexts (Raisch & Birkinshaw, 2008) and compete for scarce resources and attention, sustaining an optimal mix of both activities is enormously challenging, and involves some potential tradeoffs (Simsek et al., 2009). Earlier studies often regarded these tradeoffs

as insurmountable (e.g. Hannan & Freeman, 1977; Miller & Friesen, 1986; McGill, Slocum, & Lei, 1992). However, recent research argues that firms are most successful when managers think and act "ambidextrously", by trying to attain high levels of exploitation and exploration simultaneously (e.g. He & Wong, 2004; Gibson & Birkinshaw, 2004; Jansen, 2005; Lubatkin et al., 2006). As Simsek et al. (2009) point out: "To these researchers, exploration and exploitation are fundamentally two distinct organizational activities that should be pursued fully and concurrently to attain competitive advantage and long-term survival" (p. 867). The research reported in this paper adopts this perspective.

3. RESEARCH HYPOTHESES

As previously mentioned, this paper is aimed at analyzing the performance outcomes (profitability and growth) of interaction, balance, and connectedness between exploration (i.e. radical innovation) and exploitation (i.e. incremental innovation) in the technological innovation domain. More precisely, the ambidexterity premise will be tested, under which firms capable of simultaneously pursuing exploitation and exploration are more likely to achieve superior performance than firms emphasizing one at the expense of the other (Tushman & O'Reilly, 1996).

Thus, the first condition for the ambidexterity premise to be satisfied is that companies simultaneously engage both in incremental (i.e. exploitative) and radical (i.e. exploratory) innovation activities. By introducing small refinements in products and services, a company can sustain its product market share and profitability for a longer time (Davila, Epstein, & Shelton, 2006). Likewise, small changes in processes could lead to efficiency gains and cost reductions (Grant, 2008). On the contrary, radical innovation has the potential to rewrite the rules of the game in the industry (Davila, Epstein, & Shelton, 2006), and to enlarge markets either by attracting new customers or by encouraging existing ones to consume more (Markides, 2008). Therefore, the following hypotheses have been formulated:

H1: Engaging in incremental innovation efforts positively affects both (a) company growth and (b) company profitability.

H2: Engaging in radical innovation efforts positively affects (a) company growth and (b) company profitability.

However, considering exploration and exploitation as non-substitutable elements (Gibson & Birkinshaw, 2004), ambidexterity requires high levels of both capacities. Therefore, the multiplicative interaction of the two should be tested. In their research, He & Wong (2004) found that the multiplicative interaction between exploration and exploitation was positively related to sales growth, while Jansen (2005) found a significant influence of the former on firm profitability and on return on equity. In the same vein, Gibson & Birkinshaw (2004) found a positive relationship between the multiplicative interaction between exploration

and exploitation and firm performance. Thus, the following hypothesis has been formulated:

> *H3: The multiplicative interaction between incremental and radical innovation has a positive influence both on (a) company growth and on (b) company profitability.*

Moreover, previous research suggests that a balance is needed between exploration and exploitation activities. Along these lines, He & Wong (2004) found that the relative imbalance (absolute difference) between exploratory and exploitative innovation strategies is negatively related to sales growth, whereas Jansen (2005) did not find a significant relationship between the absolute difference between both types of innovation and firm profitability and return on equity. Hence, empirical evidence is not conclusive at this point. To test this we hypothesize that:

> *H4: The relative imbalance (absolute difference) between incremental and radical innovation has a negative influence both on (a) company growth and on (b) company profitability.*

Finally, for an organization to be ambidextrous, incremental and radical innovation should be interconnected. As already explained, considering that exploration and exploitation have to be recombined to create value (Eisenhardt & Martin, 2000; Teece, 2007; O'Reilly & Tushman, 2008), the mere coexistence of exploratory and exploitative activities is not enough: both exploration and exploitation should be complementary and mutually reinforcing, and knowledge should flow smoothly between exploration and exploitation activities. Thus, the following hypothesis has been formulated:

> *H5: Connectedness between incremental and radical innovation positively affects both (a) company growth and (b) company profitability.*

4. RESEARCH METHOD

In the first stage of the research, the population subject to study is made up of medium-high and high technology firms from the Basque Region (Spain) which carry out R&D activities and which have more than 20 employees. Table 1 shows sectors included in the study. These companies (306) have been identified thanks to EUSTAT (the Basque Institute of Statistics).

Table 1. Target population by sector

Sector	Frequency	Percentage
Chemical industry	29	9%
Manufacture of pharmaceutical products	3	1%
Manufacture of computer, electronic and optical products	29	9%
Manufacture of electrical equipment	28	9%
Manufacture of machinery and equipment	92	30%
Manufacture of motor vehicles and trailers	15	5%
Manufacture of other transport equipment	15	5%
Manufacture of instruments and medical and dental supplies	7	2%
Motion picture, video and television program production, sound recording and music publishing	4	1%
Telecommunications	2	1%
Computer programming, consultancy and other activities related to computer	37	12%
Information services	1	0%
Research and development	44	14%

In order to gather information about the relevant variables of the research, two questionnaires have been designed, one for the managing director of the company (or someone that has an overall perspective of the firm), and the other one for the innovation manager. In the first questionnaire, items measure both company performance and the degree of connectedness between incremental and radical innovation. Conversely, in the second questionnaire items refer to the degree of engagement in exploitative and exploratory innovation. These questionnaires are being completed through personal interviews held with managers and both of them encompass additional variables that are not considered in this paper. In most of the cases, questionnaires have been completed only by one manager, as the person responsible for the area of innovation was also part of the steering committee, providing both perspectives adequately.

At the moment we are writing this paper, 71 companies out of 231 companies contacted randomly (31%) have been analyzed. The remaining 75 companies will be contacted in a near future in order to close the first stage of this study. This sample size is large enough to carry out a statistical study based on structural equation modeling (partial least squares approach) by means of PLS-Graph software (Chin & Frye, 2003). In particular, the sample size required when using this technique is that which would support the most complex multiple regression of the model. For this regression to be identified the following should be observed: a) the formative construct with the largest number of indicators (i.e. the largest measurement equation) or b) the dependent latent variable with the largest number of independent latent variables influencing it (i.e. the

largest structural equation). If one were to use a regression heuristic of 10 cases per predictor, the sample size requirement would be 10 times either a) or b), whichever the greater (Barclay et al., 1995; Chin and Newsted, 1999). In this case, the minimum sample size required is made up of 50 companies.

Four models have been run for each performance dimension under analysis (growth and profitability). In the first one, only the degree of engagement in exploitative and exploratory innovation has been included, together with company performance. The other models are alternative extensions of the first model. In the second one, ambidexterity measured as the multiplicative interaction between exploration and exploitation has been added; in the third one, ambidexterity as balance has been considered; and in the fourth one, ambidexterity as connectedness between incremental and radical innovation has been included.

In the next section, the measurement model is presented in more detail.

4.1. Constructs and measures

To measure ambidexterity in the field of technological innovation, exploitative (i.e. incremental) and exploratory (i.e. radical) innovation efforts should be assessed. To this end, two scales have been developed that capture the degree of emphasis put on the two pillars of technological innovation (products and processes), the degree of novelty of the innovations being introduced, and the focus of the innovation efforts: meeting the needs of existing customers and markets, or trying to access new customers or markets (Benner & Tushman, 2003). In the case of *Exploitative innovation*, indicators measure the extent to which the company develops innovation projects aimed at: (1) improving current products and services, (2) improving current processes, (3) reinforcing the way the company competes, (4) better serving current customer segments, and (5) improving the company's position in current markets. Conversely, in the case of *Exploratory innovation*, indicators, measure the extent to which the company develops innovation projects aimed at: (1) substantially modifying current products and services, (2) introducing completely new products and services, (3) introducing completely new processes, (4) developing new technologies, and (5) accessing new markets. All the indicators used have been measured by means of 1 to 7 Likert scales and are considered to shape or (give rise to) the exploitation/exploration orientation of the company (i.e. they are formative in nature).

Setting out from these constructs, the multiplicative interaction between exploitative and exploratory innovation efforts has then been calculated, as well as the absolute difference (i.e. imbalance) between both of them. For the third ambidexterity dimension to be measured (*Connectedness*), a specific scale has been developed which is made up of three indicators: (1) we are very satisfied with the degree of fit between incremental and radical innovation in our company; (2) in our company incremental and radical innovation are mutually reinforcing; and (3) we are very good at combining incremental and radical innovation. The three indicators have been measured by means of 1 to 7 Likert scales and are reflective in nature.

Finally, as far as *Growth* and *Profitability* are concerned, in this first stage of the research we have used perceptual measures to capture the position occupied by the company vis-à-vis its competitors, based on empirical evidence that suggests that CEO self-reports on performance significantly correlate with some objective measures of firm performance (Dess & Robinson, 1984; Robinson & Pearce, 1988).

4.2. Multivariate analysis

Structural equation modeling (SEM) based on partial least squares (PLS) has been used to test the hypotheses of the research. SEM constitutes a second generation of multivariate analysis (Fornell, 1982) which combines multiple regression concerns (by examining dependency relationships) and factor analysis (by representing unobserved variables by means of multiple observed measures), in order to estimate a set of dependency relationships which are all simultaneously interrelated.

When applying SEM, two approaches can be used: the covariance-based approach and the partial least squares (PLS) approach. In the first case, the aim is to determine the matrix of model parameters in such a way that the resulting covariance matrix predicted by the theoretical model is as close as possible to the sample covariance matrix (Haenlein and Kaplan, 2004). In the second case, however, the primary objective is the minimization of error (or, equivalently, the maximization of variance explained) in all endogenous constructs (Hulland, 1999). The use of the PLS approach avoids some of the problems linked to the variance-based one, such as those related to non-unique or otherwise improper solutions (Fornell and Bookstein, 1982), and to the use of small data samples (Fornell, 1982).

A PLS model is analyzed and interpreted in two stages: firstly, an assessment of the reliability and validity of the measurement model is made, and secondly, an assessment of the structural model is carried out. This sequence ensures that the measures making up the constructs are valid and reliable before attempting to draw conclusions regarding relationships among constructs (Barclay et al., 1995).

4.2.1. Measurement model evaluation

As far as the measurement model evaluation is concerned, this differs depending on the nature of the construct being analyzed (reflective or formative). In the case of constructs made up of reflective indicators, individual item reliability, construct reliability, convergent validity and discriminant validity should be checked.

Individual item reliability refers to the extent to which a particular indicator really measures the latent variable to which it has been connected. For this to be assessed, the loadings or simple correlations of the measures with their

respective construct should be observed. A rule of thumb is to accept items with loadings of 0.707 or more, which implies more shared variance between the construct and its measures than error variance (Barclay et al., 1995; Carmines and Zeller, 1979). Since loadings are correlations, this means that more than 50% of the variance in the observed variable is shared with the construct.

Construct reliability or internal consistency refers to the extent to which all the indicators of a specific construct measure the same latent variable. If this were to be true, all the indicators making up the construct should be highly correlated. For this to be tested, two options exist: Cronbach's alpha and composite reliability (ρc). The latter was developed by Werts et al. in 1974 and is considered to be a better measure than Cronbach's alpha. Composite reliability is calculated as follows:

$$\rho_c = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum_i var(\varepsilon_i)}$$

Convergent validity is assessed by means of the so-called average variance extracted (AVE). This measure was created by Fornell and Larcker in 1981 and it provides the amount of variance that a latent variable captures from its indicators, relative to the amount due to the measurement error:

$$AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum_i var(\varepsilon_i)}$$

It is recommended that AVE should be greater than 0.50, this meaning that 50% or more of the variance of the construct is due to its own indicators.

Finally, discriminant validity indicates the extent to which a given construct is different from other constructs (i.e. the extent to which the constructs making up the research model really measure different things). For this to be true, a construct should share more variance with its measures than it shares with other constructs of the model (Fornell and Larcker, 1981). In other words, average variance extracted should be greater than the variance shared between the construct and other constructs (i.e. the squared correlation between the two constructs). As PLS-Graph software (Chin and Frye, 2003) provides the correlation matrix for the constructs and not the squared correlations, it would be easier to calculate the root value of AVE for each construct (this would be the diagonal of the correlation matrix) and to compare it with the correlations obtained. For adequate discriminant validity, the diagonal elements (i.e. the root values of AVE) should be greater than the off-diagonal elements in the corresponding rows and columns.

In the case of constructs made up of formative indicators (i.e. when the observed measures give rise to the existence of the latent variable), multicolinearity problems should be explored.

4.2.2. Structural model evaluation

Once the quality of the measurement model has been guaranteed, the quality of the structural model should then be assessed. This refers to the strength of the research hypotheses and to the predictive power achieved.

In order to assess research hypotheses, path coefficient levels should be examined. They should be interpreted in the same way as ß coefficients in traditional regression. For their degree of stability and precision to be tested, nonparametric techniques of re-sampling such as jackknifing and bootstrapping should be used. Although jackknifing requires less computational time than bootstrapping, it is considered less efficient than the latter. Indeed, jackknifing is viewed by several authors as an approximation to bootstrap (Chin, 1998; Efron and Tibshirani, 1993). Hence, bootstrapping has been the technique of analysis used in this research.

More specifically, bootstrapping provides a "t" value for each relationship represented in the model. A student "t" distribution with n-1 degrees of freedom ("n" being the number of subsamples analyzed: 500) should then be used for assessing the "t" values obtained. If the sign of the relationships has been specified (as is our case) a one-tailed distribution could be used. Otherwise, a two-tailed distribution applies.

A measure of the predictive power achieved by a PLS model is provided by the R^2 value of the endogenous construct (Barclay et al., 1995). Once more, these values should be interpreted in the same manner as the R^2 obtained from a multiple regression analysis. Consequently, R^2 values indicate the amount of variance in the constructs which is explained by the model.

According to Falk and Miller (1992), the amount of variance explained (R^2) of an endogenous construct should be equal to or greater than 0.10 (i.e. 10%). They argue that although lower values of R^2 could be statistically significant, they provide very little information and therefore, the predictive power of the hypotheses formulated with respect to the latent variable under analysis is very low.

5. RESEARCH FINDINGS

Following the sequence of analysis previously described, the main findings of the multivariate analysis carried out are as follows:

Once the quality of the measurement model has been guaranteed (to keep the paper to a reasonable length, this part of the analysis is not reported), the quality of the structural model has been assessed. This refers to the strength of the research hypotheses and to the amount of variance explained (R^2). In order to assess the research hypotheses, path coefficient levels should be examined, as well as their degree of significance, by means of bootstrapping techniques. Table 2 summarizes the results obtained in the second, third and fourth models.

In this table, we can also see the contribution of each exogenous construct to the amount of variance explained.

Table 2. Structural model evaluation

<table>
<tr><th></th><th></th><th></th><th>Exploita-tion</th><th>Exploration</th><th>Interaction</th><th>Imbalance</th><th>Connected-ness</th><th>Total R^2</th></tr>
<tr><td rowspan="9">Growth</td><td rowspan="3">Model 2</td><td>Path</td><td>0.141</td><td>0.398***</td><td>0.042</td><td></td><td></td><td></td></tr>
<tr><td>Correlation</td><td>0.155</td><td>0.407</td><td>0.015</td><td></td><td></td><td></td></tr>
<tr><td>Contribu-tion to R^2</td><td>2.19%</td><td>16.20%</td><td>0.06%</td><td></td><td></td><td>18.45%</td></tr>
<tr><td rowspan="3">Model 3</td><td>Path</td><td>0.141</td><td>0.406***</td><td></td><td>0.047</td><td></td><td></td></tr>
<tr><td>Correlation</td><td>0.155</td><td>0.407</td><td></td><td>–0.046</td><td></td><td></td></tr>
<tr><td>Contribu-tion to R^2</td><td>2.19%</td><td>16.52%</td><td></td><td>–0.22%</td><td></td><td>18.49%</td></tr>
<tr><td rowspan="3">Model 4</td><td>Path</td><td>0.095</td><td>0.403***</td><td></td><td></td><td>0.226*</td><td></td></tr>
<tr><td>Correlation</td><td>0.155</td><td>0.407</td><td></td><td></td><td>0.239</td><td></td></tr>
<tr><td>Contribu-tion to R^2</td><td>1.47%</td><td>16.40%</td><td></td><td></td><td>5.40%</td><td>23.28%</td></tr>
<tr><td rowspan="9">Profitability</td><td rowspan="3">Model 2</td><td>Path</td><td>0.140</td><td>0.303**</td><td>0.053</td><td></td><td></td><td></td></tr>
<tr><td>Correlation</td><td>0.216</td><td>0.340</td><td>–0.001</td><td></td><td></td><td></td></tr>
<tr><td>Contribu-tion to R^2</td><td>3.02%</td><td>10.30%</td><td>–0.01%</td><td></td><td></td><td>13.32%</td></tr>
<tr><td rowspan="3">Model 3</td><td>Path</td><td>0.124</td><td>0.321**</td><td></td><td>0.070</td><td></td><td></td></tr>
<tr><td>Correlation</td><td>0.216</td><td>0.340</td><td></td><td>–0.012</td><td></td><td></td></tr>
<tr><td>Contribu-tion to R^2</td><td>2.68%</td><td>10.91%</td><td></td><td>–0.08%</td><td></td><td>13.51%</td></tr>
<tr><td rowspan="3">Model 4</td><td>Path</td><td>0.120</td><td>0.290**</td><td></td><td></td><td>0.147</td><td></td></tr>
<tr><td>Correlation</td><td>0.216</td><td>0.340</td><td></td><td></td><td>0.186</td><td></td></tr>
<tr><td>Contribu-tion to R^2</td><td>2.59%</td><td>9.86%</td><td></td><td></td><td>2.73%</td><td>15.19%</td></tr>
</table>

Notes: ***$p<0.001$, **$p<0.01$, *$p<0.05$ (based on t_{499}, one-tailed test).

The results obtained show that, in the companies studied, engaging in radical (i.e. exploratory) innovation efforts is the main explanatory factor both of company growth and company profitability. Hence, hypotheses H2a and H2b are clearly supported. On the contrary, incremental (i.e. exploitative) innovation efforts do not make any significant difference in company performance. Thus, hypotheses H1a and H1b are not supported. Although descriptive analyses carried out show that, in general terms, innovation efforts are more biased towards incremental innovation than towards radical innovation, it is only the latter that exerts a significant influence both on company growth and on firm profitability.

As far as ambidexterity facets are concerned, traditional dimensions related to the multiplicative interaction between exploitation and exploration and to the degree of balance between both of them are completely non-significant. Hence, hypotheses H3 and H4 are not supported. What it really matters for firm performance (at least for company growth) is that exploitative (i.e. incremental) innovation and exploratory (i.e. radical) innovation efforts are interconnected and mutually reinforcing. The results obtained show that hypothesis H5a is supported, while hypothesis H5b (the one linking connectedness with profitability) is in the threshold of being supported (its T-statistic is very close to the 90% limit: 1.214 versus 1.282). In other words, incremental innovation should be related to and complement radical innovation efforts, but there is no need of balancing and developing them to the same extent. Actually, radical innovation efforts should be further enhanced.

6. CONCLUSION

The ambidexterity premise establishes that firms capable of simultaneously pursuing exploitation and exploration are more likely to achieve superior performance than firms emphasizing one at the expense of the other (Tushman & O'Reilly, 1996). This premise has been tested in several studies (He & Wong, 2004; Gibson & Birkinshaw, 2004; Jansen, 2005; Lubatkin et al. 2006; Venkatraman, Lee, & Iyer, 2007).

Our research, which is still in process, shows that, on the contrary, what it really matters for firm performance is to focus on radical innovation, even though returns on exploration are more uncertain and more distant in time. It is also important to highlight that none of the facets reported in the literature to measure ambidexterity has proved to be relevant. That is, neither the multiplicative interaction (i.e. the non-substitutable combination of exploration and exploitation), nor the balance between exploration and exploitation (i.e. the absolute difference between them) has shown a significant impact on firm performance (i.e. company growth and/or profitability). On the contrary, for firms to succeed, results show that it is very important (at least for company growth) that exploitative (i.e. incremental) innovation and exploratory (i.e. radical) innovation efforts are interconnected and mutually reinforcing (i.e. high level of connectedness). In other words, incremental innovation should be related to and complement radical innovation efforts, but there is no need of balancing and developing them to the same extent. Actually, radical innovation efforts should be further enhanced.

Although descriptive analyses carried out (see Table 3) show that, in general terms, innovation efforts are more biased towards incremental innovation than towards radical innovation, it is only the latter that exerts a significant influence both on company growth and on firm profitability. Therefore, companies willing to obtain superior performance should emphasize exploration efforts at the expense of exploitation ones.

Table 3. Orientation of the perceived imbalance between incremental and radical innovation

	Frequency	Percentage
No answer	2	2.8%
No bias (i.e. complete balance)	10	14.1%
Bias towards incremental innovation	43	60.6%
Bias towards radical innovation	16	22.5%

Limitations and future research directions

The study carried out has several limitations. The first one refers to the use of perceptual measures to capture company performance. Given that the fieldwork has been completed in 2012, it was not possible to obtain accounting information about firms' current results from database such as SABI at the time of writing this paper. Thus, we had no choice but to apply to the companies themselves. However, firms are often reluctant to provide this kind of information. Consequently, we decided to use perceptual indicators, based on empirical evidence that suggests that CEO self-reports on performance significantly correlate with some objective measures of firm performance (Dess & Robinson, 1984; Robinson & Pearce, 1988). Actually, this is common practice in organizational ambidexterity research (Gibson y Birkinshaw, 2004; Lubatkin et al., 2006; Andersen y Nielsen, 2007; Bierly y Daly, 2007; Sarkees et al., 2010; Schudy, 2010; Chiu et al., 2011; Çömez et al., 2011; Lee et al., 2012; Stubner et al., 2012).

The second limitation refers to the desirability of having longitudinal data in order to check the impact of firm's ambidexterity at present in its future results. However, that possibility exceeds the expected timeframe for this research, so it is suggested as a future research direction.

In addition, our sample only includes firms located in the Basque Region (Spain) and we used a convenience sample, but we do not expect this to be of major concern.

Finally, future research could examine the validity of the operationalization approach (i.e. connectedness) proposed for ambidexterity in different populations.

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