LISBON PLANE LANDING? AN EMPIRICAL STUDY OF THE DETERMINANTS AND CONSEQUENCES OF PRODUCT INNOVATION IN SMALL EUROPEAN FIRMS

SOUMODIP SARKAR
CEFAGE-UE and Department of Management, Universidade de Évora, Largo dos Colegiais 2, 7004-516 Évora, Portugal
ssarkar@uevora.pt

ANA ISABEL COSTA
MAPP, Aarhus Business School, Aarhus, Denmark
CEFAGE-UE, Universidade de Évora, Largo dos Colegiais 2, 7004-516 Évora, Portugal
anac@asb.dk
anacosta@uevora.pt

ABSTRACT

We are now more than halfway through the period given by the European Council to transform the Europe into the "most dynamic and competitive knowledge-based economy in the world" - the famous 2000 Lisbon Strategy. Still, not much is known at firm level about how small European companies are taking up this gauntlet. While the European Innovation Scoreboard, now in its sixth edition, offers a remarkable snapshot of the degree of innovation performance of firms, the need remains for a more comprehensive and detailed understanding of the determinants and consequences of product innovation in small European firms.

This paper presents the results of an empirical study of the determinants and consequences of product innovation in small European firms. Over 1000 small businesses active in the Portuguese region of Alentejo (one of the poorest in the EU15 area), across all economic sectors, were surveyed in 2006. Among others variables firms' structural characteristics, competitive market pressure, barriers to innovation, propensity for (collaborative) product innovation, R&D effort, ICT use, innovation performance, product innovativeness and market outcome were measured.

Results from our regression analyses find that engagement in R&D, and the dynamic use of web sites, to name some of the variables in our study, strongly influence SME innovation both in terms of the probability of introducing innovative products as well as the percentage of sales from innovative products. Intriguingly we discover that the presence in international markets and the existence of partners in product innovation affect the intensity of innovation but not the probability of innovating. Our regression analyses throw up another intriguing result in that the sector of activity are always non-significant suggesting that there are not significant differences regarding the innovation output and outcome across the various sectors. This is an intriguing given that most other studies show differences across sectors.

Please cite as: Sarkar, S. & Costa, A.I.A.(2008). LISBON PLANE LANDING? AN EMPIRICAL STUDY OF THE DETERMINANTS AND CONSEQUENCES OF PRODUCT INNOVATION IN SMALL EUROPEAN FIRMS. Proceedings of the 15th International Product Development Management Conference, June 29 – July 1, Hamburg, Germany.

1. INTRODUCTION

If SMEs performance is a complex and multifaceted construct that should be examined with an eye towards its complexity (Wolff and Pett, 2006), it is much more problematic when we through their innovation performance into the equation. While different aspects of innovation have been studied in varied contexts, from both macro perspectives to innovation dynamics and the management aspects of innovation, innovation performance and characteristics as well as innovation determinants for SMEs and specially in micro firms is not well understood at all. While the European Innovation Scoreboard, now in its sixth edition, offers a remarkable snapshot of the degree of innovation performance of firms, the need remains for a more comprehensive and detailed understanding of the determinants and consequences of product innovation in small European firms.

This paper presents the results of an empirical study of the determinants and consequences of product innovation in small European firms. Over 1000 small businesses active in the Portuguese region of Alentejo (one of the poorest in the EU15 area), across all economic sectors, were surveyed in 2006. We believe that our paper makes a valuable contribution towards understanding innovation determinants as well as manager-owner perspective of what is innovation and resulting market outcome for small firms. We employ two methodological approaches employed in conjunction goes some way to shed some light on small firm innovation.

First we try understand the manager-owner perspective of innovation in small firms and use the Integrated Innovation Model (Sarkar 2007) that provides the conceptual framework of analyses. Using a unique data set compiled via a survey conducted using 1020 firms in Portugal, we tried to diagnose what innovation means as well as perceived market outcome for these firms. Principal Component Analysis (PCA) was used to uncover the underlying factor structure in each of the three main dimensions. The internal consistency and convergent validity of the scales resulting from the PCA was investigated by performing a Confirmatory Factor Analysis using AMOS.

Second we run three different models to understand innovation behaviour of SMEs. Some latent variables from the PCA are used as variables (one of the three dependent variables as well as appearing as three independent variables in the models) along with other innovation measures such as innovation outcome in terms of sales, firm size, cooperation etc..

Our results from PCA and CFA show that managers perceive the existence of important positive relationships between their firms' degree of technological innovation and the level of service innovation, as well as between these two and the market return achieved.

Results from our regression analyses confirm prior research and also give intriguing new leads. We find that engagement in R&D, and the dynamic use of web sites, to name some of the variables in our study, strongly influence SME innovation both in terms of the probability of introducing innovative products as well as the percentage of sales from innovative products. One of the very intriguing results is that we discover that the presence in international markets and the existence of partners in product innovation affect the intensity of innovation but not the probability of innovating. Another intriguing result is that the sector of activity are always non-significant suggesting that there are not

significant differences regarding the innovation output and outcome across the various sectors. This is an intriguing result as most other studies show differences across sectors. One possible explanation for this result is that our sample is more homogenous in other regards than in most studies.

Our paper is organized as follows: The following section presents our model framework and the hypotheses that would be tested. Section 3 then presents the methodology engaged, including data collection, and survey measurement scales. Section 4 KIBS in some detail and their relationships with innovation as well as a characterization of the service sector, in particular of KIBS based on results from the CIS III survey, including innovation performance of firms in KIBS in Portugal. Section 4 explains the data set and a detailed description of the methodology employed for its application. Results and discussion including the tests for unidimensionality and reliability of the integration innovation model measures, followed by the results from the multiple regression and logistic regression analysis. Section 5 presents the main conclusions, some managerial implications as well as point out to some drawbacks of our study.

I2. MODEL FRAMEWORK AND HYPOTHESES

The diversity of approaches to study innovation has generated myriad typologies and model specifications depend upon the focus of study (Sarkar 2007). Despite an increasing volume of literature on innovation behavior, innovation process is still poorly understood (Coombs et al., 1996) with still no precise prescription for successful innovation (Rothwell, 1992).

In this section we analyze each determinant of innovation included in our study, as well as the control variables, briefly explaining the expected theoretical impact of the determinant and summarizing previous empirical results and the corresponding hypothesis that we shall be testing in our model.

2.1 Dependent Variables

Researchers have yet to come up with a unique measure of innovation, with different approaches to operationalizing innovation, many dictated by data constraints, with some studies using patents as innovation measures (Griliches et al. 1987). We have eschewed using such variables, and instead have opted for four measures of innovation with a different measurement method for each. The use of several measures would allow us to enhance robustness (Kleinknecht et al., 2002) as well as enable us to verify whether each measurement type provides a good fit of the model. Due to the firm characteristics in our sample being overwhelmingly small and majority family owned, we do not differentiate between process and product innovation.

The first variable we use is a categorical variable, which is the firm´s share of sales from new product introduction. Four categories of innovative sales share are measured: less than 10%; between 11% and 25% more than 25% and less than 50% and finally innovative sales more than 50%.

The second dependent variable used (in the second model) is the degree of product innovation. This variable is derived from our CPA tests of the ten point measures of the dimension that measures the degree of product innovation in the Integrated Innovation Model (which works on three dimensions- degree of market pressure, degree of product innovation and market outcome).

The third model uses new product innovation by the firm as the dependent variable.

Table X1: Single survey measures used as dependent variables in the data analysis

Dependent variables	
(1) Percent sales from new product introduction	Proxy for product innovation; firm introduced at least one new product during last 3 years; coded 1, otherwise, coded 0.
(2) Degree of product innovation	Measurement scale (see next sub-section).
(3) New product introduction	Proxy for product innovation performance; categorical variable from 0% to over 50%.

2.2 Independent Variables

Market Conditions

Following Arvantis we use product market environment as an explanatory variable that determines innovation. In the economic literature, both positive effects and negative effects from competition on innovation have been found (see, for instance, Kamien and Schwartz (1982), Martin and Theeuwes (2001), and Cohen and Levin (1989)). Aghion et al. (2005 suggests an inverse U relationship between competition and innovation with both a positive and negative effect of competition on innovation existing, depending upon the initial level of competition. In very competitive market the profits of a laggard are almost zero. On the other hand in very competitive market it pays off for firms that can outperform their opponents. Strong evidence supporting their model was found using UK panel data.

We use two variables to capture the market environment in which a firm operates. First we also demand conditions as part of the product market environment, measured by a firm´s sales expectation for the following year as an indicator of demand (Arvanitis 2008). We expect more innovative firms to have more positive outlook with regards to future sales.

Second we use the need for contracting new workers, a categorical variable (zero, less than 5, between 5 and 10 and more than 10) as another variable to measure demand conditions.

Third we use the perceived market outcome from innovation. This variable was based on CPA a ten-item scale where owners were asked to provide an assessment of the new service's financial performance, its impact on the firm's competitive advantage and market position, and the results obtained in terms of broadening the client base and increasing customer satisfaction. We believe that owner-managers that are regard favorable market outcome from innovation are more likely to invest in innovation.

In each of our three models, we test the following hypothesis:

H1: Favourable market conditions and beliefs lead to higher innovation.

Internationalization

While there is a significant body of literature on internationalization of R&D, to date little is known about internationalization and innovation performance of small firms. Hessels (2007) found that there is a positive relation between innovation and the international involvement of Small and Medium-sized Enterprises (SMEs), taking into account export as well as import activities of firms.

Kafouros et al (2007) provide a conceptual framework, with two sets of factors through which internationalization feeds through leading to enhancing innovation performance. The first (innovative capacity) relates to the factors that influence a firm's ability to produce technological innovations. R&D departments with high innovative capacity can develop better products and processes, faster and at lower cost and therefore contribute more to a firm's performance. The second set of factors (increased appropriability) allow a firm firstly, to better exploit its technological developments and to protect and appropriate the fruits of innovation.

In our model, we use percentage sales in foreign markets to measure the degree of internationalization of small firms. We describe three categorical variables for internationalization: firms with no sales outside the country; firms selling to countries in the European Union and those with sales outside the European Union .

With respect to internationalization, in our three models, we test the following hypothesis:

H2: Firms that have international presence are more likely to innovate.

Inputs for innovation- ICT and knowledge workers

Firms that choose to invest more than their rivals in information technology (computer hardware and software) tend to realize greater returns (Bharadwaj 2000). However there is little research on how ICT investment interacts with innovation (see Dibrell et al. 2008). Given that we did not have data on actual ICT asset investment, we opted for nature of web site use as a proxy of ICT use.

For knowledge workers, which is considered an important innovation determinant, we use % R&D workers in the firm. This is a categorical variable taking values from 0 (no R&D workers) till 4.

In each of our three models, we test the following hypothesis:

H3: ICT & R&D intensive firms are more likely to innovate.

Partnerships in Product Development

Looking outside for collaboration partnerships for new product development is being increasingly tapped by firms as a source of innovation. Collaboration can be defined as a type of cross-organizational linkage, which in addition to high levels of integration is characterized by high levels of transparency, mindfulness, and synergies in participants' interactions (Emden et al. 2006, Jassawalla and Sashittal, 1998).

Costa and Sarkar, (2008) define *active sources*, which also actively partake in the processing of this information and thus in the organizational knowledge creation. The relationships developed between the latter and the innovating firm in the context of (more or less formalised) joint innovation initiatives constitute what is commonly known as *innovation cooperation*.

Examples of innovation cooperation are the development of research projects in collaboration with universities and private research institutes (Knudsen, 2007), the establishment of strategic corporate alliances for new product development (Rindfleisch and Moorman, 2001), and the integration of lead-users in innovation processes (von Hippel, 1988).

We had four sets of variables to study the type of collaboration and partnerships practiced by firms. First whether the firm has cooperation or established contracts with commercial laboratories and firms specialized in R&D. The second is whether the product development was born out of collaborations with clients. Another partnership variable as a source of product development are consultants. Finally we use other sources of cooperation with external agents for product development, namely equipment suppliers, government institutions, rival firms and non governmental non profit organizations. However in our regression analyses, we used a dummy variable to distinguish between firms that cooperate from those that don't.

In our three models, we test the following hypothesis with respect to cooperation:

H4: *Firms that engage in cooperation are more innovative*

Firm Size

In their systematic review of empirical articles published between 1993 and 2003 on technological innovations in the manufacturing sector, Becheikh et al. (2006) found that size is one of the variables most studied as a determinant of innovation, with more than half of the studies included in their review of 108 papers, considering firm size to be an explanatory variable of innovating behavior.

Many studies suggest that the effect of the size of the firm is a priori ambiguous, since there are effects running in opposite direction, something that has been confirmed by different empirical studies that relate the size of the firm with innovation (using measures of innovation such as R&D intensity or number of patents).

Given that our research focuses on small firms with little significant variation among them as measured by the number of employees, we use firm sales as a proxy for firm size. We describe five types of firms in terms of their size 1) annual sales less than €50000; 2) sales between €50001 and €150000; 3) sales above €150000 and less that €500000); 4) sales between 500,001 and €1 500 000 and finally 5) sales above €1 500 000.

With regards to firm size, we test the following hypothesis:
H5: Firm size has an ambiguous impact on innovation

Competitive Pressure

Does competitive pressure increase the degree of innovation? While many contend that competitive pressure increases the propensity to innovate, innovation behaviour in the face of market pressure depends on market structure, Sarkar (2007) contends that there are four different types of archetypes, and high competitive pressure could lead to markets where the product ends up as a commodity, or products could become differentiated catering to niche markets.

With regards to competitive pressure, we test the following hypothesis:
H6: Innovation behavior is ambiguous with respect to competitive pressure

Table X2: Single survey measures used as independent and control variables in the data analysis

Measurement of	***Independent variables***	
Market conditions	(1) Sales expectations for next year	Proxy for demand; categorical variable from sales decreasing 5% to sales increasing 5%.
	(2) New hires for the following year	
Internationalization	(3) Perceived market outcome from innovation	Measurement scale (see next sub-section).
	(4) Active in international markets	Proxy for degree of firm internationalization; coded 0 if not active, coded 1 if active in EU markets, coded 2 if otherwise.
ICT and R&D Inputs of inovation	(5) Number of applications of firm website	Proxy for degree of ICT use; categorical from no use to up to four different uses of the firm's website (research, customer feed-back, on-line sales and virtual work area).
Cooperation for innovation	(6) % workers employed in R&D	Categorical variable
Cooperation for innovation	(7) Partner in product innovation	Dummy for the existence of partners in product innovation
		Proxy for firm size
Firm Size	(8) Sales volume	Measurement scale (see next sub-section).

Competitive Pressure	(9) Perceived degree of competition	Measurement scale (see next sub-section).
	Control variables	A dummy for each of the five sectors
	(10) Sector	Dummy equal to 1 if sole proprietorship 0
	(11) Firm type by ownership	otherwise

3. METHODOLOGY

3.1 Sample and data collection

Selection of the research sample was motivated by the objective of being able to generalize the findings of this study across the region and beyond the particular nature of one or two economic sectors. Consequently, data was gathered using a cross-sectional survey methodology encompassing firms from all sectors (primary, secondary and tertiary) active in the Portuguese region of Alentejo. The sampling frame consisted thus of 87 526 firms with registered headquarters in Alentejo (INE, 2004).

The survey was mailed in the spring of 2006 by ADRAL (a public/private agency promoting regional development in Alentejo since 1998) to the CEOs of each firm in Alentejo registered in the contact list of this association (about 1100 firm). To minimize social desirability bias in answers, the respondents were reminded that there were no wrong or right answers to the questions being asked. To increase CEOs' motivation to cooperate in the survey, respondents were also informed that their responses would remain anonymous and served only academic research purposes. Moreover, they would not be linked to their companies or their products. Finally, all respondents were offered an extended summary of the study's findings.

The convenience sampling approach described was able to assemble a research sample of 1020 Alentejo firms, which indicates a response rate of about 93%. Respondents clearly had a positive attitude towards the study, as demonstrated by the very high response rate and the fact that almost all of them wanted to receive a summary of its findings. Table X3 shows the main characteristics of the research sample.

Table X3 Main characteristics of the research sample (n=1020)

	Percentage of firms
Sector	
Primary sector and food industry	11%
Other industries, utilities and building	15%
Retail	45%
HORECA	9%
ICT, R&D and support services	12%
Other services	8%

Number of full-time equivalent employees	
1-9	83%
10-49	15%
50-249	2%
Annual sales volume(Euro)	
< 50 000	36%
50 000 – 150 000	28%
150 000 – 500 000	17%
500 000 – 1 000 000	11%
> 1 000 000	8%
Firm ownership by type	
Sole Proprietorship	35%
Proprietorship with shares	8%
Incorporations	51%
SAs, cooperatives and others	6%

The characteristics presented in Table X3 show that the surveyed Alentejo units were mainly firm from the tertiary sector (with the prevalence of retail firms), with less than 9 employees (*i.e.*, micro-firms), with an annual sales volume of 150 000 Euro or less. Most of these firms were either sole proprietorships or incorporated. Similar distributions of firm sector, size and ownership have been reported for the Alentejo region (INE, 2004). Consequently, we can consider this research sample to be fairly representative of the population under study.

3.2 Survey measurement scales: Integrated Model of Innovation measures

As mentioned in Table X2 and X3 the following scale variables were used in our model- degree of product innovation (one of the four dependent variables used) and three independent variables, namely- Level of competition, Knowledge-based competitive advantage and Market outcome. This data concerning the CEO's evaluation of their firms innovation activities was gathered using a set of measurement scales developed by Sarkar (2007), with the aim of providing entrepreneurs and their businesses with effective, yet user-friendly, self-assessment tools in the areas of competitive market pressure, level of innovation and market outcome. These tools are based upon an Integrated Model of Innovation (2005, 2007), which establishes the nature and intensity of the relationships between competitive market pressure, degree of innovation/ differentiation and different types of market outcomes at company or industry level.

Given that the aforementioned survey has not yet been specifically used to assess the innovation performance of small and medium size firms, a combined exploratory and confirmatory factor analysis methodology will be employed in the present study in order to validate its application in this sector. Figure X1 depicts the first-order CFA model

which represents the main dimensions of the Integrated Model of Innovation employed in this study – Level of Competition, Degree of Innovation and Market Outcome. (Note that the variables used Knowledge-based competitive advantage, was derived from the CFA analyses performed). Each main dimension, or latent variable, is linked to a set of 10 indicators, or observed variables, corresponding to a set of 10 questions, or items, in the assessment survey. Once this CFA model, or measurement model, is validated for the industry in question, the nature and intensity of the relationships between its latent variables and the other variables of interest in this study can be investigated through multiple regression and logistic regression analysis.

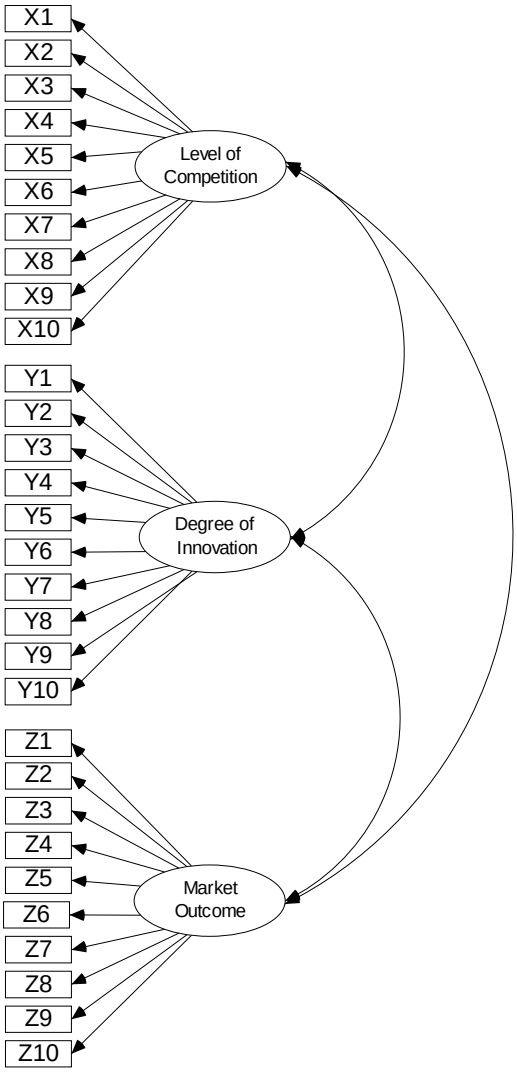

Figure X1: First-order CFA model representing the main dimensions of the Integrated Model of Innovation – Level of Competition, Degree of Innovation and Market Outcome -, as well as the respective indicator variables.

A pool of questions, or items, was generated to measure each of the latent variables in the original Integrated Innovation Model – Competitive Pressure, Degree of Innovation and Market Outcome (see Figure X1) -, based on a literature review and interviews with academicians and practitioners. The survey was pre-tested with five academicians in the area of strategic management. These were asked to identify items that were confusing, difficult to respondent or simply redundant. Problematic questions were revised or eliminated. By the end of the pre-test, 30 items (10 per latent variable) were selected for inclusion in the final survey instrument.

Measurement scales

The three latent variables depicted in Figure 3 were measured using eleven-point multi-item scales, anchored at the extremes, which were drawn from the survey developed by Sarkar (2007). The level of competition was assessed with a ten-item scale where the owners were asked to evaluate the level of competitive pressure felt by the firm, the ease of entrance in the markets where the firm was present, the number of competing products available to customers in these markets, as well as the firm's price-setting power in them.

Competitive pressure, as described in Sarkar (2007), by three factors- strength of rival firms, barriers to entry and price pressure. In reality therefore each of these factors is a latent variable with the three combined being used to gauge competitive pressure.

To measure the degree of service innovation, we used a combination of questions that attempted to capture the extent to which the new service differentiated itself from competing offers (in terms of technical performance, specialized inputs and supporting marketing strategy), and was perceived to be innovative by both firm and customers (Garcia and Calantone, 2002; Gatignon *et al.*, 2002). This scale also included items enabling the assessment of the firm's investments in innovation capacity and knowledge protection. The degree of protection via patents and specialized inputs, measures of technological and scientific capabilities, were included in the ten items (Wolf and Pett 2006, Leiponen, 2000).

Finally, market outcome was measured with a ten-item scale where owners were asked to provide an assessment of the new service's financial performance, its impact on the firm's competitive advantage and market position, and the results obtained in terms of broadening the client base and increasing customer satisfaction. We followed previous work (Chandler and Hanks 199, Zahra and George 2000) in employing a categorical approach. Questions included in the ten items were regarding pressure on profits, relative market share and sales, which are the standard measures of market returns (see also Calantone et al. 2002, Griffin and Page 1993).

3.3 Level of analysis

In the same survey that applied scale measures and hence relative innovation determinants, we also included many questions both categorical, level as well as binary type questions. The variables that used these questions for analyses were the following:

New product introduction, Percentage of firm employees involved in R&D activities and Percent sales from new product introduction as dependent variable measures (Table X2).

Respondents were asked to base their answers on the most relevant new product introduced in the marketplace by their company between 2002 and 2005. The new product must also had been launched before the 2nd semester of 2005, to ensure that the Alentejo firms' CEO had had sufficient market feed-back and information to form an assessment regarding the three main dimensions under study.

For the independent and control variables, we used Sales expectations for following year, Activity in international markets, Number of applications of firm website, type of partner in product innovation, firm size, sales volumes, sector and firm type based on ownership. Table X3 explains the manner in which the proxy variables were used in our model.

4. RESULTS AND DISCUSSION

4.1 Unidimensionality and reliability of the Integrated Model of Innovation measures

Before performing regression analyses of our models, we first tested for unidimensionality and reliability of the integration innovation model measures, which we describe in this subsection.

Because several companies from different sectors were surveyed to obtain the measurement scales, tests for between-group differences in any of the measured variables were undertaken. Analysis of variance procedures and post hoc Tukey multiple comparison tests revealed that significant ($p<.05$) sector differences existed in 11 of the 30 measured variables (about 63%), distributed across all 3 main dimensions investigated. These results indicate that sector bias could be a relevant issue in the further development and testing of the measurement scales.

To obtain unidimensionality, the item-to-total correlations were calculated for each scale, taking one of the three hypothesized scales at a time (variables X1-X10 for Level of Competition, variables Y1-Y10 for Degree of Innovation and variables Z1-Z10 for Market Outcome, see Figure 3). Items for which these correlations were lower than 0.35 (listed in Annex I) were discarded (Saxe and Weitz, 1982). This was the case for variables X2-X3, X5, X7-X10, Y1, Y4, Y8-Y9, Z4-Z5, Z9-Z10. This high number of measured variables that had to be discarded was probably related to the sector bias earlier identified. Since the main purpose of this study was not develop and validate diagnostic measurement scales for the application of the Integrated Model of Innovation to different economic sectors - but rather to study the main dimensions of this model, and their overall relationships with the other innovation-related variables of interest, for small and medium size firms in Alentejo – a decision was made to proceed with the development and test of the measurement scales with the complete research sample.

Principal Component Analysis (PCA) was used to uncover the underlying factor structure of the main dimensions. A four-factor solution was extracted, which explained 64% of the variance in the original variables. This solution comprised one factor that measured the level of competition, two factors that measured the degree of innovation – a one associated to the degree of product innovation and another related to the firms' level of knowledge-based competitive advantage -, and a fifth factor that measured the market

outcome. The results of the PCA performed also indicated that each item had a significant loading on only a single factor (most significant loadings ranged from 0.62 to 0.86, and the highest cross-loading was only 0.36). Table X4 depicts the item labels and the respective factor loadings. Computing reliability coefficients explored the reliability of each purified, unidimensional scale associated with each extracted factor. An inspection of the alpha coefficients, also provided in Table X4, reveals that these values indicated good reliability, exceeding the recommended threshold levels of 0.60 for exploratory research (Hair *et al.*, 2006).

Table X4: Item labels and factor loadings resulting from PCA

LATENT VARIABLE MEASUREMENT	**FACTOR LOADINGS**
LEVEL OF COMPETITION	
X1: Our market is characterized by (1) few competitors; (7) many competitors.	.79
X4: New competitors find it (1) very hard; (7) very easy to enter into our market.	.67
X6: Our clients (1) are practically forced to buy our product because they can't find any real alternatives; (7) can find many feasible alternatives to it.	.81
Cronbach's alpha = .62	
DEGREE OF PRODUCT INNOVATION	
Y2: We believe our new product is (1) highly innovative; (7) hardly innovative compared to competing products.	.72
Y3: We believe our new product's performance is (1) clearly superior; (7) clearly inferior to competing products.	.74
Y6: The brand associated to our new product is (1) highly decisive; (2) basically irrelevant for the purchase decisions of our customers.	.62
Y7: Our new product can reach a (1) much better; (7) much worse customer reputation than competing products.	.78
Cronbach's alpha = .68	
DEGREE OF KNOWLEDGE-BASED COMPETITIVE ADVANTAGE	
Y5: Our new product (1) can not be easily replicated; (7) can be easily replicated by our competitors.	.86
Y10: In terms of the knowledge and technologies involved, the provision of our new product (1) can not be easily replicated; (7) can be easily replicated by our competitors.	.86
Cronbach's alpha = .65	
MARKET OUTCOME	
Z1: The market share of our new product is (1) very high; (2) very low.	.63
Z2: With the new product we managed to (1) improve highly; (7) merely maintain our former market position.	.77
Z3: With the new product we were able to (1) grow into new markets and conquer new customers; (2) maintain our traditional customer base.	.68
Z6: The margins before taxes attained by the new product (1) are well above; (7) are well bellow industry average.	.64
Z7: The return on the investment made on the new product is (1) very high; (7) very low.	.76
Z8: The sales volume of our new product (1) is high and growing; (7) is low and stagnating.	.62
Cronbach's alpha = .77	

Internal consistency and convergent validity of the Integrated Model of Innovation measures

The internal consistency and convergent validity of the scales resulting from the PCA was investigated by performing a Confirmatory Factor Analysis using AMOS with ML imputation for missing values. A preliminary analysis of the normality of the measured

variables did not reveal any significant problems of skewness or kurtosis. The results of the measurement model indicated a good fit to the data (Chi-square = 214.407, df = 84, p=0.00; Comparative Fit Index (CFI) = 0.935; Root Mean Square Error of Approximation (RMSEA) = 0.039), given the sample size and the number of observed variables (Hair *et al.*, 2006). Figure X2 depicts the retained model specification, along with the respective standardized loadings estimates and correlations between latent variables. The criteria of all factor loadings being statistically significant (p<.05) was taken as sufficient indication of convergent validity (Bagozzi, Yi and Phillips, 1991).

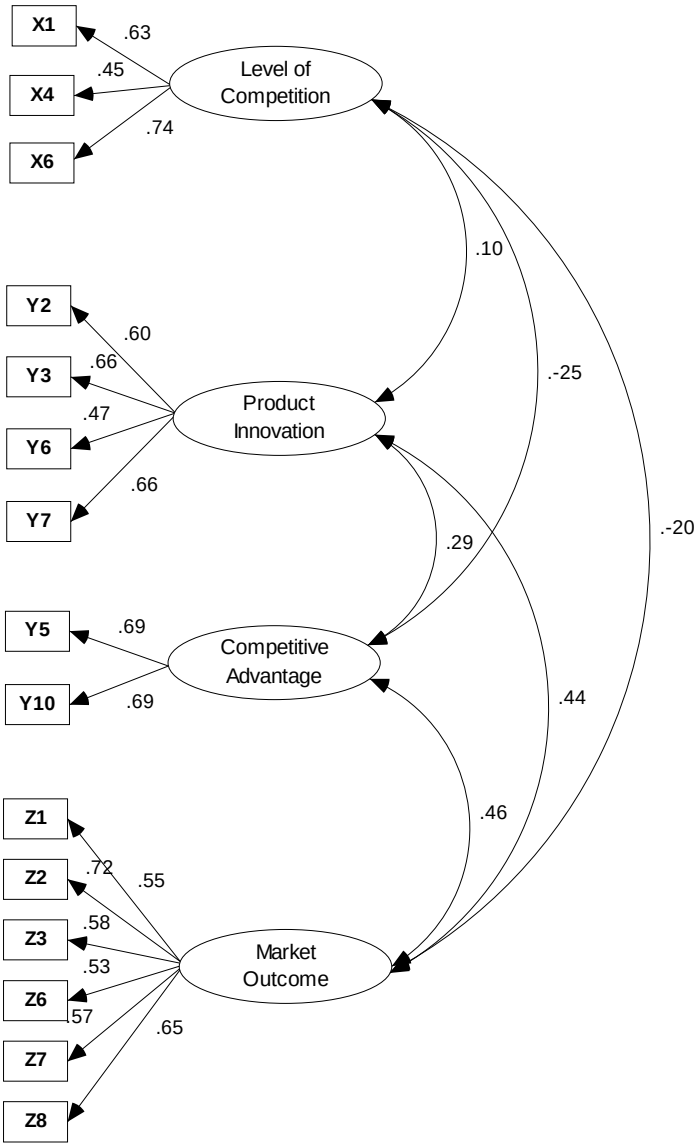

Figure X2: Estimated four-factor CFA model (Chi-square = 214.907, df = 84, p=0.00; CFI = 0.935; RMSEA = 0.039).

Values of 0.70 for composite reliability and 0.50 for average variance extracted were used as indicators of the internal consistency of the scales (Bagozzi and Yi, 1988). Table

X4 present the means, standard deviations, composite reliabilities and average variances extracted of the scales in the three-factor CFA model depicted in Figure X2. These results indicate that all composite reliabilities and average variances extracted equaled or exceeded the 0.70 and the 0.50 threshold for acceptability, respectively, except in the case of the measurement scale associated to the latent variable Knowledge-based Competitive Advantage. Therefore, we can consider that, except for this case, all the scales extracted presented an acceptable internal consistency.

Table X4: Means, standard deviations, range, Cronbach's alpha, Average Variances Extracted (AVE) and Composite Reliabilities (CR) of the scales in the four factor CFA model depicted in Figure X2.

	# Items	Mean	S.D.	Range	Alpha	AVE	CR
Level of Competition	3	3.74	0.23	3.48-3.92	0.62	0.50	0.74
Degree of Product Innovation	4	3.62	0.14	3.42-3.73	0.68	0.50	0.80
Knowledge-based Competitive Advantage	2	2.93	0.11	2.85-3.00	0.65	0.34	0.66
Market Outcome	6	2.71	0.46	2.14-3.32	0.77	0.50	0.86

The discriminant validity was assessed across the scales by re-specifying the measurement model depicted in Figure X2 in a series of constrained models in which each intetrait correlation was constrained to the unity. In every instance the constrained models showed a worse fit and the difference obtained in the Chi-Square value between each of the constrained models with the baseline measurement model was significant ($p<.05$), thus providing sufficient evidence of discriminate validity (Gerbing and Anderson, 1988).

Together, the results presented so far indicated a sufficient degree of unidimensionality, reliability and validity. Based on this evidence, the latent variables Level of Competition, Degree of Product Innovation and Market Outcome can be formed by averaging the responses to each item in one of the three scales validated.

4.2 Results from the multiple regression and logistic regression analysis

Table X-5 presents the multiple and logit regression results of the analysis using each of the dependent variables defined in Table X-2. Computation of variance inflation factors (VFI) for all three regression models never exceed 3.9, a value far lower from the recommended cut-off value of 10.0 (Hair et al, 2006). This was taken as sufficient indication of the absence of any serious measure of multicolinearity between the dependent variables.

All estimated models present a relatively strong overall significance. In fact, the F tests and the Chi-Square tests for joint significance of all covariates allow us to clearly reject the null hypothesis that all coefficients are equal to zero.

An overall look to the results of the three regressions reveals that there are some variables that are not statistically significant in all the regressions: sector dummies, ownership, sales expectations and the number of employees needed. The dummy variables referring to the sector of activity are always non-significant. This suggests that there are not significant differences regarding the innovation output and outcome across the various sectors. This is an intriguing result as most studies show differences across sectors. One possible explanation for this result is that our sample is more homogenous in other regards than in most studies. Our firms are all from the same region and they are all small in terms of number of employees. It is possible that, once these factors are considered, the differences in innovative outcomes across sectors are not so large. The variables related with market expectations influence mostly the investment in innovation. Thus we believe that the impact of these variables is to a large extent captured by the variable measuring R&D effort.

The most relevant variables in explaining the percentage of sales from innovative products are: the percentage of workers in R&D, the existence of partners in product innovation, the number of website uses, the presence in international markets and the size of the firm. As expected, all these variables have a positive impact on the percentage of sales from innovative products, except the size of the firm. Thus our results are supportive of the hypotheses H2, H3, H4 and H5. Regarding the impact of firm size on innovation, hypothesis H5, our results suggest that firms with larger sales volume have a smaller percentage of sales from innovative products, thus smaller firms have higher intensity of innovation. On the other hand, it should be noted that the variables related to market conditions and the level of competition do not have a statistically significant impact on explaining the percentage of sales from innovative products. As a consequence our results do not support H1. The fact that the level of competition does not have a statistically significant impact on the percentage of sales from innovative products is to a large extent consistent with the hypothesis H5, as we expect conflicting impacts to be present and they seem to cancel each other.

The degree of product innovation is mostly influenced by the market outcome, the competitive pressure and the number of uses of the firm website. This result is extremely interesting in light of the integrated innovation model, that explicitly connects these variables! In addition, our results are supportive of hypothesis H1 (influence of beliefs on market outcome of innovation), H3 (influence of ICT) and H6 (influence of competitive pressure). Regarding the impact of the competitive pressure our results suggest that a too strong competitive pressure influences negatively the degree of product innovation.

The logit regression explaining the probability of introduction of innovative products shows that the percentage of workers in R&D, the number of uses of the firm website and the market outcome all have a positive and statistically significant impact on the probability of the firm introducing a innovative product. Consequently, the results are supportive of hypotheses H1 and H3.

It should be noted that the number of website uses and the R&D effort affect both the probability of introducing innovative products (innovation probability) and the percentage of sales from innovative products (intensity of innovation). On the other hand, the presence in international markets and the existence of partners in product innovation affect the intensity of innovation but not the probability of innovating.

Table X-5 Results from multiple and logit regressions

	Dependent Variable					
	% Sales from new product introduction		*Degree of product innovation*		*New product introduction*	
	β	***t***	**β**	***t***	**β**	***Wald***
Sales expectations for next year	.049	1.148	-0.50	-1.424	.100	.625
New hires for the following year	.013	.184	.068	1.164	.299	2.486
Perceived market outcome from innovation	.078	1.538	.295***	6.941	.360**	5.387
Active in international markets	.260*	1.902	.048	.436	.418	.1.387
Number of applications firm website	.188***	4.364	.064*	1.805	.388***	11.910
% workers employed in R&D	.362***	7.059	-0.031	-0.483	.550***	15.068
Partner in product innovation	1.541***	13.080	-0.016	-0.167	….	….
Firm Size (Sales volume)	-0.075**	-2.035	-0.022	-0.724	.042	.174
Perceived degree of competition	-0.069	-1.615	.071*	1.950	.011	.007
Control variables						
Sector 1	.290	1.580	-0.097	-0.643	.577	1.277
Sector 2	-0.002	-0.009	.009	0.067	-0.001	0.00
Sector 3	.167	1.073	-0.047	-0.367	.407	0.829

Sector 4	.049	.256	-0.136	-0.854	.025	0.002
Sector 5	.026	.151	-0.019	-0.138	.070	0.21
Firm type by ownership	-0.031	-0.324	-0.047	-0594	.027 ---	0.009
Global Adjustment Test	F=23.315***		F=5.040***		X^2= 80.399***	

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level

5. CONCLUSIONS AND MANAGERIAL IMPLICATIONS

SME innovation is a complex and perhaps idiosyncratic area of research, and so far different studies have not been consistent in terms of innovation determinants. In this paper we present the results of an empirical study of the determinants and consequences of product innovation in small European firms. Over 1000 small businesses active in the Portuguese region of Alentejo across all economic sectors, were surveyed in 2006. We employ two methodological approaches employed in conjunction goes some way to shed some light on small firm innovation.

Our results from PCA and CFA show that managers perceive the existence of important positive relationships between their firms' degree of technological innovation and the level of service innovation, as well as between these two and the market return achieved.

Results from our regression analyses confirm prior research and further providing intriguing new leads. We find that engagement in R&D, and the dynamic use of web sites, to name some of the variables in our study, strongly influence SME innovation both in terms of the probability of introducing innovative products as well as the percentage of sales from innovative products. Intriguingly we discover that the presence in international markets and the existence of partners in product innovation affect the intensity of innovation but not the probability of innovating. For the owner-manager of micro and small firms, these results provide encouraging support to investing in knowledge workers and ICT use. Our analyses also shows that innovation pays!
Our regression analyses throw up another intriguing result in that the sector of activity are always non-significant suggesting that there are not significant differences regarding the innovation output and outcome across the various sectors. This is an intriguing given that most other studies show differences across sectors. One possible explanation for this result is that our sample is more homogenous in other regards than in most studies.

There are some limitations to the empirical study performed that suggest further avenues for research. First, we have used single-informant judgments for variables that included both causes and outcomes of innovation activities, which may have caused common method bias. To test for such a bias, we used Harman's one-factor test suggested by Podsakoff and Organ (1986). Common method variance did not seem to be present in that the un-rotated factor solution showed the presence of multiple factors (4) and no one factor accounted for the majority of covariance. Nevertheless, it is important that future studies using these innovation diagnostic tools validate these findings using multiple data sources rather than self-reports alone. Second, the analysis is based on perceptual data that enable us to pool experiences from multiple firms in different industries. Yet, despite the extensive use of such retrospective perceptual data in strategy research and especially

in innovation research, one should not rule out the shortcomings associated with subjective measures of innovation.

REFERENCES

Bagozzi, R.P. and Yi, Y. (1988). On the evaluation of structural equation models. Journal of the Academy of Marketing Science 16(1), 74-94.

Bagozzi, R.P., Yi, Y. and Phillips, L. (1991). Assessing construct validity in organizational research. Administrative Science Quarterly 36, 421-458.

Byrne, B. (2001). Structural Equation Modelling with AMOS. Mahwah, NJ: Lawrence Erlbaum.

De Jong, J.P.J. and Vermeulen, P.A.M. (2006). Determinants of product innovation in small firms: a comparison across industries. International Small Business Journal 24, 587-609.

EUROPA, Glossary, "Lisbon Strategy". http://europa.eu/scadplus/glossary/lisbon_strategy_en.htm

Garcia, R. and Calantone, R.J. (2002). A critical look at technological innovation typology and innovativeness terminology: a literature review. Journal of Product Innovation Management 19, 110-132.

Gatignon, H., Tushman, M.L., Sith, W. and Anderson, P. (2002). A structural approach to assessing innovation: construct development of innovation locus, type and characteristics. Management Science 48(9), 1103-1122.

Gerbing, D. and Anderson, J. (1988). An updated paradigm for scale development incorporating multidimensionality and its assessment. Journal of Marketing Research 25(2), 186-192.

Hair, Joseph F., Black, William C., Babin, Barry J., Anderson, Ralph E. and Tatham, Ronald L. (2006). Multivariate data analysis – 6th Ed. Upper Saddle River, NJ: Pearson Prentice Hall.

INE – Statistics Portugal (2004). Retratos Territoriais.

INNO-metrics (2006**)**. European Innovation Scoreboard 2006. Comparative analysis of innovation performance. European Commission. http://www.proinno-europe.eu/doc/EIS2006_final.pdf

Knudsen, M.P(2007). The relative importance of interfirm relationships and knowledge transfer for new product development success. Journal of Product Innovation Management 24, 117-138.

Podsakoff, P.M. and Organ, D.W. (1986). Self-reports in organizational research: Problems and prospects. Journal of Management 12, 531-544.

Sarkar, S. (2005). Innovation and market structures: an integrated approach. International Journal of Innovation and Entrepreneurship Management 5, 366-378.

Sarkar, S. (2007). Innovation, market, archetypes and outcome – An integrated approach. Heidelberg: Springer.

Saxe, R. and Weitz, B.A. (1982). The socio scales: A measure of the customer orientation of salespeople. Journal of Marketing Research 19, 343-351.

Annex I

Discarded Scale Measures (Item-to-total correlation < 0.35)
• **X2:** Our competitors in this market are (1) hardly as strong as we are; (7) stronger than we are. • **X3:** There are (1) almost no products; (7) many alternative products that perform the same functions as our new product. • **X5:** Our market has a (1) very low; (7) very high rate of firms starting and ending their activities. • **X7:** Our customers for the new product have a (1) very low; (7) very high bargaining power. • **X8:** When negotiating the sale of the new product with our customers (1) we never go under the sale price we had planned; (7) we lower the price until we can close the deal. • **X9:** The customary sale price of our new product (1) includes only to the standard functions (any extras must be paid aside); (2) includes all the special features already. • **X10:** Our firm (1) hardly ever feels any customer pressure; (7) is under constant customer pressure to lower the price of the new product. • **Y1:** Our new product has (1) many added special features; (7) only the standard, basic features. • **Y4:** The knowledge and technology involved in our new product are (1) well protected by different means; (7) not at all protected in any way. • **Y8:** The staff creating the new product (1) needed not to be highly qualified and was easily available; (7) had to be highly qualified and was hard to come about. • **Y9:** To secure a favorable market position for our new product we (1) did not need to make; (7) had to make large investments in new technology and/or staff. • **Z4:** Our customers pay (1) much more; (7) much less for the new product than for competing products. • **Z5:** Our new product attained a (1) much better; (7) much worse reputation with customers than competing products. • **Z9:** The new product (1) decreased highly; (7) did not affect the pressure upon our market position. • **Z10:** Our new product can reach a (1) much higher; (7) much lower level of customer satisfaction than competing products.