Intra- and extra-organizational foundations of innovation processes at the information and communication technology sector under the crisis in Portugal

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Abstract

This paper characterizes the joint impacts of intra and extra-organizational contexts on innovation development. Assessing these contexts in 309 firms of the Information and Communication Technology services sector during the crisis in Portugal, we performed a cluster analysis and identified two profiles. These were mostly discriminated by financial resources and clients and not by science and technology activities. Subsequently, these profiles were related to innovation, top managers’ perceptions and expectations for the future. The data shows that under favourable contexts innovation increases, the firm is perceived to drive innovation and confidence in the companies’ future emerges. In more unfavourable scenarios, innovation is compromised, the environment is perceived to block innovation and confidence is halted.

Establishing companies’ profiles for the first time in Portugal, this paper suggests that intra and extra-organizational contexts have to be jointly tackled not only to foster present innovation development but also to promote companies’ future activities.

Keywords

Innovation; Contexts of innovation; Uncertainty; Confidence; Crisis
1. Introduction

The beginning of the 21st century witnessed steady increases in innovation activities in companies operating in Portugal (OECD and Eurostat, 2005). However, between 2010 and 2012 there is an inversion of this trend with innovation activities presenting pronounced decreases (European Commission, 2014). In fact, 2010 is the year when the sovereign debt crisis bursts in Europe and 2011, the year of the beginning of the Troika’s intervention in Portugal. This is a period characterized by a social and economic downturn and a changing political context [1] (OECD, 2013). If these broad surveys sketch the overall socio-economic scenario and that of innovation activities, they do not allow us to characterize the firm and/or environmental underpinnings of these patterns during the crisis.

As expected, most studies addressing the triggers and blockers of innovation focused on non-crisis periods and revealed that innovation is framed by intra- and extra-organizational dimensions (reviewed in (Becheikh et al., 2006; Gupta et al., 2007; van der Panne et al., 2003)).

At the intra-organizational level, innovation was shown to be associated with firms’ 1) general characteristics; structure and past activities (Beneito, 2003; Romijn and Albaladejo, 2002; Koberg et al., 1996; Papadakis and Bourantas, 1998; Cainelli et al., 2006; Camisón-Zornoza et al., 2004); 2) management team and procedures (Michie and Sheehan, 2003; Beugelsdijk, 2008; de Jong and Den Hartog, 2007; Camelo-Ordaz et al., 2006; Murimbika and Urban, 2014); 3) functional assets and mobilized strategies (Jensen et al., 2007; Anderson et al., 2014; Jantunen, 2005); and 4) culture (Brattström et al., 2012; Brower et al., 2009; Madrid et al., 2014). At the extra-organizational context, indicators of firms’ 1) sector of economic activity and related variables (Beneito, 2003); 2) geographical location (Romijn and Albaladejo, 2002; Sternberg and Arndt, 2001); 3) suppliers and clients (Freel, 2006; Arranz and Fdez. de Arroyabe, 2008; Souitaris, 2001); 4) competitors (Nieto and Santamaría, 2007; Souitaris, 2001; Vermeulen et al., 2007); 5) networking and internationalization strategies (Oliveira and Carvalho, 2010; Salavisa et al., 2012; de Faria et al., 2010; Fleming et al., 2007; Romijn and Albaladejo, 2002); 6) public policies (Beneito, 2003; Vermeulen et al., 2007; Webster and Packer, 1996; Etzkowitz and
Leydesdorff, 2000; and 7) surrounding culture (Taylor and Wilson, 2012; Efrat, 2014) were shown to frame the development of innovation activities.

Altogether, these studies suggest the multi-dimensional nature of innovation processes, but, with relatively few exceptions mobilizing a confined number of variables either before (de Jong and Vermeulen, 2006; Freel, 2006; Gupta et al., 2007; Camelo-Ordaz et al., 2006) or at the crisis onset (Frey et al., 2013; Archibugi et al., 2013), this has not been addressed.

Based on what was previously said, this paper focuses on firms operating in Portugal between 2010 and 2012, i.e. during the crisis. Combining variables of the different layers of the intra- and extra-organizational dimensions (Input variables, Table 1) firms’ profiles will be established (Cluster variable, Table 1) and tested for their associations with innovation progression and outputs (Test Variables 1-4, Table 1). These dimensions and variables will be evaluated via firms’ top managers, critical innovation actors that stand at the interface of the internal and external contexts and are ultimately responsible for strategic control and decision-making (Lazonick, 2006).

Moreover, we will focus on one single sector of economic activity: the ICT services sector. The reasoning beyond this choice is the following: 1) the wide direct and indirect impacts of ICT products and services on economic performance and their transversal impact on society; 2) the fact that these firms present the highest investments on innovation and R&D; the fastest rates of innovation development; the highest outputs to both internal and external markets and productivity growth among industries in Portugal and in the European Union (EU); 3) the wide economic impact of the crisis in ICT services companies operating in Portugal presenting decreased annual turnovers since 2008, as well as decreased production values, gross value added, gross operating surplus, assets, liabilities, equity capital and gross investments in tangible goods since 2010 (INE, 2014); and 4) the strong decrease of innovation activities presented by the sector (from 89% in 2008-2010 to 79% in 2010-2012)(European Commission, 2014).

Based on the above, this paper presents an alternative approach to the ones previously followed by other studies establishing taxonomies of firms’ innovation behaviours (Pavitt, 1984; de Jong
These studies, strictly focusing in innovative companies, mostly relied on the characterization of the rates, sources and nature of innovation activities in firms with different sizes and sectors of economic activity. In spite of a comparative look into the differential patterns of innovation behaviour across sectors or firms’ size, these papers were unable to detail the specificities of the internal and external contexts framing the development of innovation activities within the same sector, where similar patterns of innovation were concomitantly shown to be present. Our study will precisely cover this path, aiming to discriminate the internal and external contexts that elicit or stop innovation development during the crisis.

2. Perceiving the internal and external impacts on innovation development

In addition to the role of the contexts of innovation to the triggering or blockage of these processes, firms’ innovative behaviour was also previously related to top managers’ perceptions of the intra-organizational context (e.g. organizational structure; culture) (Koberg et al., 2003; Bock et al., 2012), as well as to top managers’ perceptions of the extra-organizational context (e.g. environmental dynamism; networks) (Koberg et al., 2003; O'Regan and Ghobadian, 2005). This was attributed to top managers’ critical role in strategic decision-making processes, actions and eventually firms’ performance (Dean and Sharfman, 1996). Most importantly, these perceptions are socially constructed (Sutcliffe and Huber, 1998) and have impacts on present and future strategic decision processes (Chattopadhyay et al., 1999), such as the ones related to innovation development.

Specifically regarding perceptions of the crisis impacts on innovation, it has been shown that firms developing innovation activities in Portugal perceive the crisis to have negative impacts on firms’ activities, with the most dynamic firms (in what relates to economic and innovative performance) perceiving lower negative impacts [2] (Nunes, 2012). However, the authors did not address top managers’ perceptions of the impacts of other intra- and extra-organizational variables on innovation and it remains to be explored whether innovative and non-innovative firms discriminated by their intra- and extra-organizational contexts, present favourable or
unfavourable perceptions of the crisis’ impacts on innovation. As such, this study will also aim to unravel whether firms with different profiles present different perceptions of the impacts of specific variables of the intra- and extra-organizational contexts on innovation (e.g. leaderships; crisis) (Test variables 9-13, Table 1). To the best of our knowledge this has not been previously addressed.

3. Linking the past, present and future

In addition to innovation’s multiple layers, these contingent change processes are intrinsically future-oriented, since the outputs of innovation do not pre-exist their development, except as historically and contextually-framed imagined futures, visions or expectations (Borup et al., 2006). As the future is unknown (on the one hand, the development of a specific social action changes conditions for the future, and on the other, the behaviours of other social actors are beyond ones control (Barbalet, 2009a)), uncertainty is inherent to innovation progression. When exacerbated, this uncertainty can eventually stop the development of innovation (Barbalet, 2001). If, uncertainty has been previously associated with specific indicators of firms’ internal and external contexts (Freel, 2005; Galende, 2006; Pandit et al., 2011) it remains to be addressed whether uncertainty of the companies’ future (Test variable 14; Table 1) relates to firms’ profiles (Cluster variable; Table 1).

If, as previously said, uncertainty can block innovation progression it can also be outweighed by the presence of confidence (Barbalet, 2001). Confidence is understood as secure expectations, i.e. secure judgement on future contingent events, based on past and present experiences and occurring at the boundaries of consciousness (Barbalet, 2009b). As such, confidence is self-referential since one accepts the absence of concrete evidence on future outcomes. It is precisely this acceptance that allows social action to proceed under uncertainty, and eventually allows social actors to accomplish their desired outcomes (Barbalet, 2009b; Luhmann, 1979; Simmel, 2011).

In Portugal, an indirect evaluation of confidence in firms can be given by the analysis of a composite indicator of confidence. This indicator, presenting a steep decreasing pattern between
2010 and 2012 (INE, 2014), aggregates firms’ qualitative evaluation of 1) their activities; 2) demands in the preceding trimester; and 3) expected demands for the following trimester. However, there is currently no direct characterization of the intra- and extra-organizational roots (revealed in firms’ profiles: Cluster variable; Table 1) of confidence in the companies’ future (Test variable 15; Table 1). As such, this paper evaluates whether both uncertainty and confidence in the companies’ future are framed by firms’ profiles.

This paper is structured as follows: the next section delineates the aims and hypotheses of this study. The methods and results are subsequently presented and these are followed by a summary and discussion of the reported data. The paper further outlines the policy implications and limitations of this; suggests potential directions for future research and finishes with concluding remarks.

4. Aims and hypotheses

Following a quantitative methodology this paper focuses on ICT services firms to have an up-to-date thorough characterization of Portuguese organizations articulating the firm level, with the extra-organizational context. This characterization is currently unavailable. For this purpose and spanning the different internal and external layers, 1) variables previously associated with organizational processes (reviewed in (Papadakis et al., 2010)) and innovation development (reviewed in (Becheikh et al., 2006; Gupta et al., 2007)) (Input variables, Table 1) will be assessed. 2) These variables - all expressed in the same ordinal scale – will be mobilized to build ICT services companies’ profiles (Cluster variable, Table 1). 3) These profiles will be additionally characterized by the firms’ general characteristics and structure (Test variables 1-4; Table 1). Finally 4) innovation development and outputs (Test variables 5-8, Table 1); 5) perceived impacts of variables from the intra- and extra-organizational contexts on innovation development (Test variables 9-13, Table 1); and 6) expectations for the future (Test variables 14-15, Table 1) will be related to firms’ profiles. To the best of our knowledge the associations between firms’ profiles and innovation, top managers’ perceptions and expectations for the
future under a crisis context have not been addressed.

Table 1. Variables mobilized in this study.

<table>
<thead>
<tr>
<th>Input Variables</th>
<th>Cluster Variable</th>
<th>Test Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evol. of financial resources</td>
<td>Firms’ profiles</td>
<td>Test variables on firms’ general characteristics and structure</td>
</tr>
<tr>
<td>Evol. of human resources</td>
<td></td>
<td>T1. Size</td>
</tr>
<tr>
<td>Evol. of internal bureaucratic structures and procedures</td>
<td></td>
<td>T2. Date of incorporation</td>
</tr>
<tr>
<td>Evol. of discussion of strategic decisions</td>
<td></td>
<td>T3. Presence of discussion of strategic decision-making</td>
</tr>
<tr>
<td>Evol. of management of Human resources</td>
<td></td>
<td>T4. Number of participants in strategic decision-making</td>
</tr>
<tr>
<td>Evol. of knowledge-management (A)</td>
<td></td>
<td>Test variables on Innovation</td>
</tr>
<tr>
<td>Evol. of internal monitoring (B)</td>
<td></td>
<td>T5. Evol. of innovation</td>
</tr>
<tr>
<td>Evol. of external monitoring (C)</td>
<td></td>
<td>T6. Finalized innovation activities</td>
</tr>
<tr>
<td>Evol. of planning and monitoring of projects</td>
<td></td>
<td>T7. Patent initiation</td>
</tr>
<tr>
<td>Evol. of creativity stimuli (D)</td>
<td></td>
<td>Test variables on Perceptions</td>
</tr>
<tr>
<td>Evol. of employees’ motivation</td>
<td></td>
<td>T9. Perceptions of the firms’ formal structure impacts on innovation</td>
</tr>
<tr>
<td>Evol. of employees’ autonomy</td>
<td></td>
<td>T10. Perceptions of the firms’ informal structure impacts on innovation</td>
</tr>
<tr>
<td>Evol. of trust in employees</td>
<td></td>
<td>T11. Perceptions of the leaderships impacts on innovation</td>
</tr>
<tr>
<td>Evol. of clients</td>
<td></td>
<td>T12. Perceptions of the government legislation and policies impacts on innovation</td>
</tr>
<tr>
<td>Evol. of competitors</td>
<td></td>
<td>T13. Perceptions of the socio-economic crisis impacts on innovation</td>
</tr>
<tr>
<td>Evol. of networks</td>
<td></td>
<td>Test variables on Expectations</td>
</tr>
<tr>
<td>Evol. of internationalization (E)</td>
<td></td>
<td>T14. Evol. of uncertainty in the companies’ future</td>
</tr>
<tr>
<td>Evol. of external bureaucracy (F)</td>
<td></td>
<td>T15. Evol. of confidence in the companies’ future</td>
</tr>
<tr>
<td>Evol. of pressure on strategic decisions</td>
<td></td>
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<tr>
<td></td>
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</tbody>
</table>
Note: Evol.: Evolution between 2010 and 2012; (A) Activities that ease and regulate access to knowledge, e.g. identifying and organizing companies’ information and knowledge; supporting the learning of new skills; (B) E.g. monitoring of employees; (C) E.g. monitoring of competitors; financing mechanisms; (D) E.g. brainstorming sessions; team work; rotation of employees between departments; multidisciplinary teams and financial and/or non-financial incentives; (E) Includes exports; internationalization of human resources; having international partnerships, among others; (F) E.g. government regulations; legislation; (G) E.g. newsletters; meetings.

Based on the above, our hypotheses are that:

**Hypothesis 1. Firms’ profiles are innovation profiles**

Focusing on ICT services firms this paper characterizes the different internal and external layers of organizational processes (reviewed in (Papadakis et al., 2010)) (Input variables, Table 1) and establishes composite firms’ profiles based on a broad range of variables. These variables have been previously associated with innovation progression (reviewed in (Becheikh et al., 2006; Gupta et al., 2007; van der Panne et al., 2003)). In fact, many studies have shown that innovation processes are based upon scientific and technological knowledge and are framed by the specific organizational locus where they take place and the broader environmental context.
where innovation is embedded.

The scientific and technological basis of innovation is revealed, for instance, not only by the numerous studies underlining the relevance of R&D for innovation but also in the ones suggesting that mobilizing S&T-based knowledge along with experience-based knowledge (Jensen et al., 2007) increases innovation performance. Other authors have chosen to focus on financial resources (Beneito, 2003; Canepa and Stoneman, 2007) or human resources (i.e. qualifications, experience and skills (Romijn and Albaladejo, 2002)) and found that these resources are positively associated innovation outputs. Others, revealed that R&D and innovation are favoured by the mobilization of strategies targeting employees training, motivation or autonomy as well as increasing trust in employees (Michie and Sheehan, 2003; Brattström et al., 2012; Brower et al., 2009; Madrid et al., 2014; Beugelsdijk, 2008)). Studies have also shown that companies with planning, monitoring and communication strategies also have more positive innovation outputs (Huergo, 2006; Ebadi and Utterback, 1984). Finally, the data on centralization of procedures and flexibility reveals two opposite patterns: whereas older firms benefit from increasing levels of flexibility and decentralization of procedures, younger firms benefit from decreasing levels of flexibility and centralization. This seems to be the case since innovation in favoured in young firms that reduce uncertainty and focus their efforts on the limited resources they have (Koberg et al., 1996; Walsh and Dewar, 1987).

Regarding the extra-organizational underpinnings of innovation, it was shown that participation in networks and the establishment of international partnerships and access to foreign markets were associated with successful innovation development (Oliveira and Carvalho, 2010; Salavisa et al., 2012; de Faria et al., 2010; Romijn and Albaladejo, 2002). Finally, while competitors seem to negatively impact on innovation performance, clients present positive impacts (Nieto and Santamaria, 2007; Souitaris, 2001). Altogether this data points to the multi-dimensionality of innovation processes, a characteristic that has only been seldom addressed. One of these studies shows that innovation investments at the beginning of the crisis in Europe (2008) were dependent on firms’ economic performance; human resources; investments on R&D; and access to new markets (Archibugi et al., 2013). Another study reveals that innovation activities were
simultaneously dependent on companies’ size and exports in 2010 (Frey et al., 2013).

Mobilizing a different approach to the ones just reported, and focusing on a sample of ICT services’ firms (both innovative and non-innovative) we will establish ICT services firms’ profiles based on a wide range of variables. This strategy has not been previously mobilized. Since our firms’ profiles will be established with variables that in addition to their relevance for organizational processes in general, are specifically critical for innovation development, it is our expectation that firms’ profiles are also innovation profiles. That is to say that the development of innovation activities and innovation outputs (Test variables 5-9; Table I) are associated with firms’ profiles. Additionally, this has not been previously addressed under the Portuguese social-economic crisis context.

Additionally,

*Hypothesis 2.1. Top managers’ perceptions of the intra-organizational impacts on innovation are not independent of firms’ profiles.*

*Hypothesis 2.2. Top managers’ perceptions of the extra-organizational impacts on innovation are not independent of firms’ profiles.*

Specifically focusing at the intra-organizational impacts on innovation, studies have shown that innovation is associated with firms’ formal structure, firms’ informal structure (in which firms’ organizational culture, understood as the pattern of values, beliefs, expectations and practices shared by organizational members, has a central role) as well as with leaderships (Teece, 1996; Tellis et al., 2009; Papadakis and Bourantas, 1998; de Jong and Den Hartog, 2007; Denti and Hemlin, 2012). On the extra-organizational dimension specific policies and legislations (e.g. establishing intellectual property rights; promoting collaborations with the academia) (Webster and Packer, 1996; Etzkowitz and Leydesdorff, 2000) favour innovation development. Also, innovation was shown to be promoted by firms’ embeddedness in favourable and dynamic external environments (i.e. in which firms present high profit margins, have low competition and high customers’ loyalty) (Lumpkin and Dess, 2001; Covin et al., 2000). However, firms facing environmental turbulence, such as the one associated with periods of economic recession,
were shown to follow two opposite strategies. While some studies suggest that firms respond conservatively to environmental changes, decreasing costs, limiting information processing, increasing centralization and operational efficiencies, others suggest that firms adapt to changing environments engaging on proactive innovation strategies (Hansen, 2014; Nickell et al., 2013; Uzkurt et al., 2012). However the impacts of these strategies on firms’ performance have shown divergent results, with some studies suggesting that increasing innovativeness through decline is financially beneficial (Nickell et al., 2013) while others not being able to support these premises (Hansen, 2014). As previously said, the overall innovation frequencies of the highly innovative ICT services’ sector presented a 10% decrease between 2010 and 2012 (European Commission, 2014). This implies that 1) independently of the overall very high frequency of innovation activities presented by this sector (79%), more firms decreased, rather than increased innovation activities in face of the crisis in Portugal; and 2) alternative strategies to face the external turbulence associated with the socio-economic crisis might be in place.

In what regards top managers perceptions, they were shown to be socially constructed (Sutcliffe and Huber, 1998). In fact, the authors showed that perceptions (of the firms’ environment) are more similar among managers of the same firm, less similar among managers of firms of the same sector of economic activities, and much less similar among managers of firms of different sectors of economic activities (Sutcliffe and Huber, 1998). If this is the case, then it is relevant to evaluate whether top managers working at the same sector of economic activities but in firms presenting clearly different profiles, do have differential perceptions of self (of their company) and others (of the extra-organizational context). Importantly, in innovative companies, top managers’ perceptions of the companies’ organizational structure (Koberg et al., 2003); culture (Bock et al., 2012) and environmental conditions (Koberg et al., 2003; O'Regan and Ghobadian, 2005), including the crisis (Nunes, 2012), were associated with the innovation. However, it remains unknown how these perceptions in both innovative and non-innovative firms relate to firms’ profiles built on a broad range of indicators. This paper addresses these issues via an initial characterization of the impacts of top managers’ perceptions of firms’ formal and informal structure; leaderships; policies and legislation; and the crisis (Test variables 9-13,
Table 1) on innovation progression, and a subsequent assessment of the relation of these perceptions with firms’ profiles during the crisis in Portugal.

Finally,

**Hypothesis 3.1. Uncertainty in the companies’ future is not independent of firms’ profiles.**

**Hypothesis 3.2. Confidence in the companies’ future is not independent of firms’ profiles.**

It has been previously shown that expectations over future relate to organizational characteristics such as innovation strategy, management procedures, organizational culture and commercialization process (Do et al., 2014). Previous studies have also shown that in companies developing innovation activities, both confidence and uncertainty relate to intra-organizational variables such as financial resources, human resources and R&D. Additionally, if uncertainty was associated with extra-organizational indicators such as customers; suppliers and competitors (Freel, 2005; Galende, 2006; Pandit et al., 2011; Zhou et al., 2005), the framing of confidence by environmental indicators remains to be evaluated. In short, what these studies clearly show is the social roots of future’s expectations, and specifically those of uncertainty and confidence in the companies’ future. If this is the case, then it is to be expected that both uncertainty and confidence are associated with firms’ profiles. The novelty of our study rests on

1) the mobilization of both innovative and non-innovative firms; 2) the establishment of firms’ profiles with a broad range of intra- and extra-organizational indicators; 3) the evaluation of the relations between expectations and profiles under the crisis in Portugal.

4. **Methods**

We carried out an online survey to ICT services sector companies, identified as belonging to Section J, divisions 61 to 63 of the statistical classification of economic activities in the European Communities NACE-Rev. 2 (European Commission, 2008). The survey was answered by ICT services firms’ top managers during 2013. We followed a quota sampling methodology. The sample encompasses 309 firms from a total of 4310 companies listed by Statistics Portugal (INE, 2011). It is representative of the ICT services sector in terms of the
development of innovation activities at a 95% confidence interval and a 5% maximum error of estimate (European Commission, 2014). Additionally, the sample’s distribution is proportional to the universe of ICT services firms operating in Portugal in terms of classes of number of employees [3] (INE, 2011). More specifically, the sample is mainly composed of micro companies (86.8%), with small, medium and large companies representing 10.2%; 2.3% and 0.7%, respectively (European Commission, 2003). Regarding the date of incorporation, almost half of these companies (48.2%) are very recent, being established between 2007 and 2012; 33.9% were established between 2000 and 2006; and 17.9% between 1980 and 1999.

The survey comprised different sets of questions focused on the period between 2010 and 2012 and regarding 1) the evolution of specific variables from the intra- and/or extra-organizational contexts (Input variables, Table 1); 2) decision-making processes during innovation development (Test variables 3-4, Table 1); 3) innovation activities and outputs (Test variables 5-8, Table 1); 4) perceptions of the impact of the intra- and extra-organizational contexts on innovation activities (Test variables 9-13, Table 1) and 5) expectations for the companies’ future [4] (Test variables 14-15, Table 1).

A cluster analysis was performed to identify homogenous groups of companies according to the evolution of the intra- and extra-organizational contexts. These clusters were then interpreted according to their profiles relating to the different relevant dimensions using Pearson chi-square tests to assess the independence between nominal variables and adjusted standardized residuals to assess associations between categories of nominal variables.

Statistical analysis was performed with IBM SPSS Statistics, version 20, statistical package.

5. Results

5.1. Innovation development at the Portuguese ICT services sector: differentiating between companies

A hierarchical cluster analysis was conducted to discriminate between groups of companies and to establish firms’ profiles [5]. This analysis was carried out with the Input variables (see Table
and mobilizing the squared Euclidean distance as the measure of similarity between firms. Several clustering methods were tested and the increase of the agglomeration coefficients suggested the presence of two clusters. For the same number of clusters a 77% to 100% degree of convergence between tested clustering methods was found (Between-groups Average linkage; Single linkage; Complete linkage; Centroid linkage and Median linkage lies between). The classification of each subject on the clusters was performed with the non-hierarchical method \textit{k-Means} (Maroco, 2010). The clusters’ average profiles regarding each dimension are presented in \textit{Figure 1}.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure1.png}
\caption{Profiles of ICT services firms. Average profiles of variables in clusters 1 and 2. Each variable is ranked on a scale of 1 (strong decrease) to 5 (strong increase). Cluster 1 (white bars) includes 38.5% of ICT firms (n=119) and cluster 2 (black bars) includes 61.5% (n=190). Struct.: Structures; Proced.: Procedures.}
\end{figure}

The data depicted in \textit{Figure 1} clearly differentiates between clusters 1 and 2 that globally emerge with opposite patterns. On the one hand, companies in cluster 2 have on average a
positive evolution of the studied variables between 2010 and 2012. On the other, companies belonging to cluster 1, have on average a negative evolution or present no changes in the studied variables. These patterns are transversal to the intra- and/or extra-organizational contexts. These data show that ICT services firms’ profiles are discriminated by the additive impacts of intra- and extra-organizational contexts and suggest strong connections between the various contexts impacting on innovation development.

In a sector of economic activities in which innovation is present in more than two thirds of companies operating in Portugal (European Commission, 2014), it would be expected that S&T-related activities would have a very relevant differentiating role. Still, ANOVA analysis indicates that the two clusters are not differentiated in first place by variables directly assessing S&T-related activities that only emerge on the second layer of variables discriminating between the clusters (this layer includes the evolution of human resources; of planning and monitoring of projects; of R&D and of knowledge-management). In fact, the variables “evolution of the number clients” and “evolution of financial resources” contribute the most to discriminate ICT services companies. More precisely, while 55.2% of firms in cluster 1 decreased the number of clients, only 6.9% of firms in cluster 2 present decreases (25.2% decreases in all firms being analysed). Additionally, while 71.2% of firms in cluster 1 decreased their financial resources between 2010 and 2012, only 19.5% of firms in cluster 2 present decreases (39.3% decreases in all firms). One final note to report that among all analysed variables, only the number of competitors and pressure on strategic decision-making do not allow discriminating between the clusters presenting similar patterns in both [6].

Once having identified the profiles, we will now evaluate whether these relate to the general characteristics of the firms, i.e. size and incorporation date, and to the centralization of procedures (Test variables 1-4, Table 1), hereby evaluated by the presence or absence of discussion of strategic decision-making processes and well as the number of people specifically involved making the final decision (Table 2).
Table 2. Characterizing the ICT services clusters

<table>
<thead>
<tr>
<th>Size</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro</td>
<td>2.9* (94.0%)</td>
<td>-2.9* (82.4%)</td>
<td>86.8%</td>
</tr>
<tr>
<td>Small</td>
<td>-2.3* (5.1%)</td>
<td>2.3* (13.4%)</td>
<td>10.2%</td>
</tr>
<tr>
<td>Medium</td>
<td>-1.3 (0.9%)</td>
<td>1.3 (3.2%)</td>
<td>2.3%</td>
</tr>
<tr>
<td>Large</td>
<td>-1.1 (0.0%)</td>
<td>1.1 (1.1%)</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incorporation date</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-1999</td>
<td>1.5 (22.3%)</td>
<td>-1.5 (15.2%)</td>
<td>17.9%</td>
</tr>
<tr>
<td>2000-2006</td>
<td>-0.8 (31.1%)</td>
<td>0.8 (35.7%)</td>
<td>33.9%</td>
</tr>
<tr>
<td>2007-2012</td>
<td>-0.4 (46.6%)</td>
<td>0.4 (49.1%)</td>
<td>48.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discussion for DM in innovation</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>2.2* (18.5%)</td>
<td>-2.2* (7.5%)</td>
<td>10.5%</td>
</tr>
<tr>
<td>Yes</td>
<td>-2.2* (81.5%)</td>
<td>2.2* (92.5%)</td>
<td>89.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of people in DM in innovation</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.6* (53.7%)</td>
<td>-3.6* (26.7%)</td>
<td>34.0%</td>
</tr>
<tr>
<td>More than 1</td>
<td>-3.6* (46.3%)</td>
<td>3.6* (73.3%)</td>
<td>66.0%</td>
</tr>
</tbody>
</table>

Note: Values are expressed as adjusted standardized residuals and percentage within specific clusters. * Denotes statistical significance (|Z|>1.96; level of significance of 0.05); bold indicates positive significant probability of association. DM: Decision-making.

Our data show that in spite of the wide prevalence of micro companies founded after 1999, there is a high probability of companies in cluster 1 being micro companies and of companies in cluster 2 being small companies. Additionally, if significant differences were found in what concerns firms’ incorporation date, relevant differences are present when analysing the course of decision-making per se. Firstly, firms in cluster 2 present a relative high probability of discussion for strategic decision-making. Subsequently, the process of decision-making during innovation progression is decentralized in 73.3% of companies. In cluster 1, the frequency of discussion is lower, and there is a balanced division between a centralized model of decision-making (present in 53.7% of firms) and a decentralized model (46.3%). These data reflects a more centralized model of leadership than the one present in cluster 2.

In summary, firms in cluster 1 have a more unfavourable evolution of the intra- and extra-organizational contexts (Figure 1) than companies in cluster 2 and are mostly differentiated by financial resources and number of clients. While firms in cluster 1 have a high probability of being micro companies and presenting a centralized model of leadership (Table 2), companies in cluster 2 have a high probability of presenting a decentralized model of leadership.

Having established and characterized firms’ profiles we will in the following sections evaluate their associations with innovation development and outputs (Section 5.2) (test of hypothesis 1); top managers perceptions (Section 5.3) (test of hypotheses 2.1 and 2.2); and expectations for the
future (Section 5.4) (test of hypotheses 3.1 and 3.2). Aiming to simplify the analysis without losing relevant information, the data will be presented on 3-point ordinal scales in which high increases (or very favourable) and high decreases (or very unfavourable) are grouped with increases (or favourable) and decreases (or unfavourable), respectively.

5.2. Innovation development at the ICT services sector

Regarding innovation outputs, between 2010 and 2012 innovation activities were developed by 71.2% of all analysed ICT services companies (Table 3, Total). In spite of these high frequencies of innovation activities ICT services companies present low frequencies of patents (16.7% of companies applied for patents and 10.0% finalized this process (Table 3, Total)).

These numbers should reflect 1) the low level of patenting in Portugal as compared to EU (European Commission, 2013); and 2) that this analysis focuses on ICT services sector and that patents are not granted for “computer programs as such”, which are (can be) protected by copyright (European Patent Office, 2013). Secondly, the reported differences between the application for patents and patents granted might be attributed to 1) the fact that not all applications for patents are successfully finalized; and 2) the time lag between the two moments (more than 18 months [7]) in a context of increasing applications (INPI, 2012; INPI, 2013).

Following, the relations between variables characterizing innovation development on ICT services firms’ profiles were evaluated. Confirming our hypothesis 1, i.e. firms’ profiles are innovation profiles, Pearson chi-square analysis reveals that the development of innovation activities ($\chi^2(1)=31.454; p<0.001$); the finalization of patents ($\chi^2(1)=5.965; p=0.015$) but not patents’ initiation ($\chi^2(1)=3.5450; p=0.060$, with a $p$ value close to significance); and the evolution of innovation activities ($\chi^2(2)=74.436; p<0.001$) are not independent of ICT services firms profiles.

Additionally, the analysis of the associations between the clusters and the specific variables’ categories reveals that companies in cluster 2 are highly innovative: most companies developed innovation activities; increased these innovation activities between 2010 and 2012 and presented a relative high probability of finalizing patents. On the contrary, firms in cluster 1 are
mildly innovative. In this cluster, and in spite of innovation activities being developed in approximately half of the companies, there is a high probability of companies not presenting innovation outputs and of having decreased innovation activities during the same period of time. The data on innovation development fits nicely with the previous characterization of the ICT services clusters, with the highly innovative companies of cluster 2 presenting increased internal and external assets and more innovation-prone organizational environments. On the contrary, mildly innovative companies of cluster 1 present a more negative evolution of both internal and external assets and an organizational environment that does not favour innovation development.

Table 3. Innovation development in ICT services clusters.

<table>
<thead>
<tr>
<th></th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Innovation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-5.6* (52.9%)</td>
<td>5.6* (82.6%)</td>
<td>71.2%</td>
</tr>
<tr>
<td>No</td>
<td>5.6* (47.1%)</td>
<td>-5.6* (17.4%)</td>
<td>28.8%</td>
</tr>
<tr>
<td><strong>Evolution of innovation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease</td>
<td>5.5* (17.5%)</td>
<td>-5.3* (0.5%)</td>
<td>6.7%</td>
</tr>
<tr>
<td>No change</td>
<td>5.4* (57.3%)</td>
<td>-5.4* (25.3%)</td>
<td>36.8%</td>
</tr>
<tr>
<td>Increase</td>
<td>-8.0* (25.2%)</td>
<td>8.0* (74.2%)</td>
<td>56.5%</td>
</tr>
<tr>
<td><strong>Patent initiation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-1.9 (8.8%)</td>
<td>1.9 (19.7%)</td>
<td>16.7%</td>
</tr>
<tr>
<td>No</td>
<td>1.9 (91.2%)</td>
<td>-1.9 (80.3%)</td>
<td>83.3%</td>
</tr>
<tr>
<td><strong>Patent finalization</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-2.4* (1.8%)</td>
<td>2.4* (13.2%)</td>
<td>10.0%</td>
</tr>
<tr>
<td>No</td>
<td>2.4* (98.2%)</td>
<td>-2.4* (86.8%)</td>
<td>90.0%</td>
</tr>
</tbody>
</table>

Note: Values are expressed as adjusted standardized residuals and percentage within specific clusters. * Denotes statistical significance ($|Z|>1.96$; level of significance of 0.05); bold indicates positive significant probability of association.

5.3. Contextual impacts on innovation development

Table 4 reveals top managers’ perceptions of the (un)favourable impacts of intra- and extra-organizational variables on innovation development. Globally, cluster 2 companies perceive that innovation development is favourably driven by all organizational layers under study (i.e. formal and informal structure; leaderships). In opposition, firms belonging to cluster 1 mostly perceive that the different organizational layers are either unfavourable or are not favourable or unfavourable for innovation development. This data indicates that the triggering or stopping of innovation is perceived mostly as independent of the different organizational layers analysed. Confirming this data, Pearson chi-square analysis reveals that perceptions of companies’ formal and informal structures impacts on innovation as well as perceptions of leaderships’ impacts on
Innovation are not independent of firms’ profiles. \(\chi^2(2)=10.442; p=0.005; \chi^2(2)=17.707; p<0.001\) and \(\chi^2(2)=13.580; p<0.001\), respectively. This confirms our hypothesis 2.1 (stating that top managers’ perceptions of the intra-organizational impacts on innovation are not independent of firms’ profiles).

Interestingly, both clusters present similar perceptions of the impacts of the reported extra-organizational layers (i.e. legislation/policies and crisis). In fact, the aggregated data tells us that in spite of the previously reported support by the Portuguese government of entrepreneurial and innovation activities in firms [8], only a very small percentage of top managers perceive current legislation and policies as favourable for innovation progression (9.8% and 8.7%, respectively). This scenario worsens when looking at the perceived impacts of the social-economic crisis on innovation development. In fact, 81.1% and 68.1% of firms in clusters 1 and 2, respectively, perceive the crisis as unfavourable for innovation development, revealing an overall dominant negative perception among ICT services firms. This data is consistent with studies reporting decreased propensity of firms to invest in innovation during the crisis (Archibugi and Filippetti, 2013). Moreover, Pearson chi-square analysis reveals that perceptions of the legislation and policies impacts on innovation, as well as those of the crisis are globally independent of ICT services firms’ profiles (\(\chi^2(2)=1.474; p=0.479; \chi^2(2)=4.654; p=0.098\), respectively). This data refutes our hypothesis 2.2 (stating top managers’ perceptions of the extra-organizational impacts on innovation are not independent of firms’ profiles).
Table 4. Perceptions of the intra- and extra-organizational impacts on innovation development in ICT services clusters.

<table>
<thead>
<tr>
<th></th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firms’ formal structure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable</td>
<td>1.3 (15.7%)</td>
<td>-1.3 (9.3%)</td>
<td>11.0%</td>
</tr>
<tr>
<td>Neither favourable nor unfavourable</td>
<td><strong>2.0</strong> (76.5%)</td>
<td>-2.0 (60.7%)</td>
<td>64.9%</td>
</tr>
<tr>
<td>Favourable</td>
<td>-3.2* (7.8%)</td>
<td><strong>3.2</strong>* (30.0%)</td>
<td><strong>24.1%</strong></td>
</tr>
<tr>
<td><strong>Firms’ informal structure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable</td>
<td><strong>3.1</strong>* (11.8%)</td>
<td>-3.1* (1.4%)</td>
<td>4.2%</td>
</tr>
<tr>
<td>Neither favourable nor unfavourable</td>
<td><strong>3.7</strong>* (66.7%)</td>
<td>-3.7* (50.4%)</td>
<td>54.7%</td>
</tr>
<tr>
<td>Favourable</td>
<td>-3.5* (21.6%)</td>
<td><strong>3.5</strong>* (48.2%)</td>
<td><strong>41.1%</strong></td>
</tr>
<tr>
<td><strong>Leaderships</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable</td>
<td>-0.3 (2.0%)</td>
<td>0.3 (2.9%)</td>
<td>2.6%</td>
</tr>
<tr>
<td>Neither favourable nor unfavourable</td>
<td><strong>3.7</strong>* (62.7%)</td>
<td>-3.7* (33.1%)</td>
<td>41.1%</td>
</tr>
<tr>
<td>Favourable</td>
<td>-3.5* (35.3%)</td>
<td><strong>3.5</strong>* (64.0%)</td>
<td><strong>56.3%</strong></td>
</tr>
<tr>
<td><strong>Legislation and policies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable</td>
<td>1.1 (52.9%)</td>
<td>-1.1 (44.2%)</td>
<td>46.6%</td>
</tr>
<tr>
<td>Neither favourable nor unfavourable</td>
<td>-1.2 (37.3%)</td>
<td>1.2 (47.1%)</td>
<td>44.4%</td>
</tr>
<tr>
<td>Favourable</td>
<td>0.2 (9.8%)</td>
<td>-0.2 (8.7%)</td>
<td>9.0%</td>
</tr>
<tr>
<td><strong>Socio-economic crisis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable</td>
<td>1.8 (81.1%)</td>
<td>-1.8 (68.1%)</td>
<td>71.7%</td>
</tr>
<tr>
<td>Neither favourable nor unfavourable</td>
<td>-0.7 (17.0%)</td>
<td>0.7 (21.7%)</td>
<td>20.4%</td>
</tr>
<tr>
<td>Favourable</td>
<td>-1.9 (1.9%)</td>
<td>1.9 (10.1%)</td>
<td>7.9%</td>
</tr>
</tbody>
</table>

Note: Values are expressed as adjusted standardized residuals and percentage within specific clusters. * Denotes statistical significance (|Z|>1.96; level of significance of 0.05); bold indicates positive significant probability of association. This data reports only to companies that develop innovation activities (n=220).

In summary, cluster 1 firms, characterized by challenging internal and external scenarios, point to the environmental context as the main responsible for the unfavourable innovation settings.

Firms in cluster 2, previously characterized by more favourable settings, perceive, similarly to cluster 1, the unfavourable impacts of the environmental context but point to “themselves”, i.e. to the different organizational layers, as the relevant drivers of innovation development.

5.4. Expectations for the future: the role of uncertainty and confidence

Finally, in what concerns top managers’ perceptions of companies’ future (Table 5), the two clusters are very different. Cluster 2 is significantly associated with no changes in uncertainty and increased confidence in the companies’ future. In opposition, cluster 1 is characterized by a high probability of decreased levels of confidence in the companies’ future. Additionally, Pearson chi-square analysis reveals that while uncertainty is independent of firms’ profiles ($\chi^2_{(2)}$=5.746; p=0.057, with a p value close to significance), confidence in the companies’ future is not independent of ICTS firms’ profiles ($\chi^2_{(2)}$=71.895; p<0.001). As such our hypotheses 3.1 is refuted while hypotheses 3.2 is confirmed.
Table 5. Evolution of future-oriented expectations in ICT services clusters.

<table>
<thead>
<tr>
<th></th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertainty in the company’s future</td>
<td>1.0 (17.5%)</td>
<td>-1.0 (13.4%)</td>
<td>15.0%</td>
</tr>
<tr>
<td>Decrease</td>
<td>-2.4* (30.7%)</td>
<td>2.4* (44.7%)</td>
<td>39.2%</td>
</tr>
<tr>
<td>No change</td>
<td>1.7 (51.8%)</td>
<td>-1.7 (41.9%)</td>
<td>45.7%</td>
</tr>
<tr>
<td>Increase</td>
<td>1.7 (51.8%)</td>
<td>-1.7 (41.9%)</td>
<td>45.7%</td>
</tr>
<tr>
<td>Confidence in the company’s future</td>
<td>7.0* (52.6%)</td>
<td>-7.0* (14.6%)</td>
<td>29.1%</td>
</tr>
<tr>
<td>Decrease</td>
<td>0.8 (38.6%)</td>
<td>-0.8 (34.1%)</td>
<td>35.8%</td>
</tr>
<tr>
<td>No change</td>
<td>-7.5* (8.8%)</td>
<td>7.5* (51.4%)</td>
<td>35.1%</td>
</tr>
</tbody>
</table>

Note: Values are expressed as adjusted standardized residuals and percentage within specific clusters. * Denotes statistical significance (|Z|>1.96; level of significance of 0.05); bold indicates positive significant probability of association.

6. Discussion and conclusion

6.1. Innovating under the crisis: summarizing and discussing the data

This study characterizes innovation development and its contexts at ICT services firms in Portugal between 2010 and 2012, i.e. during the social-economic crisis. For this purpose, we completed an extensive up-to-date characterization of firms articulating the organizational context with the wider environmental context. This characterization revealed two innovation profiles – highly and mildly innovative firms- that are mostly discriminated by financial resources and number of clients (Figure 1; Table 3). Additionally, these firms are characterized by significantly different perceptions of the impact of the firms’ organizational layers on innovation development and similar perceptions of the impacts of the extra-organizational context. These patterns are additionally revealed in differential historically and contextually-embedded future-oriented expectations. This is, to our knowledge, the first time that the characterization of ICT services firms’ profiles was based on such a wide and diverse array of indicators. This approach allowed for a detailed picture of this sector in Portugal (Figure 2).
What this study shows is that firms with more favourable conditions, with more decentralized decision-making processes, and with higher frequencies of innovation outputs, perceive their organization as the driver of innovation. Also, these are the companies that present relative increased presence in networks and internationalization patterns (Figure 1). These companies seem to follow the previously reported proactive innovation model during times of environmental decline or recession (Hansen, 2014; Srinivasan et al., 2005). Under this scenario, companies and their actors present confidence in their future.

In the opposite situation, companies with unfavourable conditions and more centralized decision-making processes are more likely to perceive innovation development as hinging on factors outside their control and to present lower frequencies of innovation outputs. These firms seem to engage on the previously reported conservative strategies to overcome the difficulties associated with periods of crisis (Staw et al., 1981; O'Malley et al., 2011; Hansen, 2014). These companies present relative decreased presence in networks and internationalization patterns, which reveals unequal access to and position in information and communication structures. These companies are characterized by decreased confidence in their future. Such companies are more easily trapped in a limbo of uncertainty where only short-term decisions are in place and long-term projections are inaccessible. The persistence of this unfavourable scenario can trap
companies in unfavourable vicious cycles, eventually precluding innovation development. These companies have decreasing levels of confidence in their future.

6.2. Policy implications

Between 2010 and 2012, under a crisis context that frames a severe downturn in ICT services firms activities (INE, 2014), 71.2% of ICT services firms still developed innovation activities. However, when one looks at the variables that mostly contribute to discriminate firms’ profiles, i.e. financial resources and number of clients, their overall evolution is worrisome. Indeed, only approximately a fourth of all ICTS firms increased their financial resources and number of clients. This is expected to impact on companies’ survival and on present and future innovation development. Additionally, the evolution of these variables is most probably contributing to the overall negative perceptions of the crisis’ impacts on innovation development. In fact, even with the Portuguese government endorsing entrepreneurial and innovation activities as the model for social and economic development (Governo de Portugal, 2011a), there is a strong prevalence of negative perceptions of legislation and policies among innovation actors. These perceptions could be pointing to the difficulties that companies face to benefit from governmental programs and to the inability of the government in addressing persisting structural challenges. Previous studies have pointed out that Portugal has many structural constraints that need to be tackled by public policies if innovation is to be promoted. Among these stand the low educational level of the Portuguese population; the low R&D expenditures; the shortage of companies in high technology sectors; the lack of risk capital investments and available private credit as well as the scarce partnerships and networks between institutions of the innovation system (Salavisa and Vali, 2011; Conceição and Heitor, 2003). As previously shown, this reasoning remains critical during the crisis context (Filippetti and Archibugi, 2011).

The current governmental strategic program on entrepreneurship and innovation does intend to address some of these shortcomings by endorsing the development of an entrepreneurial society: promoting innovation activities in firms; networking mechanisms and the restructuring of financing mechanisms. However, the funding opportunities at the basis of this governmental
strategic programme specifically target “initiatives of excellence” (Governo de Portugal, 2011b), disregarding the clear heterogeneity of companies operating in Portugal even when one focus in a very specific and highly innovative sector of economic activities. Knowing that the evolution of financial resources is one of the variables that mostly contribute to distinguish between firms’ profiles, these measures are expected to have negative impacts on future innovation activities, which were previously shown to have a significant impact on companies’ survival (Cefis and Marsili, 2006). Indeed, these measured leave most firms “out of the game” from the very beginning and, as such, are expected to deepen opportunity inequalities among companies. Additionally, the program also disregards studies and recommendations suggesting that innovation policies, particularly in small countries like Portugal, should not be confined to institutions promoting innovation development (or their linkages with the academia), but should additionally target institutions that affect the absorption and efficient use of innovation outputs (Lundvall and Borras, 2006) (recalling that the number of clients is one of the variables that mostly contribute to establish the reported innovation profiles). This reasoning is particularly relevant in a context characterized by reduced demand of goods and services and increased uncertainties in future demands. As such, innovation policies should not only consider the heterogeneity of companies operating in Portugal but should additionally target both innovation developers and innovation consumers. The application or not of this kind of policies is expected to be critical for future innovation development and associated economic effects, an area where Portugal continues to perform under the EU average [9] (European Commission, 2014a).

6.3. Limitations and opportunities for future research

In this study, we have sketched an over-all picture of ICT services sector in Portugal and established firms’ innovation profiles. Still, since we have only addressed one sector of economic activities, the gathered results and conclusions should be carefully taken before their evaluation in other sectors of economic activities, particularly in those with similar innovation patterns. Additionally, since we have looked at innovation processes as a “general entity”, this study falls short on addressing differences between the contexts of incremental versus the
contexts of radical innovation and on delineating a detailed portrait of innovation trajectories considering the different overlapping sub-processes of innovation progression (Pavitt, 2006). Future studies should address these issues via a qualitative approach that deepens our data while taking into account the results previously presented by other comprehensive studies (Oliveira, 2008; Piteira, 2010). Detailed analysis of the historical and contextual backgrounds of the firms should also be considered. Finally, in addition to surveys/interviews to top managers, an approach that also explores the standpoint of firms’ employees should give additional avenues of analysis. This will allow us to reach firms’ activities from different angles of observation and thus, to have a more thorough approximation to innovation development. The presented limitations do not however jeopardize the scientific contributions of this study.

6.4. Concluding remarks

This study suggests that the additive impacts of the intra- and extra-organizational contexts of innovation progression have to be jointly tackled if interventions are to foster innovation development. As this study indicates that the presence or absence of confidence in the companies’ future is strongly associated with companies’ profiles it can be used as an indicator of firms’ physiognomies. This study further reveals that historically- and contextually-embedded firms’ activities frame companies’ expectations and subsequently, if these contexts and activities aren’t shortly tackled, the future of a significant proportion of companies could be compromised.

Acknowledgments

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References


Notes

[1] The 2007-2008 international financial crisis and its repercussions had strong impacts in Portugal revealed in economic and social downturns (OECD, 2013). At the political level, in March 2011, the Portuguese Prime Minister resigned and elections took place in June 2011. This resulted in a change in government from a non-majority ruling by Partido Socialista (Group of the Progressive Alliance of Socialists and Democrats in the European Parliament) to a majority coalition between Partido Social Democrata and Centro Democrático e Social – Partido Popular (European People’s Party (Christian Democrats) in the European Parliament).

[2] The sample was based on a reference population obtained from a private company dataset (inclusion criteria: annual turnover over 1 million € in 2008 with an increase over 5% between 2007 and 2008). Only firms that developed innovation activities were included and the sample was stratified by size and level of technological intensity and knowledge services.

[3] Statistics Portugal lists a total of 4310 ICT services firms in which are 87.1% have 0-10 employees (87.1% in our sample (S)); 5.7% have 10-19 (5.8% S); 4.3% have 20-49 employees (4.2% S); 2.3% have 50-250 employees (2.3% S) and 0.6%, more than 250 employees (0.6% S). Our sample presents a proportional distribution to the universe of firms operating in Portugal in terms of classes or persons employed. Additionally, 90.7% of ICT services firms operating in Portugal present annual turnovers under 1 million of euros (88.7% S); 3.5% between 1 and under 2 million of euros (4.2% S); 2.6% between 2 and under 5 million of Euros (3.2% S); 1.0% between 5 and under 10 million of euros (1.0% S); 0.9% between 10 and under 20 million of euros (0.6% S); 0.9% between 10 and under 20 million Euros (0.3% S); 0.5% between 20 and under 50 million of Euros (0.3% S); 0.3% between 50 and under 200 million of euros (0.3 S) and 0.1% of 200 or more millions of Euros (0.0% S) (INE, 2011).
All evolution variables were assessed with the question “Characterize the evolution of the following items and activities – Input variables / Test variables 5; 14 and 15 - between 2010 and 2012”. These variables were evaluated on a 5-point Likert scale ranging from 1 – strong decrease to 5 – strong increase. Decision-making processes were characterized regarding the presence or absence discussion (nominal scale Yes/No) and the number of persons involved in decision-making (metric scale). Innovation outputs and application for/finalization of patents were measured on a nominal scale (Yes/No) (Question: “Between 2010 and 2012, did your firms developed Test variables 6-9”). Perceptions were assessed with the question “Between 2010-2012, how did the “Test variables 10-13” contribute to innovation development in your firm? These were evaluated on a 5-point Likert scale ranging from 1 – highly unfavourable to 5 – highly favourable.

Other statistical procedures were evaluated and discarded. Specifically, we could not perform 1) a logistic regression analysis due to the small sample size (Burns and Burns, 2008; Hosmer and Lemeshow, 2000) and the presence of multicollinearity among predictors (Tabachnick and Fidell, 2007); and 2) a discriminant analysis since the assumptions were not met: multivariate normality of the independent variables, homoscedasticity for the groups of the dependent variable and multicollinearity among the predictors (Hair et al., 2010; Maroco, 2010).

To note that once the clusters are chosen to maximize the differences among cases in different clusters, ANOVA should only be used for descriptive purposes.

Timings reported by the European Patent Office and the Portuguese Institute for Industrial Property are accessible at their websites at http://www.epo.org/in2dex.html and http://www.marcasepatentes.pt/, respectively.

The newly elected Portuguese government implemented a strategic programme for entrepreneurial and innovation activities aiming at: 1) the development of an entrepreneurial
society via an intergenerational cultural change rooted in the school system and sustained by life-long learning activities; 2) an increase in innovation in companies, promoting linkages with the academia and exports of tradable goods and services; 3) the participation in national and international networks; and 4) financing mechanisms specifically directed to “initiatives of excellence” (Governo de Portugal, 2011a).

[9] Economic effects were assessed with indicators that evaluate the economic success in 1) employment in knowledge intensive activities; 2) medium- and high-tech exports’ contribution to the trade balance; 3) exports in knowledge-intensive services; 4) sales due to innovation activities; and 5) license and patent revenues from selling technologies abroad. Portugal is performing below EU average in all indicators except the sales’ share of new innovations (at the same level as the EU average).