QUESTIONING EU COHESION POLICY IN PORTUGAL
A COMPLEX SYSTEMS APPROACH

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Abstract

During the last decade the development of the Norte region of Portugal has been the object of several studies whose conclusions – according to the present paper – need revision in line with a new scientific paradigm. It is our understanding that regional and innovation policies should be based on a complex systems approach whose emergence is acknowledged in the first part of the paper. Accepting the usefulness of this meta-theory for research on firms' behaviour and innovation, we develop a preliminary analysis of the strategic behaviour of small and medium-sized enterprises (SMEs) in the Norte region in responding to direct financial support from Structural Funds. The empirical results confirm the research hypothesis that current policies based on financial incentives have little effectiveness in promoting the changes required by SMEs in the globalizing knowledge-based economy. Considering knowledge as an emergent property of complex social systems, as are firms and regions, the paper argues that SMEs need a customized and interactive innovation policy, managed at a regional level. This argument should be considered, both in Portugal and at the EU level, as part of the EU Cohesion Policy debate after 2006.

KEY WORDS ★ complex systems ★ firms ★ innovation policy ★ Portugal ★ regions

Most probably, the current Community Support Framework (CSF III) for Portugal (2000–6) will be the last one of this size before the enlargement of the European Union (EU) to Eastern countries.[1] Therefore, it is important for Portugal to deepen the evaluation of previous policies under the first and second rounds of CSF, whilst the growth of productivity remains a crucial challenge. However, at a time of great changes in EU institutions and reassessment of its progress in economic and social cohesion, it is important to study the current use of the Structural Funds in order to prepare EU Cohesion Policy for the knowledge-based society. In this context, small and medium-sized enterprises (SMEs) and regions will in future have an increased role as they are at the crossroads of different public policies (regional, employment, RTD, innovation) which are decisive in the development of the European Communities.

So far, EU and member-state policies have been commanded by a positivist paradigm in economic science, which is largely inspired by Newtonian physics and resists evolving in line with research in the natural sciences. However, throughout the second half of the 20th century mainstream economic science has been criticized by two heterodox streams: neo-evolutionist thinking and the theories of complexity. Although widely diffused in the management sciences, the complex systems paradigm is entering very slowly into the economics of the firm and into regional studies, in spite of some valuable contributions. However, in a time of great changes, the questioning of economic science's foundations can be theoretically fruitful and politically useful – for instance, with regard to types and direction of policy instruments – as we aim to show for innovation and regional development in the case-study of the competitive behaviour of SMEs in the Norte region of Portugal.

The first part of the paper presents the analytical

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framework of the study at theoretical and policy levels. In the second part, drawing on data about investment projects supported by SME Community Initiative (SME-CI), the paper studies the competitive behaviour of manufacturing SMEs in the Norte region of Portugal and attempts to interpret the results obtained. The third and concluding part puts forward the policy implications of the study and highlights directions for future research.

The analytical framework

The leading role of firms in contemporary economies and the relevance attributed to SMEs in regional development gave rise to a prolific academic and professional literature, frequently without any reference to the theoretical assumptions involved. Therefore, the analytical framework of the paper addresses the concepts and assumptions underlying our study. It is inspired by a scientific paradigm that may shed new light on the nature and dynamics of firms and regions, and on their mutual relationship in development processes.

The firm as a complex system

Although the neo-classical model of the firm has been improved over the last two decades, particularly by the so-called 'new growth theory', it still follows the essentials of the mainstream paradigm in economic science: atomistic thinking, homeostatic equilibrium, linear causality and maximizing behaviours (Cross, 1995).[2]

However, the second half of the 20th century produced substantial new research that questioned seriously these assumptions, although on selected issues. The work of Simon (1957) and Cyert and March (1963) on the existence of different cognitive actors adopting bounded rationality, the non-equilibrium theory of the firm by Penrose (1959) and the evolutionist work of Nelson and Winter (1982) on firms' routines, opened radically new directions in the study of the firm and established a rich theoretical background for the emergence of a new paradigm in economic science.

Although it deepened the analysis, the adoption by neo-evolutionist economists of the Darwinian metaphor also brought several theoretical difficulties, which called for a broader perspective. Indeed, unlike living systems, social systems are purposeful systems comprising subsystems and/or individuals which are purposeful agents as well (Ackoff and Gharajedaghi, 1996). This radical difference is highlighted by Corning (1995: 113) under the concept of 'self-determination' which 'implies some degrees of freedom, the potential for creativity and innovation and the ability to exercise a measure of self-control over the process of adaptation'.

Meanwhile, as a result of the interaction between different factors, a complex systems paradigm has emerged in natural sciences over the last few decades which has already begun to influence economic science (Colander, 2000). The most relevant factors are 'general systems theory', springing from different fields of research (physics, biology, neurophysiology, cybernetics), the constructivist thinking of Piaget and the chaos theory born in mathematics.

In line with this evolution in the social sciences paradigm, our point of departure will be a complex systems *meta-approach* to the firm, which is able to integrate the evolutionist stream and assimilate relevant contributions of more focused theories (Delorme, 1997a).[3]

In our framework, the firm is modelled as a social system (organization-type) formed by individuals and (possibly) subsystems in high interaction, itself being at the same time part of wider systems (Salthe, 1989). This particular social system thrives by processing resources (matter/energy, information), offering economic value to the market and responding to the environment and to its internal changes in a self-organized mode (Morel and Ramanujam, 1999).

Looking in more depth, on the one hand the firm is *opened* to the environment, which means that it is submitted to inevitable external disturbances; on the other hand, the firm *closes* itself, in the sense that it tries to control interaction with the environment. Under environmental challenges, the firm may change its internal components and functions (change the *structure*) in order to survive and succeed (maintain the *organization*). This process of *simultaneous opening and enclosure* is

sustained by internal networks which support circular relationships among the parts and between each part and the whole system whilst ensuring the stability of the system within change (Conti and Dematteis, 1995).[4]

In this perspective, we can put forward some elements of our approach to the nature of the firm that are central in the analytical framework we adopt:

- *Novelty emerges from interactions within the firm and between the firm and the environment*. Collective knowledge is an important emergence resulting from interactive processes involving cognitive agents (Ngo-Mai and Rocchia, 1999). This cognitive nature points to the radical difference between information and knowledge, which has important implications both at theoretical and policy levels.
- *Firms develop strategies* to improve their performance in response to the environment or to internal changes. For this they need memory, to register situations, and assessment criteria, to compare outcomes and select options. Therefore, the leadership of the entrepreneur, as coordinator and motivator of interactions, becomes crucial for the performance of the firm (Witt, 1998).
- *Firms are disturbed by shocks produced by the environment*. Their effects on the firm can either be diminished/eliminated by *negative* feedback or amplified by *positive* feedback (Arthur, 1988). A firm's memory, combined with these feedback effects, determines the assimilation or the elimination of innovations.
- *Redundancy is crucial for the survival of the firm.* Assuming different forms (material resources, information, competencies), redundancy enables the system to widen the range of available responses to environment changes. This is opposed to the mainstream economics idea of an optimizing selection by the markets that does not even exist in natural systems (Hodgson, 1993).

In this new paradigm the firm lives by a 'structural coupling' with its environment, which means that 'the environment selects which of the systems attractors becomes active at any time, what is also called situated or selected self-organization' (Lucas, 2001: 20). Therefore, we need to deepen our analysis of what is the environment of the firm and study the dynamics of their relationship.

Firms, territories and innovation

Recent years have shown a convergence between industrial economics and economic geography within regional development studies. Nevertheless, some contributions experience great difficulty overcoming what has been called 'one-sided analysis' (Oerlemans et al., 1999). For this, we need a new scientific paradigm that could offer a basis for the advancement of interdisciplinary research in spatial studies.

In fact, the environment is a vague reality when defined by reference to the firm, which we conceive as a complex evolutionary system. However, the environment can be approached directly under different dimensions (natural, business, social, institutional) and at different scales. Choosing the particular dimension of space, we identify the existence of geographical communities (territories) comprising different types of agents, individual and collective, which form an evolving social fabric.

So far, the most diffused models of territorial development, the 'industrial district' and the 'innovative milieu', have concentrated analytical efforts in identifying the factors of successful evolutions and explain, by default, the failure of others (Pyke and Sengenberger, 1992; Ratti et al., 1997). From our point of view, the complex systems approach offers a wider conceptual framework which gives fresh insights for the understanding of (succeeded or failed) meta-transitions in territorial communities, which should be understood as evolutionary social entities (Heylighen and Campbell, 1995).

In this context, the firm performs different roles as it belongs at the same time to an industrial network and to a territory made up of multiple networks in interaction. The firm transfers to the industrial network (frequently global) the knowledge captured in the territory and its local interactions. However, firms' positioning in the network influences the evolution of their territory, not only by using local resources but also by diffusing in the territory knowledge acquired in the network. This complex articulation between vertical and horizontal relationships makes territories much more than a location for the firm, even in the case of major organizations (Storper, 1997; Kirat and Lung, 1999). Therefore, territories may be seen as strategic assets for the firms in their specific way of building

competitive advantages. However, this relationship between the firm and the environment is not a deterministic one, as long as it rests on *co-evolutionary process*es.

This is in line with the globalization process of the so-called knowledge economy that attributes particular importance to territorial communities. As many authors have pointed out, the competitive pressures of globalization call for the adoption of continuous processes of innovation and the organization of externalities to the firms, namely territorial networks of different types with emphasis on the intangibles (Storper, 1995a). These new forms of coordination, of neither organization nor market nature, balance the disadvantages of small firms and facilitate their competitiveness on the basis of specific knowledge that is difficult to imitate (Maskell, 2001).

Although under attack for some decades, the 'linear model' of innovation continues to influence economic thinking, which has traditionally considered knowledge a homogeneous good. Opposing it, the evolutionist view deals with innovation as a non-sequential and interactive process embedded in the routines of operational management. Broadly defined, innovation involves new ways of dealing with partners in the day-to-day operations. It results from interactive processes between internal agents, and between the firm and external agents, such as customers, suppliers and knowledge-producing organizations (Kline and Rosenberg, 1986).

Furthermore, knowledge has recently been recognized as a multidimensional reality (cognitive, organizational and societal) and has been the object of intensive study that emphasizes its diversity (Nonaka and Teece, 2001). For instance, empirical research has showed that firms use a 'knowledge base' that builds on different types of knowledge: general scientific, industry/product specific and firm-level knowledge (Aslesen et al., 1999). The latter is mostly tacit and localized, involving technical, interpersonal and institutional dimensions of major importance for firms' competitiveness (Lam, 1999). In this context, firms' competitiveness ultimately 'rests on a set of material resources, human skills and relationships, and relevant knowledge. These are the competencies or competitive ingredients from which the firm builds the product features that appeal to the marketplace' (Abernathy and Clark, 1985, cited in Smith, 1996: 35).

Contrasting with the linear model, the social nature of knowledge and innovation has been established for a long time, even if the former continues to exert a strong appeal in the scientific community. Accordingly, research on local productive systems insists that geographical proximity still matters as far as it concerns tacit knowledge and some kinds of contextualized codified knowledge (Maskell and Malmberg, 1999). The results of this research show that, although codetermined by other types of proximity – namely technological and organizational – firms' innovation processes are to a large extent a territorially based phenomenon (Gertler, 2001).

Regional innovation systems or innovative regional systems?

This close articulation between knowledge, innovation and territory has been the object of a recent and fast growing line of research under the heading of 'regional innovation systems' (Braczyk et al., 1997; Tödtling and Kaufmann, 1999). This is a natural consequence of some important studies on 'national systems of innovation', a concept proposed by Freeman, Lundvall and Nelson in different but convergent contributions, which is much diffused in the academy and enjoys an increasing audience among policy authorities (Edquist, 2001).

However, Kaufmann and Tödtling (2000) pointed out that these approaches rest at the level of classical (first order) cybernetics and ignore complexity in their 'system' concept. In search of a deeper theoretical foundation, those authors proposed Niklas Luhmann's understanding of social systems, which we are going to follow as well (Luhmann, 1995[1984]).[5]

Luhmann considered social systems as 'self-referential sense-making systems'. They are constituted by *communication* events and continuously recreate themselves by a process of communication between the actors of the system (individuals or subsystems), which *are given a meaning by reference to the system itself.* Societies are wide social systems that have differentiated themselves in *functional* social (sub) systems, such as the law, economy, science, political, etc. Each system has its own identity, uses a specific code in its

communications and defines itself a boundary. Interactions between functional social systems are carried out by interorganizational relationships or networks and by individuals, sometimes inside a single organization. In the latter case, the interaction between different systems can be established around specific tasks assigned to 'hybrid organizations', which can favour innovation by producing boundary-crossing knowledge.

Taking into account that the above propositions are useful in the building of our theoretical framework, in the following points we try to disentangle the current discourse on 'regional innovation systems':

- The interactions between actors are at the roots of social complexification by which higher-order states emerge and stabilize in a given territory. According to Amin and Hausner (1997), this dynamic process depends on the existence in the territory of the following conditions: differentiation of functional institutional structures; a sense of community; a common framework of meaning; strategic guidance. Therefore, our framework uses the term 'region' to indicate territories that have acquired a 'systemic nature'. Hence, the region is a (subnational) social entity *felt as being above its actors*, although it really emerges from the interactions between them. This systemic property, which may appear in the evolution of a territorial community, manifests itself by a certain degree of autonomy under particular institutional arrangements. Being the result of a territory's evolution, it is a property that cannot be taken for granted. It must be maintained and, in particular circumstances, may regress and even disappear. Europe presents a rich variety of territories that are the result of historic processes of more or less differentiation in societies, some of which are regions in the sense we propose. This distinction is important by its policy implications, as we shall see below.
- From our theoretical point of view, the 'innovation system' concept is empty in an ontological sense, as far as we are not in the presence of a *functionally differentiated* social entity with its own recursive meaning-processing and its specific mode of communication.[6] At the national level, components usually considered as forming the innovation system (business, university, government) are per se functional social systems of societies. The interactions between them are in fact intersystem communications, which naturally raises problems due to the use of different 'languages'. Therefore, it is more adequate to work with functional social systems and to try to understand their specific objectives, decision rules and communication codes involved in innovation processes. Assuming there is no such (higher order) 'innovation system' exerting 'downward causation' over each functional social system, our attention concentrates on their identities and dynamics, and on the problems stemming from communication activities between them (Pattee, 1997; Conceição and Heitor, 1999). In this perspective, the 'triple helix' model proposed by Etzkowitz and Leydesdorff (2000), associated to a 'mode II' knowledge production, seems more in line with our theoretical framework. It points to social dynamics where tensions need not be resolved. 'A resolution would hinder the dynamics of a system which lives from the perturbations and interactions among its subsystems. [...] The system is neither integrated nor completely differentiated, but it performs on the edges of fractional differentiations and local integrations' (Leydesdorff and Etzkowitz, 2001: 26).
- In most territories we have very different types of organization, some belonging to a national system (public bodies), others to more than one (spin-off firms from academic research, technology agencies), and even others to a local level of the productive system (small and medium-sized firms). Therefore, we need to consider the specific nature of each actor in a given territory and, in doing so, use 'organizations' and 'systems' concepts in a theoretically adequate sense.[7] Under particular conditions we have mentioned above, this variety of organizations can operate and interact in *a territory where innovation emerges*, a territorial system we call a 'region'. At this next-order level of complexity, social systems (economy, university, government) establish dense and intensive interactions through actors' relationships and, thereby, favour the emergence of an 'innovative regional system'.

Policy implications

A last step in the formulation of the analytical framework addresses some policy implications of our complex systems approach, which we sketch in the following features:

- Public policies have a limited influence on the functional systems they address. The traditional hierarchical model of politics, which intervenes in the other (relatively autonomous) social systems in order to obtain predictable outcomes, is no longer adequate. Indeed, it is their mutual interactions that globally codetermine the evolution of each one, and of the social totality of which they are part, which create a self-organizing process for the whole. Although the state does not guide societies, it keeps an important normative role that secures institutional integration and social cohesion. Therefore, we argue for a model of state intervention requiring an *interactive* and *reflexive* approach to the design of public policies. In the case of territories that lack a systemic nature, there is a need of some kind of top-down interactive policy focused on local network stimulation and strategy building. At the same time, the model imposes policy reflexivity as long as it needs new types of policy instruments. In the words of Amin and Hausner (1997): 'For if it is to manage social complexity effectively, the state must be able to modify the existing public agency structure and set a new agenda for it' (p. 24).
- When a territory is not a region in the social system sense, the effectiveness of public policies depends on the creation of a progressive regional coalition aiming 'to induce individuals and institutions to modify the existing routines in order to "work together" with individuals and institutions rooted in different frameworks' (Bianchi and Miller, 1995: 190). Whenever politically possible, the national state should define the boundaries of territories and start a gradual devolution of powers, a regionalization process that initiates a spatial differentiation with the attribution to each territory of a new 'meaning'. This produces positive feedback on local actors' self-identification and gives origin to a cumulative process that favours the birth of the organizational closure of the territory (Matteaccioli, 1999). This self-organization capability plays crucial roles, such as overcoming communicational failures between local actors, shaping the quality of transorganizational relations, and harmonizing their vision of the community's future. Therefore, social innovation should be a priority for national policies addressing less developed territories and small firms (Woolcock, 1998; Cooke and Wills, 1999).
- There is a place for subnational innovation policies which, taking account the different degrees of territory's complexification, needs to be carefully coordinated with national and EU policies. Underlying the argument for a territorial level of innovation policies is the complex nature of social systems, which frequently differentiate along hierarchical spatial levels. However, as argued above, this does not mean that regional 'systemness' should be a specific innovation policy aim. The ongoing process of social differentiation of EU societies, which is progressively establishing a multi-level governance, confirms the relevance of this theoretical framework (Christiansen, 1997). In this light, centralized countries that resist regionalization are in fact refusing to increase their internal *diversity*, which could favour innovation in the communication operations of their social systems. Therefore, the evolution of communication to higher levels of complexity is less likely in these societies and, hence, their degrees of freedom under environmental pressures to change may be narrowed.

These are some elements of a mode of knowledge that builds on the convergence of ideas in different disciplines and, as a metatheory, guides this research on firms, innovation processes and their support by Structural Funds. Therefore, our complex systems approach integrates the so-called stream of 'critical realist thinking' in social sciences, which rejects both methodological positivism and the post-modern interpretivist reductionism (Sayer, 2000).

Firms' strategies in the Norte region

The Portuguese Norte-Litoral (comprising around 3m inhabitants) is the coastal and more developed

part of the Norte region. The latter is a territory provided with an administrative platform of institutional dialogue and policy coordination between central government and local authorities, but which does not have specific powers as Mainland Portugal is not regionalized. Norte-Litoral is a territory of diffused industrialization comprising the city of Porto, the head of a metropolitan area of 1.2m inhabitants. It accounts for about 98 percent of the industry of the Norte region and for 52 percent of the total manufacturing employment of Portugal. The territory has some well-defined local production systems, which concentrate most of the traditional industries of Norte region (textiles/apparel, leather/footwear, wood/furniture, and cork). However, the metropolitan area of Porto presents a more diversified industrial structure with important Machinery and Metal Products industries and a more significative presence of R&D intensive production.

Industrial change and recent policies

Important research has been produced on the entrepreneurial model of Norte-Litoral and the innovative behaviour of its small and medium-sized enterprises (SMEs) (Costa and Silva, 1993; Silva and Mota, 1996). The main conclusions of these studies support the idea of a path-dependent response of firms to the new challenges of competition after Portuguese adhesion to EU. Of major importance is the conclusion that the historical industrial specialization of the country is stable and that the first Community Support Framework (CSF) (1989–93) was mostly directed to modernization of infrastructure and productive equipment, sometimes associated with some product and process incremental innovation (Mateus et al., 1995).

The evidence of the first two years under CSF II (1994–9) shows that firms began to explore new investment directions, such as more radical innovations in production processes, technological audits and quality certification, sometimes associated with external services of technological agencies. However, the global slow change of manufacturing industrial firms is confirmed by a recent academic study. According to this study, Portuguese manufacturing industry is yet 'modestly equipped in terms of the so-called dynamic competitive factors and particularly in terms of those with more strategic relevance in the forthcoming knowledge-based economies' (our translation from Lança, 2000: 101). Indeed, after two rounds of European financial support, the Portuguese economy remains at the lowest position in the productivity ranking of the 15 EU countries, according to the Second Report on EU economic and social cohesion (European Commission, 2001).

It must be acknowledged there has been a notorious catching up of Portugal from 53 percent (1986) to about 75 percent (2000) of the average EU GDP per capita, although this progress was helped by the German reunification that dropped EU average. Nevertheless, taking account of the modest growth of labour force productivity and of the new competitive environment of 21st-century beginnings, we are led to formulate the hypothesis that the convergence process of the Portuguese economy risks slowing down if the policy paradigm underlying CSF programmes is not changed.

Research questions

In the context of a globalizing knowledge economy, the inadequate design of CSF programmes has been pointed to as an important reason behind the above-mentioned slow change in competitive behaviour of firms. Recent policy evaluation conducted by the Portuguese government points to excessive support to productive equipment, and consequently less emphasis on the 'dynamic factors' of competitiveness, in the sense proposed by the competence theories of the firm (Teece and Pisano, 1994). If this is the case, the reorientation of financial incentives made under the third CSF (2000–6) should accelerate the adoption of new competitive strategies.

SME Community Initiative (SME-CI) anticipated the new policy orientation. This Programme of €140m was executed in Portugal (1997–2001) with the objective of stimulating firms with less than 250 workers to adopt strategies based on investment in competitive 'dynamic factors'. By dynamic factors the Programme considered material and immaterial investment in technology and organizational

innovation, information and communication technologies (ICT), management reorganization, marketing strategies, systems of quality management, product design, business networking, personnel training and internationalization. Firms were asked to argue the relevance of their project application on the basis of a specific strategy, which should include a classical 'swot analysis'.

Dynamic components of the investment project were positively discriminated with a financial grant of up to 70 percent. On the contrary, infrastructure and productive equipment only received grants on the *interests* of a possible financial credit. The main reason for this differentiated support was to give a hard push to new forms of building competitive advantage all over the value chain up to market linkages and business networking.[8]

Taking into account that a similar orientation inspired the design of a large part of the Operational Programme of the Economy (POE), under current CSF III, at least for policy reasons it is important to answer the following questions:

- How sensitive were investment decisions to positive discrimination of competitiveness dynamic factors in SME-CI?
- How effective is this (re)orientation of financial incentives on the adoption of differentiation strategies by SMEs?

So far Portuguese CSF supports firms mostly by distributing financial incentives on the basis of the 'market failure' argument. They are framed by a linear model of communication that provides financial resources policymakers think are relevant and give minor attention to absorptive capacity building in the beneficiary firms (Nauwelaers and Wintjes, 2000). Accordingly, these programmes were inspired by principles of economic and financial rationality and do not look at entrepreneurs as cognitive actors 'embedded' in social systems. In fact, they do not address the critical issue that 'at the basis of the difficulty to change individual strategy there exists a cognitive "anchoring" on persistent locally shared mental models' (Seri, 2001: 3).

Thus, we expected empirical evidence of SME-CI applications to show a *low sensitivity* of firms in response to increased financial incentives to dynamic factors of competitiveness. In other words, we expected that Structural Funds would not be associated with significative changes in firms' strategies.

Methodology and empirical results

The design of the research builds on the first author's quality of 'participant observer', taking account of the experience acquired in the Programme. Indeed, the study's methodology is framed by a qualitative approach, even if a quantitative algorithm (cluster analysis) was used to analyse data on firms' investments. This preliminary use of a quantitative technique helps to identify at the outset some types of strategic behaviour and provides useful information for the qualitative part of the study (Miles and Huberman, 1994). Therefore, the empirical research presented in this second part must be seen as the beginning of a multi-method research with a dominant qualitative approach (Brannen, 1992).

Indeed, as an experienced author states, although ontological, epistemological and methodological choices are interdependent, 'in practice it is unusual, for example, for epistemology or theory to be the sole determinant of method' (Brannen, 1992: 3). In our case, the availability of relevant information on firms' investment decisions was a determinant factor the departure point of the research.

In general terms, the research is based on 'analytical induction', as opposed to the 'enumerative induction' of quantitative approaches. In a parallel with ethnographic studies, the research began with the 'immersion' of the researcher in the field. At the beginning the research problem was roughly defined. However, the richness of the experience obtained by the observation of different cases suggested the working hypothetical explanation presented above, which is also inspired by a (particular) revision of the literature on firms, regions and innovation. In a second moment, analysis of individual data enables one to see if the explanation fits the facts or, on the contrary, must be reformulated. Analytical induction arises from successive and successful testing of the formulated hypothesis, which permits its confirmation, in the large sense that it is probable, reasonable or likely to be true.

Table 1 Investment profile by cluster

Clusters		*IPROD*	*INPUT*	*GEST*	*SATIS*	*QUALI*	*RD*
1	Mean	5.3190	.0000	19.2879	.0000	.3849	75.0081
(2)	SD	7.5223	.0000	25.0297	.0000	.5444	32.0076
2	Mean	22.4722	1.0203	57.9756	9.4461	8.7413	.3444
(39)	SD	19.4968	4.7546	29.7236	19.3984	13.2593	2.1508
3	Mean	76.2450	1.3275	10.6318	3.1458	7.9822	.6678
(60)	SD	14.6678	6.3005	8.0364	5.6924	10.5086	3.4449
4	Mean	11.7043	.0000	6.3029	6.5700	75.4228	.0000
(5)	SD	16.0550	.0000	5.3888	10.8515	17.5992	.0000
TOTAL	Mean	52.0780	1.1268	28.0099	5.5660	11.2993	1.9199
(106)	SD	32.3633	5.5316	29.8845	12.9790	18.5545	11.0383

Having focused on the Norte-Litoral subregion, we have worked on 106 applications of firms located in the area that were effectively supported by SME-CI. The study began by performing a 'cluster analysis' using variables corresponding to the investment components of projects. Given the fact that cluster analysis extracts groups of similar attributes regardless of grouping rationale, the definition of the set of variables that identify firms' policy investment is of core importance for the interpretation of the results (Campbell-Hunt, 2000).

Several specifications and cluster algorithms were tested in order to achieve robust and meaningful results, both theoretical and statistical. The retained set of variables take account of the distinction between *static* and *dynamic* competitive factors and of four operational dimensions of strategies – *efficiency, client's satisfaction, innovation, quality* – the former two addressing costs and value offered, respectively, the latter two addressing both (Hill and Jones, 1995). Therefore, the components of each firm's investment (converted into percentages of the total investment) were grouped according to the following variables and related to competitive factors:

- Static factors (easy to imitate):
  - Productive equipment and logistic infrastructure (IPROD) »» *Efficiency*
- Dynamic factors (more difficult to imitate):
  - New forms of improving efficiency in inputs (INPUT) »» *Efficiency*
  - Management modernization by ICT (GEST) »» *Efficiency*
  - Improvement of relationship with market (SATIS) »» *Customer's satisfaction*
  - Quality management systems (QUALI) »» *Quality*
  - R&D activities (RD) »» *Innovation*

The particular combination of these components reveals the investment policy adopted by the firm in response to the incentives offered by the Programme. The clusters obtained with SPSS are relatively stable over method variations and reveal some interesting characteristics. For instance, it is impressive that two clusters concentrate 94 percent of the firms studied.

The results of this analysis can be briefly summarized by the following topics on the characteristics of each cluster:

- *Cluster 3* shows an investment profile in which IPROD is very high and clearly above the global mean. It corresponds to 'static modernization' of firms based on new productive equipment (with some effects on INPUT), which is in line with the traditional model of production-centred competitiveness. These firms still consider their first priority as being to modernize productive equipment, perhaps because they feel they are lagging direct competitors and, with the help of equipment suppliers, it is easy to imitate them.
- *Cluster 2* exhibits a largely dominant role of variables GEST and SATIS. These firms are investing in ICT to modernize management and are more customer-oriented. This is what we call 'dynamic modernization', which means that these firms have begun to change their

understanding about the challenges of competitiveness. However, ICT investment is not strong enough to build competitive advantages as far as ICT diffuse quickly among competitors. Besides that, investment under SATIS is sometimes trivial, for instance publicity.

- *Cluster 4* displays the great relevance of the variable QUALI and the significative importance of variable SATIS. Firms of this group have chosen some kind of 'offensive' policy investment. They explore the differentiation effects of quality management systems and of marketing on the value they offer to the market, trying to build competitive advantages other then by cost reductions.
- *Cluster 1* presents exceptional values in variable RD. The two firms of this cluster designed an investment project with a large R&D component. As in Cluster 4, this type of investment corresponds to an 'offensive' policy aiming to build strong competitive advantage by developing inside the firm some type of technology innovation.

In the next step we inquired what correspondence exists between the investment policies revealed by the applications to the Programme and business strategies adopted by firms.[9] Johnson and Scholes (1993) present the following typology of strategy directions, which we used to classify each firm: *consolidation* of current market position; *growth* in the current market; *product development* to differentiate from competitors; *market development*, which means entering new geographical markets; *diversification* by entering a new business. They are not all equivalent in respect to the competencies the firm needs to mobilize for its implementation, some being more demanding then others.

To simplify our analysis we can group these five strategy directions into three types, according to the firm's attitude towards the competitive environment: *passive* (consolidation); *active* (growth, diversification); *innovative* (new product, new market). Crossing this typology of business strategies with the performed clusters of investment projects, we obtained the results shown in Table 2. To facilitate the analysis, the same results are grouped in Table 3 according to the above mentioned typologies for firms' strategy and investment policy, which jointly characterize firms' strategic behaviour.

Looking at the combination of generic characteristics of rows and columns, two poles can be identified in Table 3: 57 percent (60) of the firms

Table 2 Firms' distribution by strategic direction and cluster

Strategy direction		Cluster 1	Cluster 2	Cluster 3	Cluster 4	TOTAL
Consolidation	Count	1	17	24	2	44
	% within Strategy direction	2.3%	38.6%	54.5%	4.5%	100.0%
	% within Clusters	50.0%	43.6%	40.0%	40.0%	41.5%
Market growth	Count		11	18	3	32
	% within Strategy direction		34.4%	56.3%	9.4%	100.0%
	% within Clusters		28.2%	30.0%	60.0%	30.2%
Product development	Count	1	3	13		17
	% within Strategy direction	5.9%	17.6%	76.5%		100.0%
	% within Clusters	50.0%	7.7%	21.7%		16.0%
Market development	Count		6	4		10
	% within Strategy direction		60.0%	40.0%		100.0%
	% within Clusters		15.4%	6.7%		9.4%
Diversification	Count		2	1		3
	% within Strategy direction		66.7%	33.3%		100.0%
	% within Clusters		5.1%	1.7%		2.8%
TOTAL	Count	**2**	**39**	**60**	**5**	**106**
	% within Strategy direction	1.9%	36.8%	56.6%	4.7%	100.0%
	% within Clusters	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3 Strategic behaviour typology

Strategy direction	Investment policy			TOTAL
	Static modern	Dynamic modern	Offensive	
PASSIVE				
• *Consolidation*	24	17	3	44
ACTIVE				
• *Growth*				
• *Diversification*	19	13	3	35
INNOVATIVE				
• *Product development*				
• *Market development*	17	9	1	27
TOTAL	**60**	**39**	**7**	**106**

exhibit a *conservative* strategic behaviour, while 12 percent (13) exhibit an *innovative* strategic behaviour. The remaining firms (31 percent) form a conglomerate of situations, some in a middle way to a more *innovative* behaviour (13), others adopting some kind of apparently contradictory mix of strategy direction and investment policy. For instance, a group of 17 firms are trying to pursue an innovative strategy, such as product or market development, underpinned by mostly 'static modernization' investment.

Finally, Table 4 presents the distribution of firms by sectors of activity and clusters. While the *innovating clusters* (1 and 4) concentrate on Machinery sectors, Rubber and Plastics and Non-metallic Minerals, the *non-innovating clusters* (2 and 3) have a largely diversified industrial composition. It is evident that for the 106 SMEs studied *non-innovating investment profiles are not sector-specific.*

Briefly stated, we arrived at the following general results in what concerns the effectiveness of SME-CI in inducing new competitive behaviour:

- Considering the generous financial support offered to the dynamic components of projects, we are confronted with a low percentage of innovative firms (13 percent), according to our standards: those who have, either an *offensive*

Table 4 Cluster's sectoral composition

	Cluster 1	*Cluster 2*	*Cluster 3*	*Cluster 4*	TOTAL
Food industries		3	2		5
Textiles		4	8		12
Leather and footwear		9	6		15
Wood and cork			3		3
Paper		2	4		6
Edition and printing		1	1		2
Chemicals		6	4		10
Rubber and plastics		3	1	1	5
Non-metallic minerals		1	2	1	4
Basic metallurgy industries			6		6
Metal products			1		1
Machinery and equipment	1	1	4	1	7
Machinery and electronic appliances	1	5	4	2	12
Medical and precision appliances		1			1
Other transport material			1		1
Furniture and other industries		3	13		16
TOTAL	**2**	**39**	**60**	**5**	**106**

investment policy combined with *non-passive* strategies, or an *innovative* strategy combined with *non-static* modernization policies. Although some signs of transition from a production-centred to a customer-centred understanding of competitiveness can be identified at the core of Table 3, it seems evident that SME-CI support to more demanding forms of building competitive advantages upon 'soft-type investments' remained largely unexplored.
- The majority of firms studied (*Cluster 3* – 57 percent) still consider modernization the primary component of their investment policies to answer competitive pressures.
- There were *no applications of projects addressing internationalization or networks of firms* for whatever aims. Taking account of the high rates of financial grants offered, it seems that firms were not able to foresee the strategic interest of these types of investment. In fact, this failure is a sign that a large number of SMEs have limited capabilities to engage in investments addressing the non-domestic market or value chain articulation with clients or suppliers.

The above results lead us to admit the existence of an internally centred cost approach to competitiveness that is deeply rooted in the cognitive frame of entrepreneurs. This is a paradigm long ago identified by different studies on Portuguese SMEs, which continues to condition SMEs' strategic behaviour, even when they apply for financial incentives addressing dynamic factors of competitiveness (Simões, 1995).[10]

Indeed, firms' paradigms are dynamic realities and their change can be accelerated by policies addressing learning processes (Lundvall and Johnson, 1994). However, this policy orientation is still lacking in Portuguese programmes financed by the European Regional Development Fund (ERDF), which are dominated by 'a single-minded emphasis on promoting individualistic instrumental rationality' (Lundvall, 1999: 33).

This orientation runs contrary to policy experiences in different European regions, which have been promoted and studied under the support of the European Commission, such as RIS (Morgan, 1997), REGIS (Tödtling and Kaufmann, 1999), CORE (Lagendijk, 1999) and SMEPOL (Nauwelaers and Wintjes, 2000). The results of these projects have not yet been the object of discussion and evaluation in Portugal, which is not surprising as they contrast sharply with current industrial and technology innovation policies, mostly based on financial incentives and managed at the national level by CSF Programmes.

Conclusions

The current changes in the environment of Portuguese SMEs derive mainly from the integration process of the Portuguese economy in the EU, and by what has been called a change in the 'techno-economic paradigm', which comprises a complex process of interdependent changes in firms (technological regimes, management and organization) and societies (Freeman and Perez, 1988). Although these changes take time, it is evident that they are at the basis of new requirements in terms of competencies and render obsolete the existing ones. Thus, they underlie individual and social processes referred to in the Schumpeterian idea of 'readiness for creative unlearning'.

In this context, SMEs are facing new challenges which demand *inter-firm* strategy and technology integration, value-creating *links* with leading customers and suppliers, and increased focus on quality and non-price factors (Dodgson, 2000). However, these challenges go largely beyond the domain of science and technology. They ultimately concern the *improvement of firms' competencies to develop innovation*, understood as a collective learning process organized by firms along their operations (Cantwell and Fai, 1999).

To overcome these challenges and find a 'high-road' path, both for SMEs and the Norte region, policy design should be informed by a complex systems perspective. To illustrate our point, we concentrate on a few issues that are relevant in the Portuguese context and contrast with current policy framework in the country:

- Political systems co-evolve with other social systems and cannot escape the creative unlearning process. This issue is of most importance for the design of an interactive and reflexive innovation policy in Portugal, in the

sense that 'policy implementers can be partners in the supported action or project, so that learning can happen both ways between policy implementers and firms [...]. This way, the tacit nature of innovation in SMEs is better approached than in more hierarchical policy modes' (Nauwelaers and Wintjes, 2000: 6). At a national level, lessons from the Danish System of Innovation (DISKO) should be carefully considered for two important reasons. First, the industrial specialization of both countries in the so-called low-tech sectors, particularly dominant in the Norte-Litoral economy, recommends the adoption of a similar strategy of competence renewal in traditional sectors. Second, the success of this endogenous orientation in Denmark is based on a strong social capital that makes it easier for people to learn, collaborate and trade (Maskell, 1998). This is a serious issue to be considered in Portugal, where local partnerships are weakly developed and suspicion of inter-firm linkages is reported as an important reason for the failure of industrial networking (Syrett, 1997).

- To build an effective innovation policy Portugal needs much more than information about EU experiences. As Lagendijk (1999) puts it, 'the crux of 'learning regions' [...] is the intertwining of business learning and policy learning, underpinning a recursive and reflexive style of collective learning' (p. 25). In fact, a new policy paradigm is needed but its implementation faces serious obstacles, such as policymakers' cognitive lock in mainstream economics and conservative coalitions that fear the empowerment of territories. To overcome these obstacles it is necessary to build a progressive coalition between regional, national and EU actors, which should endorse a regional level for innovation policy. This means substituting the current national competitive bidding for resources by individual firms for the application requirement (and encouragement) of networks of firms, representative of technological spaces, with 'demonstrable evolutionary potential, and where the synergies are regional in nature' (Storper, 1995b: 908). Centrally managed technology policy instruments, based on criteria of excellence, could still have a place when explicitly focused on the 'technology-developer' type of firm. However, for the large majority of 'follower-type' Portuguese SMEs, there is the need for a customized and interactive innovation policy, appropriately designed for a transition to the globalizing learning economy, which should be managed at the subnational level (Lundvall and Borrás, 1998).
- Institutional change must be placed at the core of a new paradigm for innovation policy in Portugal. Here we use the concept 'institution' in the broad sense given by Nelson and Sampat (2001) of ' "*social technologies" that have become a standard and expected thing to do, given the objectives and the setting'* (p. 40). For instance, the empirical results of our study strongly suggest that a large number of applications correspond to institutionalized collecting of financial support that leaves management unchanged. To overcome this conservative behaviour, policy action at a subnational level should be conducted to create in the community of entrepreneurs a strong concern with the future, both of their enterprises and of the social fabric in which they are embedded. With this aim, the reform of EU Structural Funds established the principle of 'partnership' involving regions as well as the member state and the Commission. This tripartite model, based on selective transfer of resources and joint management, was hoped to favour the empowerment of regions and, thus, promote innovative responses to problems by regional actors. However, the Portuguese case confirmed the role of 'gatekeepers' played by member-state governments and some observers' sceptical view that 'only those Commission proposals that happened to coincide with pre-established national-government priorities would be allowed to reach down to the regional level' (Smyrl, 1997: 292).
- In Portugal, the regional level corresponds to a bargaining table around which municipalities play zero-sum games under the arbitrage of the Presidency of the CCR (Regional Coordination Commission), which represents the central government. At the beginning of each CSF, the government establishes a dialogue with municipalities about local and regional needs, after which the budget and its composition is fixed centrally for each Coordination Region. These 'rules of the game' impede the formation

of a regional governance and constitute a heavy structural constraint for an autonomous intermediation with the centre (Christiansen, 1997). Therefore, the present context is in fact an obstacle to political and economic interaction within a 'development coalition', in the sense of 'a place-based inter-class coalition of political, economic and social actors devoted to economic development in a specific location' (Keating, 1997: 33). According to our theoretical framework, the empowerment of the Coordination Regions, supported by a democratic legitimization, should open up an opportunity for effective regional agency within present national structures. Nevertheless, the ultimate outcome for each region will follow from an evolutionary process where regional leaders have to explore their degrees of liberty and to translate management of particular policies, including EU programmes, into gains of autonomy (Smyrl, 1997). In so far as innovation policy is concerned, this means the power to coordinate policy instruments addressing SMEs' needs, with emphasis on pro-active tools implying face to face relationships.[11]

Ultimately, the complex systems perspective stresses that, more than financial resources, *building self-organization capabilities in less developed territories* is the crucial issue for their development. Particularly in the Portuguese case, innovation policy needs an articulation between 'government' and 'governance', both at national and regional levels, a necessary condition for SME competitiveness and territorial development. However, like any other social system, the particular evolution of the Norte region will remain an open-ended process that policymakers cannot control.

New research and final remarks

The results obtained confirm the hypothesis of inadequacy of financial policy instruments addressing strategic change in SMEs. However, the empirical research is limited to SME-CI applications from the Norte-Litoral subregion. As a next step, the research may be developed along two different but complementary lines. A first one is to proceed with the same analysis on applications to PEDIP, the major programme of CSF II addressing mostly Portuguese medium and large firms. This should answer the issue of whether or not 'firm size' is a relevant characteristic associated to Norte-Litoral firms' investment policies. A second one corresponds to a 'panel analysis' of the same firms and should be supported by qualitative research techniques, such as interviews and focus groups. Its aim would be to investigate the path of firms' strategies and confront present behaviours with those at the beginning of the SME-CI Programme. This should illuminate the dynamic effects of the Programme on the SMEs supported.

So far, CSF programmes have been the most important instruments of regional, industrial and R&D policies addressing Portuguese SMEs. They have succeeded in reducing the cost of capital for firms' modernization and decisively supported the convergence of Portugal to EU average GDP per head in a period when firms' cost-based strategies worked more or less effectively. However, to face a globalizing knowledge economy, the current policy model is no longer adequate to promote innovation-based strategies and, hence, to foster productivity growth. The difficulty of this process has been acknowledge by an eminent evolutionist author who mentioned that 'Changes in articulated strategy may be easy, but to revise structure to meet those changes and, especially, to put in place new core capabilities, may be extremely difficult' (Nelson, 1994: 246). As we argued, this needs a complex systems approach to public policies that should foster interactive learning processes.

Therefore, after the refusal of a regionalization project in the 1998 referendum, Portugal will be forced in the near future to reopen the debate on new foundations: the need for major changes in institutions and policies in order to face the challenges of competitiveness and social cohesion in a context of reduced financial resources. Let's hope the accession of Central and Eastern European states will not only focus the debate on the amount and distribution of the Cohesion Policy budget but also on new models for Regional and Innovation Policies, both in Portugal and at the EU level. Perhaps here resides the key of a 'new deal' for the European Union of the 21st century.

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Notes

1 Views expressed in this paper are exclusively those of the authors and do not necessarily correspond to those of the public authority for whom the first author is working.

2 For instance, see Nelson (1998) and Foss (1998) for an evolutionist perspective on the 'new growth theory'.

3 'Complexity' is a multidimensional concept that is present in scientific research at two levels, ontological and epistemological. This may be resumed in the following formulation: 'Complexity is not only object-based in the sense of being intrinsic to the observed object, it is also related to the observing subject: it is a cognitive notion; it is perceived complexity. [...] Now the concern regarding procedure is explicitly considered as a complex problem for the observer. Self-referential complexity cannot be solved in the sense of directly reducing it to simplicity. [...] but it can be dealt with. This is what procedural rationality tells us' (Delorme, 1997b: 38–9).

4 This view corresponds to the concept of 'organizationally closed systems'. A particular subset of this type of system is formed by 'autopoietic systems', those which subsist by continuously producing their components and boundaries by means of the same components' participation in the process of production. The transposition of this particular concept from biology to social sciences is controversial and an ongoing topic of debate. For this point see Mingers (1995). For the role of metaphors in social research see Hodgson (1999).

5 Here we do not take a position in the debate about Luhmann's controversial application of autopoiesis to social systems. Depending on the particular aspect under analysis in this paper, we adopt the cognitive point of view of the unit-system in an environment (*formal application of the autopoietic theory by Luhmann*) or the constituent units composing the system (*emergence perspective of Maturana and Varela*) (Whitaker, 1995). This is acceptable because any demarcation in the domain of the research must be contextualized with respect to the interests of the observer affecting the demarcation. And, to observe through meaningful 'experiences', the researcher needs to draw distinctions, like any other living system (Arnoldi, 2001).

6 Some core distinctions between a traditional 'system' concept and a 'complex system' concept must be remembered: social reality is complex, in the ontological and epistemological sense above mentioned; non-equilibrium processes are sources of order, which lead to the search of systems dynamics instead of equilibrium; self-organization ('organizational closure') replaces the classical model input–output to which the adaptation of the system to the environment is a learning process externally controlled (Krieger, 1998).

7 These concepts correspond in our framework to different levels of abstraction and are frequently used in the literature of innovation systems with other meanings. A 'system' is a conceptual device to classify a pluralistic reality according to a combined application of a 'genus proximus' principle with a 'differentia specifica' principle (Fikentscher, 1998). At a lower level of abstraction, it is possible to distinguish between *machines*, *organisms*, *psychic* systems and *social* systems. The latter comprise *interactions*, *organizations* and *societies* (Luhmann, 1995[1984]: 1–3).

8 The SME-CI Programme also provided a measure for 'Technological Competence Acquisition' whose projects are not included in the present study because of their exclusive concentration on specific partnerships between firms and R&D institutions. Their study is of very great importance and will be considered in a later stage of the research.

9 In our study we confronted the application statements of the firm about its strategy with information obtained from other sources, such as the report of a visit to the firm by representatives of the Programme.

10 According to Johnson (1992), a firm's paradigm is 'a core set of beliefs and assumptions which fashion an organisation's view of itself and its environment' (p. 30).

11 This point is supported by a similar conclusion in a policy report of TSER Project 'Technology, Economic Integration and Social Cohesion': 'As the pressure for transformation towards the knowledge economy increases, a major issue is then how and to what extent the current policy responsibilities between territorial levels could be redrawn as a response to the new context' (Verspagen, 1999: 77). In a similar vein see Begg and Mayes (2000).

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