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REGIONAL COMPETITIVENESS THROUGH TRIPLE HELIX MODEL. A CASE STUDY

Summary. This research aims to analyse the innovative performance of a Portuguese region (NUT III Beira Interior Sul) throughout the application of the Triple Helix (TH) approach, examining its capacity to describe and explain the innovative dynamics of the low density regions as an engine of its competitiveness. The TH model seems to be a useful analytical tool to approach and organize public policy and actors' strategy oriented to shape and nurture emerging and fragile innovation systems, namely to identify and characterize regional actors and networks, its performance and links with other institutions, as well as policy implications to embed the regional competitiveness within government-academia-industry partnerships.

Keywords: Regional Competitiveness, Innovative Performance, Innovation System, Triple Helix approach

WZMACNIANIE KONKURENCYJNOŚCI REGIONALNEJ POPRZEZ ZASTOSOWANIE MODELU POTRÓJNEJ SPIRALI. STUDIUM PRZYPADKU

Streszczenie. Celem niniejszego artykułu jest analiza innowacyjnych osiągnięć portugalskiego regionu Beira Interior Sul (NUT III) poprzez zastosowanie podejścia opartego na modelu potrójnej heliksy i wyjaśnienie, w jaki sposób innowacyjna dynamika rzadko zaludnionego regionu staje się siłą napędową powodującą rozwój jego konkurencyjności.

Model potrójnej heliksy wydaje się użytecznym narzędziem analitycznym pomagającym zorganizować politykę publiczną oraz strategię poszczególnych aktorów zorientowane na kształtowanie i wspieranie pojawiających się kruchych jeszcze systemów innowacyjnych, a mianowicie do zidentyfikowania i określenia charakteru regionalnych aktorów oraz sieci, ich osiągnięć i rezultatów działań, powiązań z innymi instytucjami oraz implikacji opracowywanych i wdrażanych polityk w celu wpisania kwestii konkurencyjności regionu w ramy partnerstwa rząd – instytucje naukowe i badawcze – przedsiębiorstwa.

Słowa kluczowe: konkurencyjność regionalna, innowacyjne osiągnięcia, system innowacji, model potrójnej heliksy

1. Introduction

Innovation and technologic change can be considered as key issues for a successful regional economic growth and development process. All economic growth and development models face diminishing returns for variable inputs such as labour and capital that can be overcome through either economies of scale or mainly new technology. This can be achieved by an permanent ongoing innovation process (Diniz, 2010).

Over the past two decades the innovation systems approach has gained considerable attention amongst both academics and policy makers. In searching of explanations concerning the relationship between globalization, economic growth, competitive advantage and technological innovation, the operationalization of the innovation system concept was extended to a variety of levels: global (e.g. Nelson, 1996; Niosi and Bellon, 1996), international (e.g. Archibugi and Coco, 2001), national (e.g. Lundvall, 1992; Nelson and Rosenberg, 1993; Edquist, 1997), regional (e.g. Braczik, Cooke and Heidenreich, 1998; Howells, Nedeva and Georghion, 1998), local (e.g. Mothe and Paquet, 1998) and sectoral (e.g. Breschi and Malerba, 1997). Each perspective emphasises the contribution of different critical elements of innovation process to competitive advantage and economic welfare.

A new approach to the innovation process was introduced by Triple Helix model which explores the relations between university/academia, industry and government institutions as a way of enhancing regional competitiveness (e.g. Etzkowitz, 2003). Based upon the contribution of the entrepreneurial culture of the MIT and Stanford University to the economic success of Boston area and Silicon Valley, the model puts the university at the core of structural economic change. The Triple Helix evolves according to the complex dynamics of trilateral relations between universities, innovative firms and government institutions driven by market and policies stimulus. The creation of hybrid organizations committed with entrepreneurial norms and engaged in closing the gap between invention and innovation, linking production and use of knowledge, are the expression of the powerful engines that drive the knowledge economy and the current focus of many countries and regions to secure competitiveness and increase prosperity (e.g. Ranga, Miedema and Jorna, 2008; Ruuska and Teigland, 2008).

Regions and local communities with weak structural conditions pose significant challenges to the Triple Helix approach, namely the absence of research-oriented universities, lack of economic competitiveness, human and social capital deficits, ageing and low population density and regional/local governments with narrow competencies related with the innovation-based development policies.

This paper aims to contribute to a better understanding of the triple helix process at regional and local levels featured by economic and social contextual disadvantages. Based on a Portuguese case study, the paper describes the internal and external dynamics among triple helix partners, analyses critical issues and explores policy implications.

2. Triple Helix relations and regional innovation systems: frontiers and opportunities

Regional literature shows several examples of high-tech regions that have flourished around the local universities (e.g. Gaffard, Longhi and Quéré, 1994; Saxenian, 1994; Braczik, European Commission, 1997; Gulbrandsen, 1997; Cooke and Heidenreich, 1998; Klofsten, Scharberg and Jones-Evans, 1998; Etzkowitz, 2003).¹

The literature identifies different knowledge transfer axes between academia and economy. The education and training function impact upon market labour (e.g. Nelson and

¹ Some of the most famous cases are Silicon Valley (Stanford University), New England (MIT), Research Triangle Park (North Carolina), Cambridge (Cambridge University), Wales (Glamorgan Business School University), Toulouse (National Institute Polytechnic of Toulouse), Grenoble (Grenoble University), Baden-Württemberg (Freiburg, Heidelberg and Karlsruhe Universities), Linköping (Linköping University), in Europe.

Rosenberg, 1993; Lucas, 1998), the spin-offs from university research; (e.g. Braczik, Cooke and Heidenreich, 1998; Klofsten, Scharberg and Jones-Evans, 1998; Etzkowitz, 2003; Etzkowitz, 2008),² the role of formal cooperation in R&D between academics and industry (e.g. Audretsch and Stephan, 1996).

The Triple Helix model gives a strategic role to the university (e.g. Etzkowitz and Leydesdorff, 1997). Contrasting with Porter's "diamond" model of competitive advantage (Porter, 1990) and national innovation system (Stern and Porter, 2000), the university moves from periphery to the centre of economic dynamics.

The Triple Helix model is based on three institutional spheres: university, industry and government. Its functioning is characterized by decentralized and interdisciplinary dynamics, self-organization and co-evolution. The development of interactions between the three institutional spheres and the internal dynamics of each one is fundamental to generate a virtuous process of economic growth and development. Thus, a greater emphasis should be given to quality of the institutional set-up, contextual conditions, learning processes and to the strategic behaviour of the actors, namely the role of the university and public policy in the task of translating knowledge and technology into economic value (Etzkowitz and Leydesdorff, 2000; Lundvall, 1994).

According to Varga (1997) the university knowledge transfers are strongly affected by territorial agglomeration of economic activities. The territorial agglomeration effects are recognised by Florida et al. (2006). They state that the university's role in economic development is beyond production of inventions and commercialisation of its research. Its fundamental contribution is rested on generation of technology, talent and tolerance and its feasibility is stimulated by urban agglomerations.

New insights are introduced by Saxenian (1994). She argues that the concepts of agglomeration and external economies cannot explain why a high level of concentration activities produces a self-reinforcing innovative dynamic. According to this author, spatial proximity reveals little about the local ability to respond to the fast changes that characterize international competition. The agglomeration-centered perspective tends to overlook the complex of institutional and social relationships.

The controversy suggests an earlier question. Can any university in any location foster a knowledge economy and society?

² As Schaettgen and Werp (1996) argue, in general the creation of spin-offs is highly independent from other technology transfer activities of the university. This means that even if a university does not provide another technology transfer services, it is possible to successfully support the foundation of spin-offs. M Gulbrandsen, (1997) underline the importance of university spin-offs within context where the outputs of university research groups are not adjusted to the needs of existing local industrial clusters. In this case the university and regional authorities try often to develop new local industrial clusters.

A step forward is given by Gaffard et al (1994). According to the authors the problem should be framed on taking an *ex ante* view about how increasing returns or external economies are achieved. The analysis must not be centered solely in the process of allocation resources, but fundamentally in the creation of resources. Regional performance seems to be related to the internal consistency of the clustering process and the ability to take advantage of external relations.

Another avenue is opened by Fourth Helix Model (Mehta, 2002; Cooper, 2009). The authors sustain that the triple helix analysis must take into account not only enterprises and private markets, but also the public sector and civil society.

From the theoretical viewpoint, these perspectives offer a landscape of opportunities favourable to the emergence and organization of knowledge intensive process phenomena at lower levels of spatial aggregation.

3. Research Methodology

In this research, the adoption of a qualitative methodology was based on the empirical model. The Triple Helix is a descriptive and explanatory model of the relational dynamics between actors who work to support and sustain innovation. This is a regionalized model, since the region, namely its resources and capabilities positively enhance the Triple Helix performance. Although the Triple Helix model can be generalized, the results are specific to the region under study. In this context, the research takes the form of a case study (Yin, 1994).

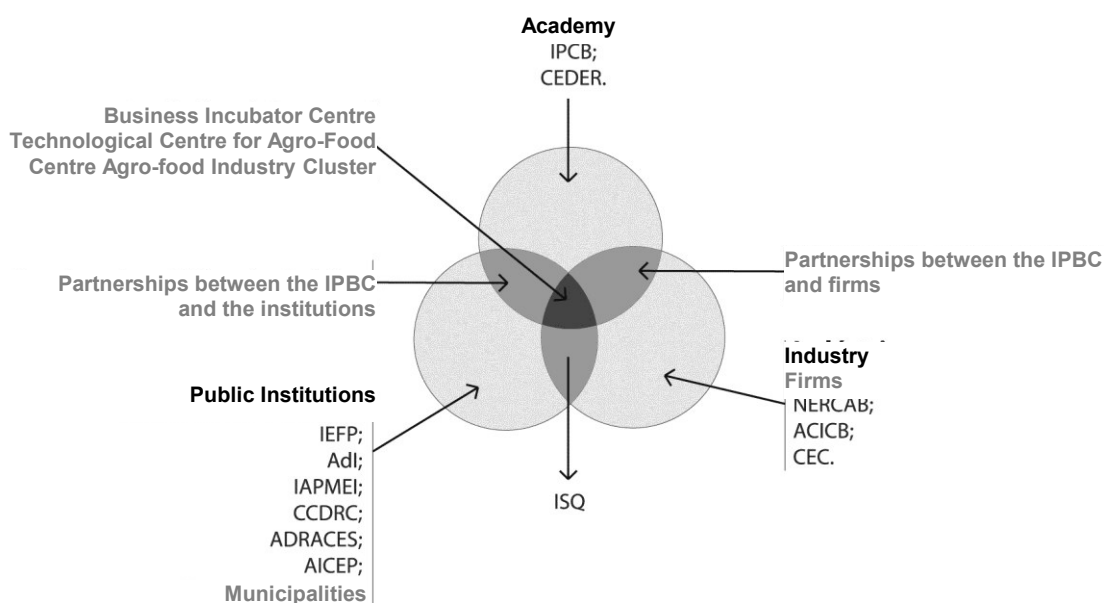
This research focuses on the unit of analysis NUTS III South Beira Interior (Portugal) comprising four counties: Castelo Branco, Idanha-a-Nova, Penamacor and Vila Velha de Ródão. Given the specific aspects of this empirical research we chose to use three different methods of data collection: bibliographic research and documents, semi-structured interviews and observation. The interviews focused on the actors with actual physical presence in the region and which present a regional based strategy; thus public institutions of national character were excluded.

4. Applying the Triple Helix to NUTS III – South Beira Interior

The NTU III South Beira Interior has a land area of 3748.3 km² and a resident population of 73,923 inhabitants. The population density in 2007 was 19.7 inhabitants per km² (INE, 2009; CCDR-C, 2009). It is a region in demographic decline with high levels of dependency

and ageing and largely homogeneous in primary factors of competitiveness, particularly with regard to population, accessibility, production support infrastructures such as energy infrastructures and telecommunications. The county of Castelo Branco (and mainly the city) emerges as the natural hub of development.

After conducting a survey of entities present in South Beira Interior it was possible to draw a representation of the regional Triple Helix (Figure 1).



IPCB – Polytechnic Institute of Castelo Branco
 CEDER – Regional Development Center
 IEFP – Institute for Employment and Training
 AdI – National Innovation Agency
 IAPMEI – Institute for the Development of Medium and Small Firms
 CCDRC – Regional Planning Commission

ADRACES – Regional Association for the Rural Development
 AICEP – National Agency for Foreign Trade
 NERCAB – Regional Association of Industrial Firms
 ACICB – Regional Association of Commerce Firms
 CEC – Regional Federation of Firms
 ISQ – Institute for Quality

Fig. 1. The Triple Helix in South Beira Interior

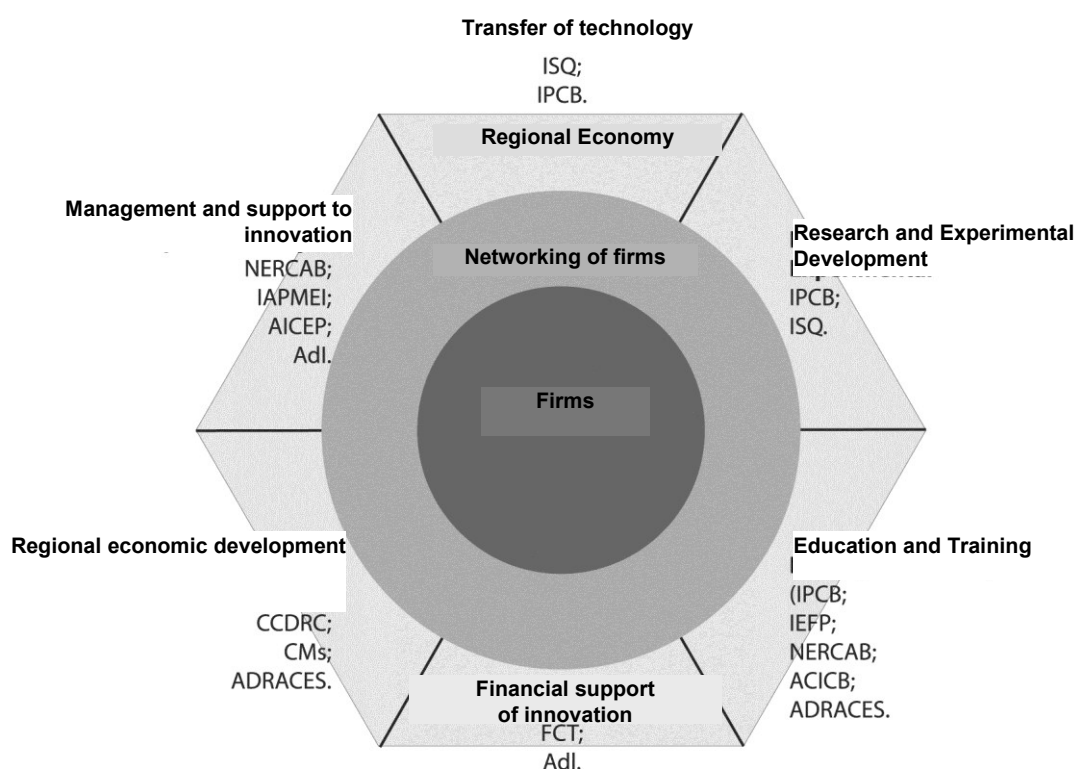
Rys. 1. Potrójna heliksa w regionie South Beira

The analysis of the model proposed shows that the individual spheres present a higher number of elements than the jointed spheres; this fact shows the current weakness of the interface structures and the need to strengthen the network of partnerships between regional actors.

5. Evaluation of the Potential of Triple Helix as a Regional Innovation System

A regional innovation system's analysis must be made considering two types of complementary factors: first, the activities that support the functioning of regional innovation system, including the characterization of actors involved in these activities and secondly, the level of involvement in socio-economic regions (Cooke, 2002). For the first type of factor, that is, the subsystem for the creation and dissemination of knowledge, six activities designed to support the regional innovation system are taken into account: basic and applied research, technology transfer, management and support to innovation, financing of innovation, education and training and regional economic development.

The second type of factor activities has an impact on three levels – individual firms, firm's networks and regional economy – which represent different degrees of involvement. The combination of these two dimensions is shown in Figure 2, where each side of the hexagon is a support innovation activity and the concentric circles represent the degrees of involvement: the innermost circle refers to the firm level, the middle one refers to the firm network level and the outer circle corresponds to the level of the regional economy.



CMs – municipalities

FCT – National Agency for Science and Technology

Fig. 2. Regional Innovation System of South Beira Interior
Rys. 2. Regionalny System Innowacji regionu South Beira

Regarding Education and Training it is noticed that the region has a strong capacity for this activity. As strengths we highlight the presence of the Polytechnic Institute of Castelo Branco, which is an higher education institution (HEI) deeply rooted in the region and the existence of a provision of vocational training geared to the needs of regional firms. The education and training activity is reflected at the three involvement levels referred earlier.

South Beira Interior is a Nuts III region that faces severe backwards regarding its development process comparing with the whole of Portugal. This can be verified by the research conducted by Sequeira T. and Diniz F. (2009). In this research a Social and Economic development Index (SEDI) was calculated for each NUTSIII Portuguese region SEDI is the result of 14 indicators representative of different development approaches for 1991 and 2001 (Table 1). Thus, as regards demography, three indicators were taken into consideration, which focus not only on the vitality but also on the human resources evolution dynamics taking place in each territory in terms of population growth – both natural and migrant. At the education level we expect to measure the population's qualifications with recourse to illiteracy rates while determining what percentage of the population has a university degree. From there, we move to other issues regarding employment, economy and the entrepreneurial sector departing from the seven indicators which can give an important contribution to a better knowledge of the population's living conditions in terms of both work and income. At this stage, we try to outline not only the territory's entrepreneurial structure profile but also the profile of a whole set of basic issues for the survival of the populations and the preservation of their sense of belonging and social cohesion. Finally, health and housing reinforce the social component presented by this index, seeking not only to assess the existing facilities and their corresponding accessibilities which, to a certain extent, show the social impact of local, economic and, demographic constraints.

Table 1

SEDI Components

Level	Indicator		Description
DEMOGRAPHY	I1	Demographic Growth	Residing population variation – % between 1991 and 2001
	I2	Natural Demographic Growth	Natural growth rate – ‰ i
	I3	Migrant Demographic Growth	Residing population according to migrations per residence, per usual residence – Internal Migration Balance
EDUCATION	I4	Illiteracy	Illiteracy rate in %
	I5	Higher Education	Population over 18 years of age with an university degree – % i
EMPLOYMENT	I6	Total Employment	Total employment rate – %
	I7	Total Unemployment	Total unemployment rate – %
	I8	Employment in non-primary	Population employed in the non-primary sector – %
	I9	Employees and Pensioners	Employed population per pensioner

cont. table 1

ECONOMY	I10	Per head GDP	Per head GDP
	I11	Purchasing Power	Purchasing Power Index
ENTREPRENEURIAL SECTOR	I12	Entrepreneurial Structure ³	Entrepreneurial Index
HEALTH	I13	Health ⁴	Health Index
HOUSING	I14	Housing Conditions ⁵	Housing Conditions Index

The same weighting was given to each of the 14 indicators seeking, albeit subjectively, that the final index would reflect the authors' perception as to each indicator's relative weight on development. Thus, the value of each indicator is first transformed as follows:

$$(I11,2,...30; I21,2...30; I31,2...30; \dots, I141,2...,30) = (X-Li)/(Ls-Li) \quad \text{where,}$$

(Ii: I = 1, 2, ..., 278) = the NUTSIII 's indicator index

X = the NUTSIII 's indicator

Li = the indicator's least favourable value

Ls = the indicator's most favourable value

Then the different indicators transformed are aggregated as follows: $SEDI = (i=1, \dots, 14 \sum Ii/14)$.

For South Beira Interior the SEDI for 1991 is 0,202 and for 2001 reaches 0,213 fairway from the best value founded to Lisbon region (0,825 and 0,887, respectively).

In what concerns regional economic development the region relies on the presence of several public institutions that implement national government policies. The role of the municipalities should be highlighted due to the financial effort made on the attraction of foreign investments. The results of this activity benefit the entire region, for, once again, an impact on the considered three levels of involvement will be found.

³ The Entrepreneurial Index per *Concelho* is the result of aggregating four indicators with equal weighting, namely: a) Business firms based on the region; b) Partnerships based on the region; c) Personnel working in partnerships based on the region; d) turnover of partnerships based on the region.

⁴ The Health Index per *Concelho* is the aggregation of four indicators with the same weighting, namely: a) Number of doctors per 1.000 inhabitants; b) Number of Chemists per 10.000 inhabitants; c) Nursing personnel per 1.000 inhabitants; d) Number of beds per 1.000 inhabitants.

⁵ The Housing Conditions Index per *Concelho* is the aggregation of eleven indicators with equal weighting in eight areas, namely: a) Accessibility: % classic dwellings owned by occupants, used as a permanent residence, according to purchasing expenses over 199,51€ and % classic dwellings occupied as a permanent residence with a rent over 149,63 €; b) Housing Deficit: normal occupation index; c) Sheltering Conditions: % Classic family dwellings; d) State of Repair: % Buildings in a fair state of repair as regards infra-structures; e) Existing equipments: % Family dwellings used as a permanent residence, with electricity, water, water-closet, heating and bath; % Family dwellings used as a permanent residence with kitchen or Kitchenette; % Buildings served by urban solid waste collection; f) Sewage collection and disposal: % Family dwellings used as a permanent residence with water-closet and connected to the sewage collection and disposal system; g) Water Supply: % Family dwellings used as a permanent residence with water supplied by the urban water supply services; h) Vacant dwellings: % Family vacant dwellings.

As regards management and innovation support activities, the entities that provide this service have no physical presence in the region and thus this activity is borne by business associations which act as priming agents of the regional economy.

Financing innovation is exclusively undertaken by the national government. There is no kind of positive discrimination for low density regions; therefore, these regions have to compete with others that are best-equipped both in terms of technological infrastructure and human capital.

The lack of both private research and experimental development or a center for science and technology is a structural weakness that must be overcome.

For the Economic and Social Development Activity the region relies on the presence of various public institutions that implement government policies supporting regional development. However, at this level it deserves special mention the activities undertaken by local councils that have been marked by great dynamism and financial effort.

For the Management and Innovation Support it appears that public entities that provide this service have no physical presence in the region and thus this activity is borne by business associations which act as priming agents of the regional economy.

Financing Innovation pertains almost exclusively to the public sector although there is already some funding effort by the Municipalities through the application of community projects. There is no positive discrimination for disadvantaged regions like South Beira Interior; thus, the region needs to compete with others that are best-equipped both in terms of technological infrastructure and human capital. Moreover, the financing of innovation tends to focus on universities to the detriment of the Polytechnic Institutes which hinders access to the available funds.

The functioning of the Technology Center and Agri-food and Agro-Industrial Cluster in the Centre of Portugal will strengthen the research infrastructures and the transfer of technology, however this new entity has a sectoral nature and, consequently, the impacts generated by its operation will also be sectoral. The lack of both private research and experimental development or a center of science and technology is a structural weakness that must be overcome.

Thus, the Triple Helix in South Beira Interior may be described as having set up only a starting point rather than a regional innovation system.

In short, knowledge is now recognized as one of the key factors of national, regional, sectoral and enterprise competitiveness. A knowledge-based economy can be defined as the ability to create new ideas, products and processes and to implement them for the real economy, creating economic value and development.

The Triple Helix model which is the result of the interaction between academia, industry and public institutions, allows the creation of a legal competence, understood as the ability to work in partnership to achieve a common goal which, by its complexity, could not be reached by the individual effort of each partner.

In this model, the traditional spheres of activity of each partner intersect in each other, allowing the formation of organizations of interface, such as business incubators, technology centers and science parks, which are entities that can the creation and transfer of innovation.

The application of the Triple Helix model of the South Beira Interior helped identify the most representative institutions in each sphere, as well as the interface institutions that have already been established. The running activities and projects that are being completed make it possible to make some inferences about the beneficial impact of Triple Helix in the regional economy and to regard it as the embryo of a regional innovation system.

6. Final Considerations

This study argues that the creation and dissemination of knowledge are located activities and depend on individual local actors as well as on their capacity to create hybrid institutions that may enhance new synergies between them.

As examples of hybrid or interface structures, we single out the business incubator of Idanha-a-Nova, the office of technology transfer and the Cluster Agro-Food of the Centre.

In the region under study, the role of innovation organizer is assumed by the Polytechnic Institute of Castelo Branco. This means that academia is the driven force for regional innovative performance, although its performance is hampered by financial reasons lack of human resources.

With regard to endogenous factors that promote innovation and competitive performance we emphasize (i) – the presence of a university deeply rooted in the region and the existence of a provision of vocational training, targeting the real needs of regional firms, which translates into a strong capacity-wide training of senior technicians and professionals; (ii) – the activities undertaken by municipalities (iii) – the setting up of an interface entity, such as the Technology Agro-Food Centre which will strengthen the research infrastructure and the technological transfer (iv) – the creation of the Technology Centre for Agro-food which is consistent with the regional productive system, in which the agro-food industries take a position in the world of transforming industries; (v) – natural conditions that favour the diversification of food products, thus creating value added; (vi) the creation of support structures for entrepreneurship such as the business incubator of Idanha-a-Nova; (vii) – the existence of institutions providing support services to private firms; (viii) – emergence of

a logic of interaction between actors aiming at the use of indigenous resources, economy stimulation and increase of regional competitiveness.

The existing activities and projects that are being completed may be regarded as a good example of the positive impact of Triple Helix in regional competitiveness. However, the different players that form the model do not yet constitute a regional innovation system as a result of several factors, namely: (i) – lack of policies for regional innovation, science and technology (ii) – very thin control and influence over strategic infrastructure, (iii) – a very limited regional financial capacity; (iv) – lack of private research entities and of experimental development from laboratories and other public research facilities; (v) – low degree of openness to the outside, (vi) – underdeveloped network dynamics, particularly with regard to both vertical and horizontal networks between companies, (vii) - the supremacy of the logic of competition over the logic of cooperation.

Despite the many studies published on the subject, the majority are mainly of a conceptual nature, with little empirical applications. Being a relatively new and still little empirically studied subject, it opens a wide range of possibilities for future research and so we suggest that the study be continued so that the dynamic evolution of the Triple Helix may be verified and paths of consolidation of regional networks may be found. This model should also be applied to contiguous territorial units in order to identify the opportunities for cooperation, and synergies between the players aiming at enhancing a broader regional innovation system.

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